

AD 717384

10 March 1969

Materiel Test Procedure 3-4-006
U. S. Army Arctic Test CenterU. S. ARMY TEST AND EVALUATION COMMAND
ENVIRONMENTAL TEST PROCEDURE

ARCTIC ENVIRONMENTAL TEST OF AUTOMATIC CREW SERVED WEAPONS

1. OBJECTIVE

The objective of this procedure as outlined in this MTP is to provide a means of evaluating the performance of automatic crew served weapons under arctic winter environmental conditions.

2. BACKGROUND

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

3. REQUIRED EQUIPMENT

- a. Rate of fire recorder
- b. Shot group computer
- c. Weapons as required
- d. Ammunition as required
- e. Standard American targets
- f. M1950 Parachutists adjustable individual weapon containers (or latest standard containers)
- g. Support aircraft
- h. Appropriate arctic winter uniforms and individual field gear.
- i. All general and special tools, tool kits, and other ancillary items for use in performing maintenance on the test item up to including general support level as specified in the technical manuals.
- j. Meteorological support facility
- k. Vehicles as required
- l. Test equipment as required
- m. Camera scale
- n. Still and motion picture cameras with associated photographic equipment (black and white or color).

4. REFERENCES

- A. AR 705-15 chg 1, Operations of Materiel Under Extreme Conditions of Environment
- B. AR 705-5, Army Research and Development
- C. AR 70-10, Army Materiel Testing

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- D. AR 750-6, Maintenance Support Planning
- E. AR 70-8, Human Factors and Social Sciences Research
- F. USATECOM Reg 705-2, Documenting, Test Plans and Reports
- G. MTP 3-2-504, Safety Evaluation - Hand and Shoulder Weapons

5. SCOPE

5.1 SUMMARY

The procedures outlined in this MTP are designed to determine and evaluate the functioning characteristics of automatic crew served weapons under arctic winter environmental conditions.

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

a. Preoperational Inspection and Physical Characteristics - This test provides for an inspection of the test item to:

- 1) Identify damage received during shipping and handling.
- 2) Determine its physical condition.
- 3) Determine if the test item dimensions, weight and characteristics conform to applicable criteria.
- 4) Locate any defects.

b. Ease of Disassembly and Assembly - The objective of this test is to determine if the test weapon is capable of being quickly and easily stripped and assembled in the field without the use of special tools.

c. Ease of Going In and Out of Action - The objective of this test is to determine the ease of handling and the ease of executing "in action" and "out of action" with the test and comparison weapons using the appropriate mounts.

d. Firing - The objective of this test is to determine the firing accuracy of automatic crew served weapons under arctic winter conditions.

e. Position Disclosing Effect - The objective of this test is to determine and measure the position disclosing effects created by the smoke and muzzle flash of the test weapons operated under arctic environmental conditions.

f. Functional and Operational Suitability - Portability - The objective of this test is to determine the ease of carrying and transporting the test weapons cross-country and over ski trails while wearing snowshoes and skis.

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

h. Human Factors Engineering - The objective of this test is to determine if all accessories and components of the test weapons enable easy operation by test crews wearing the appropriate arctic winter uniform.

i. Maintenance Evaluation - The objective of this test is to determine if the test weapons meet maintenance and maintainability requirements as

defined by QMR, TC, MC or other established criteria under arctic winter environmental conditions.

5.2 LIMITATIONS

The procedures described in this MTP are limited to the testing of automatic crew served weapons under arctic winter environmental conditions. Specific tests for other weapons may be performed using this MTP as a guide with variations applicable to the weapon to be tested.

6. PROCEDURES

6.1 PREPARATION FOR TEST

a. Arctic winter environmental tests are normally scheduled from October through March (6 months). Tests, test comparison and support weapons should be delivered to the arctic test center prior to 1 October.

b. TDY personnel will be used to augment assigned personnel and will be trained to the degree that they are as proficient on the individual weapons as the troops who will use the weapon.

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

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

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

f. Record the following information:

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

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

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

i. Prepare adequate safety precautions to provide safety for personnel and equipment, and ensure that all safety SOP's are observed throughout the test. MTP 3-2-504, Safety Evaluation-Hand and Shoulder Weapons must be completed.

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

k. Record the prevailing meteorological conditions during the storage phase, as well as test conduct, to include:

- 1) Temperature
- 2) Humidity, relative or absolute
- 3) Temperature gradient
- 4) Atmospheric pressure
- 5) Precipitation
- 6) Solar radiation
- 7) Wind speed and direction
- 8) Frequency of readings
- 9) Source of data

6.2 TEST CONDUCT

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

6.2.1 Preoperational Inspection and Physical Characteristics

a. Upon receipt, carefully inspect all test items and comparison weapons and their shipping an/or packaging containers for completeness, damage, and general conditions. Photograph any damage or deterioration noted.

NOTE: Technical manuscripts, manuals, or other publications supplied will be used as guides for the inspection.

b. Record the following:

- 1) Inventory of all test items
- 2) Damage of deterioration noted

c. Measure and weigh each test item and comparison weapon (or a representative number of them) and record the following:

- 1) Dimensions (length, height, etc.) and weight of the test item and comparison weapons.
- 2) Identification photograph of test and comparison weapons.

d. Lubricate each weapon with the applicable lubrication and check each weapon for proper mechanical operation to include all safety devices. Record the following:

- 1) Results of operational check
- 2) All discrepancies detected

6.2.2 Ease of Disassembly and Assembly

a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison weapons at prevailing ambient air temperatures (from 0°F to the coldest available temperature).

b. Utilizing five test soldiers, disassemble and assemble the test and comparison weapons three times during the hours of daylight and again during the hours of darkness.

NOTE: The test shall be performed while wearing the arctic mitten set.

c. Using a stop watch measure the elapsed time for each exercise.

d. Record the following for each test:

- 1) Ease of disassembly and assembly.
- 2) Time required to disassemble and assemble the test and comparison weapons.
- 3) Ambient air temperature during test.
- 4) Special tools required to disassemble and assemble.
- 5) Temperature at test site.

6.2.3 Ease of Going In and Out of Action

a. Cold-soak all test and comparison weapons for at least 24 hours as outlined in paragraph 6.2.2.

b. Mount the test and control weapons on tripod mounts.

c. Each of five gun crews shall go in and out of action three times during the hours of daylight and again during the hours of darkness.

NOTE: In action is defined as the weapon being in a position so as to engage a target. Out of action is defined as the weapon being in a portable condition.

d. Using a stop watch measure the elapsed time for each exercise.

NOTE: When applicable repeat the above exercise using a bipod mount.

e. Record the following for each test:

- 1) Ease of handling
- 2) Elapsed time for each exercise
- 3) Difficulties encountered

NOTE: When applicable repeat the above exercise using a bipod mount

f. Record the following for each test:

- 1) Ease of handling
- 2) Elapsed time for each exercise
- 3) Difficulties encountered
- 4) Ambient air temperatures during test

6.2.4 Firing Tests

a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison weapons, at prevailing ambient air temperatures (from 0°F to the coldest available temperature).

b. Inspect each weapon for loose, damaged or missing parts.

c. Install Standard American targets at ranges of 300 meters, 600 meters, 800 meters and 1100 meters, and zero all test and comparison weapons at the appropriate range. Record any difficulties encountered.

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

d. Each phase of the subtest shall be conducted in ambient air temperature of 0°F to -25°F, 25°F to -45°F and 45°F to the lowest available temperature.

e. Each of five gun crews shall fire the test and comparison weapons mounted on tripods.

f. Each gunner shall fire five shot groups of 100 rounds each in two to three round and six to nine round bursts at targets (16 feet square) located at ranges indicated in Table I.

g. The above exercises shall be repeated, firing the test and comparison weapons bipod mounted, when applicable.

TABLE I ACCURACY FIRING

Range-to-Target	Shots	Number of Exercises Conducted	Mount	Time
300 meters	100	3	Tripod	No Limit
600 meters	100	3	Tripod	No Limit
800 meters	100	3	Tripod	No Limit
1100 meters	100	3	Tripod	No Limit
Maximum Range	100	3	Tripod	No Limit
300 meters	100	3	Bipod If Applicable	No Limit
600 meters	100	3	Bipod If Applicable	No Limit
800 meters	100	3	Bipod If Applicable	No Limit
1100 meters	100	3	Bipod If Applicable	No Limit
Maximum Range	100	3	Bipod If Applicable	No Limit

h. Determine the cyclic rate of fire for each test and comparison weapon by firing 100 rounds in one continuous burst in each temperature range. A rate of fire recorder or stop watch shall be used to record the rate of fire.

NOTE: Cyclic rate of fire shall be determined as outlined in step (h) above at the start and completion of each firing phase and each temperature range.

i. Record the following data:

- 1) Difficulties in zeroing the weapon.
- 2) Number of rounds fired and percentage of target hits at each range for the tripod mount in each temperature bracket.
- 3) Number of rounds fired and percentage of targets hits at each range for the bipod mount, if applicable, in each temperature bracket.
- 4) Ambient air temperatures during test.
- 5) Type of ammunition.
- 6) Lot number of ammunition fired.
- 7) Deviations from boresight and zero procedures.
- 8) Effects of ice fog (if encountered) and number of rounds that can be fired before displacement is necessary.

6.2.5 Position Disclosing Effect

- a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison weapons at prevailing ambient air temperatures (ranging from 0°F to lowest available temperature).
- b. Position test and comparison weapons at a range of 1100 meters.
- c. Position an observer behind each weapon and down range at distance of 100, 500, 1000, and 1500 meters.
- d. Fabricate reference flash scales as illustrated in Figure 1, and mount the scales parallel with the barrel at the muzzle of each test weapon. Photograph the scales for record.
- e. Mount cameras perpendicular to the muzzles of the test weapons at a sufficient distance to photograph all the flash, but not closer than 4.5 feet.
- f. Fire 20 rounds, under completely darkened conditions with each test and comparison weapon. Photograph the cumulative flash from each weapon.
- g. Record the following:
 - 1) Smoke and flash effects at fire positions.
 - 2) Smoke and flash effects visible to the observers at indicated range.

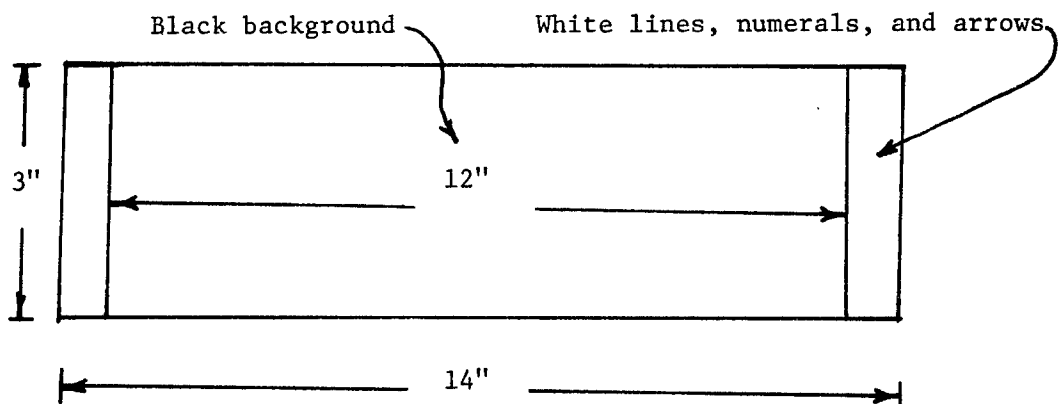


Figure 1. Reference Scale Dimensions

- 3) Annotations to the photographs of cumulative flash with regard to variations of flash during the firing.
- 4) Ambient air temperature at test site.
- 5) Light conditions

h. Repeat steps (e) and (f) above, firing a 20-round burst from each weapon.

i. Repeat steps (b) thru (g) above, utilizing the comparison weapons.

j. Remove the cameras and reference flash scales from the test and comparison weapons.

k. Repeat steps (d) thru (h) above, under daylight conditions and without photographing the cumulative flash.

6.2.6 Functional and Operational Suitability-Portability

a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison weapons, at prevailing ambient air temperatures (from 0°F to the coldest available temperature).

b. Inspect each weapon for loose, damaged or missing parts, and place in the best possible servicable condition with an empty magazine installed in each weapon. Six test crews with field gear and arctic uniforms shall carry the test and comparison weapons, ammunition and accessories over the following courses:

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

c. Dry-fire each weapon a minimum of five times during each of the above courses.

d. Thoroughly inspect each weapon and record the following:

- 1) Damage attributed to environmental effects
- 2) Problems encountered while transporting weapons
- 3) Damage to weapons due to handling
- 4) Temperature at test site

NOTE: The above exercise shall be repeated with the test crews transporting the test and comparison weapons by means of man-drawn akios.

6.2.7 Aerial Delivery

a. Cold-soak (outdoors for a period of at least 24 hours) all test and comparison weapons at prevailing ambient air temperatures (from 0°F to lowest available temperature).

b. Carefully inspect each weapon for loose, damaged or missing parts, and proper functioning and place in the best possible serviceable condition with an empty magazine installed in each weapon.

c. Subject each test and comparison weapon to a minimum of three

parachute jumps under the following conditions:

- 1) Each parachutist will be equipped with standard equipment and will jump in accordance with latest TM's.
- 2) Each test will be weapon packed in a M 1950, Parachutists Adjustable Individual Container (or latest standard container) and attached to the parachutist's person as described in appropriate TM's.
- 3) All weapons will be inspected before and after each jump for damage and proper functioning.

d. Record the following data:

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

6.2.8 Human Factors Engineering and Safety

a. During the conduct of the entire test, ensure that all test personnel are outfitted with arctic equipment and "arctic winter clothing" consisting of:

- 1) Shirt, wool, OD 108
- 2) Trousers, field, OD 107, with liner
- 3) Undershirt, winter
- 4) Drawers, winter
- 5) Socks, wool, cushion sole
- 6) Boots, vapor barrier, white
- 7) Suspenders
- 8) Cap, pile
- 9) Parka, with liner and hood
- 10) Mitten set, arctic with liners

NOTE: The year round temperature variation peculiar to the arctic prohibits the prescribing of a particular uniform for any season. The clothing which is comfortable at -50°F becomes uncomfortable at -10°F and vice versa. Since this large fluctuation is experienced on an hour-to-hour, day-to-day basis, some degree of flexibility in uniform requirements is necessary. However, since materiel tested under arctic conditions is expected to function under the most adverse conditions, the uniform worn by operating personnel must also be suitable for the most adverse conditions. Accordingly the "arctic winter clothing" referred to in this MTP is defined above.

b. Record all observations made during performance of step (a)

above, to include:

- 1) Difficulties experienced in the operation, adjustment, zeroing assembly, disassembly, maintenance, and carrying of the test and comparison weapons by personnel wearing arctic winter clothing.

6.2.9 Maintenance Evaluation

NOTE: Classifications and definitions of malfunctions shall be as approved and commonly defined by all USATECOM testing agencies.

a. Throughout the conduct of all testing as outlined in this MTP, maintain a record of performance of all scheduled and unscheduled maintenance as prescribed in the appropriate draft publications.

NOTE: Whenever possible, maintenance shall be performed under prevailing arctic environmental conditions. Reasons why this is not possible shall be recorded.

b. Continuously monitor all maintenance operations for human factors, safety implications, and to determine if ease of maintenance has been included in the design of the equipment.

c. Compare all replacement parts and components provided with the test item with anticipated and actual requirements, evaluating spare parts requirements under arctic environmental conditions.

d. Record the following information:

- 1) Record of all scheduled and unscheduled maintenance performed, to include lubrication, adjustments, repairs, and replacement of parts.
- 2) Favorable and unfavorable aspects of maintenance
- 3) Unsafe and inadequate aspects of maintenance operations
- 4) Mean time between failures (MTBF) and the mean time to repair (MTTR) the test weapons and associated equipment
- 5) Repair parts usage
- 6) Human factors implications
- 7) Suitability of cleaning equipment

e. Perform a reliability test of test and comparison weapons by transporting the weapons in the bed of a M113 Armored Personnel Carrier over tank trails and secondary roads for 100 miles.

NOTE: When applicable weapons shall be placed in vehicular mounts and fired at intermittent periods of time during transport.

f. Record the following data:

- 1) Scheduled and unscheduled maintenance.
- 2) Repair parts usage.
- 3) Mean time between failures (MTBF).

- 4) Mean time to repair (MTTR).
- 5) Any malfunction, breakage or unusual occurrence as a result of durability tests.
- 6) Comments on durability and reliability based on observations throughout the test.

g. During performance of maintenance, utilize all common and special tools and test equipment furnished with the items under test, and record the following data:

- 1) Maintenance operations for which special tools are required.
- 2) Common and special tools and test equipment required, but not furnished in the maintenance package.
- 3) Tools and test equipment furnished but not required.

h. Thoroughly analyze all publications provided with the test items for clarity and simplicity of maintenance instructions, and completeness of preventative maintenance procedures.

i. Monitor all maintenance operations to determine if instructions and the sequence of operations are adequate for the level of training possessed by appropriate maintenance personnel, or if added or special training is required.

j. Record the following data:

- 1) Accuracy and adequacy of maintenance publications.
- 2) Requirements for special training and maintenance category requiring special training.
- 3) Errors and omissions in nomenclature and parts numbers on repair parts lists.
- 4) Unclear and inadequate maintenance instructions.
- 5) Inadequate safety instructions for personnel and equipment, including environmental protection during operation and maintenance.
- 6) Desirable changes and comments.

6.3 TEST DATA

All test data to be recorded will be as specified in the individual sub-tests of this MTP.

6.4 DATA REDUCTION AND PRESENTATION

Processing of raw test data shall, in general, consist of organizing, marking for identification and correlation, and grouping the test data according to test title.

Specific instructions for the reduction and presentation of individual test data are outlined in succeeding paragraphs.

6.4.1 Preoperational Inspection and Physical Characteristics

Size and weight data, adequacy of packaging, and completeness of shipment data shall all be compared with appropriate QMR's, SDR's, MC's, TC's etc. Physical condition (damage) shall be compared with acceptable standards.

6.4.2 Functional and Operational Suitability - Portability

The adequacy with which the weapon under test feeds, extracts and ejects under extreme arctic winter conditions shall be determined by comparison with previously accepted items of like nature and specifications. The damage to the weapons attributed to environmental effects or handling shall be compared with weapon specifications contained in appropriate QMR and TC.

6.4.3 Firing Tests

Compare mean radius, hit percentage, and cyclic rate of fire to weapon specifications for possible deviations due to arctic effects.

6.4.4 Position Disclosing Effect

The data obtained from the test item shall be evaluated in accordance with data from comparison weapons and accepted military standards.

6.4.5 Aerial Delivery

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

6.4.6 Human Factors Engineering and Safety

The data obtained and observations made during performance of this subtest shall be compared with accepted standards of human engineering.

6.4.7 Maintenance Evaluation

Time required for individual maintenance operations shall be examined to determine if the resulting downtime is considered excessive, based on experience with like-type items. The maintenance ratio shall be computed as outlined in Appendix A. Maintenance ratio (M) is the number of active maintenance man-hours (TM) required to support each hour of operation (TD). The maintenance ratio reflects the frequency of failures of the system and the amount of time required to locate, repair and replace faulty components or parts. It reflects the overall maintainability of the test weapon.

APPENDIX A

MAINTENANCE AND RELIABILITY ANALYSIS CHART

INSTRUCTION SHEET

DESCRIPTION

COLUMN

- 1 Group number as indicated in the Maintenance Allocation Chart.
- 2 Component and related operations as indicated in the Maintenance Allocation Chart. Operations indicated as in Depot Category are not shown.
- 3 Maintenance Level, Prescribed. Category prescribed by the Maintenance Allocation Chart is indicated by utilizing the letters O/C, O, DS, or GS. O/C - Operator of crew; O - Organizational; DS - Direct Support; GS - General Support.
- 4 Maintenance Level, Recommended. Letters O/C, O, DS, or GS indicated the category recommended by the test agency.
- 5 TM Instructions, Adequate. An X in this column indicates the TM instructions are considered adequate.
- 6 TM Instruction, Inadequate. The test agency reference number used on DA forms 1598 is indicated in this column, if the instructions are considered inadequate.
- 7 **Active** Maintenance Time. Man hours used to the closest tenth. If the operation was not actually performed but was received, the estimated active maintenance time is indicated by using the prefix E. Average active maintenance time is used if the operation was performed more than once.
- 8 Life. Number of hours, miles, or rounds accumulated before or since this operation was performed. An entry is made each time this operation is performed, followed by the appropriate life unit; i.e., M, H, or R. An "S" will be placed in this column if the operation was performed on a sampling basis and not because of an actual failure.
- 9 Reason performed. The symbol "Unsched" will be shown in this column if the operation was performed as a result of unscheduled maintenance. If the operation was performed as a results of scheduled maintenance, it is indicated by the symbol "Sched" in this column. If the operation was performed only to verify procedures and tools, not as a result of breakdown, it is indicated by the symbol "Sim" in this column.

- 10 Remarks. If the operation is related to any other subtest covered in the body of the test report the paragraph number is inserted for cross reference. If the maintenance operation was not performed as a result of using the sampling technique authorized by AR 750-6, one of the following remarks is entered as appropriate.

- a. Reviewed - not performed.
- b. Neither reviewed nor performed due to (No TM's) or (insufficient service test time).
- c. Other, as appropriate.

If an EPR is related to a maintenance operation, the EPR number will be inserted.

A written report shall accompany all test data and shall consist of conclusions and recommendations drawn from test results. The test engineer's opinion, concerning the success or failure of any of the functions evaluated, shall be included. In addition, equipment specifications that will serve as the model for a comparison of the actual test results should be included.

Equipment evaluation will usually be limited to comparing the actual test results to the equipment specifications and the requirements as imposed by the intended usage. The results may also be compared to data gathered from previous tests of similar equipment.

GROUP NO.	COMPONENT AND RELATED OPERATIONS	O/C - Oper/Crew				TM INSTRUCTIONS	ACTIVE MAINT TIME	LIFE M-Miles H-Hours R-Rounds	REASON PERFORMED	REMARKS
		O - Orgzn DA - Direct GS - General								
		Prescribed	Recommended	Adequate	Inadequate 1598					
1	2	3	4	5	6	7	8	9	10	

MAINTENANCE AND RELIABILITY ANALYSIS CHART