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Materiel Test Procedure 4-3-055
U. S. Army Artillery BoardU. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

FUZES, ARTILLERY

1. OBJECTIVE

The objective of this document is to describe test procedures used to determine, under actual field operating conditions, the degree to which a new fuze (or a modified fuze in the case of product improvement tests) meets the requirements of the applicable QMR's, or SDR's and to determine its overall suitability for artillery use.

2. BACKGROUND

A fuze is a device used by the artillery to explode a projectile under required circumstances. To be satisfactory for field use and combat, they must be accurate in timing, reliable, and safe for use by personnel. Fuzes are precision made and are sensitive to shock.

3. REQUIRED EQUIPMENT

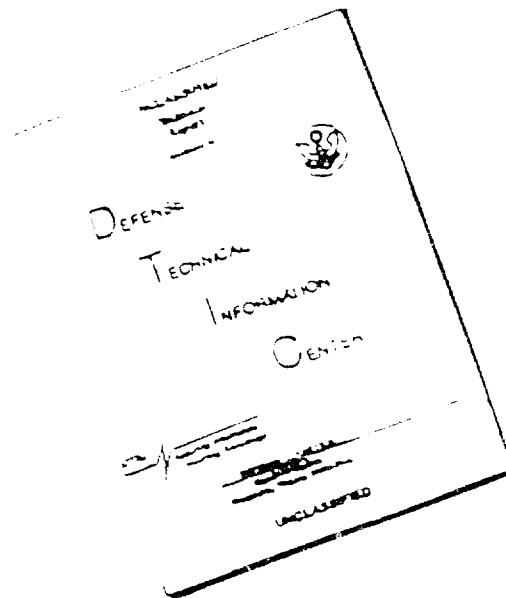
- a. Appropriate Firing Ranges
- b. Howitzers/Guns of appropriate model and caliber
- c. Flash Control
- d. Flash Observation Posts
- e. Fire Direction Equipment
- f. Ammunition Transporters
- g. Powder Thermometers
- h. Muzzle Velocity Measuring Equipment
- i. Meteorological Equipment
- j. Bursting Screens
- k. Photographic Equipment
- l. Burst-Time measuring Equipment

4. REFERENCES

- A. AR 385-63, Safety Regulations for Firing Ammunition for Training, Target Practice, and Combat.
- B. Post (or test site) Range Regulations.
- C. USAMC Regulation 385-224, Safety Manual.
- D. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- E. FM 6-40, Field Artillery Cannon Gunnery.
- F. TM 9-1300-203, Artillery Ammunition.
- G. MTP 3-3-506, Accuracy and Precision.
- H. MTP 4-3-500, Preoperational Inspection and Physical Characteristics.
- I. MTP 4-3-501, Personnel Training.
- J. MTP 4-3-507, Ammunition Functioning and Reliability.
- K. MTP 4-3-511, Transportability.
- L. MTP 4-3-513, Maintenance.

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DISCLAIMER NOTICE



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

- M. MTP 4-3-514, Safety Hazards.
- N. MTP 4-3-516, Human Factors Engineering.
- O. MTP 4-3-520, Field Storage.
- P. MTP 4-3-521, Training Manuals and Technical Publications.

5. SCOPE

5.1 SUMMARY

This materiel test procedure describes the following service tests:

- a. Preparation for Test - A determination of the condition of the test item and its physical characteristics, and operator training and familiarization procedures.
- b. Accuracy and Precision and Ballistic Match Testing - An evaluation to determine the accuracy and precision of projectiles equipped with the test fuze and a comparison with projectiles equipped with standard fuzes.
- c. Arming Range - A study to determine the minimum distance required for 100 percent arming of the test item.
- d. Suitability of Impact Element - A study to determine the ability of the impact element of the fuze to properly detonate the projectile.
- e. Accuracy in Time Transfer (Time Fuzes Only) - A study to determine accuracy within the extremities of transfer limits.
- f. Burst Height and Probable Errors - A study to determine probable errors and consistancy of functioning when assembled with various projectiles.
- g. Suitability of CVT Arming Mechanism - A study to determine the arming time required by CVT fuzes after passing over a crest.
- h. Field Storage - A study to determine the effects of field storage on the test item.
- i. Transportability - A study to determine the ability of the test item to be prepared for, and transported by service personnel.
- j. Ammunition Functioning Reliability - A study to determine the functioning reliability of the test item.
- k. Safety Hazards - A study to determine the test item's safety characteristics during use.
- l. Maintenance - A study to determine the maintenance and reliability requirements of the test item.
- m. Human Factors Engineering - A study to assess the degree of ease, simplicity, and effort in assembling and setting the test item.

5.2 LIMITATIONS

None

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Scheduling

6.1.1.1 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 as described in MTP 4-3-521 and are competent in the handling, assembling, maintenance and operation of the test item.

b. Record the adequacy of supplied training literature.

6.1.1.2 Equipment and Facilities

a. Upon notice of arrival of the test item, secure or arrange to secure all weapons to be used in testing.

b. Choose and schedule firing ranges.

NOTE: Developmental ammunition or standard ammunition with developmental components may not be fired over troops prior to flight safety release.

6.1.1.3 Test Item

Prior to testing, perform the following:

a. Subject 10-15 percent of the received test item to the storage conditions of paragraph 6.2.7.

b. Subject 10-15 percent of the received test item to the surface transport conditions of paragraph 6.2.8.

6.1.2 Preoperational Inspection and Physical Characteristics

Upon arrival, determine and record the physical characteristics and operational condition of the test item by subjecting it to the applicable procedures in MTP 4-3-500.

NOTE: Approximately 50 fuzes shall undergo a check of physical characteristics and be compared with specifications. Fuzes shall be taken at random from different packages.

6.2 TEST CONDUCT

NOTE: Throughout this test, firing of a certain subtest shall be repeated for each appropriate weapon model with which the fuze will be used. Example: An accuracy and precision procedure, with the fuze set for impact, may need to be fired with three models of the 105mm howitzer, two models of the 155mm howitzer and one model of the 8-inch howitzer.

6.2.1 Accuracy and Precision and Ballistic Match Testing

6.2.1.1 Preparation For Test

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

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

6.2.1.2 Test Conduct

Determine the accuracy and precision of the test rounds and their ballistic match with the standard rounds using the procedures of the applicable sections of MTP 3-3-506.

NOTE: Fire sets of ten test rounds alternately with sets of ten standard rounds.

6.2.2 Arming Range

6.2.2.1 Impact Elements

6.2.2.1.1 Preparation for Test - Perform the following:

- a. Set fuzes for point detonation action and assemble to high explosive (HE) shells of standard components.
- b. Emplace bursting screens in front of the weapon at a range estimated to be the distance required for the fuzes to arm themselves.

6.2.2.1.2 Test Conduct - Perform the following:

- a. Fire 10 rounds into the bursting screens and observe the number of projectiles which function.
- b. Repeat step a with the bursting screens placed at various distances to determine the minimum weapon to screen distance at which 100 percent functioning occurs.
- c. Measure and record the weapon to screen distance at which 100 percent functioning of the projectiles occurs.
- d. Record current meteorological data.

6.2.2.2 Time Element

6.2.2.2.1 Preparation for Test - Perform the following:

- a. Set 20 fuzes assembled to HE shells of standard components, 10 of which have minimum propelling charge, and 10 which have maximum propelling charge, for minimum time detonation.
- b. Set up flash ranging equipment to locate point of detonation.

6.2.2.2.2 Test Conduct - Perform the following:

- a. Fire the 10 round group of projectiles having minimum charge at a gun quadrant elevation of approximately 100 mils and locate and record points of detonation using flash ranging.
- b. Repeat step a using projectiles having maximum charge.
- c. Record current meteorological data.

6.2.3 Suitability of Impact Element

6.2.3.1 Mechanical Time and Impact Fuzes

Throughout the test, classify and record all malfunctions of mechanical time and impact fuzes such as duds, low order bursts, etc.

6.2.3.2 Control Variable Time (CVT) Fuzes

Fire ten round groups of HE projectiles fuzed with test fuzes cut at least 10 seconds in excess of the time of flight, for each applicable weapon and record the following:

- a. Weapon type, model and caliber
- b. Functioning ability of each round upon impact
- c. Current meteorological data

6.2.4 Accuracy in Time Transfer (Time Fuzes Only)

- a. Assemble time test fuzes to standard HE projectiles.
- b. Fire a high burst (see reference 4F, for the proper procedure) registration at a predetermined registration point located at one extremity of the transfer limits using data from the applicable firing tables.
- c. In as short as time as possible fire a high burst registration at a second registration point, at the other extremity of the transfer limits, using data from the applicable firing tables.
- d. Compare the did-hit data, from the second registration to the should-hit data determined by obtaining the Time K from the first registration.
- e. Repeat steps a through d using registration points located at 80 and 50 percent of the range of the weapon.
- f. Record the current meteorological data for each group of rounds.

6.2.5 Burst Height and Probable Errors

6.2.5.1 Time Fuzes

NOTE: This procedure shall be performed with each weapon and projectile appropriate to the test fuze.

- a. Fire a group of ten projectiles at maximum charge with weapon set for 100 percent maximum range, and the test fuze set for air burst and record the following:

- NOTE:
1. Compute for height which will insure air bursts for all properly functioning rounds.
 2. The firing range shall contain a flash control and flash observation posts.
 3. Ensure that the weapon settings within the ten round group are carefully set to the same value.
 4. Ensure that all fuze settings are precisely set by the same crewman.

- 1) Weapon model, type and caliber
- 2) Weapon elevation
- 3) Fuze setting:
- 4) Current meteorological data

b. Calculate and record the following from flash ranging information.

- 1) Location of air burst
- 2) Range, azimuth and height of burst

c. Repeat steps a and b with the propelling charges as indicated in the test directive.

d. Repeat steps a through c with the test weapon set at 80 percent and 50 percent of maximum range.

e. Repeat steps a through d for all appropriate weapons and projectile combinations.

6.2.5.2 CVT Fuzes

Repeat the procedures of paragraph 6.2.5.1, using a representative assortment of charges with varying angles of fall, over the following types of terrain:

- a. Cleared area
- b. Water
- c. Marshy ground
- d. Wooded area

6.2.6 Suitability of CVT Arming Mechanism

a. Select a firing range where the test projectile may be fired low over an unoccupied crest approximately 1000 meters in front of a weapon firing position.

b. Set the test fuze to arm at a minimum of one second after it passes over the crest.

c. Fire ten rounds of HE as low as possible over the crest, and record the following:

- 1) Number of rounds, if any, that burst when passing over the crest
- 2) Current meteorological data

d. Repeat steps b and c, using shorter fuze time settings, to determine, and record, the maximum fuze setting at which all properly functioning projectiles will burst over the crest.

e. Repeat steps b and c, using shorter fuze time settings, to determine, and record, the minimum fuze setting at which all properly functioning projectiles will burst over the crest and record the number of rounds, if any, that fail to burst.

f. Repeat steps a through e with the weapon to crest distance approximately:

- 1) 1500 meters
- 2) 2000 meters
- 3) 2500 meters

6.2.7 Field Storage

Determine the effects of field storage, on the test items of paragraph 6.1.1.3.a, as described in MTP 4-3-520.

6.2.8 Transportability

Determine the effects of surface transportation, on the test items of paragraph 6.1.1.3.b, as described in MTP 4-3-511.

6.2.9 Ammunition Functioning Reliability

Throughout the conduct of the test, determine the functioning reliability of the test item as described in the applicable sections of MTP 4-3-502.

6.2.10 Safety Hazards

Throughout the conduct of the test, determine and record any safety hazards as described in the applicable sections of MTP 4-3-514.

6.2.11 Maintenance

Evaluate the maintainability of the test item as described in the applicable sections of MTP 4-3-513.

6.2.12 Human Factors Engineering

Throughout the conduct of the test, determine the effectiveness of the test fuze-projectile-crew relationship as described in the applicable sections of MTP 4-3-516.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Preoperational Inspection and Physical Characteristics

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

6.3.2 Test Conduct

6.3.2.1 Accuracy and Precision and Ballistic Match Testing

Record the following for each round fired with each weapon used:

- a. Type of projectile (test, standard)

b. Data collected as described in the applicable sections of MTP 3-3-506.

6.3.2.2 Arming Range

6.3.2.2.1 Impact Elements -

Record the following:

- a. Type, model and caliber of weapon used
- b. Minimum distance for 100% functioning, in meters
- c. Current meteorological data

6.3.2.2.2 Time Element -

Record the following for each ten round group fired:

- a. Type, model and caliber of weapon used
- b. Charge size
- c. Distance from weapon to point of detonation, in meters
- d. Ambient temperature, in °F
- e. Current meteorological data

6.3.2.3 Suitability of Impact Element

6.3.2.3.1 Mechanical Time and Impact Fuzes -

Record the following malfunctions throughout the test:

- a. Duds
- b. Low order bursts
- c. Other malfunctions

6.3.2.3.2 CVT Fuzes -

Record the following for each weapon used:

- a. Type, model and caliber of weapon used
- b. Functioning of each round upon impact
- c. Current meteorological data

6.3.2.4 Accuracy in Time Transfer (Time Fuzes Only)

Record the following for each registration distance:

- a. Weapon registration point distance, in meters
- b. Type, model and caliber of weapon used
- c. Adjusted time K for first registration point
- d. Adjust time K for second registration point
- e. Current meteorological data

6.3.2.5 Burst Height and Probable Errors

Record the following for each fuze-projectile-weapon combination:

- a. Type fuze used (time, CVT)
- b. Fuze setting
- c. Type projectile used
- d. Type, model and caliber of weapon used
- e. Weapon elevation, in mils
- f. Weapon azimuth, in degrees
- g. Type terrain, when applicable (clear, marsh, etc.)
- h. Location of air burst
- i. Range, deflection and height of burst
- j. Current meteorological data

6.3.2.6 Suitability of CVT Arming Mechanism

Record the following for each weapon-crest distance:

- a. Weapon-crest distance, in meters
- b. Type, model and caliber of weapon used
- c. Propellant charge size
- d. For desired burst location:
 - 1) Maximum fuze setting
 - 2) Minimum fuze setting
- e. Total number of rounds fired
- f. For malfunctions:
 - 1) Number of round having early bursts
 - 2) Number of rounds failing to burst
 - 3) Number of rounds bursting late
- g. Current meteorological data

6.3.2.7 Field Storage

Record data collected as described in MTP 4-3-520.

6.3.2.8 Transportability

Record data collected as described in MTP 4-3-511.

6.3.2.9 Ammunition Functioning Reliability

Record data collected as described in the applicable sections of MTP 4-3-502.

6.3.2.10 Safety Hazards

Record data collected as described in MTP 4-3-514.

6.3.2.11 Maintenance

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

6.3.2.12 Human Factors Engineering

Record data collected as described in the applicable sections of MTP 4-3-516.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

Data obtained from all subtests covered by applicable MTP's shall be summarized and evaluated according to procedures described in those applicable 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 individual MTP's, wherever applicable, and all photographs, motion pictures and illustrative material shall be suitably identified.

6.4.2 Accuracy and Precision and Ballistic Match Testing

- a. Compare the accuracy and precision of the standard and test projectiles.
- b. Chart centers of comparative groups (standard projectiles and test projectiles) and depict graphically the differences in probable errors.

6.4.3 Arming Range

Present the following for each weapon/fuze combination used:

- a. Impact element - Minimum range at which 100% arming occurs.
- b. Time element - Indicate the following:
 - 1) Range to burst for minimum charge fired at 100 mils elevation
 - 2) Range to burst for maximum charge fired at 100 mils elevation

6.4.4 Suitability of Impact Elements

Classify and chart the functioning of all fuze bursts observed, for each weapon-projectile-fuze combination as functioning properly, or malfunctioning.

6.4.5 Accuracy in Time Transfer (Time Fuzes Only)

Compare test data with firing tables and chart or diagram adjusted data for each registration fired.

6.4.6 Burst Height and Probable Errors

Compute probable errors in height of burst.

6.4.7 Suitability of CVT Arming Mechanism

- a. Chart the maximum and minimum arming times for each range and propellant size.
- b. List number of early bursts for maximum fuze settings.
- c. List number of malfunctions for minimum fuze settings.