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Materiel Test Procedure 4-3-522
U. S. Army Armor and Engineer Board

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

COMBAT VEHICLE AMMUNITION FUNCTIONING

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to describe procedures for collecting and recording data during firing exercises for use in determining ammunition functioning.

2. BACKGROUND

Prior to issuing ammunition for actual combat use, it is necessary to assure a very low incidence of poor performance, i.e., misfiring, failure to function on impact, etc. In nearly all artillery caliber ammunition service testing, the number of rounds that can be used to gather a large volume of information is limited. Artillery caliber ammunition functioning tests are conducted concurrently with other firing exercises to save time and ammunition. Ammunition for automatic type weapons is usually more plentiful so that special ammunition functioning tests can be normally conducted when deemed necessary. Determining the acceptability of functioning requires detailed observation and recording of many items for each round fired. These data must then be studied and analyzed by experienced personnel to determine whether the level of functioning is acceptable.

To assist the observer personnel in the performance of their duties, a brief descriptive resume of the functioning of high order and low order explosives is presented in Appendix A. Figures 1 and 2 on page A-3 are drawings of two types of conventional artillery caliber projectiles with the nomenclature of components pertinent to the required observations.

3. REQUIRED EQUIPMENT

a. Meteorological Equipment to measure and record:

- 1) Ambient temperature
- 2) Wind speed and direction
- 3) Relative humidity

b. Applicable Weapons.

c. BC Scope or Binoculars, as required.

d. Applicable Ranges.

e. Applicable Range Regulations and Standing Operating Procedures (SOP).

f. Appropriate Work Sheet Forms for recording data (Appendices B, C,

or D).

g. Motion Picture and Still Camera and Film, as required.

h. Stop Watches, as required.

i. Appropriate Targets.

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Abberdeen Proving Ground, Maryland 21005.

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4. REFERENCES

- A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- B. TM 9-1300-203, Ammunition for Antiaircraft, Tank, Antitank and Field Artillery Weapons.
- C. FM 17-12, Tank Gunnery.
- D. USAMC Regulation 385-12, Verification of Safety of Army Materiel.
- E. MTP 3-3-503, Boresight and Zero.
- F. MTP 3-3-507, Tracking and Hitting Performance, Stationary Gun Mount-Moving Target.
- G. MTP 3-3-508, Tracking and Hitting Performance, Moving Gun-Stationary Target.
- H. MTP 3-3-509, Tracking and Hitting Performance, Moving Gun Mount-Moving Target.
- I. MTP 3-3-512, Round to Round Dispersion.
- J. MTP 3-3-513, First and Subsequent Round Hitting.
- K. MTP 4-3-502, Ammunition Functioning and Reliability.

5. SCOPE

5.1 SUMMARY

- a. Preparation for Test - An evaluation of the test item prior to testing, safety and personnel training procedures.
- b. Ammunition Functioning Tests - A description of the data to be obtained, during test item loading, firing, extraction and ejection; projectile flight to the target area and the functioning of the test item and its components in the target area.

5.2 LIMITATIONS

This MTP is primarily for use in evaluating the functioning of artillery caliber ammunition for vehicular-mounted main armament employed in a direct fire role (see reference 4C): However, this procedure can be used as a guide in observing the functioning of small arms ammunition for automatic type weapons when terminal effect becomes the primary basis for assessment of functioning as in the case of armor defecting and antimateriel projectiles where qualitative judgments or observations will be the means used to determine functioning.

The functioning of conventional artillery ammunition is covered in MTP 4-3-502.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Safety

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

before the test is started.

6.1.2 General

The project officer shall perform the following:

- a. Ensure that all test personnel are familiar with the technical publications pertaining to the ammunition being tested with special emphasis being placed on "functioning" to indicate what is normal and what is to be considered a malfunction.
- b. Ensure that test personnel have the necessary equipment to observe and record pertinent data.
- c. Schedule functioning tests in conjunction with other firing exercises when possible.

6.1.3 Personnel

a. Qualified crew members (e.g., crew chief, vehicle commander, gunner, etc) of the weapon being used, and cognizant of the data desired during ammunition functioning tests, shall be designated as observers, assigned observer numbers and given the following responsibilities:

- 1) Observer number one shall be responsible for observing the loading and firing of the ammunition, and the extraction and ejection cycle.
- 2) Observer number two shall be responsible for observing the projectile in flight to the target area.
- 3) Observer number three shall be responsible for observing the functioning of the projectile and its components in the target area.

NOTE: More than one individual may be assigned to each observer number.

- b. Test recorders shall be assigned to each observer.
- c. Record the following for each of the observer personnel:

- 1) Name
- 2) Rank or grade
- 3) Military Occupational Speciality (MOS)
- 4) Training time in MOS
- 5) Experience in MOS

6.1.4 Prefiring Ammunition Inspection

6.1.4.1 Artillery Caliber Ammunition

a. Inspect all ammunition cases and record the ammunition lot number and evidence of the following, if applicable:

- 1) Hairline cracks

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- 2) Out of roundness
- 3) Dents
- 4) Bulges
- 5) Rust (steel cases)
- 6) Corrosion or green film (brass cases)
- 7) Other visual defects

b. Inspect nonmetallic cases for, and record evidence of:

- 1) Softness or cracking
- 2) Peeling or breakup of the protective coating

NOTE: Dirty, rusted or corroded cases not having any physical defects shall be cleaned before firing. Do not use defective rounds.

c. Inspect projectiles for, and record evidence of:

- 1) Damage
- 2) Faulty crimping
- 3) Looseness in the case

d. Record total number of defective rounds for each lot of each ammunition type.

e. Record final disposition of defective rounds.

6.1.4.2 Automatic Weapons Ammunition

a. Inspect the ammunition cases and record the ammunition lot number and evidence of the following:

- 1) Hairline cracks.
- 2) Dents.
- 3) Bulges.
- 4) Rust (steel cases).
- 5) Corrosion or green film (brass cases).
- 6) Other defects that might cause a failure to extract or completely eject.

b. Inspect belted ammunition for long and short rounds and record ammunition lot number of defective ammunition.

c. Flex metal-linked ammunition to ensure that the case has not become bonded to the links by rust or corrosion.

d. Record total number of defective rounds for each lot and type of ammunition.

e. Record final disposition of defective rounds

6.2 TEST CONDUCT

a. Ammunition functioning shall be performed under the following

conditions:

- 1) Each round of ammunition fired during the commodity service test and all related common tests shall be observed for proper functioning.
 - 2) Results of all inspections and tests, where possible, shall be photographed.
 - 3) When required by an abnormal malfunction rate additional firings shall be made for the purpose of checking functioning characteristics.
- b. The following will be recorded for each series of rounds fired:
- 1) Nomenclature and serial number of the weapon and vehicle, if applicable.
 - 2) Nomenclature and lot number of the ammunition being fired.
 - 3) Date and time of firing.
 - 4) Ambient temperature.
 - 5) Wind speed and direction.
 - 6) Relative humidity.
 - 7) Gun azimuth, if applicable.
 - 8) Target description.
 - 9) For each observer:
 - a) Name and rank or grade
 - b) Observer number
 - c) Comments on each round

6.2.1 Artillery Caliber Ammunition

Data for this type of ammunition will be gathered in conjunction with other service test firing (e.g., references 4E thru 4J).

6.2.1.1 Firing and Extraction or Ejection

Observer(s) Number 1 shall be responsible for making observations of, and ensuring recordings are made of the following:

- a. For charge:
- 1) Evidence of flashback or blowback
 - 2) Cause of flashback or blowback if possible
- b. For cartridge: Evidence of rupturing or swelling of cases
- c. Inert or burning residue within the chamber or bore for combustible or consumable cartridge cases.
- d. Misfired including primer/percussion cap failure.
- e. Hangfired.
- f. Cook-offs.

6.2.1.2 Functioning of the Projectile in Flight

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Observer(s) Number 2 shall be responsible for making observations of and ensuring recording of the following for the ammunition:

- a. For tracers; when applicable:
 - 1) Failure to ignite
 - 2) Separation from projectile (approximate distance from gun)
 - 3) Intensity
 - 4) Burnout failure (approximate distance from gun, if observed)
- b. Windshield separation from projectile (distance from gun)
- c. Sabot separation and discard

6.2.1.3 Terminal Functioning of Ammunition

Observer(s) Number 3 shall be responsible for making observation of the projectile in the target area and ensuring recordings and/or accomplishment of the following:

- a. Recordings of:
 - 1) Fuze failure
 - 2) Low order detonation
 - 3) Terminal functioning or armor defeating rounds

NOTE: This functioning will be concerned only with the impact of the projectile; hard targets such as tank hulls and armor plate, when available, will be used as targets to aid sensing.

- 4) Fuze functioning and detonation of burst of antimateriel ammunition.

NOTE: In comparing functioning of various rounds, observers must be careful that the rounds are judged under the same atmospheric and terrain conditions in the target area.

- b. For smoke screening clouds:
 - 1) Photograph using appropriate cameras.
 - 2) Prepare a written description to indicate size, shape, duration, and density of the clouds.

6.2.2 Automatic Weapons Ammunition

NOTE: For automatic weapons, such as in tank cupolas, normally loaded and fired by one man, the other crew members, for testing purposes should assist by observing the feeding, loading, firing, extraction and ejection, projectile flight and terminal functioning where possible.

Record the following data for automatic weapons ammunition:

- a. Data as indicated in paragraph 6.2.1.1
- b. Data as indicated in step a of paragraph 6.2.1.2
- c. Applicable data as indicated in step a of paragraph 6.2.1.3

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. Training time in MOS in months
- e. Experience in MOS in months

6.3.1.2 Prefiring Ammunition Inspection

Record the following for each type and lot inspected:

- a. Type of ammunition (90 mm caliber, 50 caliber machine gun)
- b. Lot number of ammunition
- c. Defects observed
- d. Total number of defective rounds
- e. Disposition of defective ammunition

6.3.2 Test Conduct

Record the following for all rounds fired, as applicable:

- a. For the weapon vehicle:
 - 1) Nomenclature and serial number of weapon
 - 2) Nomenclature and serial number of the vehicle
- b. Nomenclature and lot number of ammunition being fired
- c. Date and time of firing in hour, day, month and year
- d. Ambient temperature in °F
- e. Wind speed in mph and direction
- f. Relative humidity in percent
- g. Gun azimuth in degrees
- h. Target description
- i. For each observer:
 - 1) Name
 - 2) Rank or grade
 - 3) Observer number (1, 2, 3)

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4) Comments on each round

6.3.2.1 Firing and Extraction or Ejection (Observer(s) Number 1)

Record the following when applicable: (see Appendix B for sample data sheet):

a. For charge:

- 1) Flashback or blowback
- 2) Cause if known

- b. Rupturing or swelling or cartridge case
- c. Residue within chamber or bore
- d. Misfires
- e. Hangfires
- f. Cook-offs

6.3.2.2 Functioning of the Projectile in Flight (Observer(s) Number 2)

Record the following when applicable (see Appendix C for sample data sheet)

a. For tracers:

- 1) Failure to ignite
- 2) Tracer/projectile separation distance from gun in meters
- 3) Tracer intensity (bright, medium, dim)
- 4) Distance from gun of burnout in meters

- b. Windshield separation from projectile in meters
- c. Sabot separation and discard in meters

6.3.2.3 Terminal Functioning of Ammunition (Observer(s) Number 3)

a. Record the following when applicable (see Appendix D for sample data sheet)

- 1) Fuze failure
- 2) Terminal functioning of armor defeating rounds
- 3) Low order detonations
- 4) For antimateriel ammunition:
 - a) Fuze functioning
 - b) Order of detonation (low, high)
- 5) For smoke screen clouds
 - a) Size and shape
 - b) Duration in seconds
 - c) Density

b. Retain all photographs

6.4 DATA REDUCTION AND PRESENTATION

All data obtained by inspection, observation and testing described in this MTP, including photographic coverage, shall be suitably tabulated or otherwise arranged for correlation under the appropriate subtest of the report of test and presented in a manner to indicate whether the test item meets the Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), or other applicable criteria.

APPENDIX A

AMMUNITION BACKGROUND MATERIAL

1. INTRODUCTION

A brief review of the functioning of the various components of a complete round of conventional ammunition will assist test observers in determining if the round performs satisfactorily.

2. EXPLOSIVES

All conventional explosives are capable of being burned or detonated; some are more readily burned than detonated. A powerful blow applied to certain explosives will cause them to detonate instead of burn. Readily detonated explosives are called high explosives; those which ignite easily but are hard to detonate are called low explosives. Detonation of an explosive is a high order (complete) or low order (partial). The propelling charge of a round of ammunition is an explosive which burns in the gun chamber and imparts velocity to the projectile. The explosive used in most conventional large projectiles is the detonating type which produces extensive destruction.

3. TYPES OF AMMUNITION

(a) Fixed Rounds

In fixed rounds, the cartridge cases are assembled with the primer and propelling charges. The projectile is inserted in the forward end of the case and crimped so that a uniform force (bullet-pull force) is required to separate the projectile from the case. Improperly crimped rounds result in unsatisfactory function of the ammunition.

(b) Separated Rounds

The complete round of ammunition is divided into two units:

- (1) The cartridge case containing the primer or ignition system, the propelling charge and the closing plug as one unit.
- (2) The Projectile as the second unit

(c) Semifixed Rounds

Semifixed rounds of ammunition consist of three units:

- (1) Cartridge cases containing the primer or ignition system
- (2) Propelling charges assembled in bags or separate sections
- (3) The projectile

4. PROJECTILE PHYSICAL CHARACTERISTICS

See Figures A-1 and A-2.

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APPENDIX A

PROJECTILE PHYSICAL CHARACTERISTICS

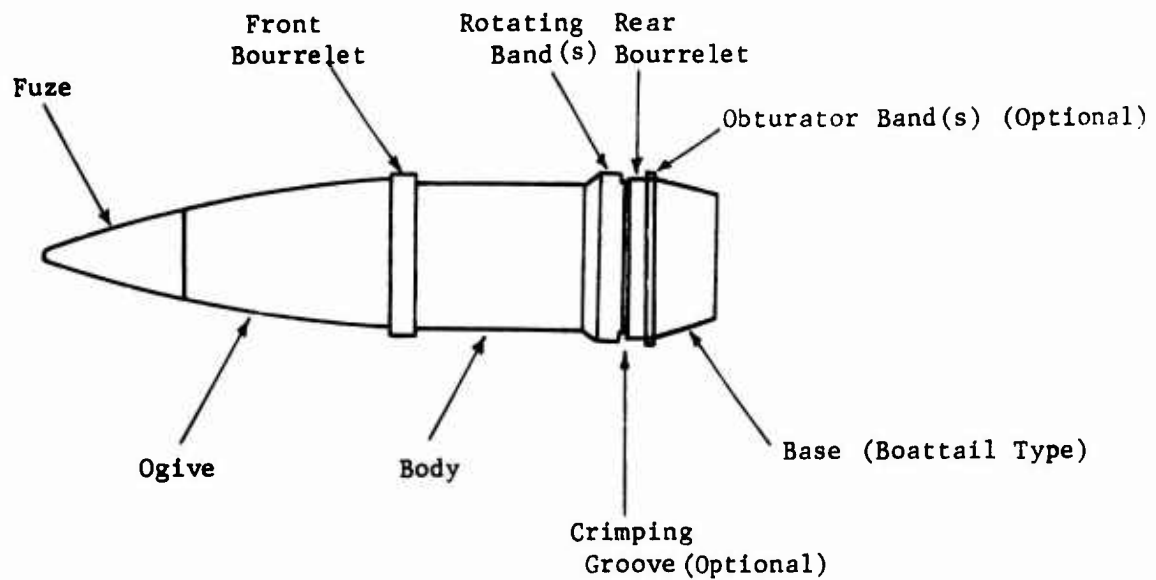


Figure A-1. High Explosive (HE) Projectile

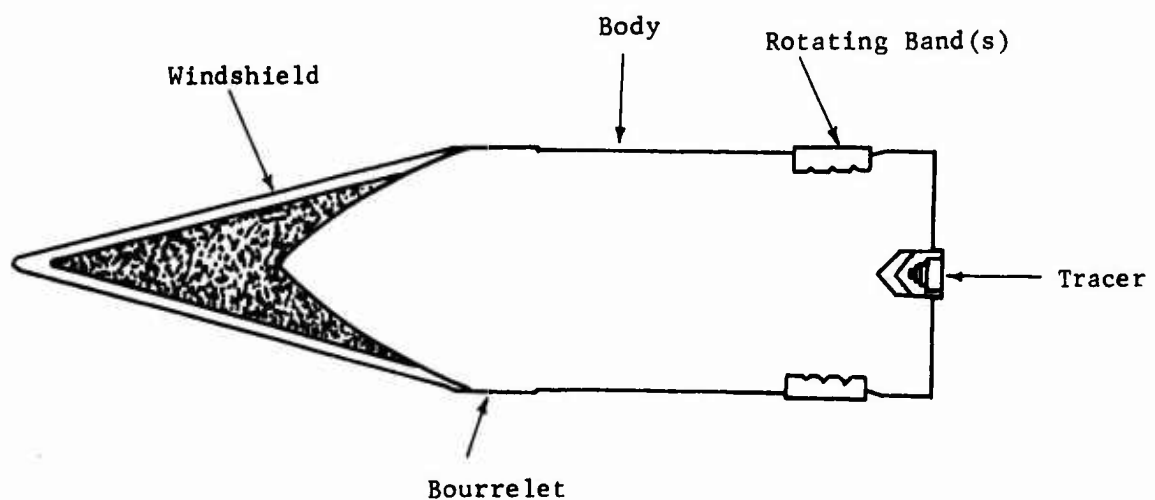


Figure A-2. Armor Piercing (AP-T) Projectile

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APPENDIX B

OBSERVER NO. 1 NAME _____

DATE _____

[illegible]

APPENDIX D

SAMPLE DATA RECORDING WORK SHEET

OBSERVER NO. 3 NAME _____ DATE _____

Type of Ammo	Lot No.	Round No.	Fuze Failure	Low Order Deton.	Projectile Breakup	Smoke Screen Char.	Armor Defeating Char.	Anti Materiel Char.	Remarks

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13. ABSTRACT This Army Service Test Procedure describes test methods for collecting and recording data during firing exercises for use in determining the ammunition functioning. Ammunition "functioning" includes its performance during: loading and firing; extraction and ejection cycle; projectile flight; fuze function and detonation in the terminal target area. The procedures are intended primarily for use in evaluating the functioning of artillery caliber ammunition for combat vehicle-mounted main armament, but is also applicable to small arms ammunition for automatic type weapons. Known as a common test procedure, it can be used in evaluation of specific ammunition as part of the overall test for determining its suitability for service use by the U. S. Army.		

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