EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

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13 ABSTRACT

Describes a method for evaluation of linked cartridge, clips, and magazines. Identifies supporting tests, facilities, and equipment required. Provides procedures for precperational inspection, physical characteristics, safety, personnel training, accuracy, dispersion, functional reliability, adverse conditions, and value analysis. Excludes ammunition lethality tests.

14 KEY WORDS	LINK A		LINK B		LINK C	
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U. S. ARMY TEST AND EVALUATION COMMAND
EXPANDED SERVICE TEST - SYSTEM TEST OPERATIONS PROCEDURES

AMSTE-RP-702-103
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SMALL ARMS AMMUNITION

SECTION I
GENERAL

1. Purpose and Scope.

a. This document provides procedures for testing small arms ammunition and related devices such as clips, magazines, or linked belts which are used to feed the ammunition into a weapon. It establishes test methods and techniques to determine if the test item meets the established criteria and is suitable for use by the U.S. Army.

b. For the purposes of this Test Operations Procedure (TOP), the term

*This TOP supersedes MTP 4-3-040, 25 May 197[illegible].

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small arms ammunition refers to cartridges of various types and sizes used in rifles (except recoilless type), carbines, pistols, revolvers, machine guns, and submachine guns, and to shells used in shotguns.

c. During all phases of testing, the test soldiers should be equipped with field uniforms, weapons, and equipment appropriate to the prevailing weather and activities in which they are engaged. Test soldiers should be informed of the objectives of the test, and the specific objectives of each test phase in which they are to participate.

d. The distinct phases of testing include preoperational inspection and physical characteristics, personnel training, accuracy and dispersion, tactical field firing, handling and transportation, field storage, and airdrop operations. Throughout all phases of testing, an evaluation should be made of each of the following: safety, functional reliability, maintenance, security from detection, human factors engineering, and value engineering. During all test phases, photographic coverage, including motion pictures should be used where appropriate to supplement other data obtained.

e. These procedures do not include an evaluation of the terminal effectiveness (lethality or kill probability) of the test ammunition.

f If the test ammunition is intended to replace a standard ammunition type, the standard ammunition should be used as a control item.

g. Pertinent weapon TOPs should be reviewed and appropriate procedures therefrom should be used in the test of the ammunition.

2. Background.

a. Present day Army tactical operations require immediate and responsive fire support, and there are continuing requirements for the development of new and improved ammunition for current small arms; as well as for ammunition to meet future munitions requirements which stem from an evaluation of the Army's small arms weapon systems and employment concepts.

b. To achieve and maintain the essential tactical capabilities, the ammunition employed must be dependable, must exhibit favorable ballistics qualities, and must be essentially free from those characteristics which result in malfunctions and stoppages. Therefore, the expanded service test must be planned to duplicate or simulate conditions of intended use including the use of typical weapons systems and test soldiers representative of those who will fire the ammunition in the field. Test exercises which simulate combat environments may be conducted on instrumented test facilities, if available. Test exercises should be conducted during both daylight and darkness. Additionally, the expanded service test should be accomplished when firing against targets representative of the enemy, and under environmental conditions equivalent to those which exist in theaters of expected operations.

c. The results of the expanded service test will be used to determine

the suitability of the test ammunition for U.S. Army use, and will provide a basis for recommendations on type classification.

3. Equipment and Facilities.

a. Equipment.

(1) Test ammunition

(2) Control ammunition, if [illegible]

(3) Weapons appropriate [illegible]

(4) Safety and first aid [illegible]

(5) Photographic [illegible]

(6) Communications [illegible]

(7) Linear and [illegible]

(8) Meteorological [illegible]

(9) Tactical vehicles, [illegible]

(10) Stopwatches

(11) Target materials.

(12) Parachutes and related [illegible]

(13) Administrative materials (data forms, rating questionnaires, pencils, and marking pens).

(14) Test troop unit, with TOE weapons and equipment.

b. Facilities.

(1) Firing ranges.

(2) Field training areas.

(3) Instrumented test facilities, if available.

(4) Classrooms, storage area, and office space.

SECTION II
TEST PROCEDURES

4. Supporting Tests.

a. The procedures outlined in this TOP provide general guidance for the conduct of expanded service tests. Detailed specific procedures are dependent on the characteristics of the ammunition being tested, and the stated criteria in applicable requirements documents.

b. In his preparation for the test, the test officer should conduct the necessary administrative, personnel, and supply preliminaries outlined in his test officer's guide or manual, or in his unit or organizational standing operating procedures. He must keep in mind that sufficient pretest training should be accomplished to ensure that test soldiers are equally familiar with the test and control items. It is extremely important that the performance of the test ammunition not be degraded because of its newness, or because the test troops were unfamiliar with the particular test item.

c. During each subtest, sufficient data should be collected to support valid conclusions. This goal may be constrained by limitations on the number of test items, the time available for testing, the manpower and funds available, and the support and control equipment available. To identify the best techniques to collect the most meaningful data available, methodology personnel (e.g., statistical analysts, experimental psychologists, human factors analysts) should be consulted when planning the test, to insure sufficient data will be acquired to permit a valid evaluation of the test item. These personnel can advise and assist the test officer in determining the appropriate experimental design to include the techniques for random sampling, sample size required to evaluate the true performance, estimating average performance (or variability of performance) from a sample, comparing materials or products with respect to average performance (or variability of performance), number of test soldiers needed, and the number of repetitions required for a specific exercise. Additional statistical guidance may be found in TOP 3-1-002, Confidence Intervals and Sample Size, and in National Bureau of Standards Handbook 91, Experimental Statistics.

d. Common Service TOPs, the tests defined in Section III, and other published documents to be considered in formulating an expanded service test plan are listed below. Additional reference material is at appendix a.

TEST SUBJECT TITLE	PUBLICATION NO.
(1) Preoperational Inspection and Physical Characteristics (refer to para 5)	
(2) Safety (refer to para 6)	
(3) Personnel Training (refer to para 7)	

	TEST SUBJECT TITLE	PUBLICATION NO.
(4)	Accuracy and Dispersion (refer to para 8)	
(5)	Functional Reliability of Ammunition (refer to para 9)	
(6)	Functional Reliability of Clips, Magazines, and Linked Cartridge Belts (refer to para 10)	
(7)	Handling and Transportation	4-3-503
(8)	Field Storage	4-3-520
(9)	Maintenance	4-3-513 and TECR 750-15
(10)	Adverse Conditions (refer to para 11)	
(11)	Security from Detection	1-3-515
(12)	Airdrop Operations	7-3-511 and 7-3-512
(13)	Human Factors Engineering	4-3-515
(14)	Value Analysis (refer to para 12)	

SECTION III
SUPPLEMENTARY INSTRUCTIONS

5. Preoperational Inspection and Physical Characteristics.

a. Objectives. To verify the completeness of the test item, compare the physical characteristics of the test item with criteria stated in requirements documents, and determine if the test item is in serviceable condition for testing.

b. Method.

(1) Upon receipt, carefully inspect all test and control items in their shipping or packaging containers for completeness, damage, and general condition. Record (and photograph, if practicable) any evidence of damage or deterioration to the packing or containers. Record identification markings, to include nomenclature, lot numbers, name of manufacturer and date of manufacture.

(2) Record special tools or equipment (such as loading devices, clips, magazines, linked belts) included with the test item.

(3) Uncrate overpacks and remove test items from the individual containers. Select random samples (sample size to be determined based on the confidence level required) and visually inspect for rust or corrosion; faulty crimping of cartridges; and bent, dented, burred or otherwise damaged items. Photograph all evidence of damage or defects.

(4) Record the physical characteristics of the samples of test items. Some examples of characteristics that might be applicable are dimensions, weight (of both individual and packaged rounds), type of material, color, and texture.

(5) Additional guidance for applicable procedures may be found in MTP/TOP 4-3-500, Preoperational Inspection and Physical Characteristics.

c. Data Required.

(1) Description of any damage or deterioration to packaging or containers.

(2) Description of any special tools or equipment received with the test item.

(3) Description of any damage or deterioration to the test items.

(4) Description of the physical characteristics of the test item.

d. Analytical Plan.

(1) Compare the physical characteristics of the test item with those specified in requirements documents to determine if applicable criteria have been met.

(2) Make a subjective analysis of the test data pertaining to completeness and serviceability of the test item to determine if it is in serviceable condition for testing.

6. Safety.

a. Objective. To determine if the test item is safe for its intended use.

b. Method.

(1) To be safe for troop use, the test item must be safe when in field storage, when transported, and when handled or fired according to applicable regulations and procedures.

(2) Safety determination is a continuing process throughout the

entire expanded service test and, to the extent practicable, should be conducted concurrently or in conjunction with other testing.

(3) Prior to committing test ammunition to field exposure, airdrop testing, or firing performance, review applicable Safety Statement or Safety Release and examine all test items for conformity, and for presence of other hazardous conditions. The Safety Release should be reviewed to determine if it places undue restrictions on tactical use of the test item. Particular emphasis should be placed on verification of safety limitations cited in the Safety Release, and on the compilation of safety data pertinent to the Safety Confirmation required by TECOM Reg 385-6.

(4) During the expanded service testing, the test officer must constantly consider not only the hazards which may be encountered during normal conditions, but those which could be encountered under the worst conditions of training and combat. The test officer should not intentionally perform tests which create unsafe conditions, but he must ensure that all phases of safety have been considered. Conditions not covered in the approved expanded service test plan may appear to be needed during the process of testing, and applicable tests should be performed. All safety hazards are major safety hazards when dealing with ammunition.

(5) Safe test procedures must be followed throughout all phases of testing. Test soldiers should continuously observe and inspect for indications of safety hazards, such as:

(a) Moisture in sealed containers.

(b) Illegible or improper markings.

(c) Faultily constructed, inadequate, or damaged containers.

(d) Rust deterioration, or corrosion.

(e) Leakage of powder.

(f) Misfires, hangfires, and cook-offs.

(6) Record all instances of safety hazards at the time they are observed or noticed. Normally all unsafe items or unsafe procedures are classified as deficiencies. In this area, it should be remembered that safety is relative, and judgment must be carefully exercised. In the event a suspected safety hazard or potential safety hazard develops, the problem must be resolved on the side of safety before the test is permitted to continue.

(7) During live firing exercises, consideration should be given to the wearing of ear and eye protection equipment by all firers and adjacent personnel.

(8) Additional guidance for safety evaluation procedures may be found in MTP 3-3-517, Infantry Weapons and Ammunition Safety, and in MTP 4-3-514, Safety Hazards.

c. Data Required.

(1) The results of studying the Safety Release, and limitations which may place undue restrictions on the tactical use of the test ammunition.

(2) A comparison of safety features of the test item with those stated in the applicable criteria.

(3) Any safety hazards reported or observed during the conduct of the test.

(4) Any additional data which will serve as a basis for the Safety Confirmation.

d. Analytical Plan. The test data should be analyzed subjectively to determine if safety criteria have been met. In compliance with the requirements of TECOM Reg 385-6, the report of test must include a statement as to whether or not the test item is safe for use. If it is concluded that the test item is not safe for use, the specific unacceptable safety hazard will be fully described in detail.

7. Personnel Training.

a. Objectives. To familiarize test participants with all aspects of using the test item, to ensure that everyone understands what is to be accomplished by the testing, and to assess the adequacy of the training package when one has been developed for the test item.

b. Method.

(1) The test soldiers selected should be representative of the intended users of the test item. The name, rank, MOS, training time in MOS, and experience in MOS for each test soldier should be recorded.

(2) All test personnel should be familiar with the required technical and operational characteristics of the test item as stated in applicable requirements documents, and should have reviewed all instructional material issued with the test item by the manufacturer, contractor, or government. Test personnel should also be familiar with the technical and operational characteristics of the weapon or weapons that will be used to fire the test ammunition. Everyone should understand the purpose and the objectives of the tests in which he will participate. Additional training guidance is contained in MTP 3-3-501 and MTP 4-3-501, both titled Personnel Training.

(3) Evaluate the instructional or training material furnished with the test item, to determine its accuracy, clarity, completeness, and general adequacy.

(4) Using the training literature provided with the test item as a basis, conduct a course of instruction for test soldiers. As the training progresses, changes and refinements in the lesson plans and in the program of instruction (POI) may be recommended by the test officer. At the completion of training, evaluate the suitability of the POI for inclusion in recommended courses of training.

(5) When testing ammunition, and subsequent to familiarization training, test soldiers should fire a record marksmanship course appropriate for the type weapon that will be used in the test. Test ammunition and control ammunition should both be fired to obtain comparative data.

c. Data Required.

(1) A record of the name, rank, MOS, training time in MOS, and experience in MOS, for each test soldier, at the time of his selection to participate in the test.

(2) A record of pretest training conducted for test personnel, including subjects taught and number of hours spent on each subject.

(3) A statement concerning the proficiency of test soldiers upon completion of the pretest training.

(4) A statement concerning the adequacy of the training package furnished with the test item.

(5) A record of individual scores attained on the record marksmanship course.

d. Analytical Plan. The test data should be analyzed subjectively to determine if training criteria have been met.

8. Accuracy and Dispersion.

a. Objective. To determine the accuracy and dispersion of test ammunition when it is fired against vertical targets at known distances.

b. Method.

(1) After completion of pretest training, test soldiers will fire both test and control ammunition against vertical targets at appropriate known distances to determine accuracy and dispersion. The mode of fire, rounds per burst or shots per target, type of weapon, and target ranges (minimum, maximum, and intermediate) should be obtained from specifications (MN, TC, PD) pertaining to the ammunition under test.

(2) Fire 100 rounds of ammunition from the lot of ammunition provided for the test, using fixture firing facilities and accuracy barrels. The results of this firing may be used to determine accurate dispersion

patterns, that may be used later for comparison with soldier/weapon/ammunition firing data.

(3) When required to compare the ballistic characteristics of different types of ammunition (e.g., ball, tracer, armor piercing), identical tests should be made with each type round using the same weapons, same sight settings, and same riflemen.

(4) When control ammunition is provided, identical tests under identical conditions should be conducted with both the test and control ammunition.

(5) Vertical targets of paper or other material suitable for easy marking and replacing should be used. Target size should be large enough to ensure that the impact location for all rounds fired can be determined. An aiming point should be established near the center of the target.

(6) Accuracy firing should be done during relatively stable weather conditions. Rapid changes in temperature, wind speed, or wind direction may cause inconsistencies in the firing results. Accuracy firings should not be conducted if the cross-range components of wind speed exceeds 10 mph, and the ammunition on hand at the firing site should be sheltered from direct sunlight or other weather effects to minimize temperature changes in group firings.

(7) The temperature and wind vector relative to the line of fire should be measured at the firing range and recorded at least once during the firing at each target. A record of the general weather conditions, (e.g., cloudy, sunny), relative humidity, and precipitation should be made every hour during the firing, or more often if significant changes occur.

(8) Weapons should be zeroed at each target range prior to firing the accuracy groupings. The initial zeroing should be confirmed at the end of the firing, or more often if sizable shifts in the center of impact locations become apparent during firing.

(9) All modes of firing (semiautomatic, automatic, controlled bursts) appropriate for the weapon being used should be conducted. The most steady, supported firing position for the weapon should be used.

(10) The required rounds for each target should be fired in sequence as rapidly as practicable to avoid unnecessary exposure to wind changes. The target should be changed after each group of shots, or each shot in each group should be marked, whichever is more economical. Any occurrence which could cause improper bullet performance should be noted. The errative impact should be marked and the shot replaced, or else the entire shot group should be refired.

(11) A sufficient number of groupings should be fired, for each type ammunition, firing mode, firing position, and target range to obtain statistically valid data.

(12) The following data for each group of rounds fired should be recorded:

(a) Date and time of firing.

(b) Firer's name.

(c) Target range (distance).

(d) Weapon identification.

(e) Ammunition nomenclature and lot number.

(f) Sight setting on weapon.

(g) Firing mode.

(h) Firing position.

(i) The location (x and y coordinates) of impact on the target should be determined for each round fired. These locations should be expressed in terms of a horizontal and vertical distance from some fixed reference point. This reference point is somewhat arbitrary and may be the center of the target, a corner of the target, the aiming point, or any fixed point on the target. Once the reference point is selected and located, the horizontal and vertical distances of each impact should be measured. These measurements should be made to the center of each hole as precisely as practicable. If a point other than the aiming point is used as a reference for these measurements, then the coordinates of the aiming point should also be measured relative to the established reference point, to facilitate comparing the location of center of impact of a group of rounds with the location of the aiming point.

c. Data Required.

(1) The data recorded from paragraph 8b, above. The horizontal and vertical standard deviations; horizontal, vertical, and extreme spread; mean radius; and deviation of the center of impact from the point of aim may be obtained from the coordinate data of impact points.

(2) Accuracy results of shot groups containing tracer rounds (combat load) may require identification of tracer impacts. Three analyses may be made: all shots, tracer alone, and non-tracer alone, in order to determine the variations in characteristics. Tracer round impact points may be identified by applying non-drying paint, dye, or other similar material to the tracer projectiles, which will leave identifying traces of the paint around the edges of target impact points.

d. Analytical Plan. Appropriate statistical tests or analyses of variance may be performed to determine if there are significant differences in the measures of accuracy and dispersion between the test and control item,

or between the test item and established criteria. Comparison results should indicate if the test item is worse than, equal to or better than the control item, or between the test item and established criteria.

9. Functional Reliability of Ammunition.

a. Objective. To determine the estimated probability of the test item performing its intended function successfully.

b. Method.

(1) Reliability testing should be performed simultaneously with other subtests to the maximum extent practicable. Throughout the conduct of all firing tests, the functioning characteristics of the test ammunition and the weapons from which it is being fired should be observed, and the causes of malfunctions and failures should be identified. Weapons should be examined after each firing test for fouling, carbonization, or other effects from firing the test ammunition.

(2) This subtest should provide data pertaining to test item loading, firing, extraction and ejection, projectile flight to the target area, (for types such as tracer ammunition) and the functioning of the test item in the target area. The intended function of the ammunition may be related to the type of ammunition. For example, tracer ammunition should provide a visible trace of its trajectory to the target; incendiary ammunition should ignite upon impact with the target; and blank ammunition should simulate the sound, smoke and flash of service ammunition. Reliability criteria usually are expressed in the requirements documents.

(3) All test personnel should be familiar with the technical characteristics of the test ammunition, with special emphasis placed on functioning to indicate what is normal and what is to be considered a malfunction. A malfunction is a faulty action of the ammunition, weapon, installation (supporting equipment), or personnel. Malfunctions are divided into two categories - those that cause stoppages (unintended interruptions of firing), and those that do not.

(a) Examples of malfunctions that cause stoppages are failure to feed, fire, extract, or eject.

(b) Examples of malfunction that do not cause stoppages are damaged weapon sear or solenoid components that cause uncontrolled firing; loss of weapon flash suppressor; and loosening and shifting of a sight.

(4) It is essential that the cause be determined for each malfunction, and whether it is attributable to the ammunition, magazine (or belt), weapon, supporting equipment, or personnel. A special category termed repetitive is used when there are repeated stoppages caused by a faulty

component, and either corrective action is not immediately determined or incorrect action is taken. If a series of identical weapon stoppages occur, and the first stoppage is attributed to the weapon because of a faulty weapon component, then the identical stoppages that follow are charged as repetitive, assuming that the fault was actually correctable following the first occurrence. For example, if a weapon should fail to fire, the firer should apply immediate action to reduce the stoppage without investigating the cause. Assume, then, that the weapon again fails to fire. Upon investigation, if it can be determined that the failure to fire was caused by a broken firing pin, only the first failure to fire should be charged to the defective weapon component. The second (and any succeeding) failures that occur before the firing pin has been replaced should be classified as repetitive.

(5) When successive malfunctions occur that are caused by faulty design of the weapon or ammunition rather than a component failure, and immediate corrective action by the test officer is not possible, then each such stoppage should be charged to the weapon or ammunition rather than to a repetitive malfunction. Malfunctions attributable to improper personnel action, such as faulty assembly of components or improper loading of ammunition, should be charged to personnel. A listing of typical malfunctions and their abbreviations is at appendix B.

c. Data Required. Record the following:

(1) Date and time of firing.

(2) Firer's name.

(3) Ammunition nomenclature and lot number.

(4) Weapon identification.

(5) Mode of fire.

(6) Number of rounds fired.

(7) Description of malfunctions or other occurrence related to functional reliability.

(8) Results of examination of weapon after each firing test.

d. Analytical Plan.

(1) Proper functioning and resultant reliability can be determined only after a valid analysis of many observations has been made, results studied, and then evaluated by experienced personnel thoroughly familiar with all ammunition service test procedures.

(2) Data reduction should consist of an analysis of all rounds fired. Initially the total number of rounds fired can be divided into two

groups: those rounds that functioned properly and within the limits prescribed by established criteria, and those rounds that had some malfunction.

(3) Reliability data may be presented either in narrative form or in the form of a statistical confidence level, computed as outlined in MTP/TOP 3-1-002. This presentation would state that so many rounds were fired, so many were observed to function normally and so many were observed to malfunction. The malfunctions should be numerically categorized according to type as described in appendix B.

10. Functional Reliability of Clips, Magazines, and Linked Cartridge Belts.

a. Objective. To determine if the test item can adequately perform the function for which it was designed.

b. Method.

(1) Ammunition clips, magazines, and linked cartridge belts are devices for feeding ammunition into a weapon for which they were designed. The number of rounds of ammunition they accommodate is dependent on their configuration, and on the mission and capability of the weapons with which they are used. They should be designed to be loaded and inserted into the weapon with ease and be operable under all conditions of combat. These devices may be evaluated individually in an expanded service test conducted for a specific device, or they may be evaluated in conjunction with a new type of ammunition. In either case, the functional reliability of the device will be evaluated by determining (as appropriate for the type of device) the ease of loading the device while it is outside the weapon, and while it is attached to the weapon; the ease of loading the device with a magazine filler or linking device; the ease of inserting the device into the weapon; and the operating characteristics of the device when the weapon is firing. Test exercises should be conducted under tactical field conditions.

(2) The firing exercises prescribed below are designed primarily to evaluate the functioning of the test clips, magazines, and linked cartridge belts, rather than for use in determining accuracy of the weapon/ammunition system. However, these firings may be used for accuracy evaluations if conducted under conditions that would provide valid findings with regard to accuracy measurements without detracting from their primary purpose of evaluating the clips, magazines, and linked belts.

(3) The sample size for test items, and the number of replications needed for a particular test action, must be consistent with reliability criteria. The desired reliability should be stated in the requirements document generated by the user. When this requirement is known, guidance in selecting samples for desired confidence levels is contained in MTP/TOP 3-1-002. If the number of samples available is not sufficient to meet the stated confidence level requirements, the test plan should indicate the confidence level that is attainable with the samples available. A statement should also be included to show the number of samples that would be required

to fully meet the stated requirements.

(4) Clips.

(a) The test soldiers should be issued empty test clips and bulk ammunition.

(b) A series of filling exercises should be conducted in accordance with instructions furnished with the test clip. In this operation, the extractor groove of the cartridge should be engaged by the inner rib of the test clip. If the test clip is spring loaded, any difficulties with that feature should be noted.

(c) When the test soldiers have gained experience in filling the empty test clip, each should insert a full test clip into the weapon several times, following the instructions for placement of thumb, amount of pressure to exert, and other guidance contained in the applicable instructions.

(d) The test soldiers should insert an empty test clip into the weapon. Following the applicable instructions, the cartridges should be inserted singly until the test clip is partially full. This exercise should be repeated several times to determine if the test soldiers experience any difficulty in partially filling the test clip.

(e) In some cases, the test clips may be intended to serve as a device for loading ammunition into magazines. This capability should be evaluated by using the procedures described below for magazines. Any difficulties encountered in transferring the cartridges from the test clip into the magazine should be noted.

(f) The above tests should be repeated during periods of limited visibility; with the test soldiers wearing the protective mask.

(g) Firing exercises should be conducted under tactical field conditions and using the clips and magazines that were filled in the above exercises to determine if the test items function properly during weapon firing. All modes of fire (e.g., semiautomatic, automatic, controlled bursts) applicable to the weapon should be used. Trials with different size bursts may be conducted, if deemed appropriate. These firing exercises should be closely observed to determine the ease with which ammunition is fed into the weapon and any malfunctions caused by the test items.

(h) When control items are furnished, comparative data for the test and control items should be obtained.

(5) Magazines.

(a) The test soldiers should be issued empty test magazines, cartridges in bulk, cartridges loaded in clips, and magazine fillers (a magazine filler is a device used as an adapter in transferring cartridges from a clip

to a magazine). Test magazines should be filled by two methods: using bulk ammunition, and using ammunition loaded in clips.

(b) Filling with bulk ammunition:

Following the applicable instructions, test soldiers should insert cartridges singly into test magazines until the magazines are filled to capacity.

(c) Filling with loaded clips:

Following the applicable instructions, test soldiers should fill test magazines with cartridge loaded in clips, using magazine fillers as an adapter between the clip and the magazine. As many clips as required should be used to fill each magazine to capacity.

(d) The test magazine loaded by the two methods above should be inserted into the magazine well of the appropriate weapons and snapped into position. Any difficulties should be noted.

(e) The above exercises should be repeated during periods of limited visibility; with the test soldiers wearing gloves; and with the test soldiers wearing protective masks.

(f) Firing exercises should be conducted to determine if the test magazines function properly during weapon firing. All modes of firing (e.g., semiautomatic, automatic, or controlled bursts) applicable to the weapon should be used. Trials with different size bursts may be conducted, if deemed appropriate. These firing exercises should be closely observed to determine the ease with which ammunition is fed into the weapon and any malfunctions caused by the test item.

(g) When control items are furnished, comparative data for test and control items should be obtained.

(6) Linked cartridge belts.

(a) Test soldiers, serving as a weapons crew, should be issued an ammunition container which contains ammunition linked in the test cartridge belt. The crew should follow appropriate procedures to put the weapon into action, and should load the weapon with the test item, in accordance with applicable instructions.

(b) The crew should repeat the above procedures with a test linked cartridge belt holding 100 (or other appropriate number) rounds of ammunition, and fire the weapon at a predetermined range and target. The rounds should be fired in bursts as specified in the applicable instructions for the weapon. Trials with different size bursts may also be conducted, if deemed appropriate. Sustained automatic fire, using the test linked cartridge belt, should be fired in accordance with capabilities of the weapon being used.

(c) These firing exercises should be closely observed to determine the automatic feeding capabilities of the test item, any malfunctions caused by the test item, the ease with which the test item can be fed into the weapon; and the manner in which the empty test item is ejected from the weapon.

(d) If the test belt is designed and intended to have the capability of being broken or separated into two or more sections, and for two belts or two sections of belts being joined together, this capability should be evaluated. Test soldiers should separate test belts into two or more sections, following prescribed instructions, and then load and fire each separate section from the appropriate weapon. The test soldiers should also join the belts, or sections of belts that have been separated, again following prescribed instructions, and then load and fire the joined sections as a single belt from the appropriate weapon. Any difficulties in separating or joining sections of the test belts, or any firing difficulties resulting from the separated or rejoined belt sections should be noted.

(e) If the test linked cartridge belt is designed and intended for reuse, that capability should also be evaluated. This can be done subsequent to the above firing exercises. When several test cartridge belts have been fired, the crew should be furnished a linking device and bulk ammunition. The empty test cartridge belts should be inspected to insure they are serviceable and then be reloaded. Any difficulties encountered should be noted. When the test cartridge belts have been reloaded, the firing exercises should be repeated.

(f) The exercises above should be repeated during periods of limited visibility, with the test soldiers wearing gloves, and with the test soldiers wearing protective masks.

(g) When control items are furnished, comparative data for test and control items should be obtained.

c. Data Required.

(1) Ammunition clips. Description of any difficulties encountered in:

(a) Filling the test clip while out of the weapon and while in the weapon.

(b) Inserting the full test clip into the weapon.

(c) Transferring cartridges from the test clip to a magazine.

(d) Performing test exercises during periods of limited visibility, when wearing gloves, and when wearing the protective mask.

(2) Magazines. Description of any difficulties encountered in:

(a) Loading the test magazine with individual cartridges.

(b) Loading the test magazine using a magazine filler and filled cartridge clips.

(c) Positioning the loaded test magazine in the weapon.

(d) Performing test exercises during periods of limited visibility, when wearing gloves, and when wearing the protective mask.

(3) Linked cartridge belts. Record the number of test cartridge belts and the amounts of ammunition used. Describe any difficulties encountered in:

(a) The automatic feeding of the test cartridge belt through the weapon.

(b) The assistant gunner feeding the test cartridge belt into the weapon.

(c) The ejection of the empty test cartridge belt from the weapon.

(d) The separating or rejoining of belt sections.

(e) The operation of the linking device.

(f) Firing the ammunition which was linked by the test soldiers in reusable type belts, and in the separated or rejoined sections of the test belts.

(g) Performing test exercises during periods of limited visibility, when wearing gloves, and when wearing the protective mask.

d. Analytical Plan. The results of testing should be presented in narrative form supplemented with tables, charts, photographs, and motion pictures as required. These data should be analyzed subjectively to determine if applicable criteria have been met.

11. Adverse Conditions.

a. Objective. To determine and compare the performance of the test and control ammunition under adverse and temperate climatic conditions.

b. Method.

(1) Throughout testing, note should be taken of the performance of the test and control ammunition after exposure to adverse and climatic conditions encountered in other subtests. Data accumulated in other subtests bearing on performance under adverse conditions should be recorded,

analyzed, and compared in this subtest.

(2) A sample (of size considered to be statistically adequate) of each type test and control ammunition, in the stage of packaging as indicated, should be placed in open storage as follows:

(a) Ammunition packaged for shipment (overpack) should be exposed for a period of 30 days.

(b) Ammunition in bandoleers/cartons should be exposed for a period of 30 days.

(c) Ammunition in clips/belts should be placed in open storage for 30 days. The cartridges, clips, and metallic link belts should be examined every tenth day during the period. The effects of exposure should be noted and recorded, but not corrected at this time. At the end of the period the clips, belts, and cartridges should be inspected.

(d) Magazines loaded with test and control ammunition should be placed in open storage for a period of 30 days. This ammunition should be exposed to rainfall, either natural or simulated, at least once during the first week of storage. At the end of 10 days of storage, half of the magazines should be unloaded and inspected. The effects of exposure should be recorded but not corrected. The ammunition should be reloaded in the magazines and replaced in open storage. The other half of the magazines should not be handled during the 30 days of storage. At the end of the 30-day period, all ammunition should be removed from all the magazines.

(3) Records should be maintained during the open storage period outlined above relative to daily temperature extremes, humidity conditions, and precipitation occuring.

(4) At the end of the 30 day storage period, all ammunition should be examined, effects of exposure noted (including photographs if appropriate), and, if deemed safe to fire, the ammunition should be fired in the appropriate weapons. Weapons performance should be observed and the results should be analyzed and compared.

(5) In a simulated tactical exercise, the test and control ammunition, in tactical packaging (bandoleers/belts) and in weapons, should be subjected to fording operations, dragged through sand and mud, and exposed to blowing dust. After exposure to the conditions described, the ammunition should be shaken or wiped off as is normally accomplished under combat conditions and, if considered safe after visual inspection, should be fired. Difficulties encountered and firing performance should be recorded. A comparison should be made between the performance of the test and control ammunition.

(6) The following test should be conducted to determine the effects of the ammunition on weapons that are not cleaned throughly after each firing and are left in open storage. The ammunition used should be new and clean; the ammunition used in the adverse conditions tests above will not be used

here. Three of each type weapons (appropriate for the test and control ammunition) should be fired for at least 5 consecutive days, with at least 100 rounds being fired each day for each rifle or automatic rifle, and 200 rounds each day for each machine gun. One of each type weapon should be fired with test ammunition; one of each type should be fired with control ammunition; and the third of each type should be fired with a mix (1 for 1) of test and control ammunition. The weapons should not be cleaned during the 5 days of firing. A round should be left chambered after each day's firing, except the last day. Weapons and ammunition should be left in open storage but covered with a poncho, or similar covering, during this period. A record of firing performance and difficulties encountered should be made. Results should be compared between the performance of test and control ammunition and weapons systems.

(7) Additional reference material pertaining to test procedures may be found in MTP/TOP 3-3-524, Adverse Conditions.

c. Data Required.

(1) Description of open storage conditions and other adverse conditions.

(2) Daily record of temperature extremes, humidity conditions, and rainfall (natural or simulated) during the open storage period.

(3) Record of ammunition inspection results at the end of the specified open storage.

(4) Record of ammunition/weapon performance after adverse conditions exposure.

(5) Record of difficulties encountered.

d. Analytical Plan.

(1) Prepare a narrative report of significant findings resulting from the collection of test data. Support the narrative with pictorial evidence where appropriate.

(2) Conduct an appropriate statistical analysis of the test data to determine any significant differences between test and control items, and between test item and stated criteria.

12. Value Analysis.

a. Objective. To determine if the test item has any features which might be eliminated without adversely affecting performance, durability, or safety.

b. Method. During the conduct of all tests, examine the test item from a value standpoint, and record comments concerning any features which

here. Three of each type weapons (appropriate for the test and control ammunition) should be fired for at least 5 consecutive days, with at least 100 rounds being fired each day for each rifle or automatic rifle, and 200 rounds each day for each machine gun. One of each type weapon should be fired with test ammunition; one of each type should be fired with control ammunition; and the third of each type should be fired with a mix (1 for 1) of test and control ammunition. The weapons should not be cleaned during the 5 days of firing. A round should be left chambered after each day's firing, except the last day. Weapons and ammunition should be left in open storage but covered with a poncho, or similar covering, during this period. A record of firing performance and difficulties encountered should be made. Results should be compared between the performance of test and control ammunition and weapons systems.

(7) Additional reference material pertaining to test procedures may be found in MTP/TOP 3-3-524, Adverse Conditions.

c. Data Required.

(1) Description of open storage conditions and other adverse conditions.

(2) Daily record of temperature extremes, humidity conditions, and rainfall (natural or simulated) during the open storage period.

(3) Record of ammunition inspection results at the end of the specified open storage.

(4) Record of ammunition/weapon performance after adverse conditions exposure.

(5) Record of difficulties encountered.

d. Analytical Plan.

(1) Prepare a narrative report of significant findings resulting from the collection of test data. Support the narrative with pictorial evidence where appropriate.

(2) Conduct an appropriate statistical analysis of the test data to determine any significant differences between test and control items, and between test item and stated criteria.

12. Value Analysis.

a. Objective. To determine if the test item has any features which might be eliminated without adversely affecting performance, durability, or safety.

b. Method. During the conduct of all tests, examine the test item from a value standpoint, and record comments concerning any features which

can be eliminated without degrading the test item in performance, durability, or safety. Guidance for the conduct of this testing may be found in TECOM Reg 700-1, Quality Assurance; Value Engineering.

c. Data Required. Comments of test soldiers and test supervisory personnel should be recorded, to include description of feature, recommended change to be made, and reasons for recommendation. Recorded comments should be in narrative form and should provide full details of conditions or events occuring during conduct of the test.

d. Analytical Plan. Summarize all data collected during the test and present the results in narrative form supplemented with charts and photographs as appropriate. Where opinions of test soldiers or judgments of test supervisory personnel are presented, identify these as such, and separate from factual data. Accumulated data should be subjectively analyzed to determine if appropriate criteria are met. Conclude with a recommendation of specific changes to be made to the test item.

Recommended changes to this publication should be forwarded to Commanding General, US Army Test and Evaluation Command, ATTN: AMSTE-ME, Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from US Army Infantry Board, ATTN: STEBC-MO-M, Fort Benning, Georgia 31905. Additional copies of this document are available from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314. This document is identified by the accession number (AD No) printed on the first page.

APPENDIX A
REFERENCES

1. AR 70-10, Test and Evaluation During Development and Acquisition of Materiel.
2. National Bureau of Standards Handbook 91, Experimental Statistics.
3. TECR 70-23, Equipment Performance Reports.
4. TECR 70-24, Documenting Test Plans and Reports.
5. TECR 310-3, TECOM Test Operations Procedures Style Manual.
6. TECR 310-6, TECOM Test Operations Procedures.
7. TECR 385-6, Verification of Safety of Materiel During Testing.
8. TECR 700-1, Quality Assurance; Value Engineering.
9. TECR 750-15, Maintenance Evaluation During Testing.
10. MTP/TOP 1-1-012, Classification of Deficiencies and Shortcomings.
11. MTP/TOP 3-1-002, Confidence Intervals and Sample Size.
12. MTP/TOP 3-3-501, Personnel Training.
13. MTP/TOP 3-3-517, Infantry Weapons and Ammunition Safety.
14. MTP/TOP 3-3-524, Adverse Conditions.
15. MTP/TOP 4-3-500, Preoperational Inspection and Physical Characteristics.
16. MTP/TOP 4-3-501, Personnel Training.
17. MTP/TOP 4-3-514, Safety Hazards.

APPENDIX B
TYPICAL MALFUNCTIONS AND THEIR ABBREVIATIONS

1. Types of Malfunctions.

FF - Failure to feed.

FF1 - Failure to feed first round.

FFR - Failure to fire.

FX - Failure to extract.

FJ - Failure to eject.

FBC - Failure of bolt to close.

IFR - Inadvertent firing.

FMR - Failure to maintain cyclic rate.

FTR - Failure of trigger to return to forward position.

F2R - Fired 2 rounds on one rearward movement of trigger.

DF - Double feed, 2 rounds fed from magazine at once.

FBF - Failure of bolt to go forward.

FCB - Fired on closure of bolt.

FBR - Failure of bolt to remain at rear after last round.

FJC - Failure to eject clip.

BCS - Bolt catch stopped forward movement of bolt before last round of magazine was fired.

FS - Failure to strip round.

FSO - Failure of bolt to sear off.

FBS - Failure of bolt to sear.

FRA - Failure to remain in assembly.

2. Causes (Usually the cause of some of the preceding malfunction):

SR - Short recoil.

BUB - Bolt underrode base of round in feeding.

BCE - Bolt catch engaged bolt carrier instead of bolt after firing the last round in the magazine.

BFE - Bolt failed to engage base of round in magazine.

BLE - Bolt lacked sufficient energy to force round from magazine.

BOB - Bolt overrode base of round in feeding from magazine.

FML*- Failure of magazine to lock in weapon.

FL - Failure to load by hand charging.

PS - Partial strip of round from magazine or link.

FFO - Failure to feed round over to stripping position.

*Cause of FF on some occasions

3. Sources (i.e., "Attributable to"):

Mag - Magazine

Ammo - Ammunition

Inst - Installation

Rep - Repetitive

Pers - Personnel

Unk - Unknown