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## AUTHORITY

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26 November 1969

Materiel Test Procedure 4-4-005
U. S. Army Arctic Test Center

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

# ARCTIC ENVIRONMENTAL TEST OF GRENADES AND GRENADE TYPE AMMUNITION

## 1. OBJECTIVE

The objective of this procedure as outlined in this MTP is to provide a means of evaluating the performance of grenades and grenade type ammunition under arctic winter environmental conditions.

## 2. BACKGROUND

Engineering tests of weapons are conducted to determine the characteristics and performance of the weapons under various conditions of operation, and to ensure their compliance with specified requirements. Testing in a natural arctic winter environment is used to substantiate or supplement data obtained from simulated tests conducted during the Engineer Design and Engineering Test phase. Testing in the arctic winter environment generally is not authorized until data from simulated environmental tests provides reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the arctic.

## 3. REQUIRED EQUIPMENT

a. Appropriate arctic winter uniform and individual field gear.
b. Weapons as required.
c. Ammunition as required.
d. Standard American targets.
e. Vehicles as required.
f. Support aircraft.
g. M1950 Parachutists individual weapons containers (or latest standard containers).
h. Drop zone.
i. All general and special tools and ancillary items required to perform maintenance on the test item.
j. Test equipment as required.
k. Shot group computer.
l. Suitable timing device.
m. Photographic equipment (black and white or color).
n. Meteorological support instrumentation.

## 4. REFERENCES

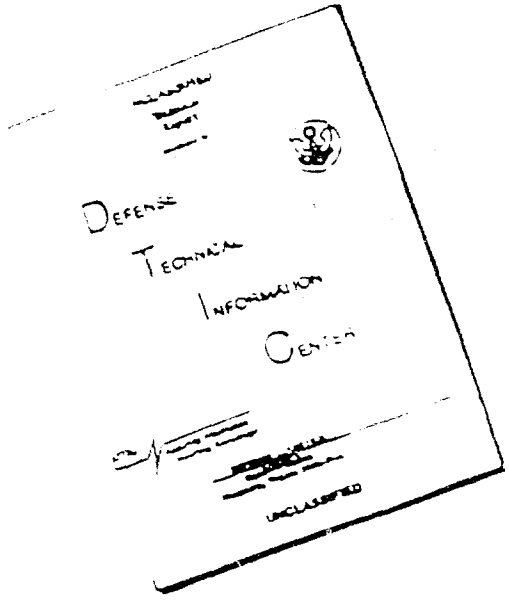
A. AR 70-8, Human Factors and Social Sciences Research.
B. AR 70-10, Army Materiel Testing.
C. AR 705-5, Army Research and Development.
D. AR 705-15, Operations of Materiel Under Extreme Conditions of Environment.
E. AR 750-6, Maintenance Support Planning.

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F. AR 700-1300-8, Malfunctions Involving Ammunition and Explosives.
G. AMCR 385-12, Verification of Safety of Materiel From Development Through Testing, Production, and Supply to Disposition.
H. AMCR 385-224, AMC Safety Manual.
I. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
J. USATECOM Regulation 385-8, Training of Test Personnel.
K. USATECOM Regulation 705-2, Documenting, Test Plans and Reports.
L. TM 9-855, Targets, Target Materiel, and Training Course Lay-Outs.
M. MTP 3-4-005, Arctic Environmental Test of Grenade Launchers.
N. MTP 4-2-813, Arena Tests of High-Explosive Fragmentation Munitions.
O. MTP 10-4-500, Arctic Environmental Testing, Preoperational Inspection, Physical Characteristics, Human Factors, Safety and Maintenance Evaluation.

## 5. SCOPE

### 5.1 SUMMARY

The procedures outlined in this MTP are designed to determine and evaluate the functioning characteristics of grenades and grenade type ammunition under arctic winter conditions.

The specific tests to be performed and their intended objectives are listed below:

a. Preoperational Inspection and Physical Characteristics - The objective of this subtest is to determine:

1) If the test and comparison items are in proper condition for testing.
2) If the test item's physical characteristics conform to applicable criteria.

b. Firing - The objective of this subtest is to determine the firing accuracy of the test items under arctic winter conditions.

c. Fragmentation - The objective of this subtest is to determine the effects of a detonation and a fragmentation pattern. Determine the duration and distance by which the test smoke grenade type ammunition can be seen by ground observers and aircraft under arctic winter environmental conditions.

d. Position Disclosing Effect - The objective of this subtest is to determine and measure the position disclosing effect created by the cumulative smoke and muzzle flash and sound produced by the test item under arctic environmental conditions.

e. Functional and Operational Suitability - The objective of this subtest is to determine the ease of carrying and transporting the test items cross-country and over ski trails while wearing snowshoes and skis, also the effects of transporting test items over cross-country trails and secondary roads in wheeled and tracked vehicles.

f. Aerial Delivery - The objective of this subtest is to determine the suitability of the test item for Phase I airborne operations under arctic environmental conditions.

g. Human Factors Evaluation and Safety - The objective of this subtest is to determine if the test items enable safe and easy operation by test crews wearing the appropriate arctic winter uniform.

h. Maintenance Evaluation - The objective of this subtest is to determine if the test item meets maintenance and maintainability requirements as defined by QMR, SDR, TC, MC or other established criteria under arctic winter environmental conditions.

5.2 LIMITATIONS

The procedures described in this MTP are limited to the testing of grenades and grenade type ammunition under arctic winter environmental conditions. Procedures for testing grenade launchers are described in MTP 3-4-005.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Since arctic winter environmental tests are normally scheduled from October through March (6 months), ensure that test items, test comparison and support weapons are delivered to the Arctic Test Center prior to 1 October.

b. TDY personnel shall be used to augment assigned personnel and shall be trained to the degree that they are as proficient on the items as the troops who will use the item.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test, such as stipulated in Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), and Technical Characteristics (TC), and record this criteria in the test plan.

d. Review all instructional material issued with the test item by the manufacturer, contractor, or government, as well as reports of previous tests conducted on the same types of equipment, and familiarize all test personnel available for reference.

e. Record the grade, MOS, background, and training of all test personnel and ensure that all personnel receive new equipment training (NET) as required.

f. Record the following information:

1) Nomenclature, serial number(s), and manufacturer's name of the test items.
2) Nomenclature, serial number(s), accuracy tolerances, calibration requirements, and last date calibrated of the test equipment selected for the tests.

g. Select test equipment ideally having an accuracy 10 times greater than that of the function to be measured.

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

i. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout

the test. MTP 3-2-504, Safety Evaluation-Hand and Shoulder Weapons must be completed.

j. Outfit grenadiers in appropriate arctic winter clothing as described in MTP 10-4-500, and with individual combat equipment, during all weapon testing.

k. Ensure that when not in use, all test weapons, control weapons and ammunition are stored and maintained in an unsheltered area and exposed to ambient air temperature and prevailing weather conditions.

l. Record the prevailing meterological conditions during the storage phase, as well as 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

6.2 TEST CONDUCT

NOTE: When conducting individual weapon test involving several subjects, samples and conditions i.e., range, temperature position, etc., a "Latin Square" or comparable test design procedure will be imposed to assure a representative distribution of variables and minimum biasing.

6.2.1 Preoperational Inspection and Physcial Characteristics

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

6.2.2 Firing Tests

6.2.2.1 Known Distance Accuracy

6.2.2.1.1 Rifle and/or Launcher

a. Cold soak all support weapons for at least 24 hours.

b. Install standard grenade targets at ranges of 100, 200, and 400 meters.

c. Order five grenadiers, to zero rifle attached launchers at a maximum range of 200 meters with the launcher attached and empty. Record any difficulties encountered.

d. Fire three (3) 10-round groups (20 rounds desirable) with the launchers loaded. Note and record the effects of launcher attachment on the zero of the rifle.

e. Re-zero the rifle attached launchers at 200 meters.

f. Fire each rifle 40 rounds semi-automatic and 40 rounds automatic at 200 meters. Note and record the effects of rifle firing on the zero of the launcher.

g. Five test grenadiers shall each fire three (3) 10 round groups (20 rounds desirable) of rifle and/or launcher grenades in accordance with Table I.

Table I Known Distance Accuracy

| Range-to-Target | Shots | Times Conducted | Position | Time |
|---|---|---|---|---|
| 100 meters | 10 | 3 | Supported | No Limit |
| 200 meters | 10 | 3 | Supported | No Limit |
| 400 meters | 10 | 3 | Supported | No Limit |
| Other ranges as directed | 10 | 3 | Supported | No Limit |
| 100 meters | 10 | 3 | Prone | No Limit |
| 200 meters | 10 | 3 | Prone | No Limit |
| 400 meters | 10 | 3 | Prone | No Limit |
| Other ranges as directed | 10 | 3 | Prone | No Limit |
| 100 meters | 10 | 3 | Kneeling | No Limit |
| 200 meters | 10 | 3 | Kneeling | No Limit |
| 400 meters | 10 | 3 | Kneeling | No Limit |
| Other ranges as directed | 10 | 3 | Kneeling | No Limit |
| 100 meters | 10 | 3 | Standing | No Limit |
| 200 meters | 10 | 3 | Standing | No Limit |
| 400 meters | 10 | 3 | Standing | No Limit |
| Other ranges as directed | 10 | 3 | Standing | No Limit |
| 100 meters | 10 | 3 | Other Positions As Directed | No Limit |
| 200 meters | 10 | 3 | | No Limit |
| 400 meters | 10 | 3 | | No Limit |
| Other ranges as directed | 10 | 3 | | No Limit |

NOTE: MTP 3-4-005, Arctic Environmental Test of Grenades Launchers, Rifle Grenades indicates the accuracy and suitability of the launcher and rifle attached launcher.

h. Record the following data:

1) Ambient air temperatures at time of firing.
2) Wind velocity and relative direction to launcher during firing.
3) Center of impact.

4) Mean radius.
5) Maximum vertical spread.
6) Maximum horizontal spread.
7) Maximum spread.
8) Weapon malfunction.
9) Number of rounds fired through each weapon.
10) Adequacy of sights.
11) Effect on zero setting of rifle.

i. Conduct the above subtest at ambient air temperatures of 0°F to -25°F, -25°F to -45°F, and -45°F to the lowest available temperature.

6.2.2.1.2 Hand Grenade

a. Cold soak all test and comparison items for at least 24 hours.
b. Inspect each item for loose, damaged or missing parts, observe safety procedures.
c. Each of five test grenadiers shall throw dummy test items on a hand grenade course, consisting of foxholes, craters and vertical targets, ranging from 15 to 35 meters, or as directed by the test plan.
d. Each of the test grenadiers shall throw five dummy test items at each type target while wearing the arctic mittens, trigger-finger mittens, and the shell leather gloves.
e. Comparison items shall also be tested in the above manner.
f. Note and record the effects of the test and test comparison items.
g. Record any difficulties encountered.
h. Record the following data:

1) Ambient air temperatures during test.
2) Accuracy of each throw while wearing arctic mittens, trigger-finger mittens and shell leather gloves.
3) Difficulties encountered with the arctic mittens, trigger-finger mittens and shell leather gloves.
4) Wind velocity and relative direction in relation to the grenadier.

i. Conduct this phase of the subtest as described in paragraph 6.2.2.1.1, i.

6.2.2.2 Rapid Fire Employment

a. Cold soak all test and comparison items for at least 24 hours.
b. Install standard grenade silhouette targets at a range of 250 meters.
c. Place grenadiers on firing line in standing position with the launcher loaded.

NOTE: Grenadiers should be wearing the arctic mitten set (consisting of trigger-finger mittens and shell leather gloves).

d. Order grenadiers to assume the prone position (kneeling position for rifle grenades) and fire 10 test items as rapidly as possible, commensurate with good firing techniques.

e. Time the firing exercise from the instant the order is given until the last item is fired.

f. Repeat above firing sequence until five grenadiers, wearing individual combat equipment, have fired the test and comparison weapons.

g. Record the following data:

1) Ambient air temperatures.
2) Wind velocity and relative direction to launcher during firing.
3) Center of impact.
4) Mean radius.
5) Maximum vertical spread.
6) Timed results of each rapid fire exercise.
7) Maximum horizontal spread.
8) Maximum spread.
9) Any diffficulty encountered.

h. Conduct this phase of the test in temperatures of -10°F to the lowest available temperature.

6.2.3 Fragmentation

6.2.3.1 Hand Grenade Type Ammunition

a. Cold soak all test and comparison weapons for at least 24 hours.

b. Erect a fragmentation course, as determined by the test requirements, consisting of a metal pole, with four circles of type E, F, and M targets surrounding the pole, as described in Appendix A (see reference M for description of targets).

c. The diameters of the circles shall be 5 meters, 10 meters, 15 meters and 20 meters, unless otherwise specified by the test directive.

NOTE: Throughout this subtest the test and comparison weapons shall be subjected to the same test procedures.

d. Attach the test item to the pole with a pull wire attached to the pull ring of the hand grenade.

e. The test item shall be detonated by pulling the pull wire, allowing the test item to fall to the ground and detonate in the center of the circles.

f. A minimum of five test items shall be detonated at ambient air temperature of 0°F to -25°F,-25°F to -45°F, and 45°F to the lowest available temperature.

g. The above exercises shall be repeated using the comparison items.

h. Record the following data:

1) Ambient air temperature
2) Depth and type of snow
3) Targets hit and number of hits per target with each detonation
4) Malfunctions
5) Height of grenade release

6.2.3.2 Rifle and Grenade Launcher Type Ammunition

a. Cold soak all test and comparison weapons for at least 24 hours.

b. Erect a fragmentation course, as determined by the test requirements, simulating a squad column, modified with E, F and M targets, as described in Appendix B.

c. The squad member targets shall be a minimum of 4 meters apart and a minimum of 10 meters from the squad leader target.

d. Five test soldiers shall fire the test items at the squad leader target, as outlined in paragraph 6.2.2.1.1,d.

e. A minimum of five test items will be launched in each ambient air temperature range of 0°F to -25°F,-25°F to -45°F and 45°F to the lowest available temperature.

f. The above exercises shall be repeated using the comparison items.

g. The above subtest is applicable to either rifle or grenade launchers.

h. Record the following data:

1) Ambient air temperatures
2) Targets hit and number of hits per target
3) Distance between point of detonation and squad leader target
4) Depth and type of snow

6.2.3.3 Smoke Grenade Type Ammunition

a. Cold soak all test and comparison weapons for at least 24 hours.

b. Five test items shall be ignited to obtain the average time from the time of ignition to the time of termination of smoke from the grenade.

c. Groups of one, two and three test items shall be ignited in a cleared area.

d. Aircraft shall fly over the test area at an altitude predetermined by the test plan.

e. Ground observers shall observe smoke produced from the grenade.

f. The above exercises shall be repeated using comparison items.

g. Each phase of this subtest shall be conducted at ambient air temperatures of 0°F to -25°F, -25°F to -45°F, and -45°F to the lowest available temperature.

h. Record the following data:

1) Elapsed time of each test and comparison smoke grenade.
2) Average time of smoke duration for test and comparison ammunition.
3) Distance of visual observation between ground and aircraft observers of the smoke produced from the test and comparison ammunition.
4) Ambient air temperatures at test site.
5) Air conditions (i.e. clouds, ice, fog, etc).
6) Malfunctions of items.

6.2.4 Position Disclosing Effects

a. Cold soak all test and comparison weapons for at least 24 hours.

b. Mount cameras perpendicular to the muzzles of the weapon at a sufficient distance to photograph all the smoke and flash.

c. Position an observer behind each weapon and down range at distance of 100, 200, 300, 400, 500 and 600 meters.

d. Order soldiers to fire the weapon at ranges as directed, under nighttime conditions.

e. Photograph the cumulative flash from each weapon.

f. Record the following:

1) Smoke and flash effects at firer position.
2) Sound, smoke, and flash effects visible to the observers at indicated ranges.
3) Annotations to the photographs of cumulative flash with regard to variations of flash during the firing.
4) Ambient air temperature at test site.
5) Light conditions (daylight or darkness).

g. Repeat steps (c) through (f) above, under daytime conditions, without photographing the cumulative flash.

h. This subtest shall be conducted in temperatures of 0°F to the lowest available temperature.

6.2.5 Functional and Operational Suitability

6.2.5.1 Portability and Transportability

a. Cold soak all test and comparison weapons for at least 24 hours.

b. Inspect each weapon for loose, damaged or missing parts and place in the best possible serviceable condition, observe safety rules.

c. Place each item in the standard individual containers where provided if no container is available, appropriate methods shall be developed.

d. Test personnel with individual field gear shall carry the test items over the following courses:

1) Snowshoe 3 miles through dense, snow-covered brush.
2) Snowshoe 5 miles over open snow-covered (cross-country) terrain.
3) Ski 10 miles over cross-country ski trails.

e. Transport the test items a minimum of 50 miles through a maximum of 200 miles over cross-country trails in track vehicles, and 50 miles minimum up to 200 miles maximum over secondary roads in wheeled vehicles.

f. Upon completion of the above exercise, all items shall be inspected for damage.

g. Record the following:

1) Damage attributed to environmental effects.
2) Problems encountered while transporting items.
3) Damage to items due to handling and transport.
4) Temperature at test site.

NOTE: A random sample of the test items shall be selected and tested to determine system performance as applicable.

h. Conduct this subtest at temperatures ranging 0°F to the lowest available temperature.

6.2.5.2 Hand Grenade

a. Cold soak all test and comparison items for at least 24 hours.

b. Attach the test and comparison item to a steel pole with a pull wire attached to the pull ring.

c. The pull wire shall be pulled, releasing the grenade and igniting the delay charge.

d. Measure and record the time between the release of the grenade to the time of detonation.

e. The time shall be measured by three observers, each using a 3-second sweep-stopwatch.

f. Alternate the control items with the test items until an efficient statistical matrix can be established.

g. Conduct this subtest at temperatures of 0°F to -25°F, -25°F to -45°F and -45°F below.

h. Record the following data:

1) Ambient air temperature.
2) Minimum, maximum and average delay of the fuze action.
3) Malfunctions of the test and control item.

6.2.6 Aerial Delivery

a. Cold soak all test and comparison weapons for at least 24 hours

NOTE: Approved or draft TM's shall be used as a guide for this subtest.

b. Inspect the test and comparison items before and after each jump for damage.

c. Subject all test and comparison items to a minimum of three parachute jumps under the following conditions:

1) Each parachutist shall be equipped with standard equipment and shall jump in accordance with latest TM's.
2) Each item shall be packed in an M 1950, Parachutists

Adjustable Individual Container (or latest standard container) and attached to the parachutist's person as prescribed in appropriate TM's.

3) All items shall be inspected before and after each item for damage and proper functioning.

d. Record the following data for each jump:

1) Altitude and speed of delivery aircraft.
2) Ambient air temperature.
3) Results of inspections.
4) Malfunctions of test and comparison items.
5) Methods used for attachment of test items to parachutists.
6) Compatibility with parachute equipment.

6.2.7 Human Factors Evaluation and Safety

a. Conduct all Human Factors and Safety Tests in accordance with the applicable sections of MTP 10-4-500.

b. Conduct these tests concurrently with the operational tests (Firing, Position Disclosure, Functional and Operational Suitability and Aerial Delivery), described in this MTP.

6.2.8 Maintenance Evaluation

a. Conduct all maintenance evaluation tests (maintenance and reliability) in accordance with applicable sections of MTP 10-4-500.

b. Conduct these tests concurrently with the operational tests (Firing, Position Disclosure, Functional and Operational Suitability and Aerial Delivery), described in this MTP.

6.3 TEST DATA

All test data to be recorded will be as specified in the individual subtests of 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 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 Firing Tests

Compare mean radius, percentage of hits, accuracy of each throw, and cyclic rate of fire to weapon specifications for possible deviations due to effects of arctic winter environmental conditions.

6.4.3 Fragmentation

Each detonation of the test item should be recorded by recovery, zone number, as described in MTP 4-2-813, Arena Tests of High-Explosive Fragmentation Munitions.

6.4.4 Position Disclosing Effect

Compare data obtained from the test item to the data obtained from the comparison item and also against accepted military standards.

6.4.5 Functional and Operational Suitability - Portability.

The operation of the grenade under test in extreme arctic winter conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to the weapons attributed to environmental effects or handling shall be compared with weapon specifications contained in appropriate QMR's and TC's.

6.4.6 Aerial Delivery

The suitability of the item under test for airborne operations under arctic winter environmental conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to and/or malfunctions of the items attributed to parachute jumps or environmental effects shall be compared with item specifications contained in appropriate QMR's and TC's.

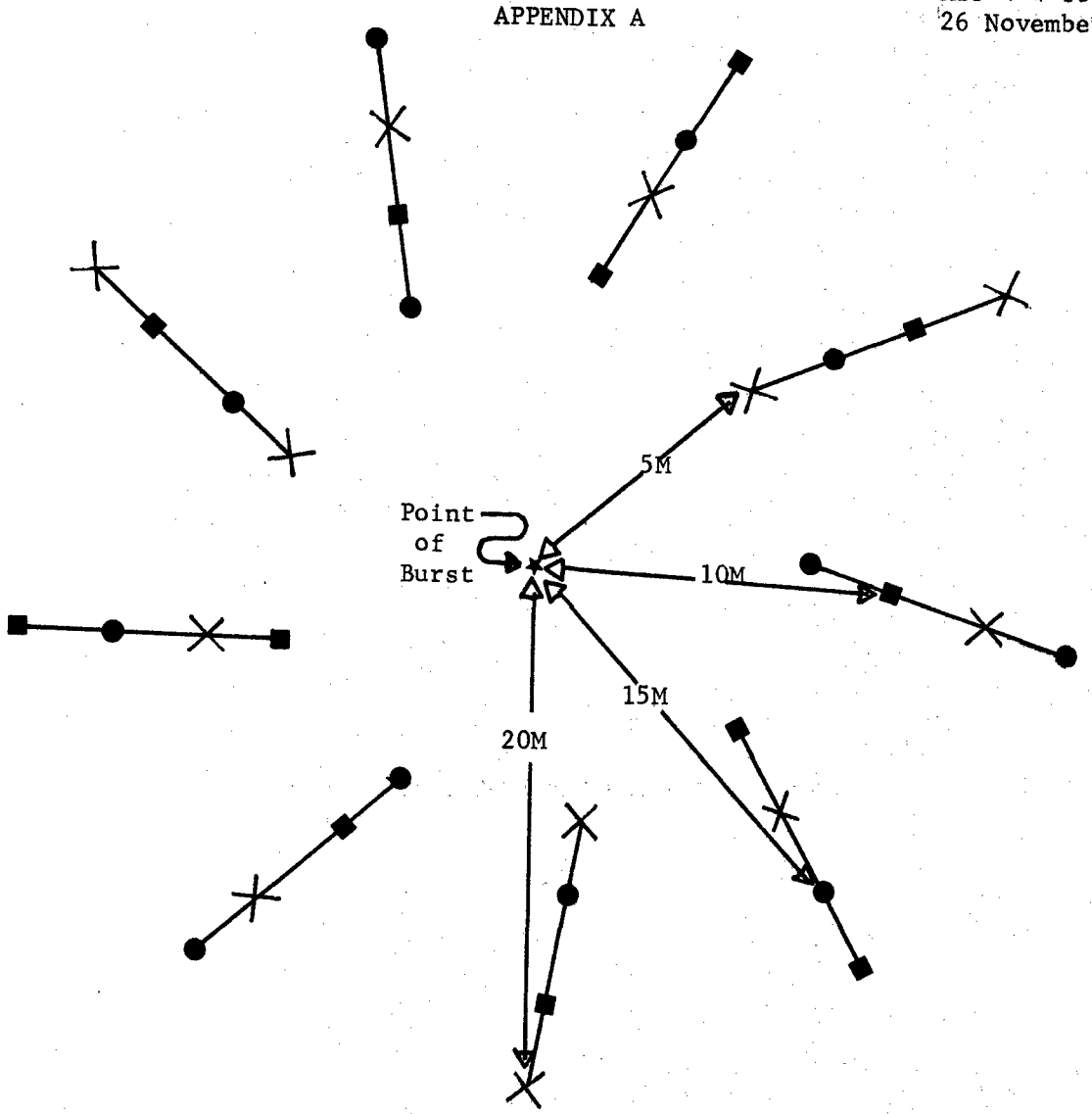
6.4.7 Human Factors Evaluation and Safety

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

6.4.8 Maintenance Evaluation

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

APPENDIX A



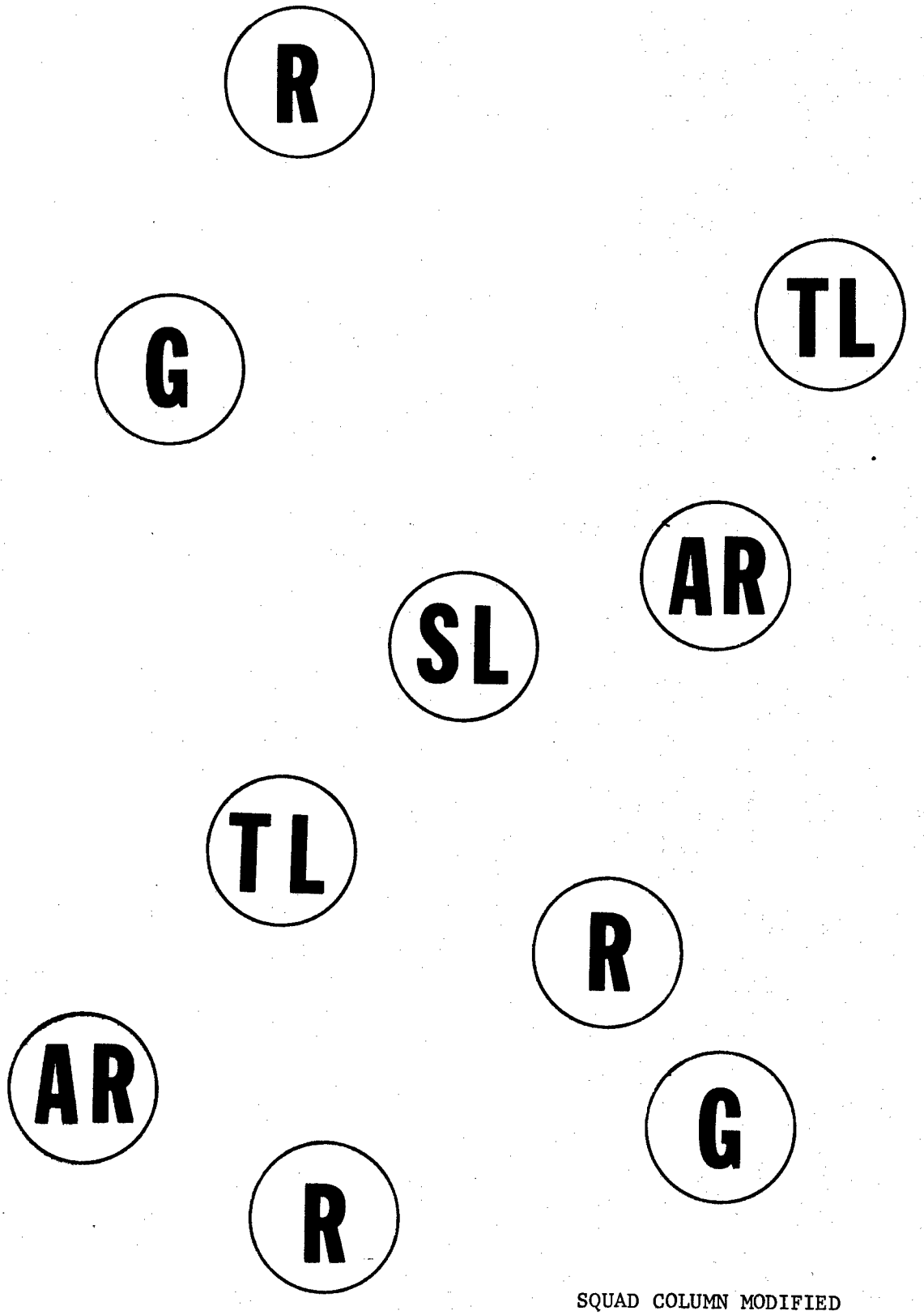

- STANDING SILHOUETTE TARGET

-- KNEELING SILHOUETTE TARGET

- PRONE SILHOUETTE TARGET

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APPENDIX B




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13. ABSTRACT

This Environmental Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Grenades and Grenade Type Ammunition under arctic winter conditions. Evaluation is related to the criteria established by Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other design requirements or specifications.

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| 14 KEY WORDS | LINK A | | LINK B | | LINK C | |
|---|---|---|---|---|---|---|
| | ROLE | WT | ROLE | WT | ROLE | WT |
| Environmental Test | | | | | | |
| Arctic Winter Environmental Test | | | | | | |
| Grenades and Grenade Type Ammunition | | | | | | |
| Test Procedures | | | | | | |
| Test Methods and Techniques | | | | | | |