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30 December 1969

Materiel Test Procedure 4-3-115
U. S. Army Field Artillery Board

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

PROJECTILE, ARTILLERY, ANTI-TANK

1. OBJECTIVE

The purpose of this MTP is to describe procedures for determining the extent to which an anti-tank projectile meets the specifications of the Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC).

2. BACKGROUND

Frequently, artillery units are required to defend position areas from attacking armor. In these situations enemy targets taken under direct fire are usually those capable of returning fire at pointblank range. Therefore, speed and accuracy of fire are of extreme importance. In addition, the projectile used in such situations must also have the capability to destroy or disable the target with a high probability of a first round hit.

Highly sophisticated, armor defeating projectiles have been developed which utilize the shaped-charge principle to produce a jet which is the instrument of damage. Resultant damage from shaped-charge missiles is generally independent of the velocity with which they strike the target and of the range at which they are fired.

Another anti-armor projectile which has been developed is the high-explosive plastic type. The plastic filler has a tendency to spread out over the target surface on impact and sets up shock waves upon detonating that cause a "spalling" or "chipping" of the backside. One of the primary reasons for developing this type of round is the excellent anti-tank protection afforded to crews of low muzzle velocity weapons firing spin-stabilized projectiles since it can be spin-stabilized without detrimental effect on its performance against armor.

3. REQUIRED EQUIPMENT

a. Howitzer/Gun of appropriate caliber and model.
b. Standard Ammunition Components (fuzes, propellants, etc. compatible with the test projectiles), if applicable.
c. Direct-fire Test Ranges.
d. Appropriate Standard Ammunition, for comparative firings.
e. High Explosive shells of appropriate caliber.
f. Organizational and Direct Support Maintenance Facilities.
g. Appropriate Firing Tables.
h. Weapon Section Equipment.
i. Direct Fire Targets, as required including:

1) Armor plate (3" to 6" thick)
2) Concrete Structure
3) Log/earth barricades

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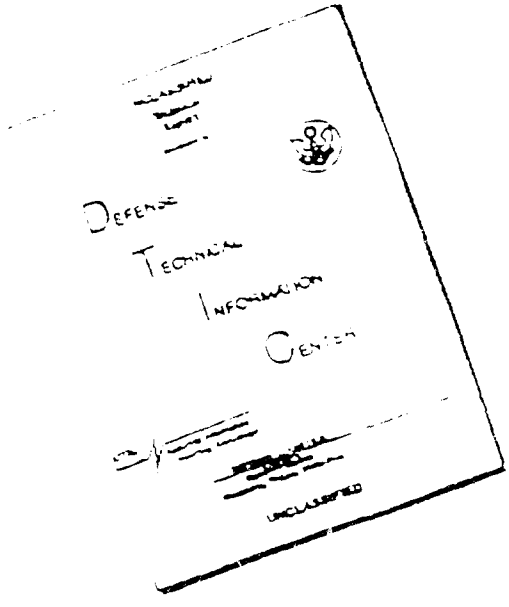

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j. Communications Equipment, as required.
k. Transport Vehicles, for ammunition, equipment and personnel.
l. Ambulance and Aidman.
m. Meteorological Equipment.
n. Still Camera with Film.
o. Gunner's Quadrant.
p. Equipment and Facilities, as required by the individual referenced MTP's.

4. REFERENCES

A. Post (or test site) Range Regulations.
B. AR 385-63, Safety Regulations for Firing Ammunition for Training, Target Practice, and Combat.
C. USAMC Regulation 385-224, AMC 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 4-3-502, Ammunition Functioning and Reliability.
K. MTP 4-3-504, User Reaction.
L. MTP 4-3-506, Adverse Conditions.
M. MTP 4-3-511, Transportability (Ammunition).
N. MTP 4-3-513, Maintenance.
O. MTP 4-3-514, Safety Hazards.
P. MTP 4-3-515, Human Factors Engineering.
Q. MTP 4-3-520, Field Storage.
R. MTP 4-3-521, Training Manuals and Technical Publications.

5. SCOPE

5.1 SUMMARY

This document describes procedures for service testing of anti-tank artillery 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, personnel training procedures and the availability of facilities and equipment for conducting the tests.
b. Compatibility with Components/Weapon - A study to determine the compatibility of the test item with other ammunition components and with the weapon(s) from which it is fired.
c. Accuracy and Precision - A study to determine the probable errors in range and deflection for the test item in direct fire and the effects of field storage and transport upon its accuracy.
d. Sight Compatability - A study to determine the effectiveness of the weapon on-carriage sighting system with respect to the test item in direct

fire.

e. Graze Functioning - A study to determine the sensitivity of the test item fuzing system to grazing impacts compared to a "standard" item and test items which have been stored and transported.

f. Terminal Effects - A study to evaluate the effectiveness of the test item against armor plate, concrete structures and log/earth barricades using various impact angles.

g. Adverse Conditions - A study to determine the effects of adverse conditions on the test item in its direct fire mission.

h. User Reaction - A determination of the reaction of personnel to the use of the test item.

i. Reliability - An evaluation of the functioning reliability of the test item.

j. Maintenance Evaluation - A study to determine the maintainability of the test item and the suitability of its maintanance package.

k. Human Factors Evaluation - A study to determine the effectiveness of the test item - weapon-crew relationships.

l. Safety Hazards - A study to determine the item-related safety hazards.

5.2 LIMITATIONS

This MTP is limited to projectiles which utilize the high-explosive shaped charge principle in an anti-tank capacity. It does not pertain to armor piercing (kinetic energy type) projectiles.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Preoperational Inspection and Physical Characteristics

Upon arrival of the test items, determine and record their physical characteristics and operational condition 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 in accordance with MTP 4-3-501 and in conjunction with the technical publications and training manuals using the criteria of MTP 4-3-521 and are cognizant of the handling, assembling, maintaining, loading, firing, and safety aspects of ammunition, ammunition components, and the test procedures.

b. Record the following for all test personnel:

1) Rank
2) MOS
3) Experience in MOS
4) Time in Training for MOS

c. Record the adequacy of the supplied literature for training purposes.

6.1.3 Weapons

a. Ensure the availability of howitzers/guns of the appropriate caliber and 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 indicated by a pull-over gauge.

6.1.4 Ammunition

a. Ensure the availability of a sufficient number of test rounds and "standard" rounds to conduct the required test firings and comparison firings.

b. Prior to testing, subject the specified number of test items, which have successfully passed the preoperational inspection and physical characteristics procedures of paragraph 6.1.1, to the field storage conditions of MTP 4-3-520 for 90 days.

c. Prior to testing, subject the specified number of test items which have successfully passed the preoperatinal inspection and physical characteristics procedures of paragraph 6.1.1 to the transportability tests as described in the applicable sections of MTP 4-3-511.

d. Ensure the availability of "standard" HE rounds for weapon checks prior to firing.

6.1.5 Firing Position(s) and Range(s)

a. Prepare direct firing site(s) which shall meet the conditions described in MTP 3-3-506, paragraph 6.2.3, and in paragraph 6.2.4.

b. Ensure the availability of targets as specified for the firing tests.

c. Provide for down range observation sites for observer personnel with the required safety features.

6.1.6 Instrumentation

Prior to firing, set-up or install instrumentation to measure the current meteorological data.

6.2 TEST CONDUCT

NOTE: 1. Normally, when testing ammunition components, only limited quantities of the test item are available. As such, all test personnel shall be aware of the necessity for gathering (accurately) maximum data for each round fired. Subtests shall be conducted concurrently with or in conjunction with other subtests, whenever possible.

2. The projectiles undergoing test will generally have the capability of being fired from several different weapons.

For complete and valid testing the test item must be fired and tested with all models of weapons for which it has been developed, as specified in the QMR and TC. Repetition of subtests shall be necessary to satisfy this requirement.

3. Anti-tank projectiles, generally, need no field preparation prior to firing since the charge is fixed, the propellant/projectiles are an all-in-one unit (with or without cartridge case). The fuze is internal to the projectile assembly, of the base-detonated, non-delay type which cannot be varied.

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

6.2.1 Compatibility with Components/Weapon(s)

a. During the preparation for firing tests determine and record any difficulty encountered in assembling complete test rounds, when applicable.

b. During the conduct of firing tests determine and record any difficulty encountered due to test item/weapon incompatibility with respect to:

1) Loading
2) Firing
3) Ejection of spent cartridge case, when applicable

6.2.2 Accuracy and Precision

6.2.2.1 Direct Fire at Stationary Targets

6.2.2.1.1 Preparation for Test - Perform the following:

a. Emplace the weapon to be used for test firing on a direct fire range.

b. Set up stationary targets as follows:

1) For light artillery:

a) 10' x 10' targets at 500 meters
b) 12' x 12' targets at 1000 meters

2) For medium artillery:

a) 14' x 14' targets at 1500 meters
b) 16' x 16' targets at 2000 meters

c. Prepare ten high-explosive rounds for checkfire.

d. Prepare a sufficient number of test rounds for firing to satisfy the requirements of the firing procedures.

e. Determine the effects of field storage on test items, stored as described in paragraph 6.1.4b and record the applicable storage and inspection data of MTP 4-3-520.

f. Determine the effects of transporting on test items transported as described in paragraph 6.1.4c and record the applicable transport and inspection data of MTP 4-3-511.

g. Boresight the test weapon.

6.2.2.1.2 Test Conduct - Perform the following:

a. Fire a ten-round MPI group of normal high-explosive (HE) ammunition, using the charge normally used for direct fire (flat trajectory), at the 500 meter range (1500 meters for medium artillery).

b. Verify that the check fire results are satisfactory before proceeding with the test firing.

c. Sight the weapon, using the direct fire on-carriage sighting equipment.

d. Measure the weapon tube elevation, prior to firing the first test round, using the gunner's quadrant.

e. Check the tube elevation, using the gunner's quadrant, for each succeeding round fired.

f. Fire three ten-round groups of test rounds at the "500 meter" range (1500 meters for medium artillery).

g. Fire a ten-round group of test rounds which had been stored as described in paragraph 6.1.4b at the 500 meter range. (1500 meters for medium artillery).

h. Fire a ten-round group of test rounds which had been subjected to the transport procedures as described in paragraph 6.1.4c, at the 500 meter range. (1500 meters for medium artillery).

i. Record the following for each round fired:

1) Type of round
2) Weapon tube elevation
3) Horizontal and vertical distance from the point of aim

NOTE: Assign a negative value to each round to the left and below the point of aim (see Appendix A).

4) Range to target

j. Check the weapon boresight at the completion of each weapon MPI group.

k. Repeat steps a through j firing at the 1000 meter range (2000 meters for medium artillery).

6.2.2.2 Direct Fire at Moving Targets

a. Perform the procedures for direct fire at moving targets, as described in MTP 3-3-506.

b. Repeat step a firing the following:

1) Rounds which have been subjected to the storage procedures of paragraph 6.1.4b.

2) Rounds which have been subjected to the transport procedures of paragraph 6.1.4c.

c. Record the type of round for each firing.

6.2.3 Sight Compatibility

a. Emplace the test weapon on a direct fire range
b. Set up stationary targets as follows:

1) For light artillery:

a) 10' x 10' target at 500 meters
b. 10' x 10' targets at 200 meter intervals up to 1500 meters

2) For medium artillery:

a) 15' x 15' target at 1000 meters
b) 15' x 15' targets at 200 meter intervals up to 2000 meters

NOTE: If the range interval markings on the sight reticle are different from the above ranges then position targets so that the ranges are compatible with the reticle graduations and record the range of each target.

c. Boresight the weapon prior to firing
d. Fire two five-round groups at each target.
e. Check the boresight at the end of each group firing.
f. Record the folllowing for each round fired:

1) Range to target
2) Horizontal and vertical miss distance from the point of aim
3) Weapon tube elevation

6.2.4 Graze Functioning

Perform the following:

a. Ensure the availability of a minimum of five test rounds which have successfully undergone the procedures of MTP 4-3-500.
b. Ensure the availability of five "standard" rounds for comparison firing.
c. Ensure the availability of the following:

1) A minimum of five test items which have undergone the storage procedures of paragraph 6.1.4b.
2) A minimum of five test items which have undergone the transport procedures of paragraph 6.1.4c.

d. Select a suitable firing range for direct fire with adequate protection for observer personnel.

NOTE: The impact area shall be fairly level and not extremely rocky.

e. Set up 4' x 8' x 3/4" targets on the firing range at a distance from the weapon position which is 10 to 30 meters beyond the minimum distance required for the test item fuze to become armed.

f. Record the type of fuze used with the test item.

g. Emplace the weapon to be fired.

h. Fire a minimum of five test rounds and five "standard" rounds alternately at the target and record the following for each round fired:

1) Type of round
2) Result at impact
3) Weapon tube elevation
4) Nominal crater diameter, if applicable.

i. Photograph the target damage for each round fired.

j. Record the range to the target.

k. Repeat steps h through j for the following:

1) Test rounds that had been subjected to storage procedures.
2) Test rounds that had been subjected to transportability procedures.

6.2.5 Terminal Effects

Ensure the availability of a minimum of 36 test rounds to fulfill the firing requirements of the following paragraphs.

6.2.5.1 Armor Plate

a. Set up a target of armor plate, three to six inches thick, and of specified size, on a direct fire range in a vertical position.

b. Emplace the weapon at a minimum distance of 400 meters, normal to the target (for flattest trajectory).

c. Fire a minimum of three rounds at the target and record the following for each round:

1) Target range.
2) Nominal angle of impact.
3) Depth of crater.
4) Nominal crater diameter.
5) Evidence of "spalling" or "chipping" of the target backside, if applicable.

d. Photograph the target damage for each round fired.

e. Repeat steps b through d with the target positioned at the following angles away from the vertical:

1) 30°
2) 45°
3) 60°

6.2.5.2 Concrete Structures

a. Set up a target of concrete, of specified size and thickness, on a direct fire range in a vertical position.
b. Repeat in procedures of paragraph 6.2.5.1, steps b through e.

6.2.5.3 Log/Earth Barricades

a. Construct a vertical log/earth barricade, of specified dimensions on a direct fire range.
b. Emplace the weapon at a minimum distance of 400 meters, normal to the vertical face of the target barricade.
c. Fire a minimum of three rounds at the target and record the following for each round:

1) Target range.
2) Nominal angle of impact, in degrees.
3) Target damage.

d. Photograph the target damage for each round fired.
e. Construct subsequent barricades as in step a with their respective target surfaces at the following angles from the vertical:

1) 30°
2) 45°
3) 60°

f. Repeat the procedures of steps b through d.

6.2.6 Adverse Conditions

Determine the effect of adverse condition on the test item as described in the applicable sections of MTP 4-3-506.

6.2.7 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.

6.2.8 Reliability

During the conduct of all firing tests determine the ammunition functioning reliability of the test item as described in the applicable sections of MTP 4-3-502.

6.2.9 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.

6.2.10 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.

6.2.11 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, collected as described in the applicable sections of MTP 4-3-500.

6.3.1.2 Personnel

a. Record the following for all test personnel:

1) Rank
2) MOS
3) Experience in MOS in months
4) Time in training for MOS in weeks

b. Record the adequacy of the supplied training literature

6.3.1.3 Weapons

Record the following for each weapon used during testing:

a. Type (howitzer, gun etc.)
b. Caliber
c. Model number
d. Physical condition

6.3.2 Test Conduct

During the conduct of firing tests record the following:

a. Type, model and caliber of weapon used
b. Current meteorological data, as follows:

1) Prior to start of firing

2) Every two hours during firing

6.3.2.1 Compatibility with Components/Weapons

Record the following:

a. Any difficulty encountered in assembling complete test rounds, as applicable.

b. Any difficulties encountered during firing due to test item weapon incompatibility with respect to:

1) Loading
2) Firing
3) Ejection of spent cartridge case when applicable.

6.3.2.2 Accuracy and Precision

6.3.2.2.1 Preparation For Test -

Record the following:

a. Storage and inspection data for stored test items, collected as described in the applicable sections of MTP 4-3-520.

b. Transport and inspection data for transported test items, collected as described in the applicable sections of MTP 4-3-511.

6.3.2.2.2 Test Conduct -

a. For direct fire at stationary targets.

1) Record the following for each round fired:

a) Type of round fired (newly-arrived, post storage, post transport).
b) Round number.
c) Weapon model, type and caliber.
d) Range, in meters.
e) Weapon elevation, in mils:

(1) Prior to firing.
(2) Post firing.

f) Horizontal and vertical miss distance, from point of aim, in feet.

2) Record the following for each MPI group:

a) Current meteorological data
b) Boresight correction required
c) Number of target misses

b. For direct fire at moving targets:

1) Record appropriate data collected as described in the applicable section of MTP 3-3-506.
2) Record the type of round fired (newly-arrived, post-storage, post-transport).

6.3.2.3 Sight Compatibility

a. Record the following for each round fired:

1) Range to target in meters.
2) Horizontal and vertical miss distance from the point of aim, in feet.
3) Weapon tube elevation in mils.

b. Record the boresight correction required after each group fired.
c. Record the current meteorological data.

6.3.2.4 Graze Functioning

a. Record the type of fuze used with the test item (base detonating, point initiating/base detonating, etc.).
b. Record the following for each grazing round fired:

1) Type of round (newly-arrived test item, "standard" item, post-storage item, post-transport item).
2) Result at impact (detonation, dud).
3) Weapon tube elevation in mils.
4) Nominal crater diameter, if applicable, in inches.

c. Record the range to the target in meters.
d. Retain all photographs.

6.3.2.5 Terminal Effects

6.3.2.5.1 Armor Plate -

a. Record the following for each round fired:

1) Target range in meters.
2) Nominal angle of impact, in degrees.
3) Depth of crater, in inches.
4) Nominal crater diameter, in inches.
5) Evidence of "spalling" or "chipping" of the target backside, if applicable.

b. Record the target dimensions as follows:

1) Height, in feet

2) Width, in feet
3) Thickness, in inches

c. Retain all photographs

6.3.2.5.2 Concrete Structures -

a. Record the following for each round fired:

1) Target range, in meters
2) Nominal angle of impact, in degrees
3) Depth of crater, in inches
4) Nominal crater diameter, in inches
5) Evidence of "spalling" or "chipping" of the target backside

b. Record the target dimensions as follows:

1) Height, in feet
2) Width, in feet
3) Thickness, in inches

c. Retain all photographs

6.3.2.5.3 Log/Earth Barricades -

a. Record the following for each round fired:

1) Target range in meters
2) Nominal angle of impact, in degrees
3) Target damage

b. Record the dimensions of each target as follows:

1) Height, in feet
2) Width, in feet
3) Depth, in feet

c. Retain all photographs

6.3.2.6 Adverse Conditions

Record data, collected as described in the applicable sections of MTP 4-3-506.

6.3.2.7 User Reaction

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

6.3.2.8 Reliability

Record the ammunition functioning reliability data for the test item, collected as described in the applicable sections of MTP 4-3-502.

6.3.2.9 Maintenance Evaluation

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

6.3.2.10 Human Factors Evaluation

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

6.3.2.11 Safety Hazards

Record 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, evaluated, and presented according to the 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, as to content along with other illustrative material enclosed.

Chart all probable errors of range and deflection from the firing test results (See Appendix A) and make comparisons between:

a. Test items not stored or transported
b. Test items placed in field storage
c. Test items transported

Chart or diagram the crater measurement results and include the appropriate photographs for armor, concrete and log/earth barricades. Summarize the results of firing the test item and present an evaluation of its suitability for:

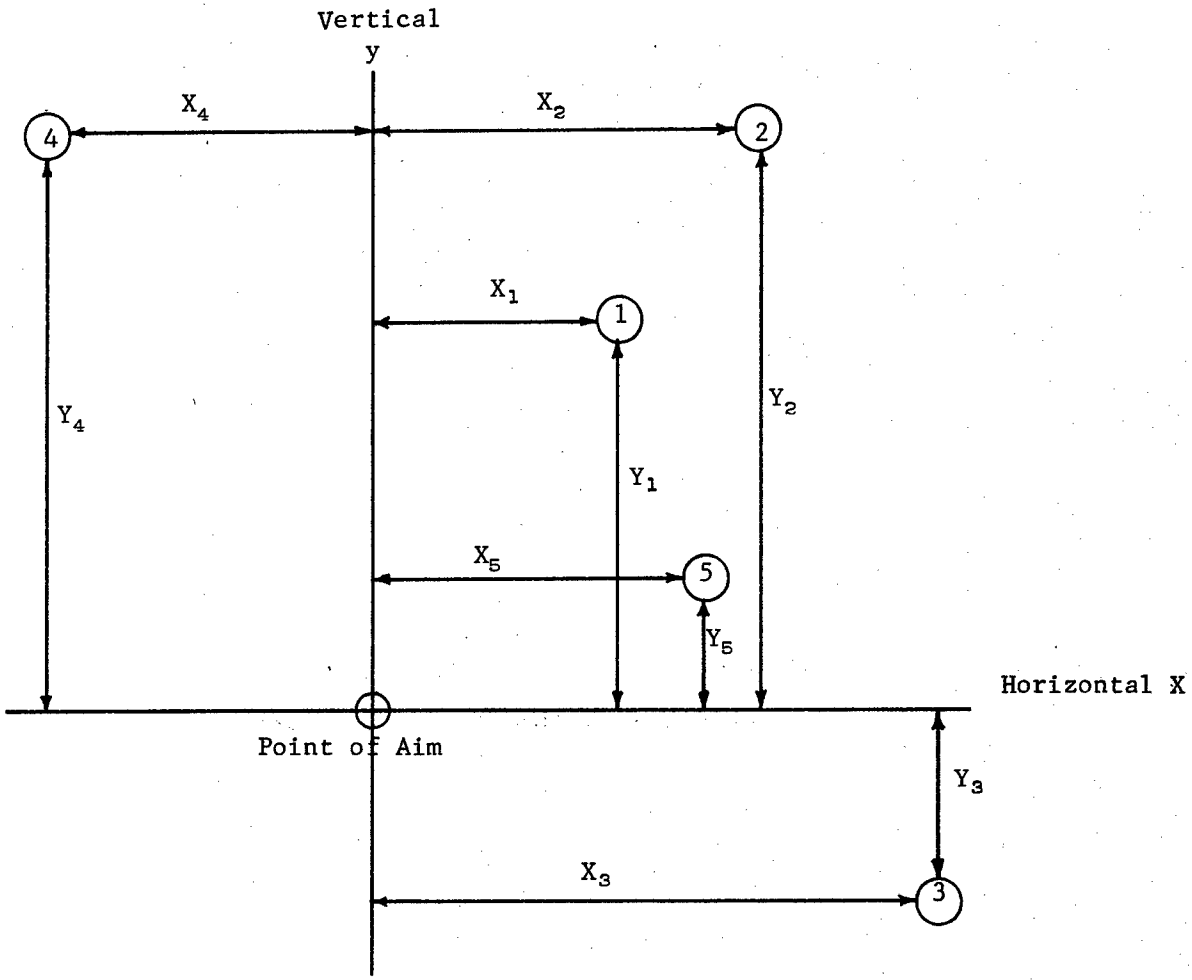
a. Grazing fire
b. Defeat of Armor
c. Destruction of concrete and log/earth structures

Compute the percentage of each group of test rounds which function in grazing fire as compared to the "standard" rounds group.

Issue a Safety Confirmation, in accordance with USATECOM Regulation 385-6, based on the data collected in paragraph 6.3.2.11.

APPENDIX A

ACCURACY AND PRECISION BURST LOCATION



NOTE: 1. Algebraic sum of horizontal miss distances from point of aim will give horizontal mean point of impact (MPI).

2. Algebraic sum of vertical miss distances from point of aim will give vertical mean point of impact (MPI).

Example:

Round 1	Plus x; Plus y
Round 2	Plus x; Plus y
Round 3	Plus x; Negative y
Round 4	Negative x; Plus y
Round 5	Plus x; Plus y

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11. SUPPLEMENTARY NOTES
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13. ABSTRACT

This Army Service Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Anti-Tank Artillery Projectiles related to the requirements expressed in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC) or other applicable documentation containing requirements and specifications.

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