UNCLASSIFIED

AD NUMBER

AD876259

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Test and Evaluation; 31 July 1970. Other requests shall be referred to HQ, US Army Test and Evaluation Command, Aberdeen Proving Ground, MD 21005.

AUTHORITY

USATEC ltr, 14 Dec 1970.

THIS PAGE IS UNCLASSIFIED

AD 876259

DDC FILE COPY

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

ARCTIC ENVIRONMENTAL TEST OF TANK AMMUNITION

1. OBJECTIVE

The objective of the procedures outlined in this MTP is to provide a means of evaluating the performance, safety, human factors engineering, maintainability and reliability aspects of tank ammunition tested under arctic winter environmental conditions.

2. BACKGROUND

Arctic testing of tank ammunition is intended to supplement the engineering and service tests performed in the temperate zone. Specific tests, particularly of the engineering type, will not be repeated unless results are expected to be materially different under arctic conditions.

Testing in a natural arctic winter environment is used to substantiate the simulated environmental test data acquired during engineering or service testing. Natural environmental testing is generally not authorized until data from simulated environmental tests provides reasonable assurance that the test item shall function satisfactorily when subjected to the conditions that would be encountered in the arctic.

3. REQUIRED EQUIPMENT

a. Arctic Winter Uniform as specified in MTP 10-4-500.
b. General and special tools, and ancillary items required for assembly and maintenance of the test item.
c. Firing Ranges (direct and indirect fire).
d. Maintenance Facilities (organizational, direct and general support shops with qualified personnel).
e. Appropriate Ammunition.
f. 18 X 18 ft. Target.
g. 7½ X 7½ ft. Target.
h. Fire Control Components (instrumentation as required).
i. Searchlights and Illuminators.
j. Flash ranging equipment and personnel.
k. Communications (radio and telephones).
l. Support Vehicles w/drivers (wrecker on call).
m. Photographic Equipment, High Speed Camera, Still and Motion Picture Cameras (black and white or color).
n. Measuring Devices and Gages (applicable to the weapons being tested).
o. Chronograph.
p. Stopwatches.
q. Borescope.
r. Tools, as required, to make physical measurements.
s. Scratch Gage.

DDC
RETRIEVED
NOV 2 1970
E

STATEMENT #2 UNCLASSIFIED

This document is subject to special export controls and each transmittal to foreign governments or foreign nationals may be made only with prior approval of USATECOM, ATTN: [illegible]

t. Pullover Gage.
u. Meteorological Instrumentation.
v. Velocity Coils.
w. Copper Crusher Gage (Type M11).
x. Binoculars.
y. Fire Fighting and Related Safety Equipment.

4. REFERENCES

A. AR 70-8, Human Factors and Social Sciences Research.
B. AR 70-10, Test and Evaluation During Research and Development of Materiel.
C. AR 70-38, Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
D. AR 705-5, Army Research and Development.
E. AR 705-50, Army Materiel Reliability and Maintainability.
F. USATECOM Regulation 350-6, Training in New or Modified Equipment and Training Devices.
G. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
H. USAMC Regulation 385-12, Verification of Safety of Materiel from Development through Testing and Supply to Disposition.
I. Frankford Arsenal Report R-1380A (c), subject: Fire Control Studies, Tank Gunnery Accuracy Evaluation (U), February 1958.
J. MTP 4-1-001, Testing Ammunition and Explosives.
K. MTP 4-2-501, Projectiles.
L. MTP 4-2-606, Calibration Firing for Master and Reference Lots of Propellant.
M. MTP 4-2-607, Check Firing for Master and Reference Propellants.
N. MTP 4-2-806, Impact Sensitivity of Fuzes.
O. MTP 4-2-807, Fuze Functioning Time-Superquick Fuzes.
P. MTP 4-2-816, Photographic Instrumentation for Trajectory Data.
Q. MTP 4-3-502, Ammunition Functioning and Reliability.
R. MTP 4-3-513, Maintenance.
S. MTP 4-3-514, Safety Hazards.
T. MTP 4-3-515, Human Factors Engineering.
U. MTP 4-3-517, Combat Vehicle Ammunition Storage and Transportability.
V. MTP 4-3-519, Compatibility with Fire Control Equipment.
W. MTP 10-4-500, Arctic Environmental Test, Preoperational Inspection, Physical Characteristics, Human Factors, Safety, and Maintenance.

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP are designed to determine and evaluate the physical characteristics of artillery in arctic environmental conditions and provide guidance for the conduct of arctic environmental testing of tank ammunition. Specific subtests include:

BLANK PAGE

a. Preoperational Inspection and Physical Characteristics
b. Compatibility
c. Fuze Functioning
d. Observation and Sensing
e. Dispersion
f. Ammunition Functioning
g. Human Factors
h. Safety
i. Maintenance Evaluation
j. Reliability

5.2 LIMITATIONS

This MTP is limited to general procedures for Service Tests, Integrated Engineering and Service Tests, Confirmatory (Type I) Tests, and Check Tests of all tank ammunition performed under arctic winter conditions. Specific tests required by the test directive, or other requirements, will be performed using this MTP as a guide.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Since arctic winter environmental tests are normally scheduled from October through March (6 months), ensure that the test items are delivered to the Arctic Test Center prior to 1 October. Any delay in the test schedule will be reported to TECOM headquarters and a revised schedule requested. The test schedule will reflect an estimate of net testing time required for each subtest.

b. When necessary to augment assigned personnel, ensure the availability of TDY personnel and their training to the degree that they are as proficient on the individual test items as the troops who will use the equipment. Assigned personnel will prepare the plan of test, supervise and conduct the test, gather test data, and report the results of the test.

c. Ensure that all test personnel are familiar with required technical and operational characteristics of the test item under test, such as stipulated in QMR's, SDR's, and TC's and record the criteria in the test plan. A familiarization class will be given to all test personnel by the test officer.

d. Ensure that all personnel receive New Equipment Training (NET) as referenced in paragraph 4F.

e. Review all instructional material issued with the test item(s) by manufacturer, contractor, or government agencies, as well as reports of previous tests conducted on the same type of equipment and familiarize all test personnel with such documents.

f. Select test equipment ideally having an accuracy 10 times greater than that of the specified tolerances of the function(s) to be measured.

g. Prepare record forms for systematic entry of data, chronology of tests, and analysis in final evaluation.

h. Prepare adequate safety precautions to provide safety for

personnel and equipment (refer to MTP 4-3-514). Ensure that a safety release has been obtained prior to test conduct.

i. Outfit all personnel in appropriate arctic uniform as described in MTP 10-4-500.

j. Record the prevailing meteorological conditions during test conduct to include:

1) Temperature
2) Humidity, relative or absolute
3) Temperature gradient
4) Atmospheric pressure
5) Precipitation
6) Solar Radiation
7) Wind Speed and direction
8) Frequency of readings
9) Source of data

k. Upon notice of arrival of the test item(s) or the estimated time of arrival, select and schedule the use of testing sites, facilities and equipment as required by the applicable subtest and/or corresponding MTP.

6.2 TEST CONDUCT

NOTE: 1. Subtests shall be conducted concurrently with other subtests whenever possible for more efficient utilization of personnel and resources available and to minimize test time, and duplication of data. Ammunition will be stored outdoors in tactical packaging and exposed to prevailing weather conditions until fired. The ammunition will not be fired until a suitable period of outdoor storage and cold-soak have been completed. During testing, attempts will be made to accumulate data in the following manner:

25% of all testing will be accomplished between 0°F and -25°F, 50% of all testing will be accomplished between -25°F and -50°F, and 25% of all testing will be accomplished at temperatures below -50°F.

2. Test operations will be continued regardless of adverse weather conditions, except when such conditions will compromise test results or endanger life or property.
3. If the test ammunition is intended to replace a standard ammunition type, the standard ammunition will be used as a comparison round.

6.2.1 Preoperational Inspection and Physical Characteristics

a. Upon receipt, carefully inspect all test items and their shipping and/or packaging containers for completeness, damage and general conditions in accordance with MTP 10-4-500.

b. Subject the gun mount, recoil system, and complete on-vehicle

fire control system at the tank used for conduct of the firing to a complete technical inspection.

c. Gage the gun tube.

d. Ensure that the fire control system is placed within acceptable tolerances as required.

e. Check the addition of any special fire control components or modifications to existing fire control components according to instructions contained in the maintenance package.

f. Record the following data:

1) Results of technical inspection and maintenance performed.
2) Record of damage sustained in shipment.
3) Identification photographs.
4) Record of physical characteristics check.
5) Discrepancies noted in check of fire control system.
6) Bore measurement of gun tube.
7) Record deficiencies noted in labeling, marking, or assembly of the test item.

6.2.2 Compatibility

a. Measure the bore diameter of the tank gun before and after firing.

b. Store a minimum of 10 randomly selected rounds of the test ammunition in the ammunition racks of the combat vehicle during durability testing.

c. Rotate the rounds listed in Step (b) above, to different rack locations at a maximum of 50 mile intervals until the durability testing is completed or circumstances require the rounds to be fired.

d. Continuous observation of the test ammunition shall be made by the test personnel with respect to the fit of the rounds and limitations affecting stability or security of the rounds.

e. Evaluate the test ammunition compatibility with the vehicle's fire control equipment during firing.

f. Use information supplied in the maintenance package and experience of the test personnel as a basis for the evaluation of special fire control equipment or modifications.

g. Compare special fire control equipment or modifications with standard fire control equipment.

h. Evaluate the test ammunition as to its effects on compatibility with related equipment during firing, recoil, extraction, breech operation, gun tube wear and removal of unfired rounds.

i. Measure the length of recoil with a scratch gage.

j. Record the following data:

1) Any difficulty encountered in stowage.
2) Any difficulties encountered with respect to special fire control equipment or modifications.
3) Any failures of the gun with respect to firing, recoil, extraction, or malfunctions during breech operations.
4) Any difficulties encountered with removal of unfired rounds.
5) Length of recoil.

6) Gun tube gaging results.
7) Ambient temperatures.

6.2.3 Fuze Functioning

NOTE: Conduct this subtest at night.

a. Attempt to fire 10-rounds of test ammunition in ambient air temperatures of 0 F to -25°F and 10-rounds in ambient air temperatures of -25 F to the lowest fuze functioning temperature limit.

b. Locate an open-shutter camera along the gun target line in the area at expected time fuzed functioning.

c. Fire the test ammunition as described in Step (a) above, consistent with safety procedures.

d. Use a high speed framing to determine fuze functioning point at muzzle action.

e. Engage representative tactical targets of the type against which an impact fuze round has been designed to be used.

f. Take high speed motion pictures of the impact test fuze round at impact.

g. If required by the test directive or developers, other specific fuze functioning tests, such as graze or ricochet tests shall be conducted.

h. Record the following data:

1) Round number and lot number of each round.
2) Ambient temperatures and windspeed direction.
3) Range and fuze setting.
4) Fuze functioning point in range and height of burst for time fuzes.
5) Photographic data.

6.2.4 Obscuration and Sensing

NOTE: During the firing tests evaluate the ability of the commander and gunner to sense the round through smoke, flash, blast, ice fog, or blowing snow.

a. Take photographs of the conditions in NOTE, above.

b. Fire five rounds of the test ammunition during daylight at the highest cycle rate possible consistent with safety and with the ability of the crew to relay the gun after each round.

c. Fire five comparison rounds in the same way and manner as Step (a), above.

d. Compare the results of firing.

e. Fire a minimum of five rounds of the test ammunition at night with and without searchlight illumination.

f. Determine the ability of the commander and gunner to sense the rounds fired in Step (d), above.

g. Record the following data:

1) Ambient temperature and wind velocity and direction.

2) Visibility conditions.
3) Description of snow cover.
4) Type of ammunition and lot number.
5) Length of time that smoke, flash, blast, ice fog, and blowing snow obscure the vision of the commander and gunner through fire control instruments.
6) Type of obscuration effects.
7) Time of firing.
8) Difficulties in observing tracer flight.
9) Highest cyclic rate of fire possible for five test rounds and five comparison rounds.
10) Photographic coverage of obscuration effects.

6.2.5 Dispersion

a. Place targets at surveyed ranges of 1,000, 1,500 and 2,000 meters.

b. Fire a minimum of one five-round shot group (consistent with safety procedures) at each range in the following temperature zone:

1) 0°F to -25°F
2) -25°F to the lowest functional temperature limit

NOTE: If sufficient test ammunition is available, one ten-round shot group shall be fired at each range in Step (a) above and within the two temperature zones in Step (b) above.

c. Fire all shot groups with the gun tube over the front of the vehicle.

d. Place velocity coils in the line of fire.

e. Recoil of the gun tube for each round fired shall be measured with a scratch gage.

f. Measure the chamber pressure of each round by the use of M11 copper crusher gages.

g. Determine the hit characteristics as closely as possible in accordance with the conditions specified in the Frankford Arsenal Report R-1380A.

h. The test will be conducted under the following conditions:

1) A well-trained gunner shall lay the weapon.
2) The primary sighting system shall be used.
3) Ensure that the lay of the weapon is precise and the back-lash is controlled.
4) Ensure that the targets are large enough (18 X 18 foot) for collection of projectile strike information.
5) Ensure that the targets have a distinct aiming point in the center within a 7½ X 7½ foot target.
6) Survey the target ranges, as applicable.
7) Zero the angle of site to near zero.
8) Remove snow from the firing pad.

9) Position the firing vehicle on the firing pad (level surface) with the brakes set.
10) Ensure that the gun tube is within the prescribed condemnation limits pertaining to dispersion and degradation of accuracy.
11) Condition the weapon by firing a warmup round.
12) Zero the weapon after conditioning.
13) Do not move the vehicle after zeroing.
14) Fire the first test round within 30 minutes after zeroing.
15) Relay the weapon on the aiming point prior to firing each round.
16) Avoid firing over prolonged intervals with rapid changes in ambient climatic conditions.
17) Using an accepted statistical method which is compatible with the test criteria compute the standard deviation and hit probability.
18) Record the following data:

a) Date and location of firing
b) Ambient temperature and windspeed and direction
c) Visibility conditions
d) Quadrant elevation
e) Test round number and lot number
f) Location of target impact for each round
g) Center of impact for each shot group (inches and mils)
h) Standard deviation of each shot group (mils)
i) Hit probability of each shot group for 7½ X 7½ feet target
j) Velocity of each round fired
k) Chamber pressure of each round

6.2.6 Ammunition Functioning

NOTE: During the firing of all test ammunition, test personnel shall observe the firing with regard to proper functioning and safety procedures.

a. Utilizing the M11 copper crusher gages measure the chamber pressure of at least half the rounds fired.

b. Determine the muzzle velocity of all rounds by the use of velocity coils, positioned in the line of fire.

c. Determine the length of recoil for all rounds by the use of a scratch gage.

d. If required, use high speed photography to determine metal posts security and round stability in the vicinity of the muzzle.

e. Record the following data:

1) Ambient temperature
2) Windspeed and direction
3) Round number and lot number
4) Muzzle velocity
5) Length of recoil

6) Chamber pressure
7) Quadrant elevation for each round
8) Any failure of the ammunition to function properly
9) Results of inflight photographs, if taken

6.2.7 Human Factors

a. Conduct all human factors tests in accordance with applicable sections of MTP 10-4-500, MTP 4-3-515, and AR 70-8.

b. Conduct this subtest concurrently with operational subtests in this MTP.

c. Determine if the test item is compatible with the skills, aptitudes, and limitations of personnel who will operate and maintain this equipment under arctic winter environmental conditions.

d. Determine if all accessories and components of the test item and the test item as a whole, enable or allow easy operation by test personnel wearing the appropriate arctic winter uniform.

e. Observe and record any and all major or minor tasks that are difficult or impossible to accomplish on or with the test item under arctic winter environmental conditions.

6.2.8 Safety

a. Conduct all safety tests in accordance with applicable sections of MTP 10-4-500, MTP 4-3-514, USATECOM Regulation 385-6, and USAMC Regulation 385-12.

b. Conduct this subtest concurrently with operational subtests in this MTP.

c. Determine if the test item is safe for United States Army use under arctic winter environmental conditions.

d. Prepare adequate safety precautions to provide safety for personnel and equipment and ensure that all safety SOP's are observed throughout the test. Ensure that a Safety Release has been obtained prior to test conduct.

e. Determine if all accessories and components of the test item and the test item as a whole, can be operated safely by test personnel wearing the appropriate arctic winter uniform.

f. Observe and record any and all major or minor tasks that are difficult or impossible to accomplish safely on or with the test item under arctic winter environmental conditions.

6.2.9 Maintenance Evaluation

NOTE: Classifications and definitions of malfunctions shall be as approved and commonly defined by all USATECOM testing agencies.

a. Conduct all maintenance evaluation tests in accordance with applicable sections of MTP 10-4-500, and MTP 4-3-513.

b. Conduct this subtest concurrently with operational subtests in this MTP.

c. Throughout the conduct of all testing as outlined in this MTP, maintain a record of performance of all scheduled and unscheduled maintenance as prescribed in the appropriate draft publications.

NOTE: Whenever possible, maintenance shall be performed under prevailing arctic environmental conditions. Reasons why this is not possible shall be recorded.

d. Continuously monitor all maintenance operations for human factors, safety implications, and to determine if ease of maintenance has been included in the design of the equipment.

e. Compare all replacement parts and components, provided with the test item, with anticipated and actual requirements, evaluating spare parts requirements under arctic environmental conditions.

f. Record the following information:

1) Scheduled and unscheduled maintenance performed, to include lubrication, adjustments, repairs, and replacement of parts.
2) Favorable and unfavorable aspects of maintenance.
3) Unsafe and inadequate aspects of maintenance operations.
4) Mean time between failures (MTBF) and the mean time to repair (MTTR) the test item and associated equipment.
5) Repair parts usage.
6) Human factors implications.

g. During performance of maintenance, utilize all common and special tools and test equipment furnished with the items under test, and record the following data:

1) Maintenance operations for which special tools are required.
2) Common and special tools and test equipment required, but not furnished in the maintenance package.
3) Tools and test equipment furnished but not required.

h. Thoroughly analyze all publications provided with the test items for clarity and simplicity of maintenance instructions, and completeness of preventative maintenance procedures.

i. Monitor all maintenance operations to determine if instructions and the sequence of operations are adequate for the level of training possessed by appropriate maintenance personnel, or if added or special training is required.

j. Record the following data:

1) Accuracy and adequacy of maintenance publications.
2) Requirements for special training and maintenance category requiring special training.
3) Errors and omissions in nomenclature and parts numbers on repair parts lists.
4) Unclear and inadequate maintenance instructions.
5) Inadequate safety instructions for personnel and equipment, including environmental protection during operation and

maintenance.
6) Desirable changes and comments.

6.2.10 Reliability

a. Conduct all reliability tests in accordance with applicable sections of AR 705-50, and MTP 4-3-502.
b. Conduct this subtest concurrently with operational subtest in this MTP.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing, marking for identification and correlation, and grouping the test data according to test title.

Specific instructions for the reduction and presentation of individual test data are outlined in the succeeding paragraphs.

6.4.1 Preoperational Inspection and Physical Characteristics

Preoperational inspection and physical characteristics data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.2 Compatibility

Examine the recorded data and evaluate the capability of the test item by determining the following:

a. The compatibility of the special fire control components or modifications to existing systems with the standard fire control equipment.
b. The compatibility of the test ammunition with the vehicle ammunition storage racks.
c. The compatibility of the test ammunition with the tank gun.

6.4.3 Fuze Functioning

Examine the recorded data and evaluate the capability of the test item's fuze to function during use in an arctic environment.

6.4.4 Obscuration and Sensing

Reduce data from observers and evaluate how well the tank commander and gunner can sense the rounds fired under the effects of smoke, flash, blast, ice fog and blowing snow in an arctic environment.

6.4.5 Dispersion

Examine the recorded data and evaluate the dispersion of the test ammunition during use in an arctic environment.

6.4.6 Ammunition Functioning

Examine the recorded data and evaluate how well the ammunition functions in an arctic environment.

6.4.7 Human Factors

Human factors data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.8 Safety

Safety data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.9 Maintenance Evaluation

Maintenance data shall be reduced and presented in accordance with MTP 10-4-500.

6.4.10 Reliability

Reliability data shall be reduced and presented in accordance with MTP 10-4-500.

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

1. ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP ----------

3. REPORT TITLE
U. S. Army Test and Evaluation Command Materiel Test Procedure 4-4-009, Environmental Test Procedure, _ "Arctic Environmental Test of Tank Ammunition".

4. DESCRIPTIVE NOTES (Type of report and, inclusive dates)
Final

5. AUTHOR(S) (First name, middle initial, last name)
----

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
31 July 1970	14	23

8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
DA-18-001-AMC-1045(R) b. PROJECT NO AMCR 310-6 c. d.	MTP 4-4-009 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ----------

10. DISTRIBUTION STATEMENT
This document is subject to special export controls and each transmittal to foreign governments or foreign nationals,-WITH THE EXCEPTION OF AUSTRALIA, CANADA, AND UNITED KINGDOM,-may be made only with prior approval of HQ,USATECOM.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
----------	Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005

13. ABSTRACT

This Environmental Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Tank Ammunition under Arctic winter conditions. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.

DD FORM 1 NOV 65 1473 (PAGE 1)
S/N 0101-807-6811

UNCLASSIFIED
Security Classification

KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Environmental Test						
Arctic Winter Environmental Test						
Tank Ammunition						
Test Procedures						
Test Methods and Techniques						

DD FORM 1 NOV 65 1473 (BACK)