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Covers procedures of testing of unguided tank and anti-tank weapons in basic cold, cold, and extreme cold (C1, C2, C3) environments as defined in AR 70-38. Includes boresight and zero, dispersion, jump firing, target engagement, tracking and hit performance, obscuration, human factors, maintenance evaluation, reliability, and safety.

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

DRSTE-RP-702-109
Test Operations Procedure 3-4-010* 1 April 1983
AD No. A130255

COLD REGIONS ENVIRONMENTAL TEST OF DIRECT FIRE UNGUIDED (BALLISTIC) WEAPONS (TANK AND ANTI-TANK WEAPONS)

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1. SCOPE. The procedures outlined in this TOP provide a means of evaluating the performance, safety, human factors engineering, maintainability and reliability aspects of direct fire unguided (ballistic) weapons (tank and anti-tank weapons) tested under cold regions winter environmental conditions. This TOP is limited to testing applicable to armament of tanks or vehicles with a tank-type configuration.

*This TOP supersedes MTP 3-4-010, dated 4 August 1970.

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Throughout this TOP, the term weapon system includes all principal types of weapons systems found on tanks and anti-tank weapons.

The outlines of test in this TOP are not intended to constitute detailed test plans. The test activity must make their own judgement as to the applicability of each test and must determine how best to obtain the required data for each weapon system undergoing test. Requirements found in requirement documents may necessitate the conduct of tests not found in this TOP. In that case, other TOP's or similar guidance will be used in formulating test plans.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

Item	Requirement
Range Firing Area	To provide safe firing areas adequate for the type and caliber of the test weapon.
Camber Adapter or V-Block Mount	To facilitate mounting of reference telescope.
Grid Board	Panel with grid spacing marked to facilitate location of gun-aiming point to within ±0.1 mil for the distance employed from weapon.
Muzzle Boresight Device	To provide accurate reference between centerline of weapon bore and aiming point.

2.2 Instrumentation.

Item	Requirement
Gunsight Camera (Video)	To record sight picture at time of firing.
Gun Tube (Bore) Camera (Video)	To record position of bore of weapon at time of firing.
Reference Telescope	To facilitate location of gun-aiming point to ±0.1 mil.
Video Camera with Telephoto Lens	To facilitate observation of round strike from control tower.
Scratch Gauge	To measure recoil of weapon system to ±0.25 cm (±0.1) inch.

3. PREPARATION FOR TEST

3.1 Since cold regions environmental tests are normally scheduled from October through March (6 months), ensure that the test items are delivered to the Center prior to 15 October.

3.2 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.

3.3 Ensure that all test personnel are familiar with required technical and operational characteristics of the test item, such as stipulated in requirement documents and record the criteria in the test plan.

3.4 Ensure that all personnel receive New Equipment Training (NET).

3.5 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.

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

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

3.8 Prepare adequate safety precautions to provide safety for personnel and equipment (TOP 3-2-805, ref 1, appendix C).

3.9 Outfit all personnel in appropriate cold-dry uniform as described in appendix D.

3.10 Record the prevailing meteorological conditions during test conduct, to include:

a. Temperature
b. Humidity, relative or absolute
c. Temperature gradient (horizontal)
d. Atmospheric pressure
e. Precipitation
f. Solar Radiation
g. Windspeed and direction
h. Frequency of readings
i. Source of data
j. Light conditions

3.11 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 TOP. Any delay in the test schedule will be reported to TECOM HQ and a revised schedule requested. The test schedule will reflect an estimate of testing time required for each subtest.

3.12 Assigned personnel will prepare the plan of test, supervise and conduct the test, gather test data, and report the results of the test.

3.13 Upon receipt, carefully inspect all test and support items and their shipping and/or packaging containers for completeness, damage, and general conditions in accordance with MTP 10-4-500 (para 6.2.1) (ref 2, appendix C).

3.14 Winterize/service as required to include borescope and gauging.

4. TEST CONTROLS

4.1 Insure that instrumentation requiring calibration has been calibrated recently enough to permit completion of testing before recalibration is necessary.

4.2 Insure test personnel, maintenance personnel, crewmembers, and evaluators are technically proficient with the specific item being tested.

4.3 Insure data is collated daily to insure completeness and validity to preclude inadequate or missing data being discovered after testing is complete.

5. PERFORMANCE TESTS

5.1 Boresight and Zero

5.1.1 Main Armament

a. Position a target with a clearly defined aiming point, as applicable.

b. Use a 5.4 x 5.4 meters (18- x 18-foot) grid board as a reference.

c. Operate the vertical and horizontal adjustments of the boresight on all sighting systems before and after boresighting and zeroing.

d. Boresight main armament and fire control on a target at the range prescribed in appropriate technical manuals.

e. Make boresight retention checks periodically during the conduct of all tests after each 480 km (300 miles) of durability and after each firing exercise in accordance with TOP 1-2-502 (ref 3, appendix C). Also check boresight if temperature changes 14 celsius degrees (25F°) or more during the course of any subtest.

f. Zero or check the weapon in accordance with applicable technical manuals.

g. Check the main armament and fire control for control zero retention during and after firing tests by firing a check round.

h. Measure the turret temperature of the main armament before and after the crew compartment heater(s) are operated in accordance with TOP 2-2-708 (ref 4, appendix C). Also record temperature of ammunition by type and location.

i. Perform alignment checks of the sighting system prior to the operation of the crew compartment heater(s).

j. Operate the crew compartment heater(s) for 1 hour.

k. Perform alignment checks of the sighting system after the operation of the crew compartment heater(s).

l. Conduct a series of boresight trials using randomly selected crew personnel.

m. Adjust and note the clarity of the reticle pattern of the sighting system to coincide with the crosshairs against a cold region winter background.

5.1.2 Coaxial Machine Gun and Cupola Machine Gun

a. Position targets with clearly defined aiming points, as applicable.

b. Use a 5.4 x 5.4 meters (18- x 18-foot) grid board as a reference.

c. Operate the vertical horizontal adjustments of the sight on all sighting systems before and after boresighting and zeroing.

d. Boresight the weapon at the range prescribed in the appropriate technical manuals and in accordance with TOP 3-2-604 (ref 5, appendix C).

e. Zero weapons IAW appropriate technical manual.

f. Observe the clarity of sight reticles against cold regions winter background.

g. Measure the vertical and horizontal limits of movement of the sight adjustment for all sights after zeroing.

h. Check the weapon sights during and after firing for correct zero retention by firing a confirming burst.

i. Conduct a series of boresight trials using randomly selected crew personnel.

5.2 Round-to-Round Dispersion

5.2.1 Fire the main armament of the vehicle during this subtest.

5.2.2 Place targets at 500-meter intervals over a surveyed range (1000 to 2000 meters).

5.2.3 Compute hit probability on the basis of a 2¼ x 2¼ meter (7½- x 7½-foot) target.

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

5.2.5 Fire one 10-round shot group of each ammunition type at each surveyed range during daylight and darkness under -18°C to -32°C (0°F to -25°F) and -32°C (-26°F) to the lowest available ambient air temperature.

NOTE: 1. In the event insufficient ammunition is available to fire 10-round shot groups, 5-round shot groups may be used.

2. In no case shall the number of rounds in a group be less than five.

5.2.6 Determine the hit characteristics of the weapon as closely as possible in accordance with the idealized conditions specified in TOP 4-2-829 (ref 6, appendix C).

a. The weapon shall be re-layed on the aiming point prior to firing each round as precisely as possible. Backlash effects shall be minimized by always relaying in the same direction; left to right or right to left, and down to up. A parallax shield (disk containing a small circular aperture) may be placed over the eyepiece of the sighting device.

b. A selected well-trained gunner will lay the weapon.

c. The primary sighting system shall be used.

d. Laying will be precise and backlash shall be controlled. Targets shall be large enough 5.4 x 5.4 meters (18 feet x 18 feet) for collection of projectile strike information and shall have a distinct aiming point in the center.

e. Target ranges will be surveyed.

f. When gun is laid on aiming point, elevation will be as close to zero degrees as possible.

g. The test vehicle with brakes set shall be positioned on a level surface. (Snow and ice shall be removed from the firing pad to prevent vehicle slippage during firing).

h. The gun tube shall be within prescribed condemnation limits.

i. The weapon shall be zeroed. After zeroing, the test vehicle shall not be moved. (The first test round shall be fired within 30 minutes after zeroing to minimize the effects of ground weather changes).

j. Projectiles of a given shot group shall be of the same ammunition lot.

k. When firing over prolonged intervals with rapid changes in ambient weather conditions the following precautions shall be taken to ensure accurate data.

(1). The wind velocity shall be as near zero as possible.

(2) The strike of each round shall be sensed by an observer in the firing control tower.

(3) Targets shall be stretched as tight as possible on the target frame, if cloth targets are used.

(4) The point of strike of each round on the target shall be measured from the center of the point of aim.

(5) The direction to the zeroing and test targets shall be as nearly the same as possible.

(6) Prior to firing each round, the tank crew shall measure and report the gunners quadrant reading of the gun.

5.3 Jump Firing

Conduct Jump Firing in accordance with TOP 3-2-817 (ref 7, appendix C). Firing should be conducted in two bands -18 to -32°C (0°F to -25°F) and -32°C (-26°F) to the lowest available ambient air temperature.

5.4 Tactical Target Engagement

5.4.1 Prepare stationary targets consisting of:

a. 2¼ x 2¼ meters (7½- x 7½-foot) cloth targets

b. Salvage military vehicles

5.4.2 Identify each target by painting an identifing number on it.

5.4.3 Set targets at ranges varying from 500-meters to maximum effective range of the weapon.

5.4.4 Ensure that a sufficient number of targets are available.

5.4.5 Measure the range, as obtained by the test item sighting on the targets.

5.4.6 Zero the main armament weapon prior to the initiation of the test, as described in appropriate technical manuals.

5.4.7 Transport the weapon 8 km (5 miles) cross-country on vehicles as specified by the test criteria.

5.4.8 Return the vehicle to the firing range.

5.4.9 Use two experienced gunnery crews to engage a minimum of 10 targets each.

Note: Firing shall be conducted in ambient air temperatures of -18 to -32°C (0°F to -25°F) and -32°C (-26°F) and below.

5.4.10 Order the crew to fire three rounds at each target or until the target is hit, whichever is the smaller number of rounds.

5.4.11 Utilize reduced visibility sights to perform a minimum of 25-percent of the engagements, if applicable (i.e. infrared, thermal etc.).

5.4.12 Two target engagements shall be performed by the vehicle commander if the vehicle is provided with controls the commander can use at his position.

5.4.13 Fire the weapon from the vehicle in the following positions:

a. Simulated tactical firing positions other than concrete firing pads.

b. Canted both laterally and longitudinally during two engagements.

c. If possible, from a hull defilade position during two engagements.

5.4.14 Utilize the following firing procedures during the conduct of this subtest:

a. The vehicle shall be placed in the selected firing position with the weapon unloaded and the fire control system indexed to battlesight (if applicable). The tank commander shall then announce "READY" to the project officer.

b. The turret shall be rotated away from the target to be engaged by approximately 500 mils.

c. The project officer shall designate a target to the vehicle commander and indicate what type of target it represents.

d. When the commander identifies the target he shall announce "GUNNER" and give a proper fire command while traversing the turret with his override control so that the gunner may identify the target in his sight. Time shall be measured from the command "GUNNER" until the first projectile lands near or strikes the target.

e. If the first round misses the target, the burst-on-target technique shall be used to fire up to two additional rounds. If the gunner cannot sense the strike of the projectile, the subsequent range change technique shall be used. After the target is hit or a total of three rounds is fired, the project officer shall announce "CEASE FIRE".

f. The time required to fire subsequent rounds shall be measured. The time interval shall be measured from the time the previous round is fired until the next round is fired.

g. Each round shall be sensed by an observer in the control tower utilizing a spotting scope. Target strike information shall be recorded. If possible, telephoto equipped video cameras will be used in lieu of an observer and spotting scope.

h. This procedure shll be continued until a total of 10 targets have been engaged. The secondary sight shall be used during two engagements.

5.5 Tracking and Hitting Performance. Conduct this subtest in temperature ranges -18 to -32°C (0°F to -25°F) and -32°C (-26°F) to the lowest available ambient air temperature. If time and the supply of ammunition permit, both nonfiring and live firing tracking exercises shall be conducted with two different gunners. Extreme caution must be exercised during the live firing exercises to prevent accidents. Firing will utilize both daylight and low light level sighting systems. Firing vehicle speeds will be governed by requirement/ capability documents for the specific test vehicle. Target speeds will be adjusted to test the capability of the system according to its design and intended use.

a. Conduct this subtest in accordance with applicable sections of TOP 3-2-603 (ref 8, appendix C) and TOP 3-2-605 (ref 9, appendixC).

b. Mount the tracking cameras on the gun sight and gun tube.

c. Activate the tracking cameras during the tracking exercises and take photographs (video tape).

d. Where applicable, ensure proper performance of related mechanisms involving:

(1) Turret power control

(2) Ballistic mechanism as described in TOP 3-2-700 (ref 10, appendix C).

(3) Boresight accuracy

(4) Sight parallelogram errors as described in TOP 3-2-701 (ref 11, appendix C), if applicable.

5.5.1 Stationary Vehicle

a. Park the vehicle with the test system on a level surface.

b. Erect 2¼ x 2¼ meters (7½- x 7½-foot) moving targets over the expected range of engagement. Large targets may be necessary at extreme ranges to assist in round capture.

c. Vary the speed of the targets for non-firing tracking exercises.

d. During the non-firing exercises track the targets by both the manual mode and power mode, if applicable, left to right and right to left.

e. Load the test weapon with ammunition as applicable.

f. Conduct live firing exercises at ranges indicated by requirements.

g. Engage targets moving left to right and right to left.

h. Vary the speed of the targets at each range, if possible.

i. Engage the targets as applicable. If the first round misses the target, one additional round may be fired using the burst-on-target technique.

5.5.2 Moving Vehicle - Stationary Target

a. Conduct this subtest if the vehicle is equipped with a gun stabilization system.

b. Conduct this subtest on smooth terrain of a figure eight course at various speeds.

c. Position stationary 2¼ x 2¼ meters (7½- x 7½-foot) targets at 500 meter intervals on the figure eight course from a range of 500 meters to maximum effective range from the starting position. The figure eight course shall not extend down range more than 400 meters from the starting point.

d. Using the power control of the test system direct the gunner to attempt to track a single target at a specific range during a complete non-firing ciruit of the course.

e. Mount a boresight camera and gun sight camera on the tracking vehicle, as applicable.

f. Operate the cameras.

g. Repeat steps 5.5.2.4 through 5.5.2.6 at different ranges on additional targets.

h. Load the test weapon with ammunition as applicable.

i. Conduct live firing exercises at various ranges from 1,000 to maximum effective range on the figure eight course, see Step 5.5.2.3, above.

j. Engage stationary 2¼ x 2¼ meters (7½- x 7½-foot) targets with the vehicle moving on the figure eight course at various speeds.

k. Engage targets as applicable. If the first round misses the targets, one additional round may be fired using the burst-on-target technique.

5.5.3 Moving Vehicle - Moving Target

a. Conduct this subtest on smooth terrain of a figure eight course at various speeds, if the vehicle is equipped with a gun stabilization system.

b. Set a moving target, 7½- x 7½-foot, at a range of 1,000 meters from the starting point of the figure eight and as described in TOP 3-2-602 (ref 12, appendix C). The figure eight course shall not extend down range more than 400 meters from the starting point.

c. Vary the speed of the moving target.

d. Mount a boresight camera and gunsight camera on the tracking vehicle, as applicable.

e. Order the gunner to track the target using power control during a complete non-firing circuit of the course.

f. Conduct live firing exercises at the moving target, with the vehicle traversing the figure eight course at various speeds.

g. Vary the moving target speed.

h. Load the test weapon with ammunition, as applicable.

i. Fire the test item, as applicable. If the first round misses the target, one additional round may be fired using the burst-on-target technique.

5.6 Weapons System Functioning

5.6.1 Observe and examine the functioning of the weapon system during all firing operations and at the completion of each 400 km (250 miles) of durability operation.

5.6.2 Pay particular attention to the following operations:

a. Feeding

b. Loading

c. Unloading

d. Extraction

e. Ejection

f. Recoil System

g. Ballistic Computer

h. Azimuth Indicator

i. Elevation Quadrant

j. Elevating and Traversing Controls

k. Firing Switches and Safeties

l. Range Finder

m. Sighting system

n. Residue left in chamber after firing combustible cased rounds (record type, weight, location, and if such residue could interfere with the loading of the next round).

5.6.3 Specific checks and/or observations shall be conducted, as applicable, as follows:

a. With the azimuth indicator zeroed, and the primary sight laid on a defined aiming point, the turret shall be rotated, first clockwise, then counter-clockwise one complete revolution until the sight is aligned on the original aiming point. If the azimuth indicator fails to reflect zero reading, the deflection difference shall be recorded. This procedure shall

be repeated with the turret being rotated to the left and right one-half revolution of the turret, then relayed on the original aiming point.

b. The weapon system's primary sight shall be laid on a definite aiming point on the boresight retention grid board. The precise reading of the quadrant shall be recorded. The gun shall then be elevated and depressed to its maximum limits at least three times. The sight shall again be laid on the original aiming point. If the quadrant reading fails to reflect the original reading, the difference shall be recorded.

c. Sluggishness, failure to respond, intermittent response, binding, or any other difficulty encountered in traversing, elevating, or depressing the weapon shall be investigated and reported in detail.

d. Test personnel will closely observe and report any difficulties encountered, when loading and unloading the weapons, which are directly related to the functioning of the system. During firing, they shall observe the extraction and ejection of the spent cartridge case and make appropriate comments regarding this function.

e. The recoil of the system shall be measured with a scratch gage during each firing phase. Insufficient or excessive recoil shall be investigated and reported.

f. Any failures of firing switches or safeties to function properly shall be reported in detail. Inspections shall be made of these devices prior to each phase of firing.

g. The range finder shall be checked prior to each phase of firing by the verification of the reading when laid on a known distance target. Any variation shall be reported. If erratic or unpredictable firing results, the range finder functioning shall be investigated.

h. The weapons system linkage shall be examined for looseness or binding during operation. Improper functioning shall be reported.

i. The function of the bore evacuator shall be observed during all firing. Test personnel shall comment on whether it adequately performs its functions under various weather conditions.

j. Test personnel shall make comments regarding the adequacy of the reticle illumination devices of the weapons system and whether sighting devices are subject to frosting during various weather conditions.

5.7 Obscuration and Sensing This subtest is primarily concerned with obscuration in the immediate vicinity of the firing vehicle.

5.7.1 Establish observer stations as applicable and in accordance with TOP 3-2-509 (ref 13, appendix C).

5.7.2 Mount cameras as applicable (gun sight/overwatch).

5.7.3 Install targets at a range of 1,500 meters.

5.7.4 Lay the test weapon on the target.

5.7.5 Fire five rounds of AP-T or TP-T ammunition from the main gun at the highest cyclic rate possible consistent with safety regulations.

5.7.6 Take photographes of smoke, blast, flash, ice fog, and blowing smoke created by firing from the main gun.

5.7.7 Using all sights and binoculars and timing devices, the commander and gunner shall sense the effects of smoke, flash, ice fog, and blowing snow during conduct of all firing.

5.7.8 Conduct firing in two categories 0 to -34°C (32°F to -30°F) and -35°C (-31°F) and below.

5.8 Secondary Weapons

5.8.1 Assemble the test weapon(s), if applicable.

5.8.2 Mount the weapon(s) on the vehicle.

5.8.3 Calibrate the weapon(s), if necessary.

5.8.4 Install targets, as appropriate.

5.8.5 Boresight and zero the test weapon(s) as required during the conduct of this subtest, IAW with appropriate technical manuals.

5.8.6 Perform maintenance on the test weapon(s) as required during the conduct of this subtest. The test weapons shall be fired in the temperature ranges of -18 to -32°C (0°F to -25°F), and -32°C (-26°F) to the lowest available temperature.

5.8.7 Test each weapon as per applicable sections of MTP 3-2-075 (ref 14, appendix C).

5.9 Human Factors Evaluation

5.9.1 Conduct all human factors evaluation in accordance with applicable sections of TOP 1-2-611 (ref 15, appendix C).

5.9.2 Conduct this subtest concurrent with operational subtests in this TOP.

5.9.3 Determine if the item is compatible with the skills, aptitudes, and limitations of personnel who will operate and maintain it under cold regions winter environmental conditions.

5.9.4 Determine if the test item and all its accessories and components enable easy operation by test personnel wearing the appropriate winter uniform.

5.9.5 Observe and record any major and minor tasks which are difficult or impossible to accomplish on or with the test item under cold regions winter environmental conditions.

5.10 Logistic Supportability. Classifications and definitions of malfunctions shall be as approved and defined by all USATECOM testing agencies.

5.10.1 Conduct all logistic supportability tests in accordance with applicable sections of TECOM Supplement 1 to DARCOM Regulation 700-15 (ref 16, appendix C).

5.10.2 Conduct this subtest concurrent with operational subtests in this TOP.

5.10.3 Evaluate spare parts requirements under cold regions environmental conditions and compare with all replacement parts and components provided with the test item.

5.10.4 Utilize all common and special tools and test equipment furnished with the test item.

5.10.5 Analyze all publications provided with the test items for clarity and simplicity of instructions and completeness of preventive maintenance procedures, especially those associated with operation in a cold regions environment.

5.10.6 Monitor all maintenance operations to determine if instructions and sequence of operations are adequate for the level of training of the maintenance personnel.

5.11 Safety

5.11.1 Conduct all safety tests in accordance with applicable sections of TOP 3-2-805 (ref 1, appendix C).

5.11.2 Conduct this subtest concurrent with operational subtests in this TOP.

5.11.3 Determine if the test item is safe for US Army use under cold regions environmental conditions.

5.11.4 Prepare an adequate safety SOP to provide safety for personnel and equipment and ensure that all safety SOP's are observed throughout the test. Be sure to obtain a safety release prior to test conduct.

5.11.5 Determine if the test item and all its accessories and components can be operated safely by test personnel wearing appropriate winter uniform.

5.12 Reliability

5.12.1 Conduct all reliability tests in accordance with applicable sections of TOP 3-1-005 (ref 17, appendix C) and MTP 10-4-500 (ref 2, appendix C).

5.12.2 Conduct this subtest concurrently with the operational subtest in this TOP.

5.13 Data Required

5.13.1 Boresight and Zero

a. For the main armament record the following data:

(1) Time required to complete the boresighting procedures.

(2) Total vertical and horizontal limits of movement of sight adjustment knobs.

(3) Vertical and horizontal limits of movement of sight adjustment knobs after boresighting.

(4) Vertical and horizontal limits of movement of sight adjustment knobs after zeroing.

(5) Any deviation noted during boresight retention tests.

(6) Any deviation noted as a result of vehicle heater(s) operation.

(7) Any failure to retain zero during zero retention tests.

(8) Observations with respect to the clarity of sight reticles against cold regions winter background.

(9) Impact of all rounds in deflection and elevation from point of aim.

b. For the Coaxial Machine Gun and Cupola Machine Gun record the following data:

(1) Time required to complete the boresighting procedures.

(2) Total vertical and horizontal limits of movement of sight adjustment knobs.

(3) Vertical and horizontal limits of movement of sight adjustment knobs after boresighting.

(4) Vertical and horizontal limits of movement of sight adjustment knobs after zeroing.

(5) Any deviation noted during boresight retention tests.

(6) Any deviation noted as a result of vehicle heater(s) operation.

(7) Any failure to retain zero during zero retention tests.

(8) Observations with respect to the clarity of sight reticles against a cold regions winter background.

5.13.2 Round to Round Dispersion

Record the following data:

a. Date and location of firing

b. Meteorological data

c. Visibility conditions

d. Quadrant elevation

e. Azimuth of line-of-fire measured from forward center position.

f. Test round number and tube round number.

g. Type of ammunition.

h. Lot number.

i. Time of firing.

j. Location of target impact for each round.

k. Center of impact for each shot group (cm and km).

l. Standard deviation of each shot group (mils).

m. Hit percentage of each shot group for target.

5.13.3 Jump Firing

Record the following data:

a. Weapon cant, in direction and degrees.

b. Weapon pitch, in direction and degrees.

c. Target cant, in degrees.

d. Target non-perpendicularity, in degrees.

e. Target position, in degrees, as regards:

(1) Gun center position (traverse).

(2) Gun zero (elevation).

f. Distance from weapon muzzle to target in meters.

g. Superelevation of test weapon in mils.

h. Time of firing (hour, day, month, year).

i. Model nomenclature of weapon.

j. Number of previous rounds fired.

k. Type and lot number of projectile fired.

l. Weight of projectile, in kg.

m. Muzzle velocity of projectile, in meters per second.

5.13.4 Tactical Target Engagement

Record the following data:

a. Meteorological data.

b. Visibility conditions.

c. Target description.

d. Range to target.

e. Position of vehicle.

f. Times required to fire each round.

g. Type of ammunition and lot number.

h. Type of sight used.

i. Method of subsequent engagement used.

j. Observations of test personnel with respect to ease of engaging the target and any difficulties noted in firing against cold region winter background. Photos of target and background.

5.13.4.11 Target strike.

5.13.5 Tracking and Hitting Performance

Record the following data for each subtest:

a. Meteorological conditions.

b. Visibility conditions.

c. Description of course and targets.

d. Total time on target versus time target is tracked for non-firing exercises, where applicable.

e. Type of ammunition and lot number.

f. Speed of target and vehicle for all exercises.

g. Results of target engagements for live-fire exercises.

h. Photograph coverage of tracking and hitting.

5.13.6 Weapons System Functioning

Record the followng data:

a. Observations of test personnel relative to improper functioning of any weapon system component.

b. Record of failures of weapons systems components.

c. Results of azimuth indicator checks.

d. Results of elevation quadrant checks.

e. Length of recoil.

f. Failures of firing switches or safeties.

g. Deviation in range finder accuracy.

h. Adequacy of bore evacuator.

i. Adequacy of reticle illumination in varying light conditions and backgrounds.

j. Any difficulties encountered during loading and unloading.

5.13.7 Obscuration and Sensing

Record the following data:

a. Meteorological data (temperature, wind velocity, and direction).

b. Visibility condition.

c. Classification of snow cover or ground surface.

d. Type of ammunition and lot number.

e. Length of time that smoke, flash, ice fog, and blowing snow obscure the vision of the commander and gunner through fire control instruments.

f. Length of time obscuration effects in the target area obscure target identification.

g. Type of obscuration effects.

h. Time of firing.

i. Difficulties in observing tracer flight.

j. Highest cyclic rate of fire possible for five rounds.

k. Photographic coverage of obscuration effects at the main gun, firing vehicle and target.

5.13.8 Secondary Weapons

Record the following data:

a. Type of weapon and serial number.

b. Observations of test personnel relative to improper functioning of test weapon components.

c. Any difficulties experienced while servicing or firing the test weapons.

d. Percentage of hits.

e. Meteorological data.

f. Lot number and type of ammunition fired.

5.13.9 Human Factors Evaluation

Record the following data:

a. Difficulties encountered by test personnel in handling, operating, using, adjusting, zeroing, assembly, disassembly, carrying, or maintaining the test item.

b. Amounts of annoying odors and fumes.

c. Inadequacies of test item for cold regions winter protection when applicable.

d. Special inadequacies.

e. Noise level measured.

f. Objectionable heat or cold conditions associated with the test item.

g. Operations requiring undue effort on part of the personnel.

5.13.10 Logistic supporability

Record the following data:

a. Scheduled and unscheduled maintenance performed to include lubrication, adjustments, repairs, and replacement of parts.

b. Favorable and unfavorable aspects of maintenance.

c. Unsafe and inadequate aspects of maintenance performance.

d. Mean-time-between-failures (MTBF) and the mean-time-to-repair (MTTR) the test items and associated equipment.

e. Repair parts usage.

f. Human Factors aspects of maintenance performance.

g. Suitability of cleaning equipment.

h. Tools and test equipment required but not furnished in the maintenance package.

i. Adequacy of tools and test equipment for cold regions use.

5.13.11 Safety

a. Record any safety hazard regarding any of the following:

(1) Protrusions or sharp projections.

(2) Obstacles to movements.

(3) Dangerous moving parts.

(4) Fire risks.

b. Record observations regarding the following:

(1) Exit, entry, and escape hatches.

(2) Warning signals.

(3) Toxic fumes and vision hazards.

5.13.12 Reliabilty Record the data needed to analyze if the test item meets the reliability requirements as defined by requirements documents or other established criteria under cold regions winter environmental conditions.

6. DATA REDUCTION AND PRESENTATION

6.1 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.

6.2 Boresight and Zero Examine the recorded data and evaluate the precision and reliability of the sighting subsystem. Reduce and present data in accordance with TOP 1-2-502 (ref 3, appendix C).

6.3 Round-to-Round Dispersion Examine the recorded data and evaluate the hit characteristics of the test weapon(s) during use under cold regions winter environmental conditions.

6.4 Jump Firing Examine the recorded data and evaluate the jump characteristics of the particular weapon. Data shall be reduced and presented in accordance with TOP 3-2-817 (ref 7, appendix C).

6.5 Tactical Target Engagement Examine the recorded data and evaluate the ease of engaging the target against cold regions winter background.

6.6 Tracking Hitting Performance Tracking and hitting performance data shall be reduced and presented in accordance with TOP 3-2-603 (ref 8, appendix C) and TOP 3-2-605 (ref 9, appendix C).

6.7 Weapons System Functioning Examine the recorded data and evaluate the functioning of the weapon system under cold regions winter environmental conditions.

6.8 Obscuration and Sensing Obscuration and sensing data shall be reduced and presented in accordance with TOP 3-2-509 (ref 13, appendix C).

6.9 Secondary Weapons Examine the recorded data and evaluate the functioning of the secondary weapons under cold regions winter environmental conditions.

6.10 Human Factors Evaluation. Human factors data will be reduced and presented in accordance with TOP 1-2-611 (ref 14, appendix C).

6.11 Logistic Supportability. Maintenance data shall be reduced and presented in accordance with TECOM Supplement 1 to DARCOM Regulation 700-15.

6.12 Safety. Summarize safety data and present in terms of a statement regarding the safety aspects and acceptability of the test item for use under cold regions winter conditions.

6.13 Reliability. Perform a statistical anaylsis of the data and evaluate the performance of the test item against the criteria defined by the requirements documents.

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APPENDIX A - CHECKLIST

Pre-Test Checklist

		Yes	No
1.	Environmental impact assessment on hand?		
2.	SSP Listing on hand?		
3.	Safety Release on hand?		
4.	SSP Complete?		
5.	Required TDY's on station?		
6.	Proper TA 50 issued?		
7.	New Equipment Training complete?		
8.	Test item(s) on hand?		
9.	Inventory of test items complete?		
10.	Serial numbers recorded?		
11.	Winterization complete?		
12.	Instrumentation installed and checked?		
13.	Ranges scheduled?		
14.	Ammunition on hand?		

Range Checklist

		Yes	No
1.	Range scheduled for use?		
2.	Range OIC on site and briefed?		
3.	Safety Officer on site and briefed?		
4.	Copy of Safety SOP on site?		
5.	Road blocks/road guards in place?		
6.	Communications established with range control?		
7.	Medical evacuation on site?		
8.	Sufficient ammunition on hand?		
9.	Targets in place?		
10.	Moving targets operational?		
11.	MET Team on site?		
12.	Extra targets available?		
13.	Range sweep complete?		
14.	Instrumentation operational?		
15.	Communications with firing vehicle?		
16.	Muzzle boresight available?		
17.	Reference telescope available?		
18.	Grid board available?		
19.	Heaters functioning in warmups?		
20.	Fire extinguishers on hand at all stoves?		

APPENDIX B - SAMPLE DATA COLLECTION FORMS

Pre Test Data

Vehicle Type_____

NSN_____

Serial Number_____ USA Number_____

Manufacturer_____

Mileage_____ Hour Meter Reading_____

Main Weapon Nomenclature_____

Main Weapon Serial Number_____

Rounds Fired_____ Rounds Remaining_____

Auxiliary Weapons:

(A) Nomenclature_____ Serial Number_____

(B) Nomenclature_____ Serial Number_____

(C) Nomenclature_____ Serial Number_____

(D) Nomenclature_____ Serial Number_____

Fire Control System:

Computer Type_____ Serial Number_____

Manufacturer_____

Main Weapon Sight Type_____ Serial Number_____

Manufacturer_____

Auxiliary Sight Type _____ Serial Number_____

Manufacturer_____

Night Vision Device Type_____ Serial Number_____

Manufacturer_____

Note any damages or shortages in the equipment below:

Gunner_____

Boresight and Zero

Date_____ Time_____

Temp_____ Windspeed_____ Direction_____

Relative Humidity_____ Precipition_____

Boresight Settings AZ_____ EL_____

Travel Remaining UP_____ Left_____

Down_____ Right_____

Impact of Initial Rounds

Center of group
(inches from Bull)

Computed Correction AZ_____ EL_____

Sight Settings AZ_____ EL_____

Impact of Subsequent Rounds

Center of Group AZ_____ EL_____
(Inches from Bull)

Computed Correction AZ_____ EL_____

Sight Settings AZ_____ EL_____

Impact of Subsequent Rounds

Center of Group AZ_____ EL_____
(Cm from Bull)

If weapon is not zeroed at this point, re-boresight and re-zero.

Round Type_____ Lot number_____

Total Rounds fired_____

Ammunition Temperature_____

Dispersion Firing

Date_____ Time_____

Temperature_____ Windspeed_____ Direction_____

Relative_____ Precipitation_____

Ammunition Type_____ Lot Number_____

Ammunition Temperature*_____

Quadrant Elevation_____ mils. Range to Target_____

Target position_____° right or left of center traverse.

Target position_____° up or down from zero elevation.

Azimuth of Fire_____

Coordinates of round strike: (State Right/Left, Up/Down from Aim Point).

1	AZ_____cm	EL_____cm
2	AZ_____cm	EL_____cn
3	AZ_____cm	EL_____cm
4	AZ_____cm	EL_____cm
5	AZ_____cm	EL_____cm
6	AZ_____cm	EL_____cm
7	AZ_____cm	EL_____cm
8	AZ_____cm	EL_____cm
9	AZ_____cm	EL_____cm
10	AZ_____cm	EL_____cm

Center of Impact for Group AZ_____cm EL_____cm

Percentage_____

* Conditioned temperature as measured on representative rounds.

Gunner_____

Jump Firing

Date_____ Time_____

Temperature_____ Windspeed_____ Directions_____

Relative Humidity_____ Precipitation_____

Ammunition Type_____ Lot Number_____

Ammunition Temperature*_____ Muzzle Velocity_____

Number of Rounds fired on Gun Tube_____

Rounds remaining_____

Weapon Cant_____° _____direction.

Weapon Pitch_____° _____direction.

Target Cant _____° Target non-prependicularity_____°

Target position_____° right or left of center traverse (gun).

Target position_____° above or below zero elevation (gun).

Distance - muzzle to target_____m.

Quadrant Elevation_____mils.

Coordinates of round strike:

A	AZ_____cm	EL_____cm
B	AZ_____cm	EL_____cm
C	AZ_____cm	EL_____cm
D	AZ_____cm	EL_____cm
E	AZ_____cm	EL_____cm
F	AZ_____cm	EL_____cm
G	AZ_____cm	EL_____cm
H	AZ_____cm	EL_____cm
I	AZ_____cm	EL_____cm
J	AZ_____cm	EL_____cm

* Conditioned temperature as measured on representative rounds.

Tactical Target Engagement

Crew _____ Cdr
_____ Gnr
_____ Dvr
_____ Ldr

Date _____ Time _____

Temperature _____ Windspeed _____ Directions _____

Relative Humidity _____ Precipitation _____

Visibility _____

Target description _____

Range actual _____ Range indicated _____

Time of Fire: 1st rd _____ Subsequent rd _____ Closing _____

Sight used _____ Fired by: GUNNER COMMANDER

Method of subsequent engagement _____

Ammunition type _____ Lot no. _____

Target strike AZ _____ EL _____

Sensing (if miss) _____ INDICATE RD STRIKE BELOW

REMARKS:

Tracking and Hitting

Crew _____ Cdr
_____ Gnr
_____ Dvr
_____ Ldr

Date _____ Time _____

Temperature _____ Windspeed _____ Directions _____

Relative Humidity _____ Precipitation _____

Visibility _____ Type Target _____

Course description:

Time on target _____ Total tracking time _____

Type ammunition _____ Lot no. _____

Speed of target _____ Speed of test vehicle _____

Target hits: indicate below by rd number

Hit percentage _____ % Total rounds fired _____

Hits _____ Misses _____

Center of impact of group AZ _____ EL _____

Standard deviation of group _____

Weapon System Functioning

Date_____ Time_____

Temperature_____Windspeed_____Direction_____

Relative Humidity_____

Azimuth indicator error_____mils.

Quadrant error_____mils.

Length of recoil_____cm.

Rangefinder error_____meters @ _____meters.

List below any malfunctions, probable causes and corrective action.

Was the bore evacuator adequate? (explain any "no" response)

Was the sight reticle visible?

Was there any difficulity loading or unloading?

Obscuration and Sensing

Date_____ Time_____ Crew Gnr_____

Temp_____ Visiblity_____ Cdr_____

Windspeed_____ Direction_____ Ldr_____

Relative Humidity_____ Dvr_____

Preciptation_____Snow Classification_____

Ammunition Type _____Lot no._____

Ammunition Temperature*_____

Time target obscured through fire control:

Commanders Position_____sec.

Gunners Position_____sec.

Time of obscuration at target_____sec.

Cyclic rate of fire for test_____rds/min.

Note below any difficulties in observing tracer, round impact of sensing:

* Conditioned temperature as measured on representative rounds.

Secondary Weapons

Date_____ Time_____ Crew Gnr_____

Temp_____ Visiblity_____ Cdr_____

Windspeed_____ Direction_____ Ldr_____

Relative Humidity_____ Dvr_____

Precipitation_____

Nomenclature of Weapon_____ Serial No._____

Ammunition Type_____ Lot No._____

Target type_____ No. of rds fired_____

Range_____ Hits or Area Coverage_____

Note below any malfunctions and possible cause:

Were there any difficulties in loading, unloading, firing, or maintaining the weapons?

Human Factors Evaluation

Evaluator_____

Date_____ Time_____ Cdr_____

Temp_____ Relative Humidity_____ Gnr _____

Windspeed_____ Directions_____ Ldr _____

Wind Chill Factor_____ Dvr _____

Precipitation_____ Weapon used_____

Test Location_____ Crew Position_____

The following tasks will be observed, performance will be rated as follows:

S = Satisfactory U = Unsatisfactory N/A = Not Applicable

(Explain unsatisfactory ratings in comments)

Task	Rating	Comments
1. Gain access/egress from vehicle		
a. Ease of entry		
b. Carrying load during entry/exit		
c. Raise load to entry/exit point		
d. Use structural members for mounting		
e. Handholds/railings		
f. Read/observe cautions or warnings		
g. Grasp hatch handlers		
h. Open/close hatches		
i. Lock/unlock hatches		

(Explain unsatisfactory ratings in comments)

Task	Rating	Comments
2. Prepare for operation		
a. Visual inspection of components		
b. Verify readiness		
c. Follow published procedures		
d. Input test signals/interpret result		
e. Set controls		
f. Enter/leave station		
g. Take/leave seat		
h. Don/doff equipment at station		
i. Store clothing/equipment		
j. Adjust seat		
3. Operation		
a. Read labels		
b. Pre-set controls		
c. Check displays/guages		
d. Manipulate controls		
e. Communicate with crew		
f. View externally		
g. Perform post operation checks		

(Explain unsatisfactory ratings in comments)

Task	Rating	Comments

4. Weapons preparation

   a. Unpack/unstow

   b. Mount

   c. Perform checkout

   d. Clean

   e. Adjust

   f. Verify readiness

   g. Follow instructions

   h. Identify ammunition

   i. Ready ammunition

   j. Load/unload

   k. Sighting/ranging

   l. Visual aids

   m. Sensors

5. Weapon Use

   a. Position for aiming

   b. Aiming aids

   c. Target detection/identification

   d. Precise lay on target

   e. Fire weapon

   f. Alter/adjust aim

   g. Monitor/observe firing

   h. Verify weapon effect

   i. Weapon safety mechanism

   j. Secure/stow weapon

Personnel Data

Name_____ Rank_____ Date_____

MOS_____ SSN_____

Crew Position (Test)_____

Months experience (in test position)_____

Height_____ Weight_____ Date of Birth_____

Length of service (months)_____ Civilian education (yrs)_____

Major area (if applicable)_____

Physical Profile P U L H E S

___ ___ ___ ___ ___ ___

Last MOS Test Score_____ MOS_____

Training Test Score (if applicable)_____

Minimum performance standard attained (Yes/No)_____

PT scores on last test _____ (composite)
_____ push-ups
_____ sit-ups
_____ 2 mile run

Military schooling completed (Date and Type)_____

_____

_____

_____

_____

Human Factors Questionnaire

Name_____ Rank_____ Date_____

Position_____ Vehicle Nomenclature_____

Answer the following questions using the 6-point scale below:

6 - Extremely easy	or	Excellent
5 - Easy	or	Very Good
4 - Could be easier	or	Adequate
3 - Difficult at times	or	Not Quite Adequate
2 - Difficult	or	Poor
1 - Extremely Difficult	or	Extremely Poor

(Explain any ratings of 1 - 4 in comments)

Task/Item	Rating	Comments
1. Entering/exiting through hatches		
2. Access to your station		
3. Opening/securing hatches		
4. Loading supplies through hatches		
5. Communicating with crew		
6. Firing weapon		
7. Seat adjustment		
8. Use of vision devices		
9. Operating controls		
10. Accessibility of controls		
11. Field of view		
12. Space provided for position		
13. Stowage space for equipment		

(Explain any ratings of 1 - 4 in comments)

Task/Item	Rating	Comments
14. Stability of weapon		
15. Ventilation		
16. Heating		
17. Lighting		
18. Padding		
19. Fumes		
20. Wearing of appropriate clothing		
21. Chemical Protection		
22. Safety		
23. Loading/unloading weapon		
24. Ammunition stowage		
25. Use of handwear		
26. Noise		

APPENDIX C - REFERENCES

1. TOP 3-2-805, 12 July 1977, "Safety Evaluation of Cannon and Recoilless Weapons."

2. MTP 10-4-500, 25 June 1969, "Arctic Preoperational Inspection, Physical Characterisitics, Human Factors, Safety, and Maintenance Evaluation."

3. TOP 1-2-502, 14 September 1972 and C1, 13 August 1973, "Durability Testing."

4. TOP 2-2-708, 18 July 1980, "Vehicle Personnel Heater Compatibility."

5. TOP 3-2-604, 9 August 1976, "Boresight Retention."

6. TOP 4-2-829, 9 April 1976, "Vertical Target Accuracy and Dispersion."

7. TOP 3-2-817, 9 May 1978, "Jump Firing."

8. TOP 3-2-603, 13 August 1976, "Crew Control Systems (Vehicular)."

9. TOP 3-2-605, 10 March 1982, "Accuracy Firing of Tank Weapons."

10. TOP 3-2-700, 8 March 1978, "Ballistic Correction Systems."

11. TOP 3-2-701, 13 October 1976, "Gun Sight Synchronization."

12. TOP 3-2-602, 3 September 1976, "Gun Stabilization Systems (Vehicular)."

13. TOP 3-2-509, 29 December 1970, "Artillery Cannon."

14. MTP 3-2-075, 2 February 1971, "Secondary Armament, Vehicular Mounted".

15. TOP 1-2-611, 20 January 1978, "Cold Regions Human Factors Engineering."

16. TECOM Supplement 1, 20 June 1980 to DARCOM Regulation 700-15, 26 November 1979, "Integrated Logistics Support."

17. TOP 3-1-005, 1 March 1972 and C1, 10 June 1974, "Field Artillery Statistics."

APPENDIX D - COLD-DRY UNIFORM

The year-round temperature variation peculiar to the cold regions prohibits the prescribing of a particular uniform for any season. The clothing which is comfortable at approximately -45°C (-50°F) becomes uncomfortable at approximately -25°C (-]5°F) and vice versa. Since a large fluctuation is experienced on an hour-by-hour, day-by-day basis, some degree of flexibility in uniform requirements is necessary.

The cold-wet uniform is designed to afford maximum protection against the hazards of changing temperatures, rain, wet snow, mud, and slush of a cold-wet environment.

The cold-dry uniform is designed to provide protection against the hazards of extreme temperatures, high winds, and snow of a cold-dry environment. As indicated below, the cold-wet uniform is part of the cold-dry uniform. The cold-wet uniform provides the inner insulating components of the cold-dry uniform. Progressing from cold-wet to cold-dry is accomplished by adding more insulation in the form of additional outer garments.

The necessary clothing components of the cold weather uniforms are worn as defined in TM 10-275, DA, Cold Weather Clothing and Sleeping Equipment, dated April 1968 as amended by current Supply Bulletins and 172d Infantry Brigade (Arctic) Directives.

Item	Cold-Wet	Cold-Dry
a. Undershirt man, 50% cotton, 50% wool, full sleeve.	X	X
b. Drawers, cold weather, mans, 50% cotton, 50% wool, knit, ankle length.	X	X
c. Socks, mans, wool, cushion sole, OG 408, stretch type.	X	X
d. Suspenders, trousers, scissor back type.	X	X
e. Shirt, cold weather, wool/nylon flannel, OG 108.	X	X
f. Trousers, cold weather, wool serge, OG 108.	X	X
g. Trousers, utility, cotton sateen, OG 107.	X	X
h. Trousers, camouflage, cotton/nylon, water repellent, white.	X	X
i. Liner, cold weather, trousers, nylon rip-stop, quilted, white.	X	X

Item	Cold-Wet	Cold-Dry
j. Liner, snow trousers, camouflage, nylon ripstop, quilted, white.		X
k. Boot, extreme cold weather, mens, rubber, white, with release valve.		X
*l. Boot, cold weather, mens, rubber, black, with release valve.	X	
m. Coat, cold weather, mans, cotton/nylon, wind resistant sateen.	X	X
n. Liner, cold weather, coat, nylon quilted, 6.2 ounce, OG 106.	X	X
o. Parka, extreme cold weather, mans, cotton/nylon oxford, OG 107, without hood.		X
p. Liner, extreme cold weather, parka, mans, nylon quilted, OG 106.		X
q. Cap, cold weather, cotton/nylon oxford, OG 107.	X	X
r. Hood, extreme cold weather, cotton/nylon, OG 107, with fur ruff.		X
s. Handwear:		
(1) Mitten set, arctic: Gauntlet style shell with leather palm.	X	X
**(2) Mitten shell, trigger finger, leather palm and thumb; mitten inserts, wool/nylon knit, OG, trigger finger.	X	X
**(3) Glove shells, work, leather; glove inserts, wool/nylon knit, OG 208.	X	X
(4) Gloves, cloth, work type (anticontact).	X	X
t. Special purpose clothing items:		
(1) Parka, snow camouflage, white.	X	X
(2) Trousers, snow camouflage, white.	X	X
(3) Mask, extreme cold weather.	X	X

Item	Cold-Wet	Cold-Dry
(4) Dickey, rayon, OD (local item of issue).	X	X
(5) Balaclava, wool, navy blue (local item of issue).	X	X

*Not available to CRTC.
**Items not worn at same time.