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13. ABSTRACT

Describes a method for evaluation of hand weapon physical and functional performance characteristics. Identifies supporting tests, facilities, and equipment required. Provides procedures for preoperational inspection, physical characteristics, safety, personnel training, accuracy, compatability with combat tasks, durability, reliability, portability, adverse conditions, maintainability, human factors, and value analysis. Applicable to small arm hand held pistols and revolvers. Not applicable to trench knives and submachine guns.

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EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURE

AMSTE-RP-702-102
*Test Operations Procedure 3-3-060

3 November 1972

HAND WEAPONS (PERSONAL DEFENSE)

SECTION I
GENERAL

1. Purpose and Scope.

a. This Test Operations Procedure (TOP) is a guide to assist a test officer in preparing a plan of test for Expanded Service Test (EST) of a pistol or revolver (personal defense weapon). It describes methods and techniques to be used in determining if a candidate hand weapon meets the criteria established in the appropriate materiel need documents and is suitable for use by the US Army.

*This TOP supersedes MTP 3-3-060, 30 April 1971.

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b. These procedures address (1) a preoperational inspection and physical check of the characteristics of the test item, (2) a series of appropriate tests designed to examine the functional and operational performance of the item, and (3) an examination of the human factors and value analysis aspects of the candidate hand weapon.

c. The subject of these procedures is envisioned as being a small arm, hand-held pistol or revolver, carried by an individual to provide a personal means of self defense in close-in combat situations. Other self defense weapons, such as trench knives and submachine guns, are not addressed in this test operations procedure.

2. Background.

a. The predominant hand gun of the military services, the automatic pistol, caliber .45, M1911, designed by John M. Browning, was introduced to the U.S. Army in 1911 and, with very few modifications, remains the official personal defense weapon of U.S. military forces today. The automatic portion of the nomenclature is technically a misnomer in that the weapon has the inherent characteristics of a semi-automatic hand gun since it fires only once each time the trigger is pulled. The energy needed to operate the pistol for subsequent rounds is produced by cartridge powder gas expanding and forcing a mechanical movement of precision parts as each round of ammunition is fired. The rugged simplicity of this recoil-operated, locked-breech mechanism developed by Browning has been imitated by pistol manufacturers all over the world, and with but minor variations has been produced in at least seven calibers in more than a dozen countries.

b. The reputation established by the Browning M1911 and M1911A1 pistols in the areas of ruggedness, reliability, and lethality of its ammunition has outweighed its disadvantages of weight, limited magazine capacity, lack of a double action, and difficulty in mastering.

c. To date, no military handgun tested since 1911 has been considered to possess features and characteristics significantly superior to those of the M1911A1 pistol to warrant its replacement.

d. Efforts undertaken in the western world since the late 1930's to provide handguns have centered on semiautomatic pistols designed for the 9mm parabellum (luger) cartridge. The 9mm was adopted as standard for pistols and submachine guns by NATO after World War II, except for the U.S. Armed Forces.

e. Recent improvements in ammunition characteristics and weapon construction materials indicate that significantly improved candidate successors to the M1911A1 pistol may be expected in the not too distant future.

1b

3. Equipment and Facilities.

a. Equipment.

(1) Test weapons, their components, training, and maintenance packages.

(2) Control weapons.

(3) Infantry unit.

(4) Qualified pistol and revolver marksmen.

(5) Weighing equipment.

(6) Linear measuring equipment.

(7) Photographic equipment.

(8) Communications equipment.

(9) Tactical vehicles, air and ground.

(10) Qualified parachutists.

(11) Meteorological equipment.

(12) Safety and first aid equipment.

(13) Ear plugs.

(14) Cleaning materials and lubricants.

(15) Ammunition.

(16) Photometer.

(17) Stopwatch.

(18) Binoculars.

(19) Individual protective clothing and equipment, CB.

(20) Other equipment as prescribed in referenced procedures.

b. Facilities.

(1) Suitable firing ranges and appropriate targets.

(2) Range instrumentation and recording equipment.

(3) Classroom, office, and storage space.

(4) Airfield and drop zone.

(5) Other facilities as prescribed in referenced procedures.

SECTION II
TEST PROCEDURES

4. Supporting Tests.

a. Although testing procedures are described in successive paragraphs, they need not be conducted in the order in which they are presented. Some will overlap or be performed simultaneously with others. The supporting tests are flexible and allow the test officer the latitude necessary to tailor a test plan to the precise characteristics and requirements of a specific test item, and the state-of-the-art at the time and place of testing.

b. Data should be obtained in sufficient quantities and be of a quality to support valid conclusions. This objective may be constrained by limited numbers of test or control items; by a limited time in which to accomplish testing; or by limited funds, manpower, or general support facilities. To identify the best means of securing meaningful data within the limitations imposed, the test officer should establish close liaison with available statistical and human factors personnel. The statistician can contribute to establishing the overall experimental pattern or design, recommending the number of test soldiers required, and advising on the number of repetitions or replications required to obtain maximum results for specific operations. Human factors representation can add training and experience in providing guidance in the development and presentation of questionnaires, interview techniques, and the human factors input required in tests, plans, and reports. Further assistance may be found in the statistical guidance of MTP/TOP 3-1-002, Confidence Intervals and Sample Size.

c. Ammunition will play a major role in the evaluation of any weapon. Every effort must be made to ensure that the ammunition furnished for the conduct of the expanded service test is identical in every respect to that which will be available for standard use should the test weapon be accepted for entry into the Army's inventory.

d. A log book should be maintained as a chronological record of remarks, observations, meteorological data, times, comparisons, and other

pertinent events and data. An accurate compilation will expedite the collation of information required in the reduction and presentation phase of each supporting test. Photography, motion studies, charts, graphs, and other pictorial or graphic aids are recommended as supplements to the narratives.

e. Meteorological data (temperature, relative humidity, precipitation, wind speed and direction) and light level readings should be collected in those test situations where such data will have a bearing on the test results.

f. When directed, results of the risk analysis will be provided HQ TECOM. TECOM Reg 70-34, Risk Analysis for Suitability Tests, will provide the test officer with the needed guidance.

g. To provide as realistic a combat environment as possible, and to insure adequate preconditioning (stressing) of the test item and test soldiers, all field testing and selected range firing should be integrated with an appropriate combat exercise as described in TOP 1-1-046, Field Combat Test Exercises. The degree of integration will depend on the precise characteristics of the test item, the data being sought, and the resources available to the test officer at the time and place of testing.

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

TEST SUBJECT TITLE	PUBLICATION NUMBER
(1) Preoperational Inspection and Physical Characteristics (refer to para 5)	3-3-500
(2) Safety (refer to para 6)	3-3-517
(3) Personnel Training (refer to para 7)	3-3-501
(4) Accuracy (refer to para 8)	
(5) Compatibility with Combat Tasks (refer to para 9)	
(6) Durability/Reliability (refer to para 10)	

TEST SUBJECT TITLE	PUBLICATION NO.
(7) Portability (refer to para 11)	7-3-511 and 10-3-506
(8) Adverse Conditions (refer to para 12)	3-3-524, 3-4-001, 3-4-003, 3-4-004
(9) Maintainability (refer to para 13)	10-3-504
(10) Human Factors Engineering (refer to para 14)	3-3-521
(11) Value Analysis (refer to para 15)	

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Preoperational Inspection and Physical Characteristics.

a. The objectives of this subtest are (1) to verify the completeness of the candidate hand weapon, (2) to determine if the test item and all of its components are in a serviceable condition and suitable for subsequent tests, and (3) to compare its physical characteristics with the criteria stated in the appropriate materiel need documents.

b. In collecting data to support the test findings, it is important to isolate the when and where of events as well as the final judgment of what happened. It is possible that a malfunction or failure, attributed to the mechanics of an expanded service test, may actually have originated as a fault of inadequate product control during manufacturing, or through poor shipping or handling processes. This type defect must be detected and documented during this phase, before subsequent testing begins.

c. Physical characteristics, such as weight, size, type of action, trigger pull, length, finish, and other particular characteristics of the test item as defined in the accompanying requirements and specification documents, should be thoroughly examined and properly recorded during this preliminary subtest.

d. The applicable procedures of MTP/TOP 3-3-500, Preoperational Inspection and Physical Characteristics, should be performed to accomplish the objectives described above.

6. Safety.

a. This subtest should be conducted in accordance with the applicable procedures of MTP/TOP 3-3-517, Infantry Weapons and Ammunition Safety, to determine the effectiveness of safety features, and to confirm the safety of each component of the test item.

b. Safety must be considered throughout the conduct of testing and, to the extent practicable, should be evaluated concurrently with or as an adjunct to other subtests. To be safe for troop use, a hand weapon must be free of any conditions or feature which may cause injury to the user or adjacent personnel. The area of concern applies to the real and potential hazards of the test item itself, and to its relation to any combination of items with which it may be used.

c. Particular attention should be given to verifying safety limitations and compiling data pertinent to the safety confirmation required by TECOM Reg 385-6, Verification of Safety During Testing. In the absence of a safety release, and when directed by competent authority, the limitations established by the developer as cited in the safety statement may be used in lieu of a safety release. The test officer must identify restrictions imposed by the safety release, directives, or local regulations which, in his judgment, may influence the results of the tests. In any instance where safety considerations materially affect test findings, such circumstances should be duly reported.

7. Personnel Training.

a. The applicable procedures of MTP/TOP 3-3-501, Personnel Training, should be performed to (1) determine the type and duration of the training required to prepare soldiers to use the test item, (2) determine whether the proposed program of instruction is adequate, (3) determine whether the training criteria established in the applicable materiel need documents are met by the test weapon and its training package, and (4) orient the test participants to objectives and to their individual responsibilities.

b. Test personnel should be representative of those who will use the test weapon is a user environment. Generally, they will be representative of the 5th through 95th percentile in height, weight, and body configuration as determined from the applicable charts in Military Standard 1472A, Human Engineering Design Criteria. In addition, some of the test personnel should be left handed, and some should wear eyeglasses.

c. To minimize bias and achieve a high degree of validity during tests of comparison, it is essential that the training period produces a test soldier equally familiar with the test and control weapons. This may require a considerable amount of mechanical training, preliminary marksmanship training, and familiarization firing.

d. An evaluation of the ease of assembly and disassembly will be made during this and other appropriate supporting tests. Supervisory personnel should note any difficulties encountered and solicit comments and opinions from the test soldiers as the latter progress through familiarization and mechanical functioning exercises.

8. Accuracy.

a. Objective.

To evaluate the capability of the test weapon to deliver effective fire upon a designated target when fired by expert and average marksmen.

b. Method.

(1) Test personnel selected to perform the accuracy test should be of two separate and distinct categories: (1) the best and highest qualified shooters available, and (2) soldiers selected at random as being representative of the average individual armed with a hand weapon. Each category of shooter should be given sufficient preliminary pistol marksmanship training and instructional practice firing (para 57, FM 23-35) to assure a representative performance when the test weapon is fired for record.

(2) Following an adequate period of familiarization instructional marksmanship and firing, test personnel should fire for record. Record fire will be conducted on a combat pistol qualification course (CPQC) similar to that described in paragraph 59, FM 23-35, in accordance with the guidance contained in Paragraphs 60-65 of the same manual.

(3) Each test group should fire the control weapon over the same courses as those selected for test weapon accuracy firing in order to provide a basis for comparison.

c. Data Required.

(1) The following data should be recorded (by firer, course, and weapon fired):

(a) A description of the firing procedure followed.

(b) Range fired.

(c) Position of shooter.

(d) Number of rounds fired.

(e) Time limitations, where appropriate.

(f) Type of targets used.

(g) Type and lot number of ammunition used.

(h) Total hits, time to engage target, time to first round, time to first hit, and time to shift fire (on combat ranges).

(2) The weather and the light conditions at time of each firing exercise.

(3) Stoppages, other malfunctions, and other anomalies.

(4) The comments and observations of participating personnel (to include suitability of sights and adjustment features thereof).

d. Analytical Plan.

1) All data obtained from each firing exercise should be collated.

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

(a) Subjective information collected in each exercise.

(b) Mean times and distances recorded.

(c) Comparative performance data, test versus control weapon performance.

(3) A narrative report should be prepared and supplemented with charts, graphs, or other visual aids when appropriate.

9. Compatibility with Combat Tasks.

a. Objective.

To determine if the test hand weapon is compatible with the other items which are worn, carried, or used by a soldier engaged in combat or in combat-related tasks.

b. Method.

(1) Test soldiers, carrying test and control weapons (randomly selected) should participate in a series of tactical exercises conducted under the varying conditions of a combat environment, to include:

(a) Road and cross-country marches, foot and motor.

(b) Crew-served weapons drill.

(c) Crew-served weapons firing.

(d) Command post and observation post exercises.

(e) Day and night patrolling exercises.

(f) Unit attack, defense, and retrograde field exercises.

(g) Armored vehicle transported movements.

(h) Parachute and air mobile operations.

(i) Vehicle, crew-served weapons, and other maintenance efforts.

(2) Ground exercises should be conducted over varying terrain which should include open, heavily wooded, marshy, swampy, streams, and thick underbrush areas. Note should be taken of any restraints or limitations imposed on the soldier by the test item as he performs various combat related tasks. Compatibility with other equipment and clothing should be noted as the soldier walks, runs, jumps, and crawls while operating, handling, and carrying the variety of equipment required to satisfy the diversified missions.

(3) An instrumented clothing and equipment test facility (CETF), located at Fort Benning, Georgia, can expedite the collection of performance data. Most of the exercises are adaptable to local sites if access to the CETF is impractical.

c. Data Required.

(1) The type and duration of each exercise.

(2) Weather conditions.

(3) The effects of the test item on the soldier's mobility, efficiency, and ability to perform the combat-related tasks tested during each exercise.

(4) The comments and observations of test personnel as related to the compatibility performances of the test and control weapons.

d. Analytical Plan.

(1) Data obtained during the course of the exercises will be summarized and use should be made of charts and photographs when appropriate.

(2) A statement of the adequacy of the test item as related to the tasks of a soldier in the field should be prepared and changes or improvements suggested as appropriate. Judgments should be founded on an appropriate analysis of the information and data obtained.

10. Durability/Reliability.

a. Objective.

To determine the ability of the test item to survive a projected service life, remain serviceable, and continue to function properly.

b. Method.

(1) Test firers should fire the number of rounds prescribed in the materiel need documents as the minimum for acceptable performance from as large a sample of test weapons as is feasible. Particular attention should be directed to firing the designated amount of rounds at the rate of fire and in the mode designated.

(2) The firing required for this phase of testing should consist primarily of range firing conducted during the course of the other supporting tests. In the collection of data to support a judgment in this area, note should be taken of and records maintained concerning malfunctions, equipment failures, and other responses having a bearing on the service life of the test item. Particular attention should be given to conditions or circumstances which cause weapon stoppages or otherwise prevent or limit the operational functioning or capabilities of the test item. Every effort should be made to determine whether stoppages and other malfunctions are chargeable to the weapon, ammunition, accessories, or personnel error.

c. Data Required.

(1) The following should be recorded as the information becomes available in any phase of the EST.

(a) The total number of rounds, by type, fired from each test weapon.

(b) The number of rounds by mode of fire.

(c) Stoppages, by type, by weapon and cause (if determined).

(d) Other malfunctions, by type, by weapon, and by cause (if determined).

(e) The time required to reduce stoppages and other malfunctions.

(f) Any breakage, or other component part failures.

(2) The comments and observations of test personnel related to durability and reliability.

d. Analytical Plan.

(1) All durability and reliability information and data acquired during the various test phases should be collated and reduced to a workable form.

(2) An appropriate analysis of times and comparisons collected should be prepared.

(3) An analysis of comments and observations expressed by test participants as related to the issue should be prepared.

(4) Findings should be presented in a narrative form, supplemented by pictorial or graphic evidence when appropriate.

11. Portability.

a. This supporting test should be conducted in accordance with the applicable procedures of MTP/TOP 10-3-506, Man-Portability/Transportability, to determine the suitability of the test item for carry and transport.

b. The field and range exercises of the other supporting tests should normally provide adequate opportunities for observing test soldiers handling, carrying, and transporting the test weapon over varying distances and terrain under simulated combat conditions. When necessary, special exercises or courses should be conducted or traversed in order to ensure that combat-equipped test soldiers carry or transport the test item under a wide range of test conditions, including delivery by individual parachutist and man-transport in land and air tactical vehicles. TOP 7-3-511, Airdrop Operations, Personnel and Individual Equipment, describes techniques and methods for testing the suitability of a test item for parachute delivery by an individual.

12. Adverse Conditions.

a. The applicable procedures of MTP/TOP 3-3-524, Adverse Conditions, should be performed to determine the test item's capability to function properly under conditions other than normal.

b. Tests to evaluate the functioning of the test item under the extreme climatic conditions common to the desert, tropic, and arctic regions may be found in MTP/TOP 3-4-001, 3-4-003, and 3-4-004, respectively.

c. A candidate weapon, 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 development and engineering stages, a hand weapon should be evaluated and subjected to precisely controlled and instrumented environmental chamber tests under extremes of temperatures, humidity, and other atmospheric conditions. However, the actual service use of a hand weapon under severe climatic conditions, in a tactical environment, and in the hands of representative troops may produce results undiscovered during controlled testing.

d. Test weapons will be fired following exposure to the adverse conditions experienced during the conduct of the other subtests.

13. Maintainability.

a. Objectives.

(1) To determine whether the maintenance functions, as listed in the applicable maintenance allocation chart, can be readily accomplished using the literature, tools, repair parts, and skills authorized.

(2) To determine whether the pertinent maintenance manuals are accurate and adequate.

(3) To determine whether the test item's maintenance requirements meet the criteria expressed in the materiel need documents.

b. Method.

(1) An evaluation of maintainability should be conducted in accordance with the applicable provisions of TECOM Reg 750-15, Maintenance Evaluation.

(2) During testing, the following should be emphasized:

(a) All scheduled and unscheduled maintenance functions should be performed by using only those tools and procedures prescribed by the instructions contained in the maintenance package.

(b) Operator maintenance should be performed by the test soldiers as the requirement arises.

(c) Direct and general support maintenance functions should be performed by mechanics with the MOS appropriate to the level of activity.

(d) Test soldiers and maintenance personnel should be observed while performing maintenance and they should be questioned to determine whether any function is unduly difficult, requires excessive time, requires tools not provided, or reveals any discrepancy prejudicial to the ease of proper maintenance.

(e) Literature issued to support the test item should be evaluated for completeness, clarity, errors, and/or omissions.

c. Data Required.

The following should be recorded:

(1) Operator maintenance performed on each weapon.

(2) Higher echelon maintenance required or performed.

(3) Observations of test personnel related to the ease or difficulty of performing the necessary maintenance functions.

(4) Errors or omissions detected in maintenance literature.

(5) Specific observations regarding the adequacy of the maintenance package.

d. Analytical Plan.

All maintenance data collected during the course of the EST should be collated and a narrative report prepared. The narrative should be supported by pictures, charts, or diagrams when appropriate.

14. Human Factors Engineering.

a. This supporting test should be conducted under the applicable procedures of MTP/TOP 3-3-521, Human Factors Engineering. Data to support judgments in this area should be obtained throughout the conduct of the EST.

b. Particular attention should be directed toward the following:

(1) The adaptability of the hand weapon to both right and left-handed shooters in all firing positions.

(2) The compatibility of the weapon with the field equipment, weapons, environmental clothing, and CB protective clothing and equipment worn, carried, or employed by the soldier.

(3) Any undue discomfort to the firer from blast, noise, or recoil.

(4) Smoothness of trigger action and the amount of trigger pressure required to fire the weapon.

(5) Ejection pattern interference to the firer or to near-by personnel.

(6) The number, location, and design of safety(ies) and controls, with respect to the ease of location, identification, and operation with a minimum of wasted motion.

(7) The effectiveness and suitability of sights.

(8) Soldier reaction, likes, and dislikes of the weapon's design, functioning, or effects.

15. Value Analysis.

a. Objective.

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

b. Method.

Throughout the course of the EST, note should be made of any unnecessary, costly, or nice-to-have-but-superfluous features which might be eliminated without compromising the effectiveness or safety of the test hand weapon.

c. Data Required.

The comments, observations, and reports of areas identified as potential areas for an appropriate value engineering re-evaluation effort should be recorded.

d. Analytical Plan.

Data collected should be analyzed and a narrative prepared recommending developer improvement in the appropriate areas, if any. Recommendations should be supported with pictorial or graphic supplements 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) stamped on the first page.

APPENDIX
REFERENCES

1. AR 70-10, Research and Development, Test and Evaluation During Development and Acquisition of Materiel.

2. TECOM Regulation 70-24, Documenting Test Plans and Reports.

3. TECOM Regulation 70-34, Risk Analysis for Suitability Tests.

4. TECOM Regulation 385-6, Verification of Safety During Testing.

5. TECOM Regulation 700-1, Value Engineering.

6. TECOM Regulation 750-15, Maintenance Evaluation During Testing.

7. FM 23-35, Pistols and Revolvers.

8. TM 9-1005-211-35, Pistol, Caliber .45 Automatic: M1911A1 with Holster, Hip, W/E. Pistol, Caliber .45 Automatic: with Holster, Shoulder, W/E.

9. TOP 1-1-012, Classification of Deficiencies and Shortcomings.

10. TOP 1-1-046, Field Combat Test Exercises.

11. MTP/TOP 3-1-002, Confidence Levels and Sample Size.