REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
30-05-2012	Final	

4. TITLE AND SUBTITLE
Test Operations Procedure (TOP)
03-4-004A Natural Cold Weather Environment Test of Small Arms, Hand and Shoulder Weapons and Machineguns

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHORS

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Yuma Proving Ground
Cold Regions Test Center
P.O. Box 31350
Fort Greely, AK 99731

8. PERFORMING ORGANIZATION REPORT NUMBER
TOP 03-4-004A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Range Infrastructure Division (CSTE-TM)
US Army Test and Evaluation Command
2202 Aberdeen Boulevard
Aberdeen Proving Ground, MD 21005-5001

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
Same as item 8

12. DISTRIBUTION/AVAILABILITY STATEMENT
Distribution Statement A. Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES
Defense Technical Information Center (DTIC), AD No.:
This TOP supersedes TOP 03-4-004 dated 29 May 1969, and TOP 03-4-006 dated 10 March 1969.

Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue, due to the extent of the changes.

14. ABSTRACT
This environmental test procedure enhances test methods and techniques detailed in TOP 03-2-045, Small Arms, Hand and Shoulder Weapons and Machineguns for evaluating the functional characteristics of small arms, hand and shoulder fired weapons and machineguns under natural cold weather environmental conditions.

15. SUBJECT TERMS
Small arms, natural environment, cold weather, shoulder fired weapons

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**B. ABSTRACT**	**C. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
Unclassified	Unclassified	Unclassified	SAR	20	

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US ARMY TEST AND EVAUATION COMMAND
TEST OPERATIONS PROCEDURE

*Test Operations Procedure 03-4-004A 30 May 2012
DTIC AD No.

NATURAL COLD WEATHER ENVIRONMENT TEST OF SMALL ARMS, HAND AND SHOULDER WEAPONS AND MACHINEGUNS

* This TOP supersedes TOP 03-4-004 Arctic Environmental Test of Individual Weapons Rifles (Semi-Automatic and Automatic) and Pistols, 29 May 1969, and TOP 03-4-006 Arctic Environmental Test of Automatic Crew Served Weapons, 10 March 1969.

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1. SCOPE.

The procedures in this Test Operations Procedure (TOP) are a supplement to enhance the procedures outlined in TOP 03-02-045[1]* and will be used collectively. Testing in a natural cold weather environment is used to substantiate or supplement data obtained from simulated tests conducted during the early design phases of testing. Testing in the cold weather environment is generally not performed until data from simulated environment tests provide reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the natural environment. Not all tests performed on small arms need be repeated in the cold. The subtests listed below are the minimum that should be considered when planning a cold environment test:

a. Initial Inspection. This test provides for an inspection of the test item to identify damage received during shipping and handling and document its physical characteristics.

b. Human Factors Engineering (HFE) and Safety. The objective of this subtest is to document if all accessories and components of the test ammunition enable operation by test personnel wearing the appropriate cold environment winter uniform Extended Cold Weather Clothing System (ECWCS).

c. Reliability and Durability. The objective of this subtest is to assess the probabilistic reliability of the weapon/cartridge system in a natural cold environmental.

d. Accuracy and Dispersion. The objective of this subtest is to assess the accuracy and dispersion of small arms ammunition under natural cold environmental conditions.

e. Rate of Fire. The objective of this subtest is to assess the rate of fire while operating in a natural cold environment.

f. Signature Effects. The objective of this subtest is to assess and measure the position disclosing effect created by the muzzle flash, smoke/ice fog, and noise of the test weapon when fired under natural cold environmental conditions.

g. Manpack Mobility. The objective of this subtest is to assess the effects of carrying and transporting the test weapon cross-country and utilizing over snow mobility techniques such as wearing snowshoes and skis.

h. Final Inspection. The objective of this subtest is to document any adverse conditions not previously identified with the test weapon after being utilized in natural cold environmental conditions.

*Superscript numbers correspond to Appendix B, References.

2. FACILITIES AND INSTRUMENTATION.

a. Typical facility requirements are presented in Table 1.

TABLE 1. FACILITY REQUIREMENTS

ITEM	REQUIREMENT
Firing ranges	Ranges suitable to ensure safe firing at all required distances. Range fans and surface danger zones must allow for the effect of catastrophic failure of weapons or ammunition.
Test stands	Must safely restrain the weapon and absorb recoil during firing.
Ground mounts (bipods, tripods, and gimbals)	Specific to weapons.
Support ammunition	Used to verify test procedures and for test conduct.
Targets	Either physical or electronic, providing the capability of recording the X and Y coordinates of each projectile passing through the plane of the target. Specific accuracy and precision requirements will vary by ammunition type and the particular test performed.

b. Typical instrumentation requirements are provided in Table 2.

TABLE 2. INSTRUMENTATION REQUIREMENTS

ITEM	MAXIMUM PERMISSIBLE ERROR OF MEASUREMENT*
Acoustic scoring system	1% of the outside dimension of the sensor array.
Cyclic rate recorder	+ 1% at rates up to 6000 rpm and burst lengths of 100 rounds
Stargage and airgage	+ 0.025 mm
Thermograph/thermocouples	+ 0.6 ºC (1 ºF)
Velocimeter	0.1% or 0.5 m/s (whichever is highest) for bursts to 6000 rpm

*Values can be assumed to represent ± 2 standard deviations; thus, the stated tolerances should not be exceeded in more than 1 measurement of 20.

LEGEND:
% percent
C Celsius
F Fahrenheit
mm millimeter
m/s meters per second
rpm rounds per minute

c. Other required support is provided in Table 3.

TABLE 3. OTHER REQUIRED SUPPORT

ITEM	REQUIREMENT
Photographic	Photo or video documentation may be required to capture any anomalies found during testing.
Meteorological	Hourly recordings of conditions at firing point and target area. At a minimum, temperature, relative humidity, wind speed, wind gusts, wind direction.
Appropriate cold weather clothing	When assessing HFE the appropriate military uniform must be utilized to ensure all issues are determined. The ECWCS is the standard uniform.
Skis and snowshoes	As applicable.

3. REQUIRED TEST CONDITIONS.

3.1 Planning.

a. Since natural cold environmental tests are normally scheduled from October through March (6 months), ensure that the weapons (test and comparison) and ammunition type to be fired are delivered to the test center prior to 01 October. Ammunition shipments (barges) are normally scheduled for the spring and fall. Contact the ammunition officer for the exact schedule. It is the Program Manager's (PM's) responsibility to submit the ammunition requests to G3 through the US Army Test and Evaluation Command (ATEC) ammunition management to ensure ammunition is validated for testing. Additionally, the PM should submit a special request to receive a single lot of ammunition for use in testing.

b. Temporary duty (TDY) personnel may be required to augment assigned personnel and must be trained to the degree that they are as proficient on the individual weapons as the Soldiers who will use the weapon. If Soldiers are desired, ensure a Test Schedule and Review Committee (TSARC) request is submitted as early as possible.

c. Ensure that all test personnel are familiar with the required technical and operational characteristics of the item under test in a cold environment and record these criteria in the test plan.

d. Prepare adequate safety precautions to provide safety for personnel and equipment. If required, ensure that a Safety Release and Human Research Protection Plan (HRPP) have been obtained prior to test conduct.

e. Ensure all test personnel have appropriate winter clothing and individual field equipment, as required.

f. Ensure that when not in use, all test and comparison weapons are stored and maintained in an unsheltered area and exposed to ambient air temperature and prevailing weather conditions. If this TOP is being used to support chamber testing, weapons and ammunition will be maintained at the temperature listed in the test plan. A portable cold chamber may be utilized to maintain stable test conditions. This requirement may be altered at the discretion of the test officer or test customer for security reasons.

3.2 Test Sequence.

When testing in a cold environment schedule the conduct of safety and nondestructive tests first. This TOP does not include a recommended sequence for the complete series of subtests due to the many variations of ammunition and weapon designs and considerations such as the scheduling of ranges, facilities, weather, and personnel.

3.3 Test Conduct.

a. Weapons. Care must be taken during testing to assure that the distinction is made between inherent weapons functioning and ammunition induced problems. Weapons will be maintained in accordance with technical manuals for the environment. Weapons will always be cleaned, inspected, and lubricated (CIL) at the end of each test procedure and before the start of another procedure (the CIL at the end of a test procedure may serve as the CIL for the start of a subsequent test procedure based on the judgment of the test officer). At a minimum, the CIL will be conducted at the operator level (often referred to as "field strip and clean"). More detailed maintenance will be done as required. Weapon lubricants, gas port settings, etc. may be specific to test conditions such as extreme temperatures and must be applied in accordance with training manuals, technical manuals, or requirements documents. All maintenance actions will be recorded. Weapon maintenance procedures will be coordinated with the test customer.

b. Firing Tests. Test weapons must be fired to determine their performance. The procedures in this TOP are a supplement to TOP 03-2-045. Testing in a cold environment uses standard small arms firing procedures, with only slight modifications or minor procedural changes because of unique challenges when testing in subzero temperatures.

c. Firing Ranges. When planning the establishment of ranges, the Test Officer should consider firing line orientation due to low-level sun on the southern horizon when in a northern latitude (above 60 degrees north latitude). This will ensure firing at all times of day is possible without firing directly into a low sitting sun, which may adversely affect target acquisition and data.

d. Support (comparison) Weapons. The support weapon is used to confirm test set ups, instrumentation function, support ammunition function, and to perform trial runs prior to the use of the test weapons. The support weapons used must be fully identified; record the full nomenclature, serial number, and item number.

e. Ammunition Handling. The ammunition will be kept in its original shipping and storage containers until immediately before use. Make a general visual examination of the

ammunition after it is removed from its packaging; record any discrepancies such as shipping damage, evidence of improper storage, etc. Save some of the original shipping containers and packing materials; they are often needed to repack ammunition.

4. TEST PROCEDURES.

4.1 Initial Inspection.

There are no significant modifications required to conduct the Initial Inspection in a cold environment. Special attention should be paid to damages that appear to be caused by cold weather or mishandling in the cold.

4.2 Human Factors Engineering (HFE) and Safety.

a. HFE and Safety will be observed throughout all phases of testing, concentrating on issues caused by the use of cold weather clothing or adverse weather conditions.

b. All personnel will pay special attention to factors that impede with the use of the weapon, such as clothing interference, inadvertent mishandling caused by bulky gloves or mittens, etc. Areas of concern may include difficulty manipulating triggers, knobs, switches, buttons, loading, firing, unloading, and clearing misfires.

4.3 Firing Tests.

These procedures and those outlined in TOP 03-2-045 will be used to establish range set up and test conduct for all firing events. Additional guidance is given for the various specialized events.

a. Cold conditioning should occur outdoors for a period of at least three hours prior to commencement of each test event for all test and comparison ammunition. However, should unusual conditions persist; portable environmental chambers may be used to supplement natural environmental conditioning. Each phase of the subtest will be conducted in ambient air temperatures of -18 ºC to -31 ºC (0 ºF to -25 ºF), -32 ºC to -46 ºC (-26 ºF to -50 ºF), or as specified in the requirements document.

b. All test participants will wear anti-contact gloves and balaclavas when handling weapons and ammunition to reduce the chance of contact frostbite from contact with extremely cold metals.

c. All weapons will be lubricated for cold weather use in accordance with appropriate Technical Manuals (TMs). The use of the wrong lubricants can severely affect performance of the weapons and may cause undue malfunctions, weapons breakage, and test delays.

d. To reduce the chance of weapons breakage or malfunction during initial firing, begin firing at a slow rate of fire to allow the weapon to warm up before attempting maximum rate of fire. This may be disregarded if conducting strength of design or other destructive type test events.

e. If using optics, such as rifle scopes and close combat optics, care must be taken not to breathe or exhale onto the lenses of the optics. Moisture will freeze on the lenses, making target acquisition impossible.

f. Weapons to be used in these tests will be inspected, verified serviceable, and documented by a certified maintainer (Installation Maintenance Facility) prior to test initiation.

g. Zero weapons using support ammunition to ensure proper functioning prior to test events. This should be conducted in temperatures comparable to the test temperatures.

4.3.1 Reliability and Durability.

a. This subtest determines the robustness and reliability of the weapon when fired in a natural cold environment. Reliability and durability testing is conducted to determine the functional life of the weapon and its component parts. The data from this test helps establish logistical requirements for parts stockage and replacement schedules, aids in "repair or discard" decisions, and supports the cost benefit analysis.

b. Reliability and durability data will be obtained during all phases of testing and reported as found. All failures will be preliminarily scored against the specific Failure Definition Scoring Criteria (FDSC) if available.

4.3.2 Accuracy and Dispersion.

This subtest determines the inherent accuracy and dispersion characteristics of the test weapon when fired in a natural cold environment. Accuracy is a measure of the ability of the weapon and ammunition combination to center projectile impacts on the point of aim. Dispersion is the extent to which projectile impacts spread about the center of impact because of shot-to-shot variations. Methods of calculating measurements of accuracy and dispersion are given in International Test Operations Procedure (ITOP) 04-2-829[2].

a. Meteorological data are an absolute requirement for exterior ballistics computations. Meteorological conditions can have profound effects on the performance of ammunition and weapons. Temperature, wind, air density, and humidity all influence the ballistics of the ammunition to varying degrees. For example, cold temperatures reduce the burn rates of propellants, which in turn cause reduced velocities, which can affect accuracy at longer ranges. Generally, with the use of modern smokeless propellants, accuracy is not significantly influenced by the cold until ranges beyond 500 meters. The effects on weapons vary based on weapons type (bolt action, semi-automatic, or automatic) from sluggish and difficult to manipulate to completely inoperative. Testers must understand the limitations of items being tested and make certain test conditions are not outside the listed limitations of the test item. The results from cold weather should be compared to those from temperate climates to determine the effect of temperature on the inherent accuracy or dispersion.

b. During accuracy firing, weapons should be fired from appropriate test mounts to eliminate human error if available. When man firing, ensure personnel are fully qualified on the

weapons to be fired and the weapon is used with a solid benchrest. When firing for extended periods, the cold can greatly affect the manned firer and care must be taken to ensure frequent warming is allowed. During warming breaks, the weapons and ammunition will remain outside.

c. All weapons and ammunition will be conditioned and maintained to the temperatures listed in the test plan until the rounds are fired.

d. Rates of fire during accuracy and dispersion firing will be slow and deliberate to allow the weapon to remain cooler and to minimize heat transfer to the ammunition.

4.3.3 Rate of Fire.

This subtest determines the effect of extreme low temperatures on the functioning performance of weapons. The following procedures will be used along with TOP 03–2–045.

a. Rates of fire may decrease due to cold, sluggish, or improperly lubricated weapons. Ensure all weapons are properly lubricated in accordance with the TMs or manufacturer's guidance.

b. Care must be taken when firing belt fed weapons to ensure ice and snow does not accumulate in the links, which can induce malfunctions.

4.3.4 Signature and Safety Effects.

Signature effects are those that characterize the use of a specific weapons performance. Some signature effects, such as smoke, ice fog, and muzzle flash and noise, can reveal a shooter's position and interfere with his view of the target. Other effects, such as noise and recoil, have safety implications. In all cases, signature effects affect the utility and usefulness of a weapon.

a. Firing weapons in temperatures below -29 ºC (-20 ºF) can cause the formation of ice fog, which can disclose the location of the weapon or obscure the shooters observation of the target.

b. The noise associated with the firing of a weapon (the report) can carry for unusually long distances in the cold, dense, dry air found in this environment; though the speed of sound decreases in the cold, the conduction of sound increases in the cold, dense air. This may increase the distances an enemy would be able to locate the firer's position.

c. Flash tests are usually done as comparison-type tests in a dark environment, however in the arctic and subarctic during periods of cold below -29 ºC (-20 ºF), it would be desirable to conduct this test during periods of daylight to view and document other visual effects such as ice fog. Test weapons will be fired in alternate trials with standard (support or comparison) weapons to determine if the test weapon provides an increase or decrease in flash as compared to the standard weapon.

4.3.5 Manpack Mobility

a. Small arms are required to be carried by the individual Soldier. This subtest determines the cold weather effects of transporting weapons by the Soldier. For example, when moving through snow covered terrain, snow intrusion and moisture from body heat into weapons is common. Repeated transition from unheated to heated areas causes condensation and freezing, which can cause malfunctions or inoperative weapons.

b. This subtest will be conducted in temperatures from 0 °F (-18 °C) to the lowest available.

c. Perform the following procedures:

(1) Inspect all test and comparison weapons for damage and document all discrepancies.

(2) Pack the test and comparison weapons in the prescribed carrying cases if required or hand carry utilizing appropriate slings and transport the items over the following courses (use an empty magazine or dummy belt for movement):

(a) Snowshoe three miles through dense, snow-covered brush to an established firing range. Conduct an operational/functional check: insert a loaded magazine or load a belt into belt fed weapons. Perform a functional firing event of at least 10 rounds for hand guns, 30 rounds for shoulder fired weapons, and 50 rounds for machineguns. Thoroughly inspect each test item and document all discrepancies.

(b) Snowshoe five miles over open-covered (cross-country) terrain. Conduct an operational/functional check: insert a loaded magazine or load a belt into belt fed weapons. Perform a functional firing event of at least 10 rounds for hand guns, 30 rounds for shoulder fired weapons, and 50 rounds for machineguns. Thoroughly inspect each test item and document all discrepancies.

(c) Ski 10 miles over cross-country trails (as required by Capabilities Production Document (CPD)). Conduct an operational/functional check: insert a loaded magazine or load a belt into belt fed weapons. Perform a functional firing event of at least 10 rounds for hand guns, 30 rounds for shoulder fired weapons, and 50 rounds for machineguns. Thoroughly inspect each test item and document all discrepancies.

(d) Conduct individual movement techniques (IMT) for 100 meters, over snow-covered terrain. Conduct an operational/functional check: insert a loaded magazine or load a belt into belt fed weapons. Perform a functional firing event of at least 10 rounds for hand guns, 30 rounds for shoulder fired weapons, and 50 rounds for machineguns. Thoroughly inspect each test item and document all discrepancies. (IMT will include 3-5 second rushes, high and low crawl, and rolling to left or right).

(e) Conduct operations in a Military Operations in Urban Terrain (MOUT) environment, concentrating on transitions between heated and unheated buildings. Personnel will remain in each environment for a minimum of 10 minutes, for at least 3 iterations. Move to an approved firing location while keeping the weapons cold. Conduct an operational/functional check: insert a loaded magazine or load a belt into belt fed weapons. Perform a functional firing event of at least 10 rounds for hand guns, 30 rounds for shoulder fired weapons, and 50 rounds for machineguns. Thoroughly inspect each test item and document all discrepancies.

c. Data Required.

(1) Damage attributed to environmental effects.

(2) Problems encountered while transporting ammunition.

(3) Damage to ammunition due to handling.

(4) Meteorological conditions at the test site.

(5) Maximum load that can be carried in each mode of movement.

(6) Photographs of stowed ammunition and packaging, and problems encountered.

(7) Results of the operational/functional check.

4.4 Final Inspection.

Weapons must be inspected for damages as a result of testing, which were not found during the conduct of testing. The inspection conducted, and data required for a cold event, follow the same as listed in TOP 03-2-045 and TOP 03-2-504[3].

5. DATA REQUIRED.

a. Data requirements are identified in the TOP 03-2-045 for each specific subtest.

b. The purpose of recording weapon functioning data is to establish an accurate, complete historic profile of the items being evaluated.

c. The Test Center will provide Safety Release or Safety Confirmation recommendations to the proper US Army Evaluation Center (AEC) Test Division based on any safety test anomalies occurring during the natural cold environmental tests.

d. Data should be presented using standard terminology and definitions. Standard definitions for weapon/ammunition interactions and malfunctions may be found in TOP 03-2-045.

6. DATA PRESENTATION.

a. In all cases, the test data must be presented in formats that are factual, comprehensive, and easy to understand. General guidance on presentation of data in reports is given in ATEC Publication Number 1-8[4]. Use this guidance for both printed and electronic presentations. A sample data collection form is provided as Table 4. The type of data to be collected will be dependent upon the needs of the customer and the ATEC Evaluator.

b. Level 1 through 3 data are not usually published, but are retained for future use or analysis (see Chapter 4 of ATEC Pamphlet 73-1[5]). Data levels 4 and 5 form the basis for test reports, safety release recommendations, etc.

c. Test results are analyzed by suitable statistical procedures for comparing samples, for obtaining point or interval estimates of a parameter, and for determining from test results whether specific requirements have been satisfied. ITOP 03-1-005[6] provides guidance on analyzing and presenting test results.

TABLE 4. SAMPLE DATA COLLECTION FORM

Weapon Model:				Ammunition Nomenclaure:		
Weapon Serial Number:				Ammunition Lot:		
Optics Type and Model:				Target Type:		
Optics Serial No.:				Laser Borelight Offset:		
Optics Mount Location On Rail:				10 meter Zeroing Offset:		
Trial No.	Temperature, °C	Wind Speed, m/s	Round Velocity	Distance To Target, meters	Point of Impact	
					X from Point of Aim, mm	Y from Point of Aim, mm
1						
2						
3						
4						
5						
6						
7						
8						
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10						
Comments:						

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APPENDIX A. ABBREVIATIONS.

AEC	US Army Evaluation Center
ATEC	US Army Test and Evaluation Command
C	Celsius
CIL	cleaned, inspected, and lubricated
CPD	Capabilities Production Document
ECWCS	Extended Cold Weather Clothing System
F	Fahrenheit
FDSC	Failure Definition Scoring Criteria
HFE	Human Factors Engineering
HRPP	Human Research Protection Plan
IMT	individual movement techniques
ITOP	International Test Operations Procedure
m/s	meters per second
mm	millimeter
MOUT	Military Operations in Urban Terrain
PM	Program Manager
rpm	rounds per minute
TDY	Temporary Duty
TM	Technical Manual
TOP	Test Operations Procedure
TSARC	Test Schedule and Review Committee

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APPENDIX B. REFERENCES.

1. TOP 03-2-045, Small Arms - Hand and Shoulder Weapons and Machineguns, 17 September 2007.

2. ITOP 04-2-829, Vertical Target Accuracy and Dispersion, 07 September 1999.

3. TOP 03-2-504, Safety Evaluation of Hand and Shoulder Weapons, 1 March 1977.

4. ATEC Publication Number 1-8 (change 2), Technical Document Style Manual, April 2007.

5. ATEC Pam 73-1, System Test and Evaluation Procedures, 16 June 2010.

6. ITOP 03-1-005, Statistics for Test Assessment, 23 October 2003.

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APPENDIX C. APPROVAL AUTHORITY.

CSTE-TM 18 June 2012

MEMORANDUM FOR

Commanders, All Test Centers
Technical Directors, All Test Centers
Directors, US Army Evaluation Center
US Army Operational Test Command

SUBJECT: Test Operations Procedure (TOP) 03-4-004A, Natural Cold Weather Environmental Test of Small Arms, Hand and Shoulder Weapons and Machine Guns, Approved for Publication

1. TOP 03-4-004A, Natural Cold Weather Environmental Test of Small Arms, Hand and Shoulder Weapons and Machine Guns, has been reviewed by the US Army Test and Evaluation Command (ATEC) Test Centers, the US Army Operational Test Command, and the US Army Evaluation Center. All comments received during the formal coordination period have been adjudicated by the preparing agency. An abstract of the document is as follows:

The procedures in this TOP are a supplement to enhance the procedures outlined in TOP 03-02-045 and will be used collectively. Testing in a natural cold weather environment is used to substantiate or supplement data obtained from simulated tests conducted during the early design phases of testing. Testing in the cold weather environment is generally not performed until data from simulated environment tests provide reasonable assurance that the test item will function satisfactorily when subjected to the conditions that would be encountered in the natural environment. Not all tests performed on small arms need be repeated in the cold.

2. This document is approved for publication and has been posted to the Reference Library of the ATEC Vision Digital Library System (VDLS). The VDLS website can be accessed at https://vdls.atc.army.mil/.

3. Comments, suggestions, or questions on this document should be addressed to US Army Test and Evaluation Command, 2202 Aberdeen Boulevard, ATTN: CSTE-TM, Aberdeen Proving Ground, MD 21005-5001; or e-mailed to usarmy.apg.atec.mbx.atec-standards@mail.mil.

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MICHAEL J. ZWIEBEL
Director, Test Management Directorate (G9)

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Forward comments, recommended changes, or any pertinent data which may be of use in improving this publication to the following address: Range Infrastructure Division (CSTE-TM), US Army Test and Evaluation Command, 2202 Aberdeen Boulevard, Aberdeen Proving Ground, MD 21005-5001. Technical information may be obtained from the preparing activity: Test Management Office (TEDT-YPC-TM), US Army Cold Regions Test Center, PO Box 31350, Fort Greely, AK 99731. Additional copies can be requested through the following website: http://itops.dtc.army.mil/RequestForDocuments.aspx, or through the Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Fort Belvoir, VA 22060-6218. This document is identified by the accession number (AD No.) printed on the first page.