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Materiel Test Procedure 3-3-046
U. S. Army Armor and Engineer Board

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

MACHINE GUN, TANK

1. OBJECTIVE

The objective of this Materiel Test Procedure (MTP) is to outline procedures for determining the suitability of specially designed machine guns for use in tanks or other combat vehicle installations where space is a limiting factor.

2. BACKGROUND

For the purpose of this MTP a machine gun is defined as an automatic gun using small-arms ammunition for rapid continuous firing. Machine guns have played a major role in ground and air combat actions since their invention. In World War I, they were the primary armament for the first tanks developed and committed to combat by the Allied Forces. The first machine guns were called water-cooled because a circulating water system with an outside source or reservoir of water was required to cool the gun barrel. Air-cooled machine guns were initially developed for use in aircraft. These were used in U. S. Army tanks and other combat vehicles until the beginning of World War II when they were replaced by a less expensive air-cooled machine gun that had been developed for general use by ground troops.

Development of tanks during and after World War II led to the use of increasingly larger main guns and thicker armor. These developments along with the increased size of main armament ammunition and the requirement to keep outside dimensions of the vehicle within usable limits reduced available space within the tanks to a point that use of general purpose machine guns became impractical.

The development of short receiver machine guns of the 7.62 millimeter and .50 caliber class for use in tanks was initiated in 1951. Except for an enforced period of approximately 2½ years of inactivity during the mid-1950's development and testing of these type weapons and associated ammunition and equipment has continued to this date. The 7.62 millimeter gun was developed primarily for use as a coaxial weapon for the main gun while the .50 caliber short receiver gun was primarily for use in cupolas.

In order to determine the extent to which its mission performance and military characteristics conform to requirements of the applicable Qualitative Materiel Requirement (QMR), Small Development Requirement (SDR), or other appropriate criteria, each weapon system must be tested in the field by personnel representative of those that will actually use and maintain the item under combat conditions.

3. REQUIRED EQUIPMENT

- a. Maintenance Facilities (organizational, direct support and

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general support).

- b. Vehicles for which test items are designed.
- c. On Equipment Materiel (OEM) for above vehicles and Basic Issue Items of Stowage.
- d. Applicable Firing Ranges and Targets.
- e. Appropriate Driving Areas (Paved Highways, Gravel Roads, and Cross-Country Courses).
- f. Cameras, Still, Motion or Video as available with necessary Film and Video Recorder when applicable.
- g. Platform Scales.
- h. Stop Watches.
- i. Appropriate Standard Ammunition
- j. Ambulance with medical aid personnel and equipment.
- k. Boresighting devices as required.
- l. Star Gage, Borescope or other instruments as required to measure barrel wear and overall condition.
- m. Gridded Target.
- n. Tape Measure.
- o. Meteorological Equipment as required for determining:
 - 1) Wind speed and direction
 - 2) Ambient temperature
 - 3) Relative humidity
- p. Comparison weapons.
- q. Forms for recording data.
- r. Fixed and Rotary Wing Aircraft.
- s. Radio Controlled Aircraft Target (RCAT) Drones.
- t. Towed (Sleeve Type) Targets

4.

REFERENCES

- A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- B. USAMC Regulation 385-12, Verification of Safety of Materiel From Development through Testing, Production, and Supply to Disposition.
- C. AR 385-63, Safety Regulations for Firing Ammunition for Training, Target Practice, and Combat.
- D. FM 17-12, Tank Gunnery, November 1964, or later version.
- E. MTP 2-3-500, Preoperational Inspection and Physical Characteristics.
- F. MTP 2-3-501, Safety Hazards.
- G. MTP 2-3-502, Maintainability.
- H. MTP 2-3-507, Reliability.
- I. MTP 2-3-508, Stowage.
- J. MTP 2-3-527, Maintenance Evaluation - Tools and Test Equipment.
- K. MTP 2-3-528, Maintenance Evaluation - Technical Manuscripts and Manuals.
- L. MTP 3-3-500, Preoperational Inspection and Physical Characteristics (Armament and Individual Weapons).
- M. MTP 3-3-503, Boresight and Zero.

- N. MTP 3-3-504, Close-In Fields of View and Fire.
- O. MTP 3-3-505, Speed and Precision of Lay.
- P. MTP 3-3-507, Tracking and Hitting Performance, Stationary Gun Mount-Moving Target.
- Q. MTP 3-3-508, Tracking and Hitting Performance, Moving Gun Mount-Stationary Target.
- R. MTP 3-3-509, Tracking and Hitting Performance, Moving Gun Mount-Moving Target.
- S. MTP 3-3-510, Weapons Functioning.
- T. MTP 3-3-515, Position Disclosing Effects.
- U. MTP 3-3-516, Obscuration.
- V. MTP 3-3-521, Human Factors Engineering.
- W. MTP 3-3-522, Ease of Assembly and Disassembly.
- X. MTP 3-3-523, Troop Acceptability.
- Y. MTP 3-3-524, Adverse Conditions.
- Z. MTP 3-3-525, Vehicular Mounted Automatic Weapon Dispersion.
- AA. MTP 4-3-519, Compatibility with Fire Control Equipment.
- AB. MTP 10-3-501, Operator Training and Familiarization.

5. SCOPE

5.1 SUMMARY

This MTP outlines the following procedures for evaluating machine guns designed for use in tanks.

a. Preparation for Test - Procedures for the training of personnel, arranging for equipment and facilities and for reviewing the safety release to determine the operational limitations, if any, placed on the test item due to safety hazards.

b. Safety Hazards - A determination of the inherent safety hazards and a continuous evaluation of the safety aspects of the test item throughout the service test to support the safety confirmation (safe for intended use) statement required in service test reports by reference 4A.

c. Preoperational Inspection and Physical Characteristics - Pretest inspection, service and repair of the test item as required to ensure that it is in proper condition for test operation, and to determine whether physical characteristics meet specified requirements.

d. Human Factors Engineering - An evaluation to determine the human factors engineering aspects of the test item and its compatibility with the skills and aptitudes of personnel who will operate and service it.

e. Ease of Assembly and Disassembly - A test to determine the simplicity and ease of assembly and disassembly of the test item.

f. Installation - A test to determine the time, tools and level of maintenance required to make the initial installation and the time and tools required by crewmen for subsequent removal and reinstallation of the test weapon and auxiliary equipment and the effect of vehicle stowage on the installed test item.

g. Compatibility With Fire Control Equipment - A test to determine the compatibility of sights and other related fire control equipment for use with the test weapon.

h. Break-In Firing - Firing exercises to ensure that all aspects of the weapon system are functioning properly or to service, adjust or repair the system as required to obtain maximum performance.

i. Boresight and Zero - A test to determine whether the test weapon and associated fire control equipment can be alined on a common aiming point at prescribed ranges; whether there is sufficient movement of the sights or mount to permit zeroing the system; the degree to which boresight alinement can be maintained under varying climatic and operating conditions.

j. Close-In Fields of View and Fire - A test to determine the lateral and vertical close-in fields of view and fire of the test item installed in appropriate vehicles.

k. Speed and Precision of Lay - A test to determine the average time to lay the sights precisely on a target under optimum and field conditions.

l. Dispersion - A test to determine the dispersion of the test weapon throughout various stages of the usable life of the gun barrel.

m. Weapon Functioning - An evaluation of all aspects of weapon functioning throughout various stages of useful gun life.

n. Obscuration - An evaluation to determine the degree and time that muzzle flash, smoke, blast and dust causes the target to be obscured from the gunner's/commander's view.

o. Position Disclosing Effects - An evaluation to determine vehicle exposure and signature effects (silhouette, smoke, flash, blast and reflections) resulting from day and night firing of the test weapon.

p. Tracking and Hitting Performance - A series of tests to determine the effectiveness of the test weapon and associated fire control equipment under conditions of stationary gun mount-moving target; moving gun mount-stationary target and moving gun mount-moving target.

q. Antiaircraft Firing - A test to determine the capability of the test weapon and associated fire control equipment to track and successfully engage aerial type targets.

r. Tank Crew Gunnery Qualification Firing - A series of tests to compare the test and comparison (standard) weapon, which the test item is intended to replace, using established procedures and qualification courses.

s. Troop Acceptability - An evaluation of the subjective appraisal of the individual soldier as to the overall acceptability of the test weapon for troop use.

t. Adverse Conditions - A test to determine the performance of the test item under adverse environmental conditions encountered during service testing.

u. Maintenance Evaluation consisting of the following:

- 1) Maintainability - A determination of the maintenance requirements, both scheduled and unscheduled, of the test item, and the ease of performing the required maintenance action.
- 2) Tools and Test Equipment - An evaluation to determine whether common and special tools and test equipment furnished for the test item are suitable for intended purpose and maintenance level.
- 3) Technical Manuscripts and Manuals - An evaluation to determine

the adequacy of technical publications provided.

v. Reliability - An evaluation of the test item's reliability to include information regarding expected service life.

5.2 LIMITATIONS

The procedures in this MTP are limited to in-vehicle installations of tank machine guns, i.e., coaxial and cupola applications.

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Personnel

Ensure that the data described in MTP 10-3-501 is recorded for each test participant and that personnel are trained in accordance with the procedure outlined therein and in AR 385-63 (reference 4C).

6.1.2 Equipment and Facilities

Ensure that equipment and facilities listed in paragraph 3 and in Materiel Test Procedures shown in paragraph 4 are available.

6.1.3 Safety Release

The project officer shall ensure that a safety release in accordance with USATECOM Regulation 385-6 (reference 4A) which includes information pertaining to operational limitations and specific hazards peculiar to the test item, has been received from HQ USATECOM and is understood prior to commencing testing.

6.2 TEST CONDUCT

NOTE: Standard machine guns should be used in side by side comparison testing to the fullest extent practicable.

6.2.1 Safety Hazards

Conduct a continuing evaluation of all safety aspects of the test item throughout the service test as described in applicable sections of MTP 2-3-501.

6.2.2 Preoperational Inspection and Physical Characteristics

Perform inspections, inventories, measurements (dimensions), weighing, photographing, servicing and required repairs to the test item and all related fire control equipment and vehicular components as described in MTP 3-3-500 and MTP 2-3-500.

6.2.3 Human Factors Engineering

Determine the effectiveness of the man-machine relationship during use of the test item as described in MTP 3-3-521.

6.2.4 Ease of Assembly and Disassembly

a. Have test item disassembled and assembled by a least five crewmen a sufficient number of times to compile a valid average for representative crewmen and record data as described in MTP 3-3-522.

b. Make motion or video pictures of the above tasks to the extent practical.

c. Review films, especially those of personnel with slower than average times to determine problem areas, if possible.

6.2.5 Installation

a. Unless otherwise directed and if it appears feasible, initially install the test item and auxiliary equipment in one of the vehicles in which it is intended to be used using the vehicle crew and on equipment materiel (OEM) tools and record the following:

NOTE: If installation is beyond the capability of the vehicle crew, organizational or direct support maintenance personnel and tools and equipment will be used as necessary.

- 1) Serial number of test item installed.
- 2) Type and serial number, when applicable, of all auxiliary equipment received with the test item.
- 3) Modification made to the test item or auxiliary equipment, if any.
- 4) For the vehicle in which the test item and auxiliary equipment were installed:
 - a) Nomenclature and serial number
 - b) Modifications made
- 5) Level of maintenance at which test items were installed and/or modified.
- 6) Number of personnel required for installation by military occupation specialty (MOS).
- 7) Number of man hours and clock hours required for:
 - a) Making modifications
 - b) Installing test items and auxiliary equipment
- 8) Tools required for making modifications and/or installing

b. After installation, perform the following to ascertain, whether the test item and auxiliary equipment as installed, interferes in any way with the normal functioning of the vehicle or other on-vehicle components and record results:

- 1) Elevate and depress test item to the maximum.
- 2) Traverse test item to maximum extent.
- 3) Check for twisting or binding of ammunition feed chute and empty cartridge case and link chutes while performing tasks described in b.1 and b.2, above.
- 4) Check for interference or dragging of empty cartridge case and belt link bag while performing tasks described in b.1 and b.2 above.
- 5) Determine whether the weapon sight(s) can be used without undue strain on the gunner while performing tasks described in b.1 and b.2, above

c. After crews are familiar with installation and removal procedures for the test weapon(s), repeat these tasks at least five times and record the difficulties encountered and the time required for each task. Determine and record the average time for each task and perform the following:

- 1) Make motion or video pictures of above tasks to the extent practicable.
- 2) Review films, especially those of personnel with lower than average times in an effort to determine the reasons therefor.
- 3) Photograph the installed test gun using dummy ammunition belt with the gun in the following attitudes:
 - a) Level
 - b) Maximum elevation
 - c) Maximum depression

d. Stow and photograph the fighting compartments of the parent vehicle to the extent practical using as guidelines the procedures described in MTP 2-3-508 recording all substitute materiel used for missing OEM and basic items of equipment and repeat the procedures described in steps a and b, above.

e. Repeat the procedures described in step a through d above, for each additional type vehicle in which the test item is intended to be used, if available, and record the following:

- 1) All vehicles in which the test item is intended to be installed.
- 2) Serial number of each test weapon received but not installed.

6.2.6 Compatibility with Fire Control Equipment

Verify the compatibility of the test item with the fire control system by performing the applicable portion of procedures described in MTP 4-3-519, and recording the applicable data.

6.2.7 Break-In Firing

a. Conduct single shot and prescribed size burst firing, with the test item installed in one of the vehicles in which it is intended to be used, using a firing range of not greater than 100 meters, to the extent required to ensure that:

- 1) The test weapon and firing mechanism are properly adjusted.
- 2) The test weapon is positively secured to the weapon mount and that the bolts or studs used for securing the mount are properly tightened and locked, when applicable.
- 3) The firing rate control mechanism, if provided, is functioning properly.
- 4) The weapon will feed properly from both sides, when applicable.

b. Make adjustments, replacements and repairs as required to obtain proper functioning, reasonable accuracy and consistency in target strike while firing by single shots and bursts.

c. Identify and photograph the targets of groups fired, all defective parts, damaged cartridge cases, jammed feed chutes, twisted belts or other evidence of malfunction as practicable.

d. Repeat procedures described in steps a, b, and c above for each type vehicle in which the test item is intended to be used.

e. Record the following for each test item-parent vehicle combination:

- 1) Date and time.
- 2) Nomenclature and serial number of test item.
- 3) Nomenclature and serial number of parent vehicle.
- 4) Range to target.
- 5) Type and lot number of ammunition.
- 6) Number of single shots fired.
- 7) Number and size of bursts fired.
- 8) Rate of fire (slow or full automatic), when applicable.
- 9) Problems encountered in loading, feeding, firing, extracting or ejecting.
- 10) Servicing, adjustments, repairs or parts replaced.
- 11) Fire control equipment used.
- 12) Extreme (100 percent) horizontal and vertical dispersion in inches for each final group fired:
 - a) Single shot
 - b) Slow automatic
 - c) Full automatic
- 13) Ambient temperature.
- 14) Relative humidity.
- 15) Wind speed and direction.

6.2.8 Boresight and Zero

Boresight and zero the test item as described in applicable sections of MTP 3-3-503.

6.2.9 Close-In Fields of View and Fire

Determine the close-in fields of view and fire characteristics of the test item as described in the applicable sections of MTP 3-3-504.

6.2.10 Speed and Precision of Lay

Determine the speed and precision of the lay characteristics of the test item as described in the applicable sections of MTP 3-3-505.

6.2.11 Dispersion

Determine the dispersion characteristics of the test item as described in the applicable sections of MTP 3-3-525.

6.2.12 Weapons Functioning

Determine the weapon functional characteristics of the test item as described in the applicable sections of MTP 3-3-510.

6.2.13 Obscuration

Determine the obscuration characteristics of the test item as described in the applicable sections of MTP 3-3-516.

6.2.14 Position Disclosing Effects

Determine the position disclosing characteristics of the test item as described in the applicable sections of MTP 3-3-515.

6.2.15 Tracking and Hitting Performance

Evaluate the tracking and hitting performance of the test item as described in the applicable section of the indicated MTP's for each of the following weapon target modes:

- a. Stationary Gun Mount-Moving Target, MTP 3-3-507
- b. Moving Gun Mount-Stationary Target, MTP 3-3-508
- c. Moving Gun Mount-Moving Target, MTP 3-3-509

6.2.16 Antiaircraft Firing

- NOTE:
1. This test will be divided into two parts, i.e., non-firing and firing.
 2. Comparison weapons will be used to the extent possible in both the non-firing and firing exercises.

6.2.16.1 Non-Firing Procedures

a. Boresight and zero the cupola weapon system as described in paragraph 6.2.8 and mount and align a motion or video camera on the weapon with the weapon and sight.

b. Have fixed rotary wing aircraft capable of speeds up to 250 knots and RCAT drones, if available, operate and take evasive action similar to actual combat situations within test item range in accordance with the following guidelines:

- 1) The direction of approach of the aircraft will be unknown to the gunner (tank commander).
- 2) The project officer will alert the gunner that aircraft is approaching without indicating the direction of approach and start his stop watch. He will stop his watch and notify the gunner when the aircraft becomes masked, he considers it to have outmaneuvered the weapon system or passed beyond effective range. Upon being alerted the gunner must:
 - a) Locate aircraft.
 - b) Traverse cupola and align sights on aircraft, depress firing switch and track target with firing switch depressed until told to cease firing.
- 3) Total time for procedure will be recorded as indicated on the project officer's stop watch.
- 4) The following should be photographed and clearly shown on the film and recorded:
 - a) Date and time
 - b) Gunner's name or numerical designation
 - c) Exercise number
 - d) Weapon used including model and serial number
 - e) Type of aircraft
 - f) Speed and direction of approach of aircraft

c. Repeat step b until at least three gunners perform the procedures of step b above at least three times on each type of aircraft available and vary the altitude, speed, direction of approach and evasive maneuvering of the aircraft to the greatest extent practicable.

d. Record the following for each exercise for each gunner:

- 1) Type vehicle gun was installed in
- 2) Mode of operation (power or manual)
- 3) Type photography used
- 4) Type sight used
- 5) Total length of exercise
- 6) Evasive maneuvering, if any, by target
- 7) Time gunner was on-target
- 8) Percentage of time gunner was on-target
- 9) Difficulties, if any, in manipulating weapon system controls

6.2.16.2 Firing Procedures

a. Prepare the weapon and camera for firing as described in paragraph 6.2.16.1.a.

b. Engage RCAT drones at slant ranges and speeds specified for the weapon system or if none is specified, at ranges up to 1,000 meters and speeds up to 250 knots using experienced gunners who participated in the non-firing test and perform the following:

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NOTE: Firing conditions should simulate actual combat to the extent possible within safety requirements.

- 1) All firing will begin and cease upon command of the project officer.
- 2) Each procedure should be photographed with the following clearly shown on the film and recorded:
 - a) Date and time
 - b) Gunner's name or numerical designation
 - c) Procedure number
 - d) Weapon used
 - e) Type of aircraft
 - f) Speed, range to target, and direction of flight in relation to the weapon during period of firing.
- 3) Record the data of paragraph 6.2.16.1.b4 and the following:
 - a) Type of ammunition.
 - b) Target hit or missed and number of hits on target, when applicable.
 - c) Number of rounds fired.
- 4) Review all films and record the following:
 - a) Time target was in view.
 - b) Time proper lead was maintained (indicate whether an automatic lead computer was used).
 - c) Time target was not in view.

c. Repeat step b until a minimum of two gunners have performed the described procedures at least twice for each target/range condition.

d. Repeat the procedures in steps a and b above using sleeve type targets towed by fixed and/or rotary wing type aircraft with the target crossing left to right, right to left and incoming.

6.2.17 Tank Crew Gunnery Qualification Firing

a. Using procedures and range facilities as prescribed in FM 17-12 Tank Gunnery (reference 4D) for each Specified Firing Table, conduct the following or applicable parts thereof for the test item and a comparison (standard) weapon.

- 1) Table I - Zeroing and Initial Lay Exercises (paragraph 206, page 171).
- 2) Table VIA - Crew Machinegun Exercises (Day) (paragraph 215, page 188).
- 3) Table VIIIA - Crew Proficiency Exercises (Day) (paragraph 219, page 198).

b. Establish score cards and record results of firing conducted in

a above as shown in FM 17-12 (reference 4D) for each of the Tables.

c. Repeat the procedures and record data as described in steps a and b above respectively for each of the vehicles on which the test item is intended to be used with at least four different crewmen firing each table at least twice and with the standard weapon firing concurrently with the test item.

d. Photograph representative targets as appropriate to show variations in dispersion patterns and centers of impact from aiming point for each weapon-vehicle combination.

6.2.18 Troop Acceptability

Determine the troop acceptability of the test item as described in the applicable sections of MTP 3-3-523.

6.2.19 Adverse Conditions

Determine the suitability of the test item for its intended purpose under adverse conditions as described in the applicable sections of MTP 3-3-524.

6.2.20 Maintenance Evaluation

6.2.20.1 Maintainability

Determine the maintainability of the test item by conducting the maintainability evaluations and computations and recording data as described in MTP 2-3-502, classifying the malfunctions, as indicated in step f below, using the following standards which are applicable for testing coaxial machine guns and in principle are applicable for cupola mounted machine guns.

NOTE: Standards for cupola mounted machine guns are not available but in principle would be similar to and handled with the same format as for the coaxial machine gun.

a. A minimum of adjustments shall be required and ease of maintenance to include unit replacement of major assemblies shall be provided.

b. If possible, adjustments affecting functioning shall not be required. Any essential initial adjustments shall be simple and readjustments shall be unnecessary during firing.

c. A quick-change barrel is desirable.

d. It is desirable that standard lubricants be used.

e. Spare parts, as appropriate, with spare parts box shall be furnished.

f. The critical factor in respect to tank machine gun malfunctioning is that of time out of action. The following definitions and time limits for various classes of malfunctions shall apply:

- NOTE: 1. Appendix A is a list of abbreviations for use in reporting types, causes and sources of malfunctions.
2. Any or all of the information in Appendix A may require revision because of changes in design of weapons and

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nomenclature of parts.

- 1) Class I - Malfunctions due to gun, ammunition, or feed system which can be corrected by immediate action within a 10-second period of time, including a 5-second delay to allow for possible hangfire.
- 2) Class II - Malfunctions due to gun, ammunition, or feed system which are not correctable by immediate action procedures but which can be corrected by minor adjustment within a 60-second period of time.
- 3) Class III - Malfunctions not corrected by immediate action followed by troubleshooting procedures in an elapsed time of 1 minute (I and II, above) but which can be corrected by minor adjustment(s), lubrication, or part replacement effected by the tank crew loader using only tools and repair parts authorized as on-vehicle BIIL and restoring the weapon to operation in an elapsed time of not more than 3 minutes (desirable) or not longer than 5 minutes, including time for field-stripping/reassembly.
- 4) Class IV - Malfunctions which cannot be corrected by the tank crew loader under the terms of Class I, II, and III, above (including lack of an essential part as spare) but which are correctable by an organizational turret mechanic using the tools, spare parts resources and/or skills normally available at that level, to include detailed disassembly of the weapon as necessary. No specific time limit is defined as part of this criterion.
- 5) Class V - Malfunctions of a nature which can be equated to basic weapon failure not correctable at organizational maintenance level and which require evacuation of the failed weapon to a Direct Support or General Support installation for special maintenance or rebuild.

6.2.20.2 Tools and Test Equipment

Throughout the performance of all daily maintenance service and all maintenance tasks, maintain a record of tools and test equipment utilization as prescribed in MTP 2-3-527 for determining whether the common and special tools and test equipment are suitable for the intended purpose and prescribed level of maintenance.

6.2.20.3 Technical Manuscripts and Manuals

Evaluate throughout the test all equipment publications provided with or furnished as guidance for the use and maintenance of the test item with respect to availability, adequacy, accuracy and currency and the forwarding of required changes as prescribed in MTP 2-3-528.

6.2.21 Reliability

Determine the reliability of the test items, expected service life

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and logistic support requirements for the test item as described in the applicable sections of MTP 2-3-507, using the following standards which are applicable for testing coaxial machine guns and in principle are applicable for cupola mounted machine guns:

NOTE: Standards for current cupola machine guns are not available but in principle are similar to and handled with the same format as for the coaxial machine gun.

a. Mechanical reliability is the prime consideration. The gun shall be simple, rugged, and incorporate a minimum number of parts.

b. The barrel shall retain an accuracy life for 3,000 rounds when fired at a rate of 85 rounds per minute in 20-round bursts, or 1,500 rounds when fired at a rate of 150 rounds per minute in 30-round bursts.

c. Design shall incorporate reliability.

d. Working parts, particularly recoiling parts, shall be protected against weather and unfavorable handling and operating conditions.

e. The functional reliability of the machine gun, with mounting-firing accessories, and the related durability of working parts shall be such as to minimize the occurrence of malfunctions of all classes.

f. Acceptable incidence rates for coaxial machine guns for each of the five classes of malfunctions (I through V) defined in paragraph 6.2.20.1.f above are based on 95 percent level of confidence and are as follows: (See Appendix B for confidence curves).

- 1) No more than one stoppage (Class I malfunction) clearable by immediate action in 1,000 rounds.
- 2) No more than one stoppage (Class II malfunction) not clearable by immediate action but not requiring parts replacement in 2,500 rounds.
- 3) No more than one malfunction requiring parts replacement by the operator (Class III malfunction) in 10,000 rounds.
- 4) No more than one malfunction requiring Organizational or Direct Support correction (Class IV and V malfunctions) in 24,000 rounds.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Personnel

Record data for each test participant as described in MTP 10-3-501.

6.3.2 Test Conduct

6.3.2.1 Safety Hazards

Record data collected as described in applicable sections of MTP 2-3-501.

6.3.2.2 Preoperational Inspection and Physical Characteristics

Record data collected as described in applicable sections of MTP 2-3-500 and MTP 3-3-500.

6.3.2.3 Human Factors Engineering

Record data collected as described in the applicable sections of MTP 3-3-521.

6.3.2.4 Ease of Assembly and Disassembly

a. Record the following:

- 1) Data collected as described in the applicable sections of MTP 3-3-522.
- 2) Problems encountered.

b. Retain all films.

6.3.2.5 Installation

Record or retain the following:

- a. Number of test weapons received by serial number.
- b. Number, type and serial number, when applicable, of all auxiliary equipment received with test items.
- c. Vehicles by nomenclature in which the test item is intended to be used.
- d. For each vehicle in which the test weapon and auxiliary equipment were installed:

- 1) Serial number of installed test item.
- 2) Nomenclature and serial number of vehicle.
- 3) Modifications, if any, made to test materiel or parent vehicle.
- 4) The level of maintenance at which test items were installed and/or modified.
- 5) Number of personnel required to perform task by military occupation specialty (MOS).
- 6) Number of man hours and clock hours required for:
 - a) Making modifications
 - b) Installing test items and auxiliary equipment
- 7) Tools required to:
 - a) Make modifications
 - b) Install test item(s) and auxiliary equipment
- 8) Interference encountered while elevating, depressing and traversing the test item.
- 9) Twisting and binding of ammunition feed chute.
- 10) Dragging or rubbing of empty cartridge case and belt link bag.

- 11) Problems, if any, in using the sight(s) at varying degrees of elevation and depression.
- 12) Time required for each crew to make each installation and removal of the test weapon.
- 13) Average time required to install and remove the test weapon.
- 14) All on equipment materiel (OEM) and basic issue items of equipment not available for stowing in the fighting compartment.

e. Retain all photographs.

6.3.2.6 Compatibility With Related Fire Control Equipment

Record data collected as described in the applicable sections of MTP 4-3-519.

6.3.2.7 Break-In Firing

a. Record the following for each test item-parent vehicle combination:

- 1) Date and time.
- 2) Nomenclature and serial number of test item.
- 3) Nomenclature and serial number of parent vehicle.
- 4) Range to target in meters.
- 5) Type and lot number of ammunition.
- 6) Number of single shots fired.
- 7) Number and size of bursts fired.
- 8) Rate of fire (slow or full automatic), when applicable.
- 9) Problems encountered in loading, feeding, firing, extracting or ejecting.
- 10) Servicing, adjustments, repairs or parts replaced.
- 11) Fire control equipment used.
- 12) Extreme (100 percent) horizontal and vertical dispersion in inches for each final group fired:
 - a) Single shot
 - b) Slow automatic
 - c) Full automatic
- 13) Ambient temperature in °F.
- 14) Relative humidity in %.
- 15) Windspeed and direction in mph and degrees.

b. Retain all photographs

6.3.2.8 Boresight and Zero

Record data collected as described in the applicable sections of MTP 3-3-503.

6.3.2.9 Close-In Fields of View and Fire

Record data collected as described in the applicable sections of MTP 3-3-504.

6.3.2.10 Speed and Precision of Lay

Record data collected as described in the applicable sections of MTP 3-3-505.

6.3.2.11 Dispersion

Record data collected as described in the applicable sections of MTP 3-3-525.

6.3.2.12 Weapons Functioning

Record data collected as described in the applicable sections of MTP 3-3-510.

6.3.2.13 Obscuration

Record data collected as described in the applicable sections of MTP 3-3-516.

6.3.2.14 Position Disclosing Effects

Record data collected as described in the applicable sections of MTP 3-3-515

6.3.2.15 Tracking and Hitting Performance

Record data collected as described in applicable sections of:

- a. MTP 3-3-507 for stationary gun mount-moving target
- b. MTP 3-3-508 for moving gun mount-stationary target
- c. MTP 3-3-509 for moving gun mount-moving target

6.3.2.16 Antiaircraft Firing

6.3.2.16.1 Non-Firing Procedures -

Record the following for each exercise for each gunner:

- a. Date and time
- b. Model number and serial number of gun used
- c. Type vehicle gun was installed in
- d. Mode of operation (power or manual)
- e. Exercise number
- f. Type of target
- g. Speed and direction of target travel
- h. Type photography used
- i. Type sight used

- j. Total length of exercise (minutes and seconds)
- k. Evasive maneuvering, if any, by target
- l. Time gunner was on-target
- m. Percentage of time gunner was on-target
- n. Difficulties, if any, in manipulating weapon system controls
- o. Gunners name and numerical designation

6.3.2.16.2 Firing Procedures -

Record data as indicated in paragraph 6.3.2.16.1 and the following for each firing exercise for each gunner:

- a. Type of ammunition used
- b. Target hit or missed and number of hits on target, when applicable
- c. Number of rounds fired
- d. Time target was in view in seconds
- e. Time target was not in view in seconds
- f. Time proper lead was maintained in seconds
- g. Whether or not automatic lead computer was used

6.3.2.17 Tank Crew Gunnery Qualification Firing

- a. Retain all score cards and photographs
- b. Record all difficulties and problem areas encountered

6.3.2.18 Troop Acceptability

Record data collected as described in the applicable sections of MTP 3-3-523.

6.3.2.19 Adverse Conditions

Record data collected as described in the applicable sections of MTP 3-3-524.

6.3.2.20 Maintenance Evaluation

6.3.2.20.1 Maintainability -

Record data collected as described in the applicable sections of MTP 2-3-502.

6.3.2.20.2 Tools and Test Equipment -

Record data collected as described in the applicable sections of MTP 2-3-527.

6.3.2.20.3 Technical Manuscripts and Manuals -

Record data collected as described in the applicable sections of MTP 2-3-528.

6.3.2.21 Reliability

Record data collected as described in the applicable sections of MTP 2-3-507.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 General

a. All data obtained by inspection, observation, questionnaires and testing, including photographs, should be suitably tabulated or otherwise arranged and presented in a manner to indicate whether the test item met the established criteria.

b. A Safety Confirmation shall be presented in accordance with USATECOM Regulation 385-6 (reference 4A).

6.4.2 Antiaircraft Firing

6.4.2.1 Non-Firing Procedures

Compute the average of the percentage of time-on-target for non-firing runs for each gunner with each type weapon in each type vehicle in each mode of operation for each sight and each target condition. Total the averages and present a summary for all gunners for each condition and the grand average.

6.4.2.2 Firing Procedures

Compute the average percentage of targets hit by each gunner with each type weapon in each type vehicle in each mode of operation for each sight and each target condition. Total the averages and present a summary for all gunners for each condition and the grand average.

6.4.2.3 Tank Crew Gunnery Qualification Firing

Average the score obtained by each crewman with each weapon-vehicle combination for each Table fired in the qualification firing. Total the average for all crewmen with each weapon-vehicle combination for each Table and compute the grand average for each weapon-vehicle combination.

Present a summary of malfunctions showing type/cause relationship. (See Table I sample data presentation).

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Table I. Example of Data Presentation for Malfunctions

Malfunctions During Dispersion Test - Gun No. 0001 (1000 Rounds Fired)																																							
Type	No.	Cause	Attributed to																																				
FF	4	Rounds mispositioned in defective links	Links, 4																																				
	1	Damaged round	Ammo, 1																																				
FFR	1	Broken firing pin	Gun, 1																																				
	1	Firing pin not installed	Pers, 1																																				
FX	2	Broken extractor	Gun, 1																																				
			Rep, 1																																				
FJ	2	SR, damaged piston	Gun, 1																																				
			Rep, 1																																				
FBC	1	Weak driving spring	Gun, 1																																				
IFR	1	Uncontrolled fire, worn sear	Gun, 1																																				
FF	1	Unknown	Unk, 1																																				
<u>Summary of Malfunctions</u> <table> <tr> <th></th><th><u>Attributed To</u></th><th><u>Stoppages</u></th><th><u>Other</u></th></tr> <tr> <td>Gun</td><td>4</td><td>1</td><td></td></tr> <tr> <td>Links</td><td>4</td><td>-</td><td></td></tr> <tr> <td>Ammunition</td><td>1</td><td>-</td><td></td></tr> <tr> <td>Installation</td><td>-</td><td>1</td><td></td></tr> <tr> <td>Repetitive</td><td>-</td><td>2</td><td></td></tr> <tr> <td>Personnel</td><td>-</td><td>1</td><td></td></tr> <tr> <td>Unknown</td><td><u>1</u></td><td><u>-</u></td><td></td></tr> <tr> <td>TOTALS</td><td>10</td><td>5</td><td></td></tr> </table>					<u>Attributed To</u>	<u>Stoppages</u>	<u>Other</u>	Gun	4	1		Links	4	-		Ammunition	1	-		Installation	-	1		Repetitive	-	2		Personnel	-	1		Unknown	<u>1</u>	<u>-</u>		TOTALS	10	5	
	<u>Attributed To</u>	<u>Stoppages</u>	<u>Other</u>																																				
Gun	4	1																																					
Links	4	-																																					
Ammunition	1	-																																					
Installation	-	1																																					
Repetitive	-	2																																					
Personnel	-	1																																					
Unknown	<u>1</u>	<u>-</u>																																					
TOTALS	10	5																																					

APPENDIX A

ABBREVIATIONS USED IN REPORTING MALFUNCTIONS

Types of Malfunctions

FF	- Failure to feed
FFR	- Failure to fire
FX	- Failure to extract
FJ	- Failure to eject
FRA	- Failure to remain in assembly
IFR	- Inadvertent firing
FC	- Failure to chamber round
FMR	- Failure to maintain cyclic rate
PS	- Partial strip round from link
FFR ELC	- Failure to fire electrically
FXS	- Failure to extract because of swelled cartridge case
FBR	- Failure of bolt to remain at rear after last round
FJL	- Failure to eject link
FD	- Failure to detonate
FS	- Failure to strip round from link
FBC	- Failure of bolt (breechblock) to close

Causes (Usually the cause of some of the preceding malfunctions)

SR	- Short recoil
BS	- Belt separation
BUB	- Bolt underrode base of round in feeding
WO	- Walk off of round from link
BCE	- Bolt catch engaged bolt carrier instead of bolt after firing the last round
LB	- Light blow on primer
BFE	- Bolt failed to engage base of round
FL	- Failure to load by hand charging
PS	- Partial slip of round from link
FFO	- Failure to feed round over to stripping position

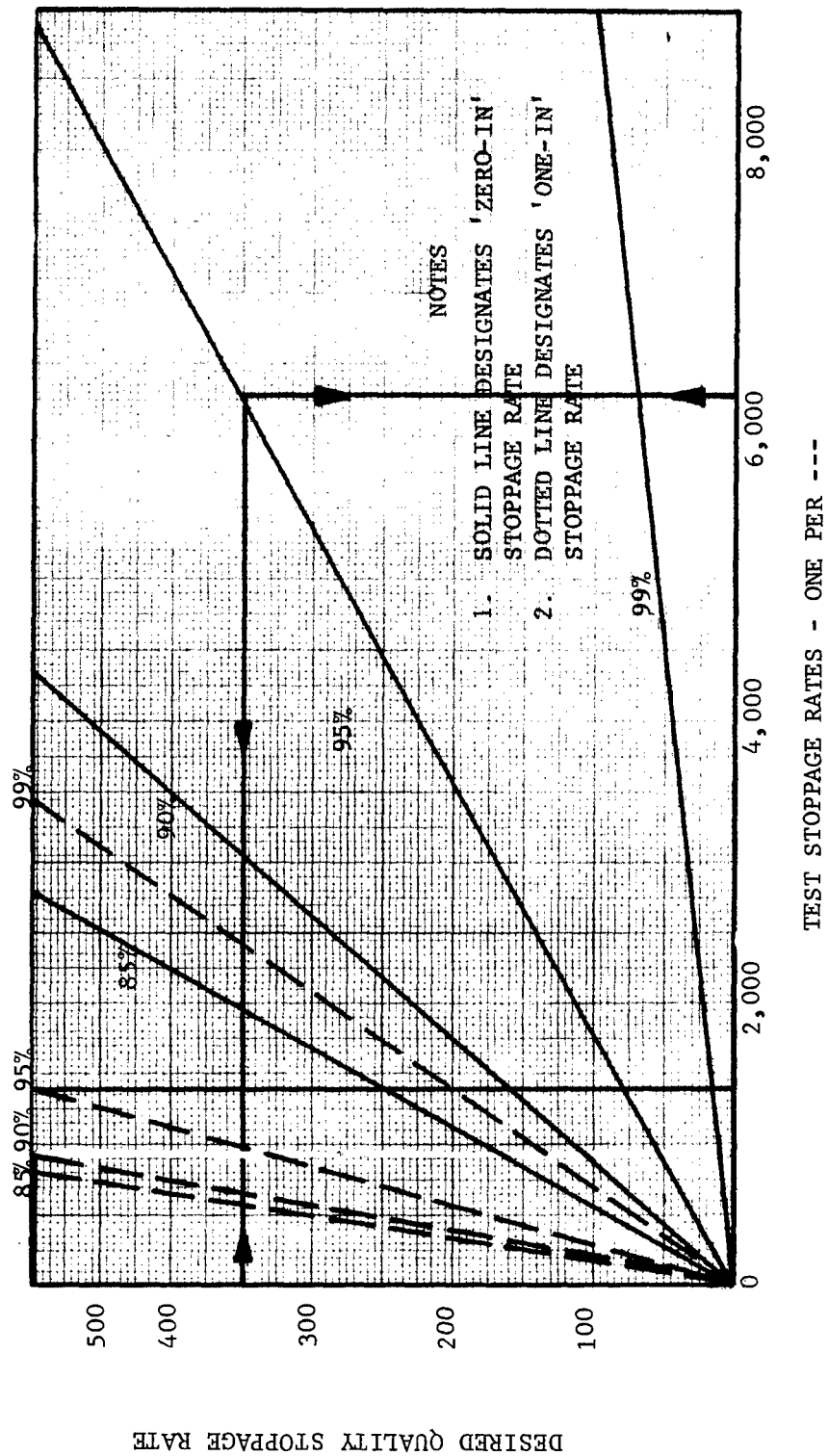
Sources (i.e., "Attributable to")

Ammo	- Ammunition
Inst	- Installation
Rep	- Repetitive
Pers	- Personnel
Unk	- Unknown

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APPENDIX B
CONFIDENCE CURVES
TEST STOPPAGE RATE
VS
DESIRED QUALITY RATE



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13. ABSTRACT This Army Service Test Procedure describes test methods and techniques for evaluating the performance and characteristics of Machine Guns (for Tanks or other Combat Vehicles), and for determining their suitability for service use by the U. S. Army. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), or other appropriate design requirements and specifications.			

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