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LAUNCHER, ROCKET, INDIVIDUAL WEAPON

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Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland

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U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-102

*Test Operations Procedure 3-3-040.

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LAUNCHER, ROCKET, INDIVIDUAL WEAPON

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SECTION I
GENERAL

1. Purpose and Scope.

a. This Test Operations Procedure (TOP) is a guide designed to assist a test officer in preparing a plan to support an expanded service test (EST) of a type rocket launcher. It describes methods and techniques

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to be used in determining if a candidate launcher meets the criteria established in appropriate needs documents and is suitable for use by the U.S. Army.

b. Selected subtests offer methodology in examining physical characteristics, functional responses, test personnel selection and training, human factors considerations, and value analysis. The procedures deal with individually fired launchers only and do not address multiple or vehicular mounted systems.

c. Assuming that a possibility exists that an ammunition-type item, similar to the current standard M72A2 (LAW), may be offered for further expanded service testing, these procedures will present dual common TOP references (ammunition and weapon) when such documentation is available and appropriate.

d. The lethality or other terminal effects of the projectile's impact are a function of engineering and other tests and will not be addressed in these procedures.

2. Background.

a. Individual weapons designed for launching rockets are used primarily in the antitank role but may also be used in a secondary role against pill boxes, gun emplacements, or assembled personnel. The type system has evolved from the bazooka type rocket of World War II to a single packaged, lightweight and expendable unit issued as an item of ammunition (Rocket, HE, 66-mm, Antitank, M72A2 (LAW)).

b. An expanded service test will determine the overall efficiency of a candidate test launcher as examined in a projected user environment of troops in the field. Results of the test will provide a basis for a type-classification recommendation.

3. Equipment, Facilities, and Personnel.

a. Equipment.

- (1) Test item with components.
- (2) Control item with components.
- (3) Weighing equipment.
- (4) Linear measurement equipment.

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- (5) Photographic equipment.
 - (6) Communications equipment.
 - (7) Tactical vehicles, air and ground.
 - (8) Meteorological equipment.
 - (9) Safety and First Aid equipment.
 - (10) Ear plugs.
 - (11) Air delivery equipment.
 - (12) Cleaning equipment.
 - (13) Ammunition.
 - (14) Other equipment prescribed by referenced procedure documents.
- b. Facilities.
- (1) Firing ranges and appropriate targets.
 - (2) Field training area.
 - (3) Maintenance facilities.
 - (4) Airfield and drop-zone.
 - (5) Classroom, office, and storage space.
 - (6) Other facilities specified in referenced procedure documents.
- c. Personnel.
- (1) TOE Infantry unit.
 - (2) Parachute qualified personnel.

SECTION II
TEST PROCEDURES

4. Supporting Tests.

a. Proposed testing procedures are described in successive paragraphs, but need not be conducted in the order of their listing. Some may

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overlap or be conducted simultaneously. The procedures are flexible and are not intended to usurp the prerogatives of the test officer, whose exact and detailed plan of test should reflect the experience and expertise of available advisors and the state-of-the-art at the time and place of testing.

b. Data should be collected in sufficient quantities to support valid conclusions. This objective may be constrained by limited number of tests or control items, a limited time in which testing must be accomplished, or limits of funds, manpower, or support facilities. To identify the best means of securing meaningful data within the limitations imposed, the test officer must remain in close liaison with available statistical and human factors expertise. The statistician will assist in selecting the experimental design or pattern and fixing such requirements as the number of test personnel, items to be tested, and repetitions or replications needed for specific operations. The human factors representative will provide guidance in the development and presentation of questionnaires, interview techniques, and human factors input required in tests, plans, and reports. Statistical guidance related to the selection of appropriate samples and levels of confidence may be found in MTP/TOP 3-1-002, Confidence Intervals and Sample Size.

c. The technique of comparing a candidate launcher with a standard or control item will be used throughout the course of these procedures. The control item will normally be a standard inventory weapon, related characteristically as close to the candidate launcher as possible. To aid in obtaining a valid comparison, the control item should be in new or near-new condition and subjected to the same care and maintenance considerations as the test item throughout the conduct of the test.

d. A log book should be maintained as a chronological record of remarks, observations, data, times, comparisons, and other pertinent events as they occur or are obtained. An accurate compilation will expedite the collation process required to support test findings. Photography, charts, graphs, and other pictorial or visual aids are suggested as supplementary evidence to accompany narrative reports.

e. When directed, the results of risk analysis will be provided to Headquarters, US Army Test and Evaluation Command. TECOM Reg 70-34, Risk Analysis for Suitability Tests, will provide adequate guidance.

f. Common service, environmental test MTP/TOP, the tests described in Section III, and other published documents to be considered in formulating an EST plan are listed in the reference appendix and below:

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<u>TEST SUBJECT TITLE</u>	<u>PUBLICATION NUMBER</u>
(1) Preoperational Inspection and Physical Characteristics (refer to para 5)	3-3-500, 4-3-500
(2) Safety (refer to para 6)	3-3-517
(3) Personnel Training (refer to para 7)	3-3-501, 4-3-501
(4) Boresighting (refer to para 8)	3-3-503
(5) Range and Accuracy (refer to para 9)	
(6) Antipersonnel/Antimateriel Capabilities (refer to para 10)	4-3-104
(7) Durability/Reliability (refer to para 11)	
(8) Obscuration and Security From Detection (refer to para 12)	1-3-515, 3-3-516
(9) Adverse Conditions (refer to para 13)	3-3-524, 3-4-001 3-4-003, 3-4-007
(10) Portability/Transportability (refer to para 14)	4-5-503, 4-3-511 7-3-511, 10-3-506
(11) Maintainability (refer to para 15)	
(12) Human Factors Engineering (refer to para 16)	3-3-521
(13) Value Analysis (refer to para 17)	

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Preoperational Inspection and Physical Characteristics.

- a. The applicable procedures of TOP 3-3-500, Preoperational

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Inspection and Physical Characteristics, Armor and Individual Weapons, or TOP 4-3-500, Preoperational Inspection and Physical Characteristics, should be performed to: (1) verify the completeness of the test item, (2) compare its physical characteristics with the criteria of appropriate needs documents, and (3) determine that the test launcher and its components are in a serviceable condition and suitable for further testing.

b. In collecting data to support test findings, it is important to isolate the when, where, and why of events in addition to the final judgment of what happened. Possibly a failure, later attributed to the stress of expanded service testing, may originate during the manufacturing or shipping processes prior to arriving at the test site. Such defects must be detected during this preliminary inspection and the defective test items replaced in order to assure pinpoint accuracy of test findings and reports.

c. In the event a test item, similar to the M72A2, is issued as an item of ammunition rather than a weapon, inspection will be limited to visual examination of the sealed unit until the unit is ready to be fired. Examinations should assure that all seals are intact and that the tube has not been cracked, punctured, or crushed. The procedures of TOP 4-3-500, an ammunition oriented document, will govern.

6. Safety.

a. The applicable procedures of TOP 3-3-517, Infantry Weapons and Ammunition Safety, should be performed to determine the effectiveness of the safety features and confirm the safety of each component of the items received for testing.

b. Safety must be considered throughout the course of the EST and, to the extent possible, should be evaluated concurrently with or as an adjunct to other subtests. To be safe for troop use, an item must be free of conditions or features which may cause personal injury or inadvertent property damage. The area of concern applies to the real and potential hazards of the test item, and to its relation to any combination of items with which it may be used.

c. Particular attention is directed to the requirement to verify safety limits and compile data pertinent to the safety confirmation which is contained in TECOM Reg 385-6, Verification of Safety During Testing. The test officer will identify restrictions imposed by the release, directives, or local regulations which, in his judgment, may influence test results; when safety restrictions limit testing, reports will so indicate.

7. Personnel Training.

a. The procedures of TOP 3-3-501 and TOP 4-3-501, both entitled Personnel Training will afford the test officer sufficient methodology to determine: (1) the type and duration of instruction required to train soldiers in the use of the test item, (2) whether the proposed program of instruction (POI) is adequate and, (3) if the test item meets the training criteria of the appropriate needs documents.

b. During this phase, test personnel should be familiarized thoroughly with:

- (1) The mechanical and technical characteristics of the test item.
- (2) The conduct of, procedures for, and objectives and criteria of the EST.
- (3) Their individual assignments and responsibilities.

c. To minimize bias and achieve a high degree of validity during a test which compares a new or improved launcher with an older and more familiar model, it is essential that this training period produce a test soldier as familiar with the test item as with the control launcher. Extensive training may be necessary to meet this end.

8. Boresighting.

a. Boresighting provides a basis for all sight adjustment. It is performed to establish a definite relationship between the axis of the weapon and its sight(s) and accomplished by paralleling the axis of the sight with the axis of the bore when a range setting of zero is on the sight(s). With launchers, boresighting is accomplished by the distant target or infinity method as prescribed in applicable technical or training manuals.

b. TOP 3-3-503, Boresight and Zero, provides an adequate method to boresight a candidate rocket launcher. Although that TOP is written to support boresighting and zeroing of the main armament and coaxially mounted weapons of combat vehicles, its principles are appropriate to any direct fire weapon system.

9. Range and Accuracy.

a. Objectives.

To determine: (1) the distances at which the test item will provide accurate and effective fire, (2) the degree to which

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the test launcher meets the range and accuracy criteria of appropriate needs documents, and (3) the effectiveness of the sighting system provided.

b. Method.

(1) Test and control launchers will be range-fired by test soldiers representative of projected user population. The firing exercises should include but not be limited to:

- (a) Stationary targets at known ranges (7½ ft by 7½ ft panels).
- (b) Stationary targets at unknown ranges (7½ ft by 7½ ft panels).
- (c) Moving targets at known ranges (7½ ft by 15 ft).
- (d) Moving targets at unknown ranges (7½ ft by 15 ft).

NOTE: Test personnel should fire a specified number of rounds from each launcher (test and control) at ranges specified by the criteria, from each authorized position, i.e., prone, sitting, kneeling, and standing. The amount and type of ammunition used, mode of launcher operation, sight(s) employed, and other specific live-fire requirements will be dictated by the characteristics prescribed by the applicable needs documents and test directives.

(2) An appropriate portion of range firing will be conducted at night and/or during periods of reduced visibility during daytime. Any aid-to-vision device appropriate to the employment of the test or control items should be used.

(3) The adequacy of the sighting system will be observed during all firing.

c. Data Required.

The following data should be recorded:

- (1) Number and identity of firers.
- (2) Range to target.
- (3) Target description (size, shape, moving or stationary).

- (4) Ammunition fired (by type).
- (5) Mode of launcher operation (slow or rapid).
- (6) Position of firer (supported-unsupported, prone, sitting, kneeling, standing).
- (7) Time to fire first round (each firer, each range).
- (8) First round hits (each firer).
- (9) Total hits (each firer).
- (10) Total misses and miss distance.
- (11) Secondary missiles produced, if any (describe).
- (12) Malfunctions.
- (13) Firers estimated ranges at targets of unknown range.
- (14) Meteorological readings.
- (15) Comments and observations of test personnel.

d. Analytical Plan.

(1) An appropriate statistical analysis of the measures of effectiveness should be prepared which emphasizes any manifested differences between the test and control launcher system and/or between the test item and the stated criteria. This should include a study of significant findings resultant to the recorded mean-time comparisons.

(2) A subjective analysis of comments and observations of test personnel should be prepared.

(3) Data should be collated, and a report, in narrative form, of significant findings presented. The narrative should be supported with pictorial and/or graphic evidence when appropriate.

10. Antipersonnel/Antimateriel Capabilities.

a. An ancillary role of a rocket launched projectile employed against enemy personnel and materiel will be evaluated during this

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phase of the EST. A test weapon assumes this role with the selection and utilization of an appropriate round of antipersonnel or antimateriel ammunition. Because of its blast, fragmentation, and/or concussion effects, an appropriate type of ammunition might be employed against field fortifications, bunkers, pill-boxes, personnel, buildings, lightly or unarmored vehicles, built-up areas, assembled personnel, or crew-served weapons.

b. The capability of a launcher system to fire a designated antipersonnel or antimateriel round of ammunition may be determined by performing the applicable procedures of TOP 4-3-104, Projectile, Antipersonnel/Antimateriel. The procedures address:

- (1) Canister (any antipersonnel (APERS) projectile not fused).
- (2) APERS (antipersonnel incorporating a fuze).
- (3) High Explosive (HE).
- (4) High Explosive Plastic (HEP).
- (5) High Explosive Antitank-Multipurpose (HEAT-MP).
- (6) White Phosphorus (WP).

c. TOP 4-3-104 contains detailed procedures which outline firing exercises, target arrangement, scoring, and the collection and processing of data to support an evaluation of this potential ancillary capability of a candidate test launcher system.

11. Durability/Reliability.

a. Objective. To determine the degree to which the candidate launcher system will survive a projected service-life, in a serviceable condition, while performing its intended military function.

b. Method.

(1) Durability/Reliability characteristics of a test item are examined throughout the course of an EST by developing a test history of deterioration, degradation, weaknesses, malfunctions, and other shortcomings or failures. Records of tests should cover each major component of the test item and its ancillary equipment and document the time and circumstances of each incident affecting durability or reliability.

(2) Test and control launchers should be subjected to field exercises emphasizing tactical employment in a combat environment, with test personnel undertaking as many diversified combat related tasks as feasible. The exercises should be of sufficient duration to determine if the life expectancy of the test item (as stated in materiel needs documents) is affected by sustained tactical usage. Test items will be inspected, thoroughly, following each exercise. Appropriate field exercises may be found in TOP 1-1-046, Field Combat Test Exercises.

c. Data Required.

(1) The comments and observations of all failures, weaknesses, or malfunctions occurring during the course of the EST. Particular attention should be directed toward firing exercises, portability, adverse conditions, and air delivery subtests.

(2) The results of inspections conducted prior to, during, and following field exercises.

(3) Statistics related to mean-time-between failures (MTBF) of both test and control items in similar situations, if applicable.

(4) Pictorial evidence applicable to wear out, deterioration, or other manifestations of durability or serviceability interests.

d. Analytical Plan.

(1) An appropriate analysis of the following should be prepared:

(a) Comments and observations related to the durability/reliability performances of the test and control items in like circumstances.

(b) The statistical findings of significant implications in areas of comparison - test versus control items, and test item versus criteria established in the appropriate materiel needs documents.

(2) A narrative report of significant findings should be prepared, supplemented with pictures, charts, graphs, or other graphics when appropriate.

12. Obscuration and Security From Detection.

a. Two common service test procedures, 1-3-515, Security From Detection, and 3-3-516, Obscuration, should provide the test officer with sufficient procedures for him to determine:

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(1) The degree to which the test item produces signature characteristics which will aid an enemy to locate the friendly position by sight, sound, or instruments.

(2) The degree to which targets may be obscured from a friendly view by signature characteristics of smoke, flash, dust, and blast.

b. Successful combat operations dictate minimum signature effects from a weapon. Every effort must be made to ensure that noise, flash, reflection, blast, smoke, and heat radiation are thoroughly examined, measured, and properly evaluated for each test launcher. MTP/TOP 1-3-515 outlines a series of subtests designed to fulfill the requirement.

c. Obscuration of the target immediately after firing is a phenomenon typically caused by smoke discharged or dust raised by muzzle blast. Muzzle blast is a generic term used frequently in conjunction with direct fire weaponry to describe the physical effects of the release of propellant gases at high pressure upon the ground. This normally lifts dust, dried vegetation, and/or small debris. Further, the flash of the weapon may momentarily glaze or obstruct a gunner's line of sight, thereby obscuring the target and obstructing the sensing required for firing adjustments.

d. The techniques of testing described in the two common service procedures referenced above allow the combining of their subtests to obtain common results. The principle difference, that of objective, is generated only by perspective: position disclosing effects are initiated from an enemy point of observation, while obscuration is a friendly gun position consideration. Most of the requirements may be achieved concurrently with the live-fire exercises of other subtests by means of observers and photography from different locations.

13. Adverse Conditions.

a. The applicable procedures of TOP 3-3-524, Adverse Conditions, should be accomplished to determine the performance level of the test item under nonstandard and abnormal environmental conditions.

b. A candidate rocket launcher, its ammunition, and ancillary equipment must be designed to function properly under the most rigorous environmental conditions likely to be encountered in combat. During the preliminary stages of development and engineering, a test item will be subjected to precisely controlled and instrumented environmental chamber tests under extremes of temperature, humidity,

and other atmospheric conditions. A test launcher system may be further subjected to vibration, drop, shock, altitude cycle, immersion, salt spray, ice fog, and hundreds of mechanical cycling tests during these tests. However, the actual use of the test system under severe climatic conditions, in a combat or similar environment, and in the hands of representative troops may produce different results from those of controlled testing. (If the results of chamber tests are known at the time of the EST, test officers should review those findings and exert the major effort of the EST to other areas).

c. Procedures for subjecting the test item to the conditions of a desert, tropic, or arctic environment will be found in the following:

- (1) TOP 3-4-001, Desert Environmental Test of Armament and Individual Weapons.
- (2) TOP 3-4-003, Armament and Individual Weapons (Tropic).
- (3) TOP 3-4-007, Arctic Environmental Test of Recoilless Weapons.

14. Portability/Transportability.

a. The applicable procedures contained in the following listed documents should be performed to determine the suitability of the test item to be carried as a component of an individual's fighting and/or existence load while performing combat or combat associated tasks:

- (1) TOP 10-3-506, Man Portability/Transportability.
- (2) TOP 7-3-511, Airdrop Operations - Personnel and Individual Equipment.
- (3) TOP 4-3-503, Battlefield Mobility, Tactical Flexibility, and Portability.
- (4) TOP 4-3-511, Transportability (Ammunition).

b. The field exercise and range firing conducted in other subtests will provide adequate opportunity to observe the test launcher system in the hands of a soldier as he handles, carries, and transports the test item through a variety of conditions, activities, and circumstances. In addition, a Clothing and Equipment Test Facility (CETF) operated by the US Army Infantry Board at Fort Benning, Georgia, offers an opportunity to examine a test item's compatibility with

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combat-oriented tasks by means of exposing the test system (carried by a soldier) to various statistic-producing tactical situations. Although the Benning facility depends largely on a sophisticated instrumentation system, its exercises and tasks are adaptable to improvisation at other locations if access to the CETF is not feasible.

15. Maintainability.

a. Objectives.

To determine: (1) whether the maintenance functions, as listed on the maintenance allocation chart, can be readily accomplished using the manuals, tools, repair parts, and skills authorized, (2) whether the pertinent manuals are accurate and adequate, and (3) whether the test launcher system meets the maintenance requirements of the appropriate needs documents.

b. Method.

An examination of maintainability should be conducted in accordance with the applicable provisions of TECOM Reg 750-15, Maintenance Evaluation During Testing. As a minimum, the following should be emphasized:

(1) Throughout the course of the EST, all scheduled and unscheduled maintenance functions will be performed by using only those tools and procedures authorized in maintenance package instructions.

(2) Operator maintenance will be performed by test personnel as the requirement arises.

(3) Direct and general support maintenance functions will be performed by mechanics with the MOS appropriate to the level of performance.

(4) Test soldiers and maintenance personnel will be observed while performing tasks and questioned to determine whether any function is unduly difficult, requires excessive time, or reveals discrepancies prejudicial to the ease of maintenance.

(5) Maintenance manuals, issued with the test item, will be constantly scrutinized for clarity, errors, and/or omissions.

c. Data Required.

During the course of the EST the following should be recorded:

- (1) Operator maintenance performed on each test item.
- (2) Organizational, direct support, and general support maintenance required and performed.
- (3) Comments and observations related to ease or difficulty of maintenance effort required.
- (4) Data related to adequacy of maintenance literature.
- (5) Observations and comments related to the adequacy of the total maintenance package.

d. Analytical Plan.

- (1) Maintenance data obtained throughout the course of the EST should be collated and subjected to appropriate analysis.
- (2) A narrative report should be prepared, supported by pictorial and/or graphic supplements when appropriate.

16. Human Factors Engineering.

a. The applicable procedures of TOP 3-3-521, Human Factors Engineering, should be accomplished to determine: (1) if the test item meets the human factors requirements as expressed in the appropriate needs documents, (2) is designed in accordance with basic human factors principles, and (3) the degree to which the test item meets with troop acceptance.

b. In recommending a new weapon as suitable for Army use, care must be exercised in evaluating the man-machine relationship which dictates compatibility with skills, aptitudes, and the limitations of the soldier who will use the item. Human factors personnel should assist the test officer in identifying, examining, and reporting pertinent information and data which will facilitate an accurate judgment in this important area.

17. Value Analysis.

a. Objective. To identify potential fruitful areas for subsequent value engineering by the developer.

b. Method. Throughout testing, note will be taken of any unnecessary, costly, or nice-to-have features which might be modified or eliminated without compromising the effectiveness or safety of the candidate test item. (Attention is directed to TECOM Reg 700-1, Value Engineering).

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c. Data Required. A record of the comments, observations, and reports of areas detected and identified as potential regions for value engineering effort.

d. Analytical Plan. Collected data should be analyzed and a narrative recommendation prepared for developer improvement in appropriate areas. The narrative should be supplemented with pictorial or graphic support when appropriate.

Recommended changes to this publication should be forwarded to Commanding General, US Army Test and Evaluation Command, ATTN: AMSTE-ME, Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from US Army Infantry Board, ATTN: STEBC-MO-M, Fort Benning, Georgia 31905. Additional copies of this document are available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. This document is identified by the accession number (AD No) printed on the first page.

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APPENDIX
REFERENCES

1. AR 70-10, Research and Development, Test and Evaluation During Development and Acquisition of Materiel.
2. TECOM Reg 70-24, Documenting Test Plans and Reports.
3. TECOM Reg 70-34, Risk Analysis for Suitability Tests.
4. TECOM Reg 385-6, Verification of Safety During Testing.
5. TECOM Reg 700-1, Value Engineering.
6. TECOM Reg 750-15, Maintenance Evaluation During Testing.
7. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
8. TOP 1-1-045, General Supplies and Equipment Testing.
9. TOP 1-1-046, Field Combat Test Exercises.
10. TOP 3-1-002, Confidence Levels and Sample Size.
11. FM 23-32, 3.5 Inch Rocket Launcher.
12. FM 23-33, 66-mm High Explosive Antitank Rocket, M72.