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Materiel Test Procedure 4-3-114
U. S. Army Artillery BoardU. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

PROJECTILE, HIGH EXPLOSIVE

1. OBJECTIVE

The objective of this MTP is to outline procedures for determining the degree that a high explosive projectile, coupled with other ammunition components, meets the specifications of the Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR) and Military Characteristics (MC).

2. BACKGROUND

Of the many different types of projectiles available to the Artillery, the most commonly used is the high explosive projectile. To be effective, reliable and safe to use, it must be accurate and possess the capability of being delivered at long and short ranges under a variety of conditions. It must also be safe to handle, easy to prepare and relatively simple to use.

3. REQUIRED EQUIPMENT

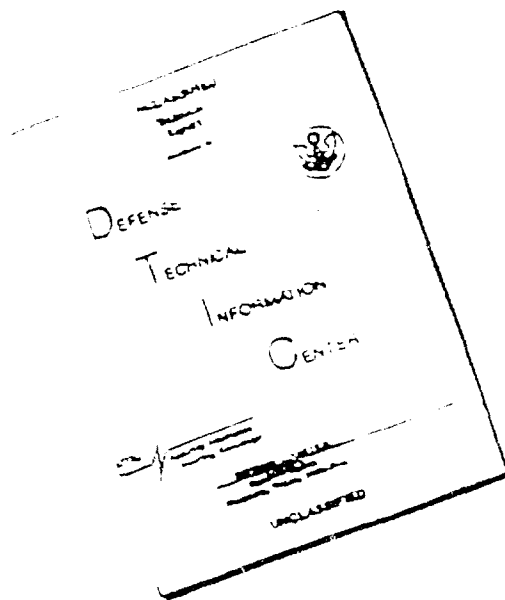
- a. Weapon of appropriate caliber and model.
- b. Standard Ammunition Components (fuses and propellants) compatible with the test projectiles.
- c. Firing Range(s).
- d. Appropriate Standard Ammunition, for comparative firings.
- e. Organizational and Direct Support Maintenance Facilities.
- f. Appropriate Firing Tables.
- g. Weapon Section Equipment.
- h. Communications Equipment, as required.
- i. Transport Vehicles, for Ammunition, Equipment, and Personnel.
- j. Meteorological Equipment.
- k. Ambulance and Aidman.
- l. Equipment and Facilities, as required by the individual referenced MTP's.
- m. Weapon Hop Measuring Instrumentation.
- n. Weapon Recoil Measuring Device

4. REFERENCES

- A. Post (or test site) Range Regulations.
- B. AR 385-10, Army Safety Program.
- C. AR 385-63, Safety Regulations for Firing Ammunition for Training, Target Practice and Combat.
- D. AR 700-1300-8, Malfunctions Involving Ammunition and Explosives.
- E. FM 6-40, Field Artillery Cannon Gunnery.
- F. USAMC Regulation 385-244, AMC Safety Manual.
- G. TM 9-1300-203, Artillery Ammunition.
- H. TM 9-1300-206, Care, Handling, Preservation, and Destruction of Ammunition.

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

- I. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- J. MTP 3-3-506, Accuracy and Precision.
- K. MTP 4-3-500, Preoperational Inspection and Physical Characteristics.
- L. MTP 4-3-501, Personnel Training.
- M. MTP 4-3-502, Ammunition Functioning and Reliability.
- N. MTP 4-3-504, User Reaction.
- O. MTP 4-3-511, Transportability (Ammunition).
- P. MTP 4-3-513, Maintenance.
- Q. MTP 4-3-514, Safety Hazards.
- R. MTP 4-3-515, Human Factors Engineering.
- S. MTP 4-3-520, Field Storage.
- T. MTP 4-3-521, Training Manuals and Technical Publications.

5. SCOPE

5.1 SUMMARY

This document outlines procedures for service testing of high explosive projectiles in order to evaluate their suitability for use by the Army. The evaluation includes:

- a. Preparation for Test - A determination of the condition of the test item upon arrival, its physical characteristics, the availability of facilities, personnel training procedures and safety aspects of the test.
- b. Component Compatibility - A study to determine the compatibility of the test item with "standard" ammunition components of the appropriate size.
- c. Accuracy and Precision and Ballistic Match - A study to compare the test item with a standard item in accuracy and precision when fired and the effects of field storage and transport on the test item.
- d. Terminal Effects - A determination of the overall effects of the test item at impact or detonation.
- e. User Reaction - A determination of the reaction of personnel to the use of the test item.
- f. Ammunition Functioning Reliability - A study to evaluate the reliability of rounds using the test item.
- g. Maintenance Evaluation - A study to determine the maintainability of the test item and an evaluation of the test item maintenance package.
- h. Human Factors Evaluation - A study to determine the effectiveness of the test item-weapon-crew relationship.
- i. Safety Hazards - A study to determine test item-related safety hazards.

5.2 LIMITATIONS

None.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Preoperational Inspection and Physical Characteristics

Upon arrival, determine and record the physical characteristics and operational condition of the test items by subjecting them to the applicable sections of MTP 4-3-500.

6.1.2 Personnel

- a. Ensure the availability of service personnel who have been trained using the criteria of MTP 4-3-501 in conjunction with the appropriate technical publications and training manuals of MTP 4-3-521 and are cognizant of the handling, assembling, maintaining, loading and firing, and safety hazard aspects of ammunition and ammunition components and the object of the procedure.
- b. Record the adequacy of the supplied training literature.

6.1.3 Weapons

- a. Ensure the availability of weapons of the appropriate caliber and tube model(s) which have had average use and which preferably have two-thirds of their tube life remaining.
- b. Record the type, caliber and model number of each weapon used.
- c. Determine and record the physical condition of each weapon used as indicated by visual inspection, borescoping, and tube wear measurements as indicated by a pull-over gauge.

6.1.4 Ammunition and Ammunition Components

- a. Ensure the availability of sufficient standard ammunition components and standard ammunition to allow for comparative firings, as required, for the various fuze types required.
- b. Prior to testing, subject a minimum of 30 test items which have successfully passed the initial inspection procedures of paragraph 6.1.1 to the field storage conditions of MTP 4-3-520 for 90 days.
- c. Prior to testing, subject a minimum of 30 test items which have successfully passed the initial inspection procedures of paragraph 6.1.1 to cross-country vehicle transportation tests as described in paragraph 6.2.2.3 below.

6.1.5 Firing Position and Range

Prepare firing sites which shall meet the conditions described in MTP 3-3-506 for indirect fire and direct fire as concerns range, flash observation posts and impact points.

6.1.6 Instrumentation

Prior to firing, install instrumentation to measure the following:

- a. Muzzle velocity of each round fired
- b. Weapon recoil length for each round fired
- c. Weapon hop for each round fired

d. Current meteorological data

6.2 TEST CONDUCT

- NOTE: 1. Normally, when testing ammunition components, only limited quantities of the test item is available, as such all test personnel shall be acquainted with the necessity of accurately gathering maximum data for each round fired. As such, subtests shall be conducted concurrently with, or in conjunction with, other subtests, whenever possible.
2. The projectile undergoing test will normally have the capability of being fired with several different fuzes and propellants and from several different models of tubes. For complete and valid testing, the test item must be fired and tested in all combinations of fuzes and propellants with which it will be used if standardized and with all models of tubes specified in the QMR's and MC's. This will necessitate repetition of each of the subtests listed below:

a. Record the current meteorological data just prior to the start of firing, and at least every two hours thereafter, during testing.

b. Record the following for each round fired in paragraphs 6.2.2.1 through 6.2.2.3:

- 1) Fall of shot
- 2) Muzzle velocity
- 3) Recoil length
- 4) Depth of ram of projectile
- 5) Weapon hop

NOTE: Insofar as possible ensure that all projectiles are rammed equally and to the same depth.

6.2.1 Component Compatibility

a. Prior to firing assemble complete rounds in such number as to equal the number of different fuzes in combination with the test item and record evidence of incompatibility of the test item with the following:

- 1) Propellant charge shell-casing
- 2) Each type of fuze assembled to the test item

b. Disassemble the items of step a and return them to their packaging.

c. During the firing procedures of paragraph 6.2.2 record any difficulty encountered in setting the fuze on the test round.

6.2.2 Accuracy and Precision and Ballistic Match

NOTE: 1. Accuracy and precision firings with time fuzes will vary

slightly from the procedures in MTP 3-3-506. The ten round groups will be fired with the same weapon settings at a point in the air saving ammunition in that probable errors in range, deflection and height of bursts may be determined from each ten round group.

2. Ballistic match will have been achieved if the center of comparative groups are within the allowable range, deflection and height of burst probable errors of each other as set forth in the test directive, and they have comparable dispersion patterns. Under these conditions the test projectiles, assembled with standard components, are considered to "shoot" the same as the standard projectiles and is, therefore, suitably accurate.

6.2.2.1 Comparison Firings

a. Assemble a sufficient number of test rounds consisting of standard components with test projectiles to meet the minimum requirements of the applicable sections of MTP 3-3-506.

b. Assemble "standard rounds" using all standard components and projectiles equal in number to the rounds of step a.

c. Fire alternately the test rounds and standard rounds and determine the location of impact for each as described in the applicable sections of MTP 3-3-506 and record the following:

- 1) Data, as required, in the applicable sections of MTP 3-3-506
- 2) Type, caliber, and model number of each weapon used
- 3) Propellant charge used
- 4) Fuze, primer, (components) lot number

6.2.2.2 Field Storage

a. Determine the effects of field storage, as described in paragraph 6.1.4.b above and record the applicable storage and inspection data of MTP 4-3-520.

b. At the completion of step a above subject the stored test items, and an equal number of non-stored test items to the applicable procedures of MTP 3-3-506 and record the data of paragraph 6.2.2.1.c.

6.2.2.3 Transportability

a. Subject the test items of paragraph 6.1.4.c using the criteria of MTP 4-3-511, to cross-country vehicle transportation tests using trailers, trucks, and self-propelled weapon storage racks, as applicable for a distance of 500 miles.

b. At the completion of each 100 miles of travel, unload the test items and record the following:

- 1) Type of vehicle used
- 2) Material handling equipment used
- 3) Damage sustained by the test item/test item container

c. At the completion of steps a and b above, determine the effects of transport on the accuracy and precision of the transported test items by subjecting them and an equal number of non-transported test items to the applicable firing procedures of MTP 3-3-506 and record the data of paragraph 6.2.2.1.c.

6.2.3 Terminal Effects

a. During the firing tests of paragraph 6.2.2 observe the detonation of each round fired and classify each burst as to its order of functioning (i.e. low order, high order, normal).

b. Record any rounds which fail to detonate.

NOTE: Lethality data are determined from firings and studies conducted by the Ballistic Research Laboratory.

6.2.4 User Reaction

Determine the "user reaction" to the test item during the period of testing as described in the applicable sections of MTP 4-3-504.

6.2.5 Ammunition Functioning Reliability

During the conduct of all firing tests determine the ammunition functioning reliability of the test item and standard item as described in the applicable sections of MTP 4-3-506.

6.2.6 Maintenance Evaluation

During the period of testing determine the maintenance characteristics of the test item as described in the applicable sections of MTP 4-3-513.

6.2.7 Human Factors Evaluation

Evaluate the effectiveness of the test item-weapon-personnel relationships during the period of testing as described in the applicable sections of MTP 4-3-515.

6.2.8 Safety Hazards

Evaluate the safety aspects of the test item during the period of testing as described in the applicable sections of MTP 4-3-514.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Preoperational Inspection and Physical Characteristics

Record data as described in the applicable sections of MTP 4-3-500.

6.3.1.2 Personnel

Record the adequacy of supplied training literature.

6.3.1.3 Weapons

Record the following for each weapon used:

- a. Type
- b. Caliber
- c. Model Number
- d. Physical condition

6.3.2 Test Conduct

6.3.2.1 Component Compatibility

Record the following:

- a. Any difficulty encountered in assembling the test item to the components.
- b. Any difficulty encountered in setting the fuze on the test rounds.

6.3.2.2 Accuracy and Precision and Ballistic Match

a. For firing data:

- 1) Record the type, model and caliber of each weapon used
- 2) Record the following for each round fired:
 - a) Projectile used (standard, newly arrived test item, post storage test item, post transportation test item).
 - b) Data collected as described in the applicable section of MTP 3-3-506.
 - c) Fall of shot.
 - d) Muzzle velocity in fps.
 - e) Recoil length in inches.
 - f) Depth of ram in inches.
 - g) Propelling charge used.
 - h) Weapon hop.
 - i) Fuze, primer and component lot number used.

4-3-520: b. Record the following for stored test items as indicated in MTP

- 1) Storage data
- 2) Inspection data

c. Record the following for transported test items:

- 1) After each 100 miles of travel
 - a) Number of miles travelled (100, 200, etc.)

- b) Vehicle used
- c) Material handling equipment used

- (1) Loading the vehicle
- (2) Unloading the vehicle

- d) Damage sustained:

- (1) Loading the vehicle
- (2) Unloading the vehicle

2) At the completion of transportation testing:

- a) Number of test items rendered unsatisfactory for firing
- b) Damage sustained

6.3.2.3 Terminal Effects

Record the type of detonation for each round fired as follows:

- a. Round type (time fuze, impact, etc.)
- b. Type detonation low order, high order, normal, dud)

6.3.2.4 User Reaction

Record data, collected as described in the applicable sections of MTP 4-3-504.

6.3.2.5 Ammunition Functioning and Reliability

Record the ammunition functioning reliability data for the test item and standard item, collected as described in the applicable sections of MTP 4-4-502.

6.3.2.6 Maintenance Evaluation

Record data, collected as described in the applicable sections of MTP 4-3-513.

6.3.2.7 Human Factors Evaluation

Record data, collected as described in the applicable sections of MTP 4-3-515.

6.3.2.8 Safety Hazards

Record safety data, collected as described in the applicable sections of MTP 4-3-514.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained from all subtests covered by applicable referenced MTP's shall be summarized and evaluated according to procedures described in those MTP's. Appropriate charts, graphs and tabulated summaries shall be used to present the data in a clear manner. Special consideration shall be given to any condition or circumstance contributing to any test result.

Calculations shall be performed as specified by the referenced individual MTP's, wherever applicable. All photographs shall be retained and suitably identified along with other illustrative material.

Chart all probable errors in range, deflection and height of burst and compare the probable errors of:

- a. Test items not stored or transported
- b. Test items placed in field storage
- c. Test items transported
- d. Standard items fired for comparison purposes

An overall evaluation of the suitability of the test item for use by the Army shall be made, based on the QMR, SDR, MC or other reliable criteria.

Prepare a Safety Confirmation recommendation in accordance with USATECOM Regulation 385-6, based on the data collected in paragraph 6.3.2.8.