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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This TOP prescribes methods for determining the stability of indirect fire weapons fired from varied terrain types incurred in nothern regions durino the various seasons. Requirements for facilities and test instrumentation are included.

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U.S. ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-102 30 June 1976
Test Operations Procedure 3-2-830
AD No.

COLD REGIONS STABILITY TEST OF INDIRECT FIRE ARTILLERY WEAPONS

1. SCOPE. The procedures specified in this TOP are designed to allow evaluation of the stability of cannon type artillery weapons during firing from arctic and subarctic terrain under varying conditions. This TOP is limited to towed and self-propelled weapons employed in the indirect fire mode. Due to differences in emplacement techniques, mortar stability testing is not included. Stability testing during direct fire is the subject of a different TOP.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

2.1.1 A controlled access firing range with the following characteristics:

2.1.1.1 Impact area usable from minimum high angle to maximum range of the test weapon.

2.1.1.2 Firing positions which will satisfy the following seasonal terrain conditions:

Winter: Level snow-covered ground, level nonglazed ice, level muskeg, and glacial riverbed with forward and reverse slopes of 0, 5, 10, and 15 percent and 10 percent right and left cant.

Summer: Level muskeg and glacial riverbed.

2.1.1.3 A minimum of four observation posts (OP's) which can observe the predicted impact point of each round.

2.1.1.4 Survey control at each observation post and firing position (1:3000 accuracy).

2.1.1.5 Electrical power at OP's and firing positions of sufficient capacity for colocated instrumentation and auxiliary equipment. Power and instrumentation cables at the firing position will be buried or otherwise protected from damage.

*This TOP supersedes MTP 3-4-009, 22 July 1970. — AD 875 628

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2.1.1.6 Environmental and fragmentation protection for test personnel. Utilize electrical heat sources whenever possible to minimize ice fog.

2.1.1.7 Radio and/or wire telephone communications between all observation posts, firing positions, and test control/fire direction center. Both modes of communications are preferred to allow a backup system. The use of wire telephone communications is preferred in order to minimize interference with test instrumentation.

2.1.2 Secure storage areas for the test weapon(s) and ammunition components. The degree of required environmental protection will be specified in the requirements documents.

2.2 Instrumentation.

2.2.1	Digital theodolites or aiming circles	0-360° ± 0.01° 0-6400 mil ± 1 mil
2.2.2	Powder thermometer	-55°C to +40°C ± 1°C
2.2.3	Muzzle Velocity Radar	42 to 1200 meters/sec ± 4 meters/sec
2.2.4	Measuring Tape	0-10 meters ± 0.5 cm
2.2.5	Weight Scales	0-100 kg ± 1 gm
2.2.6	Motion picture camera	400 frames/sec
2.2.7	Television system	125 frames/sec
2.2.8	Meteorological support:	
	Ambient air temperature	-55 to +40°C ± 1°C
	Wind velocity	0-100 kts ± 2 kts
	Wind direction	0-360 degrees ± 2 degrees
	Relative humidity	5 percent to 95 percent ± 5 percent
	RAWIN (upper air)	120 percent maximum ordinate at 2-hour intervals
2.2.9	HOP cards	NA

2.3 Personnel.

2.3.1 Weapon Crew (4)

2.3.2 Weapon Position Instrument Operators (4)

2.3.3 Muzzle Velocity Radar Operator (1)

2.3.4 Motion Picture or Television Operator (2)

2.3.5 Observation Post Instrument Operators (8)

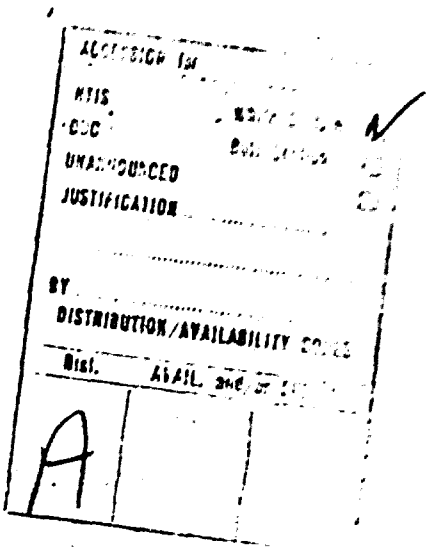
2.3.6 Fire Direction/Plotting (3)

2.3.7 Data Recorder (1)

2.3.8 Safety Officer (1)

2.3.9 Test Officer (1)

2.3.10 Test NCO (1)



3. PREPARATION FOR TEST.

3.1 Facilities. Insure that facilities meet the requirements specified in paragraph 2.1.

3.2 Equipment. Inspect the test weapon for completeness and serviceability. Insure that the associated sighting and boresighting equipment are complete and serviceable. Insure that sufficient ammunition and components are available for test completion.

3.3 Instrumentation: Insure that all instrumentation which is required for the test (para 2.2) is available, in operating condition, and calibrated. Arrange for meteorological support, to include RAWIN (upper air) data at 2-hour intervals beginning 1 hour prior to firing the first round.

3.4 Data Required

3.4.1 Test weapon: Nomenclature, model numbers, serial numbers, general condition, damage and discrepancies, documentation photographs, lot numbers of all ammunition components, projectile weight zones.

3.4.2 Instrumentation: Type, nomenclature, serial numbers, range and accuracy, calibration due date, application, location.

3.4.3 Facilities: Surveyed locations of observation posts and firing points and orienting angles.

3.4.4 Test personnel: Names, rank, MOS, experience, and degree of proficiency. Assigned duties.

3.4.5 Meteorological support: Equipment range and accuracies.

4. TEST CONTROLS.

4.1 Crew-on-weapon firing will not be conducted unless a safety release or safety statement has been obtained in accordance with TECOM Regulation 385.6, Verification of Safety of Materiel during Testing. Applicable range and safety SOP's will be adhered to during testing.

4.2 All ammunition components fired will be from the same lot number as accuracy and precision firing tests.

4.3 All personnel will wear the appropriate components of the cold-dry uniform, as specified in TM 10-275, DA, Cold Weather Clothing and Sleeping Equipment.

4.4 Firing ranges will correspond to those used for accuracy and precision firing for comparison of results.

5. PERFORMANCE TEST.

5.1 Method.

5.1.1 Emplace and lay the weapon with center of traverse in the primary direction of fire at a firing position which satisfies one of the terrain conditions described in table 5.1.

TABLE 5.1.--Terrain Conditions for Stability Firing Exercise

Condition	Season		
	Breakup	Summer	Winter
Snow-covered ground, level			X
Nonglazed ice, level			X
Muskeg, level	X	X	X
Glacial riverbed, level	X	X	X
Glacial riverbed, 5, 10, and 15 percent forward slope			X
Glacial riverbed, 5, 10, and 15 percent reverse slope			X
Glacial riverbed, 10 percent right and left cant			X

5.1.2 Establish a triangulation baseline 50 meters to the rear of the weapon, perpendicular to the direction of fire, 100 meters long. A minimum of two instruments will be located 50 meters to either side of center line of weapon.

5.1.3 Place a minimum of two contrasting marks on the nonmoving portion of the weapon carriage as far apart as possible which can be seen by digital theodolites or aiming circles at all deflection and elevation settings of the weapon.

5.1.4 Install the muzzle velocity radar at the test weapon.

5.1.5 Verify test weapon boresight before and after firing each group.

5.1.6 Prepare a minimum of eight complete rounds of ammunition utilizing the maximum charge zone, in addition to the number of warmup and seating rounds determined from precision fire exercises.

5.1.7 After tube warmup, fire eight rounds at 2-minute intervals, at center of traverse, at the elevation corresponding to maximum range of the weapon.

5.1.8 Measure muzzle velocity of each round.

5.1.9 Adjust weapon to commanded quadrant elevation and deflection after each round.

5.1.10 Determine aiming post displacement after each round (if displacement exceeds sight correction limits; record displacement, relay weapon, and continue firing).

5.1.11 Measure weapon hop, using the procedures of MTP 3-2-816, of one round of the group after the weapon is fully seated.

5.1.12 Measure and record horizontal and vertical angles to all weapon reference marks from each survey instrument prior to firing and after firing each round.

5.1.13 Take high speed motion picture or video tape recordings of selected rounds.

5.1.14 Observe and record any unusual incidents during firing.

5.1.15 Observers at OPs will observe the impact of each round and report any abnormalities (duds, low order bursts, etc.). Horizontal and vertical angles to round impact will be observed and recorded in accordance with TOP/MTP 3-3-506.

5.1.16 Plot the observed impact of each round in real time.

5.1.17 Record ambient temperature, 2 meter wind velocity and wind direction, relative humidity, precipitation and visibility for each group.

5.1.18 Check boresight after each group, record any corrections.

5.1.19 Re-emplace the weapon with center of traverse in primary direction of fire and repeat paragraphs 5.1.1 through 5.1.18 at maximum quadrant elevation less one turn of elevation handwheel.

5.1.20 Re-emplace the weapon with center of traverse in primary direction of fire and repeat paragraphs 5.1.1 through 5.1.18 at quadrant elevation of 200 mils.

5.1.21 Repeat paragraphs 5.1.1 through 5.1.20 except that the weapon will be layed with primary direction of fire at the right traverse limit less one turn of handwheel.

5.1.22 Repeat paragraphs 5.1.1 through 5.1.20 with primary direction of fire at the left traverse limit less one turn of handwheel.

5.1.23 Repeat paragraphs 5.1.1 through 5.1.22 for each of the conditions described in table 5.1.

5.2 Data Required.

5.2.1 Record the following data for each group fired. A sample data sheet is included at appendix A.

5.2.1.1 Terrain and season (from table 5.1).

5.2.1.2 Length of triangulation base and initial horizontal and vertical angles to weapon reference marks.

5.2.1.3 Horizontal and vertical angles to weapon reference marks after completion of group.

5.2.1.4 Boresight corrections after firing group (if applicable).

5.2.1.5 Total aiming post displacement after firing group.

5.2.1.6 Average powder temperature.

5.2.1.7 Ambient weather conditions before and after each group.

5.2.1.8 Ammunition lot numbers.

5.2.1.9 Surveyed locations of observation posts and weapon.

5.2.1.10 Quadrant elevation, weapon traverse position, and azimuth of fire.

5.2.1.11 Meteorological corrections for range and deflection.

5.2.2 Record the following data for each round fired. A sample data sheet is included at appendix A.

5.2.2.1 Horizontal and vertical angles to impact from each OP.

5.2.2.2 Corrections required to relay weapon.

5.2.2.3 Aiming post displacement.

5.2.2.4 Horizontal and vertical angles to weapon reference marks after each round.

5.2.2.5 Muzzle velocity.

5.2.2.6 Motion pictures or video tape recordings of selected rounds.

5.2.2.7 Hop cards for selected rounds.

5.2.2.8 Unusual occurrence or incidents observed at firing position or impact area.

6. DATA REDUCTION AND PRESENTATION

6.1 Data Reduction.

6.1.1 Calculate center of impact and dispersion for each group.

6.1.2 Calculate the weapon displacement for each round, using the horizontal and vertical angles measured to the weapon reference marks and triangulation computation methods.

6.1.3 Reduce the muzzle velocity radar data to the actual muzzle of the weapon.

6.1.4 Edit and annotate the motion picture film or video tape recordings.

6.2 Data Presentation.

6.2.1 Summarize comments by test personnel and present in narrative format.

6.2.2 Present the test conditions, weapon and aiming post displacement, and impact data in tabular form. A sample presentation is shown at appendix A.

6.2.3 Include edited and annotated motion picture or video tape recordings as an annex to the report.

Recommended changes to this publication should be forwarded to Commander, US Army Test and Evaluation Command, ATTN: DRSTE-ME, Aberdeen Proving Ground, MD 21005. Technical information may be obtained from the preparing activity: Commander, US Army Cold Regions Test Center, ATTN: STECR-TD, APO Seattle 98733. Additional copies are available from the Defense Documentation Center, Cameron Station, Alexandria, VA 22314. This document is identified by the accession number (AD No.) printed on the first page.

APPENDIX A

COLD WEATHER STABILITY TEST OF ARTILLERY WEAPONS FLASH BASE DATA

SUBTEST NUMBER _____ ___ ___

OBSERVATION POST NAME _____ INSTRUMENT TYPE _____ ANGLES IN MILS ___ DEGREES ___

COORDINATES N _____ E _____ ALT _____

ORIENTATION DATA:

NUMBER 1 - NAME _____ HORIZ ANGLE _____ VERTICAL ANGLE _____

NUMBER 2 - NAME _____ HORIZ ANGLE _____ VERTICAL ANGLE _____

ROUND NUMBER	HORIZONTAL ANGLE	VERTICAL ANGLE
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		

COLD WEATHER STABILITY TEST OF ARTILLERY WEAPONS
WEAPON DISPLACEMENT DATA

SUBTEST NUMBER _____
INSTRUMENT NUMBER _____ TYPE _____

ROUND NO.	PT NO. 1		PT NO. 2		PT NO. 3		PT NO. 4	
Initial Angle	Horiz.	Vert.	Horiz.	Vert.	Horiz.	Vert.	Horiz.	Vert.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

COLD WEATHER STABILITY TEST OF ARTILLERY WEAPONS
DATA SUMMARY

SUBTEST NUMBER _____
TERRAIN TYPE _____ SLOPE _____ DATE _____ AIR TEMPERATURE _____
WINDSPEED (2M) _____ DIRECTION _____ REL HUM _____ GROUND CONDITION _____
AMMO LOT: PROS _____ POW _____ FUZE _____ PRIMER _____ POWDER TEMPERATURE _____
QUADRANT EL: _____ AZIMUTH OF FIRE _____ TRAVERSE _____

WEAPON DISPLACEMENT

ROUND	MV	VERT (cm)	LAT (cm)	LONG (cm)	YAW (deg)	ROLL (deg)	AIMING POST DISP (mils)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							