

1 December 1967

Matériel Test Procedure 3-3-506
U. S. Army Artillery Board

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

ACCURACY AND PRECISION

AD 718677

1. OBJECTIVE

The objective of this document is to set forth the service test methodology, testing techniques and minimum test requirements necessary for determining the accuracy and precision of a tube artillery weapon (howitzer or gun, towed or self-propelled) during direct and indirect firing, and comparing the results with the standards set forth in Qualitative Matériel Requirements (QMR's).

2. BACKGROUND

Artillerymen must have knowledge of the accuracy and precision of the weapons he employs. This will enable him to estimate properly the effectiveness of fires that are planned and to evaluate fires that have been delivered.

The distinction between accuracy and precision is as follows:

a. Accuracy is defined by the combined errors of all the elements used in computing or deriving firing data. Accuracy deals with the mean of a large number of rounds with respect to a target. It embraces the geometric relationship between the gun and the target, weather, ammunition, and weapon.

b. Precision is a factor in measuring the effectiveness of a gun-ammunition combination. It is concerned with the grouping of individual rounds about the mean location of a large number of rounds fired with the same weapon with the same settings. As a weapon has greater precision, the problem of achieving accuracy becomes easier; less ammunition will be used for observed adjustments and the probability of achieving desired results with computed fire missions or the assurance of hitting small targets with less ammunition will be greater.

3. REQUIRED EQUIPMENT

- a. Firing Ranges (direct and indirect)
- b. Ammunition, as required
- c. Firing Tables (provisional or other aiming data)
- d. Surveyed flash bases and a flash central with operating equipment and personnel
- e. Wire or radio communications between flash observation posts and flash control, and between flash control and the gun/howitzer firing position
 - 1. Ammunition personnel
 - 2. Ammunition transporter
 - 3. Medical aid personnel and equipment
 - 4. Muzzle velocity measuring devices with operating personnel

19

DISCLAIMER NOTICE

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

MTP 3-3-506
4 December 1967

- j. Meteorological data
- k. Scales accurate to 1/10 pound (for determining projectile weights)
- l. Boresighting devices
- m. Firing data reduction equipment (computer or calculator)
- n. Survey personnel and equipment
- o. Powder thermometer

4. REFERENCES

- A. FM 6-40 Field Artillery Cannon Gunnery
- B. FM 6-140 The Field Artillery Battery
- C. MTP 3-3-501 Personnel Training
- D. MTP 3-3-503 Boresight and Zero
- E. MTP 3-3-512 Round-to-Round Dispersion
- F. MTP 3-3-516 Obscuration
- G. "Introduction to Statistical Analysis" W. J. Dixon and F. J. Massey, Jr., McGraw-Hill Book Company, Inc., New York (1957)

5. SCOPE

5.1 SUMMARY

This procedure describes the following tests:

- a. Indirect Fire - A study to determine the accuracy and precision of indirect fire at low elevation angles for ranges of 50 and 80 percent of maximum range per charge, high elevation firing angles for 80 percent of maximum range per charge, and at normal firing angles for 100 percent of maximum range per charge.
- b. Direct Fire at Stationary Targets - A study to determine the ability of the gun crew/weapon combination to hit stationary targets.
- c. Direct Fire at Moving Targets - A study to determine the ability of several gun crew/weapon combinations to hit moving targets.
- d. Determination of Maximum Range - A study to determine the maximum range the gun crew/weapon/ammunition combination can achieve, and the elevation angle at which this occurs.
- e. Determination of Minimum Range High Angle Fire - A study to determine the maximum elevation angle at which the gun crew/weapon/ammunition can be fired with assurance that flight stability and fuze functioning shall occur.

5.2 LIMITATIONS

This procedure is limited to the determination of accuracy and precision, maximum range and minimum range of artillery weapons. The tests described and computations explained are applicable to any weapon that is used in the indirect firing role, the direct firing role, or both. Basically, the tests are limited to howitzers or guns, however, with adaptation

they may be applied to some small arms, mortars, grenade launchers, and the main armament portion of tanks and other combat vehicles.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Personnel

Ensure the availability of service personnel, representative of those who will operate the test item in the field, who have been trained using the criteria of MTP 3-3-501 and are capable of operating the test item. Record the following for the personnel:

- 1) Grade
- 2) MOS
- 3) Training time in MOS
- 4) Experience in MOS

6.1.2 Inspection

a. Record the following for the test item:

- 1) Nomenclature and Model No.
- 2) Serial No.
- 3) Manufacturer
- 4) For associated equipment:

- a) Nomenclature and Model No.
- b) Serial No.

b. Subject the test item to the technical and preoperational inspection of MTP 3-3-500.

6.2 TEST CONDUCT

During the conduct of this procedure, the following provisions and restrictions shall be observed:

- a. All rounds of a mean point of impact (MPI) group shall, insofar as possible, be fired under the same environmental conditions.
- b. MPI groups shall not be fired when ambient conditions are irregular:

- 1) high gusty winds
- 2) rapid changes, i.e.:
 - a) early morning
 - b) late afternoon
 - c) during a frontal passage

c. Rounds shall be fired at 1 to 3 minute intervals to avoid the buildup of heat in the tube breech and to minimize effects of weather changes.

d. The weapon shall not be loaded until just prior to firing and rounds of ammunition shall not be allowed to remain in the gun or howitzer for long periods (maximum of two minutes) of time.

e. Provision should be made for proper storage of ammunition at the firing point.

NOTE: It should be stored on dunnage and covered or protected to ensure that powder temperature remains the same during any one MPI group.

f. All ammunition used shall be from the same lot number.

6.2.1 Indirect Fire

6.2.1.1 Preparation for Test

a. Select firing positions so that three ranges can be fired per charge:

- 1) Short range (50 percent of maximum range)
- 2) Midrange (80 percent of maximum range)
- 3) Long range (100 percent of maximum range)

Observing the following considerations:

- 1) The three firing positions should be selected so as to be capable of including high angle firings.
- 2) The firing position and the impact area for each MPI group should be on approximately level or gently sloping ground.

b. Survey a minimum of four flash observation posts to an accuracy of 1/3000.

NOTE: Caution shall be exercised in the selection of these positions to ensure that the observers are able to see the burst of each round, not just rising or blowing smoke.

c. Weigh all projectiles to be used:

NOTE: Select rounds for MPI groups by weight.

6.2.1.2 Firing Procedure

- a. Perform normal prefiring checks.
- b. Emplace the test weapon in its firing position.

- c. Boresight the test weapon.
- d. Instrument to measure muzzle velocity.
- e. Select a point of impact that can be clearly seen by all flash observation posts for short range firing of the test item's minimum charge rates and low angle. Compute the firing data for this point for all known non-standard conditions.
- f. Fire a minimum of 10 rounds (MPI group) using test item's minimum charge.
- g. Record the following for the group:
 - 1) Officer in charge
 - 2) Date and time
 - 3) Ammunition used (shell, fuze, and powder lot as appropriate)
 - 4) Charge
 - 5) Elevation
 - 6) Azimuth of fire
 - 7) Ambient temperature
 - 8) Relative humidity
 - 9) Wind speed and direction
 - 10) Number and coordinates of firing position
 - 11) Power temperature
- h. Record the following for each round fired:
 - 1) Depth of each ram for separate loading ammunition
 - 2) Instrument reading from each flash observation post to each burst
 - 3) Flashed location of each round
 - 4) Muzzle velocity reading for each round
 - 5) Weight of fuzed projectile
- i. Check boresight at the completion of each MPI group, correct if necessary and record corrections necessary.
- j. Repeat steps e through i for all applicable charges.
- k. Repeat steps e through j for midrange firing at low elevation angle.
- l. Repeat steps a through j for midrange firing at high elevation angle.
- m. Repeat steps a through j for long range at normal elevation firing angle.

6.2.2 Direct Fire at Stationary Targets

6.2.2.1 Preparation for Test

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

MTP 3-3-506
4 December 1967

- 1) For light artillery:
 - a) 10' x 10' targets at 500 meters
 - b) 12' x 12' targets at 1000 meters
- 2) For medium and heavy artillery:
 - a) 14' x 14' targets at 1500 meters
 - b) 16' x 16' targets at 2000 meters

6.2.2.2 Firing Procedures

- a. Boresight the test weapon
- b. Fire three 10-round MPI groups of each type of ammunition, normally used for direct fire by the test weapon, at 500 meter range targets and indicate the method of direct fire sighting.

NOTE: Use the charge specified for direct fire (normally maximum charge).

- c. Record the following for each MPI group fired:

- 1) Type of ammunition
- 2) Charge

- d. Record the following for each round fired:

- 1) Horizontal and vertical distance from point of aim

NOTE: All rounds to the left and below the point of aim are given a negative value.

- e. Boresight the test weapon at the completion of each MPI group firing and record required corrections.
- f. Repeat steps a through e for the remaining targets, as appropriate.

6.2.3 Direct Fire at Moving Targets

6.2.3.1 Preparation for Test

- a. Have a minimum of three service personnel gun crews ready for firing.
- b. Emplace the test weapon on a firing range which has 6' x 13' moving targets capable of varying the gun-target distance from 500 to 1000 meters in non-repetitive patterns.

6.2.3.2 Firing Procedure

- a. Boresight the test weapon.
- b. Perform the following with one of the gun crews of paragraph 6.2.3.1.a.:

- 1) Fire a 5-round group using a type of ammunition and charge normally used in direct fire at moving targets at the moving target of paragraph 6.2.3.1.b.

NOTE: The targets shall move in different positions and speeds for each 5-round group.

- 2) Record the following:
 - a) Number of hits obtained
 - b) Time required for the crew to recover from the effects of each round
 - c) Misses due to:
 - (1) Weapon/ammunition malfunction
 - (2) Crew error
- 3) Observe and evaluate the effects of obscuration.
- 4) Boresight the weapon and record observed changes from step a.
- 5) Repeat steps b.1 through b.4 until a minimum of ten 5-round groups have been fired.
- 6) Repeat steps b.1 through b.5 for each type ammunition normally used for direct fire at moving targets.

- c. Repeat steps a and b using the second gun crew.
- d. Repeat steps a and b using the third gun crew.

6.2.4 Determination of Maximum Range

- a. Emplace the test weapon on the appropriate firing range equipped with flash observation posts.
- b. Instrument to measure muzzle velocity.
- c. Boresight the test weapon.
- d. Fire a 10-round MPI with a test weapon elevation of 800 mils.
- e. Record the information required in paragraphs 6.2.1.2.g. through 6.2.1.2.i.
- f. Repeat steps c through e in ascending 20 mil increments until the range starts to decrease.
- g. At the completion of step f, repeat steps c through e in descending 20 mil increments until the range starts to decrease.

6.2.5 Determination of Minimum Range High Angle Fire

- a. Emplace the test weapon on approximately level ground on a test firing range equipped with flash observation posts.

MTP 3-3-500
1 December 1967

- b. Instrument to measure muzzle velocity.
- c. Bore-sight the test weapon.
- d. Fire a 10-round MPI with the weapon at its maximum economical elevation and using its minimum charge.

NOTE: During this firing, it may be necessary to reduce elevation to obtain stable flight and ensure fuze activation.

- e. Record the applicable information required in paragraphs 6.2.1.2.g. through 6.2.1.2.i.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personnel

Record the following for all gun crew service personnel involved:

- a. Grade
- b. MOS
- c. Training time in MOS, in weeks
- d. Experience in MOS, in months

6.3.1.2 Inspection

- a. Record the following for each test weapon used:
 - 1) Nomenclature and model No.
 - 2) Serial No.
 - 3) Manufacturer
 - 4) For associated equipment:
 - a) Nomenclature and model No.
 - b) Serial No.
 - 5) Data as required by the technical and preoperational inspection of MTP 3-3-500.

6.3.2 Test Conduct

6.3.2.1 Indirect Fire

- a. Record the following for each MPI group fired:
 - 1) Officer in charge
 - 2) Date and time
 - 3) MPI group number

- 4) For the ammunition used, as appropriate:
 - a) Shell
 - b) Fuze
 - c) Powder lot
 - d) Charge
- 5) Gun elevation, in mils
- 6) Azimuth of fire, in mils
- 7) Ambient temperature, in °F
- 8) Relative humidity, in %
- 9) Wind speed, in mph, and direction
- 10) Number and coordinates of the firing position
- 11) Powder temperature, in °F
- 12) Boresight corrections at the completion of a MPI group firing

b. Record the following for each round in MPI group:

- 1) Instrument reading from each flash observation post to each burst
- 2) Flashed location of each round
- 3) Muzzle velocity, in feet per second
- 4) Weight of fuzed projectile, in pounds
- 5) Depth of each ram, when appropriate, in feet

6.3.2.2 Direct Fire at Stationary Targets

a. Record the following for each MPI group fired:

- 1) MPI group number
- 2) Type of ammunition used
- 3) Charge
- 4) Target distance, in meters
- 5) Method of sighting (two-man, two-sight; two-man, one-sight; one-man, one-sight)
- 6) Boresight corrections at the completion of the MPI group firing

b. Record the following for each round fired:

- 1) Distance from point of aim, in feet:
 - a) Horizontal
 - b) Vertical

6.3.2.3 Direct Firing at Moving Targets

a. Record the following for each MPI group fired:

MTP 3-3-506
4 December 1967

- 1) MPI group number
- 2) Gun crew number
- 3) Type of ammunition used
- 4) Charge
- 5) Number of hits obtained
- 6) Cause of miss:
 - a) Weapon/ammunition malfunction
 - b) Crew error
- 7) For each round fired:
 - a) Time required for the crew to recover from the effects of firing, in seconds
- 8) Effects of obscuration

b. Record the following at the completion of the test:

- 1) Crew number
- 2) Total number of rounds fired
- 3) Total number of hits obtained
- 4) Total cause of miss:
 - a) Weapon/ammunition malfunction
 - b) Crew error

6.3.2.4 Determination of Maximum Range

a. Record the following for each MPI group fired:

- 1) Officer in charge
- 2) Date and time
- 3) MPI group number
- 4) For the ammunition used, as appropriate:
 - a) Shell
 - b) Fuze
 - c) Powder lot
 - d) Charge
- 5) Gun elevation, in mils
- 6) Azimuth of fire, in mils
- 7) Ambient temperature, in °F
- 8) Relative humidity, in %
- 9) Wind speed, in mph, and direction
- 10) Number and coordinates of the firing position
- 11) Powder temperature, in °F
- 12) Boresight corrections at the completion of an MPI group firing

- b. Record the following for each round of an MPI group
 - 1) Instrument reading from each flash observation point to each burst
 - 2) Flashed location of each round
 - 3) Muzzle velocity, in feet per second
 - 4) Weight of fuzed projectile, in pounds
 - 5) Depth of each ram, when appropriate, in feet

6.3.2.5 Determination of Minimum Range High Angle Fire

Record the following:

- a. Officer in charge
- b. Date and time
- c. For the ammunition, as appropriate:
 - 1) Shell
 - 2) Fuze
 - 3) Powder lot
 - 4) Charge
- d. Gun elevation, in mils
- e. Azimuth of fire, in mils
- f. Ambient temperature, in °F
- g. Relative humidity, in %
- h. Wind speed, in mph, and direction
- i. Number and coordinates of the firing position
- j. Powder temperature, in °F
- k. Boresight corrections at the completion of firing
- l. For each round fired:
 - 1) Instrument reading from each flash observation point to each burst
 - 2) Flashed location of each round
 - 3) Muzzle velocity, in feet per second
 - 4) Weight of fuzed projectile, in pounds
 - 5) Depth of each ram, when appropriate, in feet

6.4 DATA REDUC .ON AND PRESENTATION

6.4.1 Indirect Fire

After computing range and azimuth from weapon to each MPI, deflection and range probable errors should be computed by two methods -- standard deviations and successive differences. If trends existed during tests, such as constantly increasing wind, the successive differences method should yield smaller probable errors. If no trends are present, the standard deviation method should yield the smaller results. If large differences exist, carefully examine results and investigate causes. When

assured that data are valid and correct, use the smaller values determined as the best estimate of probable errors.

a. Standard Deviations:

- 1) Using grid coordinates plot the location of each burst (see Appendix A).
- 2) If some rounds obviously appear to be erratic, compare with muzzle velocity readings, examine all other data, apply outlier determination (see Appendix D) and eliminate if appropriate.
- 3) Add the eastings of all rounds and add the northings for all rounds. Divide each total by the number of rounds. This will give the average mean easting and the average mean northing.
- 4) Plot the mean easting and the mean northing for location of MPI of the group.
- 5) Draw a line through the MPI from the firing position. This is the mean line of fire.
- 6) Parallel to the mean line of fire measure the distance of each round over or short of the MPI. Measure the distance right or left of the MPI perpendicular to the azimuth of fire. These are the deviations in range and deflection.
- 7) Using the following formula compute the probable errors for range and deflection:

$$\begin{array}{l} \text{EPR} \\ \text{EPD} \end{array} = \alpha \sqrt{\frac{\sum \Delta^2}{n}}$$

Where: Δ = Deviation from MPI

n = Number of rounds (at least 10)

α = Value obtained from table on Appendix B

NOTE: See Appendix C for sample problem and worksheet.

b. Successive Differences:

- 1) Repeat steps 1 through 6 of standard deviation method.
- 2) Measuring parallel to the mean line of fire, find the difference in range between rounds 1 and 2, 2 and 3, 3 and 4, etc. These will be the successive differences between rounds in range.
- 3) Measuring perpendicular to the mean line of fire, find

the distances between rounds 1 and 2, 2 and 3, 3 and 4, etc. These will be the successive differences in deflection.

- 4) Using the formula below compute the probable errors in range and deflection:

$$\begin{array}{l} \text{EPR} \\ \text{EPD} \end{array} = .4769 \sqrt{\frac{\sum \sigma^2}{n-1}}$$

Where Σ = Sum

σ = Successive differences between rounds

n = Number rounds used (at least 10)

NOTE: See Appendix C for sample problem and worksheet.

c. Rapid Method for Approximating Probable Errors:

Probable errors can be estimated by multiplying maximum deviations by a factor which is a function of the number of rounds fired. Some of these factors are:

<u>n</u>	<u>Factor</u>
8	.24
9	.23
10	.22
11	.21
12	.21

Example:

- (a) Round No. 2 was the longest round in a MPI group of 10 rounds and Round No. 8 was the shortest.

The distance between rounds 2 and 8 was 120 meters.

$$.22 \times 120 = 26.4 \text{ meters - PE in range}$$

- (b) Repeat same process for deflection probable errors.

6.4.2 Direct Fire at Stationary Targets

- a. Compute the MPI for each 10-round group as follows:
(Remember that all rounds at the left and below the point of aim are given a

negative value.)

$$CI(H) = \frac{X_1 + X_2 + X_3 + X_4 \dots X_{10}}{n}$$

$$CI(V) = \frac{Y_1 + Y_2 + Y_3 + Y_4 \dots Y_{10}}{n}$$

n = number of rounds

b. Allowing for sight offset (horizontal distance of line of sight from axis of bore) evaluate the MPI group differences between the MPI and the point of aim. If large differences are found, improper ammunition, gun, or fire control performance is indicated. At 500 meters and 1,000 meters all rounds should hit the target. For medium and heavy artillery 95 percent should hit the target at 1,500 meters and 90 percent should hit the target at 2,000 meters. Compute probable errors, horizontal and vertical. Valid probable errors cannot be determined if any round misses the target.

6.4.3 Direct Fire at Moving Targets

Compare the percent of target hits with the QMR specifications.

6.4.4 Determining Maximum Range

Using the meteorological data obtained compute the effects of nonstandard conditions and remove from surveyed range. Use MPI for longest range obtained.

6.4.5 Determining Minimum Range High Angle Fire

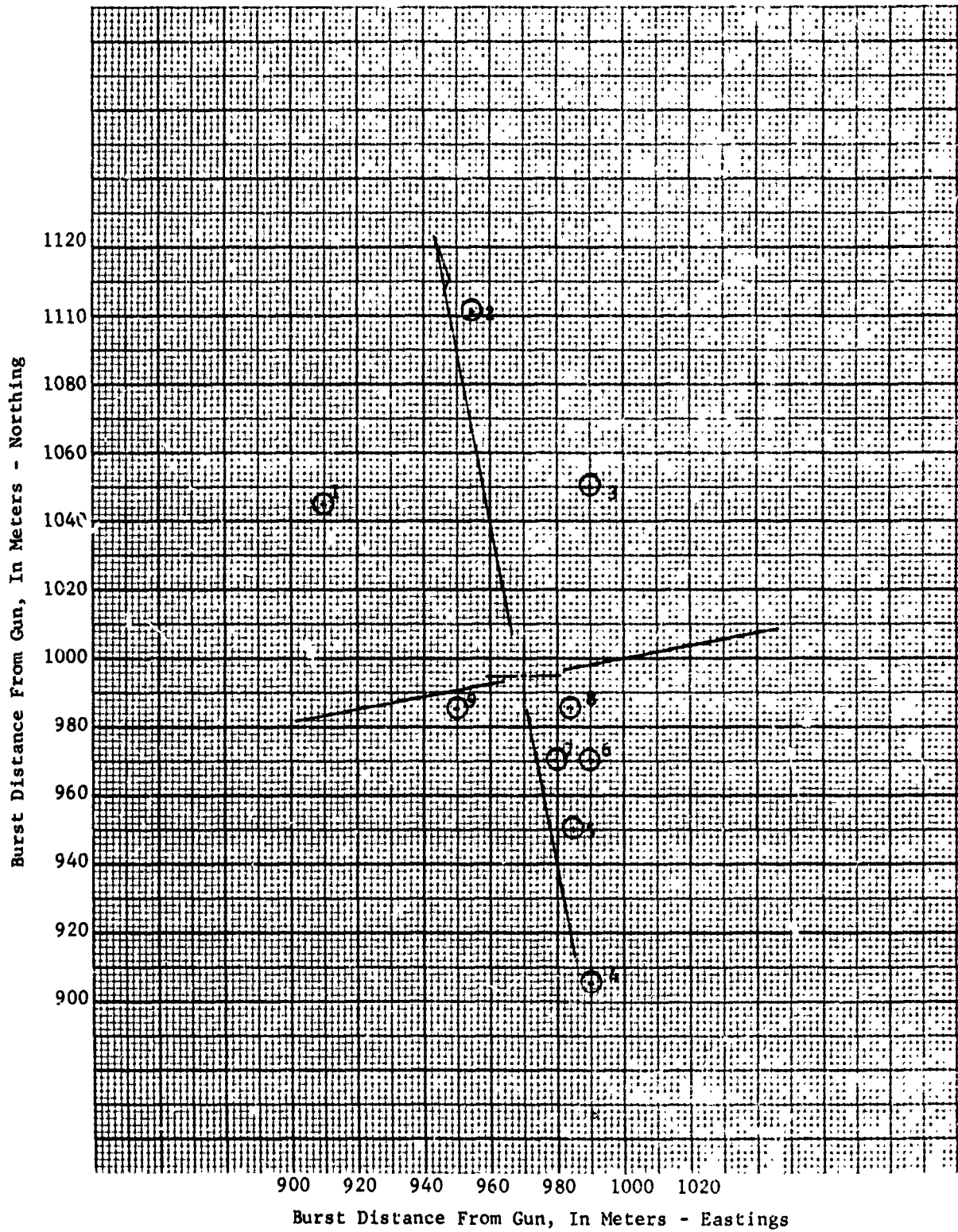
Using the meteorological data obtained compute the effects of nonstandard conditions and remove from surveyed range. Use MPI obtained in 6.2.5.

6.4.6 Accuracy in Indirect Fire

The distance between the predicted point of impact and the MPI is the miss distance and is an indication of the accuracy of the weapon. A standard of acceptance for accuracy for artillery weapons has not been specified. Results should be compared with results of tests on weapons that have been type classified and weighed and analyzed by experienced artillery personnel.

APPENDIX A

BURST LOCATION



MFP 3-3-506
4 December 1967

APPENDIX B

MATHEMATICAL DETERMINATION OF ERRORS

$$\text{EPD} = \delta \sqrt{\frac{\sum \Delta^2}{n}}$$

Δ = Deviation from MPI

EPR

n = Number of rounds

$$\text{EPD} = .4769 \sqrt{\frac{\sum \sigma^2}{n-1}}$$

σ = Successive differences between rounds

EPR

Σ = Sum

δ = See table below

TABLE FOR USE WITH
STANDARD DEVIATION

n	δ
2	1.19550
3	.93213
4	.84535
5	.80225
6	.77650
7	.75939
8	.74719
9	.73805
10	.73096
11	.72529
12	.72065
13	.71679
14	.71353
15	.71073
16	.70831
17	.70619
18	.70432
19	.70266
20	.70117

MTP 3-3-506
4 December 1967

APPENDIX C

PROBABLE ERROR

Standard Deviation & Successive Differences

Rd	Dev from Center of Impact Sq Deviation						Successive Rounds	Differences Sq Difference			
	No	Over	Short	Left	Right	Range		Deflection	Range	Deflec	Range
1	60			51							
2	106				5						
3	50				29						
4			93		3						
5			47		6						
6			28		15						
7			27		5						
8			13		12						
9			6	23							
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
Dev Should Equal Zero							332 SUM 170				
216		214		74		75					
430		149									
Sum Squares Dev		29912		4435		Sum Square Diff		28424		5852	
No Rds ()		9		9		No Rds - 1 ()		8		8	
Avg Sq of Dev		3324.00		492.77		Avg Sq of Diff		3553.00		731.50	
PE/S (X)		57.66		22.20		Sq Rt of Avg Diff		59.61		27.05	
EPR (X)		.73805		.73805							
EPD (M)		42.55		X		(X)		.4769		.4769	
EPR (M)				16.38		EPR (M)		28.43		X	
EPR (yds)						EPD (M)				12.90	
EPD (yds)						EPR (yds)					
EPD (yds)						EPD (yds)					
Computer		Checked		Date		EPD (yds)					
PFC Konsor				5 Dec 62							

MFP 3-3-506
4 December 1967

APPENDIX D

OUTLIER DETERMINATION

A rather brief method of determining outlying observations is outlined in a text by Dixon and Massey. A duplicate copy of the table of critical values is inclosed. The most effective way to outline the technique is to work through a typical problem.

Upon firing 10 rounds under identical conditions, the following data were recorded:

<u>Round Number</u>	<u>Range</u>	<u>Rank</u>
908	8205	X ₁
902	8310	X ₂
903	8316	X ₃
907	8324	X ₄
904	8327	X ₅
910	8336	X ₆
905	8337	X ₇
909	8350	X ₈
901	8359	X ₉
906	8368	X ₁₀

These data have been ranked in ascending order (data may be in ascending or descending order). Enter Table I at k = 10. For k,

Dixon and Massey's ratio $R_{11} = \frac{X_2 - X_1}{X_{k-1} - X_1}$. A confidence level of 95 percent

(OC = .05) is generally considered an acceptable level of significance and is the level used for this problem. After comparing r_{11} with the critical value for k = 10, $r_{11} = 105/154 = .682 > .477$, the conclusion can be drawn at the 95 percent level of confidence that X₁ (Round No. 908) is an outlier and should be eliminated.

The test should be repeated with n-1 observations (k = 9) to examine the possibility of any other outliers being present.

TABLE I
Criteria for Testing for Extreme Mean

Statistic	Number of obsn, k	Critical Values				
		$\alpha = .20$	$\alpha = .10$	$\alpha = .05$	$\alpha = .01$	$\alpha = .005$
$F_{10} = \frac{X_2 - X_1}{X_k - X_1}$	3	.781	.886	.941	.988	.994
	4	.560	.679	.765	.889	.926
	5	.451	.557	.642	.780	.821
	6	.386	.482	.560	.698	.740
	7	.344	.434	.507	.637	.680
$F_{11} = \frac{X_2 - X_1}{X_{k-1} - X_1}$	8	.385	.479	.554	.683	.725
	9	.352	.441	.512	.635	.677
	10	.325	.409	.477	.597	.639
$F_{21} = \frac{X_3 - X_1}{X_{k-1} - X_1}$	11	.442	.517	.576	.679	.713
	12	.419	.490	.546	.642	.675
	13	.399	.467	.521	.615	.649
$F_{22} = \frac{X_3 - X_1}{X_{k-2} - X_1}$	14	.421	.492	.546	.641	.674
	15	.402	.472	.525	.616	.647
	16	.386	.454	.507	.595	.624
	17	.373	.438	.490	.577	.605
	18	.361	.424	.475	.561	.589
	19	.350	.412	.462	.547	.575
	20	.340	.401	.450	.535	.562
	21	.331	.391	.440	.524	.551
	22	.323	.382	.430	.514	.541
	23	.316	.374	.421	.505	.532
	24	.310	.367	.413	.497	.524
	25	.304	.360	.406	.489	.516

ACCESSION for

CFBT: WHITE SECTION

ODG: BUFF SECTION

UNANNOUNCED

JUSTIFICATION

BY

DISTRIBUTION/AVAILABILITY CODES

DIST. * A*AIL. and/or SPECIAL

/