

AD-759 148

DESERT ENVIRONMENTAL TESTING OF AIR-  
CRAFT ARMAMENT

Army Test and Evaluation Command  
Aberdeen Proving Ground, Maryland

2 October 1972

DISTRIBUTED BY:

**NTIS**

**National Technical Information Service**  
**U. S. DEPARTMENT OF COMMERCE**  
5285 Port Royal Road, Springfield Va. 22151

UNCLASSIFIED

Security Classification

AD. 759148

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) U. S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	
		2b. GROUP	
3. REPORT TITLE U. S. Army Test and Evaluation Command Test Operations Procedure "Desert Environmental Testing of Aircraft Armament"			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final			
5. AUTHOR(S) (First name, middle initial, last name)			
6. REPORT DATE 2 October 1972		7a. TOTAL NO. OF PAGES 16	7b. NO. OF REFS 17
8a. CONTRACT OR GRANT NO.		8b. ORIGINATOR'S REPORT NUMBER(S) TOP 7-4-003	
b. PROJECT NO.		8c. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
c. AMCR 310-6			
d.			
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited.			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY Headquarters U. S. Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT  Describes a method for evaluation of aircraft armament operational and functional performance characteristics. Discusses preparation for tests, facilities, and equipment required. Provides procedures for exposure, performance, maintenance evaluation, human factors, and safety tests.			

Reproduced by  
NATIONAL TECHNICAL  
INFORMATION SERVICE  
U S Department of Commerce  
Springfield VA 22131

DD FORM 1473

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

UNCLASSIFIED

Security Classification

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Aircraft Armament Desert Enviromental Test						

UNCLASSIFIED

Security Classification

1a

U. S. ARMY TEST AND EVALUATION COMMAND  
ENGINEERING TEST - COMMON TEST OPERATIONS PROCEDURES

AMSTE-RP-702-106

Test Operations Procedure 7-1-005

2 October 1972

DESERT ENVIRONMENTAL TESTING OF AIRCRAFT ARMAMENT

Section I.	GENERAL	Paragraph	Page
	Purpose and Scope . . . . .	1	1
	Background . . . . .	2	2
	Equipment and Facilities . . . . .	3	2
II.	TEST PROCEDURES		
	Preparation for Test . . . . .	4	3
	Exposure Tests . . . . .	5	5
	Performance Tests . . . . .	6	9
	Maintenance Tests . . . . .	7	9
	Human Factors Engineering Tests . . . . .	8	10
	Safety Tests . . . . .	9	10
APPENDIX A.	REFERENCES . . . . .		A-1
B.	ASSOCIATED MTP/TOP DOCUMENTS . . . . .		B-1

AD 759148

REC'D C  
MAY 4 1973  
REGISTRATION

SECTION I  
GENERAL

1. Purpose and Scope. The objective of the procedures outlined in this Test Operations Procedure (TOP) is to provide a means of evaluating the performance, safety, human factors engineering, maintainability and reliability aspects of Aircraft Armament while functioning effectively within desert environments. The procedures outlined in this TOP provide guidance for the desert environmental testing of aircraft armament subsystems. Specific requirements and test criteria will vary for each armament subsystem and the test procedures must be modified accordingly. Specific subtests include:

a. Exposure. The object of this subtest is to determine the effects of desert environmental exposure on aircraft armament subsystems.

b. Performance. The object of this subtest is to determine the capability of aircraft armament subsystems to function effectively in the desert environment.

c. Maintenance. The object of this subtest is to determine the maintenance requirements for aircraft armament subsystems to function effectively in the desert environment, and to investigate maintenance problems caused by the environment.

d. Safety. The object of this subtest is to determine the safety requirements of aircraft armament subsystems operated in a desert environment.

Approved for public release; distribution unlimited.

R

2 October 1972

The procedures provided by this TOP do not constitute detailed test plans. A detailed test plan for desert environmental testing of aircraft armament systems may be assembled from the guidance provided by the TOP and other applicable literature, but each environmental test planning activity must make its own judgment as to the applicability of each procedure and must determine how best to obtain the required data from each item under test. Those procedures that duplicate testing that has been conducted at other facilities and are not peculiar to a desert summer environment will not normally be conducted.

## 2. Background.

a. Materiel deployed or intended for combat use in desert areas may be uniquely stressed by the environment to the extent that dependability, serviceability, maintainability, safety, and ultimately, the success of military operations may be seriously jeopardized. Combat systems, therefore, must be designed to withstand desert environmental stresses whenever they are designated for use on a worldwide basis. Although many of these stresses are known in advance and can be reproduced in the laboratory, testing in the natural desert environment is necessary to provide complete assurance that the system will function as intended during desert operations. Additionally, such testing serves to reveal design or production deficiencies and to identify targets for corrective action often missed during laboratory testing.

b. Common engineering and systems engineering MTPs/TOPs which may be considered in formulating an engineering test plan (depending on the specific item or system to be tested) are contained in appendix B.

## 3. Equipment and Facilities.

a. Meteorological support instrumentation.

b. Still and motion picture cameras and associated photographic equipment.

c. Support aircraft.

d. Ammunition.

e. Supply of armament subsystem repair parts for duration of test period.

f. Test equipment as required.

g. Suitable firing range (representative of three main desert types: sandy, gravelly, and stony, and which possesses an instrumented ballistic range).

2 October 1972

TOP 7-1-005

h. General and special tools and ancillary equipment required for repairs or maintenance on the test item.

i. Vehicles (cargo).

j. Measuring tools for determination of dimensions and weights.

4. Preparation for Test.

a. General Preparation. Personnel responsible for conducting tests shall ensure the following prior to testing:

(1) That testing facilities, equipment and accessories are available and properly calibrated and functional.

(2) That all required test personnel will be available and briefed on the purpose of the test and results expected, prior to testing.

(3) That power sources are checked to ensure correct outputs.

(4) That final arrangements are made with supporting or participating agencies, activities or facilities.

(5) That operating instructions for test instruments and equipment are obtained and are made available to test personnel.

b. Test Item Preparation. Personnel responsible for conducting the tests shall ensure that the following preparations are made prior to testing:

(1) The test item sample size shall be developed during test planning to ensure that each test lot or test condition shall consist of a sufficient number of test items or test replications to permit a meaningful statistical analysis of the test, and to permit isolation and identification of the effects of the desert environment (refer to MTP 3-1-002).

(2) An initial inspection of the test item shall be performed to determine the following (refer to TOP 1-3-505 and MTP 7-3-500):

(a) That all test items, ancillary equipment and maintenance packages are present at the test installation and are in an acceptable condition.

(b) That the test items and their components are correctly assembled, labeled and ready for test.

2 October 1972

(c) That all test items and ancillary equipment are cleaned and lubricated according to appropriate maintenance instructions.

(3) Items shall be repacked upon completion of initial inspection with the exception of those items required to be instrumented for exposure testing (refer to TOP 1-3-505). The lack of any required item shall be corrected whenever possible or noted in the test log for consideration during the test data reduction phase.

(4) The following physical characteristics shall be determined:

(a) The actual exterior dimensions of the test item such as length, width, diameter, etc.

(b) The actual interior dimensions of the test item such as cavity depths, thread diameters, etc.

(c) The actual weight of test items and major components.

(d) The color of test items including any reflecting or shiny surfaces.

(e) Other physical measurements or characteristics which may assist in the evaluation of the test item.

c. Subtest Preparation.

(1) Exposure Subtest Preparation. Test items to be subjected to desert storage exposure shall be instrumented in accordance with MTP 3-4-001 and to provide the following temperature data:

(a) Overpack and container skin temperatures.

(b) Storage container interior air temperature.

(c) Average warhead and motor skin temperature.

(d) Temperatures of critical components.

(e) Propellant and explosive component temperatures (refer to AMCP 706-177).

Install instrumentation required to determine and record the ambient air temperatures for each storage site. Install instrumentation required to determine and record the wind speed and direction, and the solar radiation levels at the test site. Instrumentation location shall be shown by photographs or line drawings as required.

2 October 1972

TOP 7-1-005

(2) Performance Subtest Preparation. Items which have been left in sealed containers will be removed and identified. Inspect test items for visual signs of deterioration. Remeasure physical characteristics of selected items to determine change wrought by exposure. Items which are components of major items shall be assembled to standard components. Accomplish any other preparatory steps as specified in the applicable MTP/TOP being utilized.

(3) Safety Subtest Preparation. Prior to committing aircraft armament systems to exposure tests involving handling and to operational and functional tests, the applicable safety statement or safety release shall be reviewed.

## 5. Exposure Tests.

### a. Storage Exposure

(1) Methods (refer to TOP 1-1-006). Hot-dry climates are intrinsically favorable for the preservation of mechanical equipment. However, certain chemical compounds, particularly those used in explosives and propellants, are susceptible to accelerated deterioration under extremes of heat and solar radiation, ozone concentrations and rapid temperature changes which are associated with desert environments. Blowing sand results in rapid abrasion of exposed surfaces. Sand may penetrate small crevices and clog moving parts; it will also clog delicate mechanisms.

(2) After each storage period, inspect the test items in accordance with paragraph 4.b.(2), and if possible, repair or replace any defective parts noted in the course of inspection. Failed and badly deteriorated parts should be preserved for examination to determine extent, type, and cause of deterioration. Extreme care should be used if explosives or propellants appear deteriorated, discolored, or if exudation is evident. Allow only qualified personnel to handle such items.

#### (a) Forward Depot Storage

1. Leave the test item in the sealed shipment container and place on open desert terrain for a period of three months with normal modes of covering.

2. Visually examine the test item regularly once a month and note and record all signs of deterioration.

(b) Forward Area Storage. The forward area storage subtest shall be conducted upon completion of the road transportation subtest. The test item will be placed in the forward storage area for a period of 60 days, with minimum of 48 days with temperatures over 100°F. for

2 October 1972

6-hour periods. At the conclusion of the forward area storage period, test personnel shall visually inspect the test item and note and record all apparent effects. Deficiencies shall be corrected or noted. At this time, the test item shall be performance tested to determine effects not discovered during inspection. Data of this test will be recorded.

b. Data Required. The following data will be recorded at regular intervals during storage test periods:

- (1) Ambient air temperature.
- (2) Ground temperature.
- (3) Humidity.
- (4) Precipitation.
- (5) Wind speed.
- (6) Wind direction.
- (7) Solar radiation.

The following data will be recorded when storage installation is first made and each time the test item is relocated:

- (8) Site conditions (terrain, vegetation, etc., including photographs).
- (9) Test item orientation.

The following data will be recorded at the conclusion of each storage period:

- (10) All evidence of deterioration including location, effects and corrective actions taken.
- (11) All deficiencies attributable to storage exposure.
- (12) Degree-hour data accumulated.
- (13) Results of performance tests.

c. Analytical Plan. Graphically summarize data recorded in 5b. for the total test period as follows:

- (1) Plot monthly summaries of meteorological conditions.

(2) Plot data in (1) above at hourly intervals for a 24-hour period showing the most extreme and mildest days, and a representative day during the exposure period.

(3) Describe malfunctions and failures attributed to desert environmental stresses. Compare these values with desired malfunction and failure rates stated as criterion, and determine the acceptability of the test item.

6. Transportation Exposure.

a. Method. For many aircraft armament systems, the transportation environment is much more severe than the storage environment.

b. Since aircraft armament weapons are often carried on open racks or launchers, all factors of the desert are brought into play on the test item. After each of the transportation cycles described below, inspect the test item for failures.

(1) Road Transportation, Forward Depot Storage to Forward Area Storage. This subtest is intended to be conducted when test items are to be transported from the depot storage area to the forward area storage site and should not be initiated until completion of the depot storage subtest.

(a) Place test items on wheeled cargo carries or transporters and transport them, in their usual configuration, from the forward depot storage area to the forward area storage site. Test items shall be transported during the daylight hours of the hot summer months, and movement shall consist of a minimum of 150 miles along paved roads, 450 miles of secondary roads and maximum exposure to dust.

(b) Upon conclusion of the transportation phase of testing, inspect the test items and record inspection results in the test log. Deficiencies discovered during the inspection shall be corrected when possible or noted for consideration during the data reduction phase of the test.

(2) Road Transportation, Tactical Deployment. This subtest is intended to be conducted when test items are to be tactically deployed from the forward area storage site and should not be conducted until completion of forward area storage subtest. The following procedures shall be complied with when road testing aircraft armament systems in the desert environment.

(a) Load the test items on light tactical wheeled vehicles consistent with the usual mode of field transport for the test item, and move the item over the terrain combinations and interconnecting secondary roads in compliance with the test requirements.

2 October 1973

(b) Total transportation mileage for the first cycle will be 150 miles minimum, including 60 miles over secondary roads in convoy and 90 miles over mountains, badlands, hills, washes, plains, dunes, and courses, in any combination.

(3) Aircraft Flight Test. This subtest will be conducted upon completion of all other exposure tests.

(a) The test items shall be unpacked, inspected, and mounted on the aircraft in the complete design configuration, including a full complement of ammunition. The aircraft shall fly at various attitudes to include: low level, hover, landings, and takeoffs in selected types of desert terrain (loose sand, rocks, etc.). The test item should be exposed to conditions under which it was designed to operate during this test phase.

(b) Prior to aerial firing, a sample of explosive items, such as warheads and fuzes, shall be ground-launched as a safety precaution prior to aircraft and personnel exposure. Aerial firing shall be conducted following a normal firing procedure.

(c) Adverse effects of the environment on the normal operation of the test item will be noted and recorded.

b. Data Required. During the movement phase of exposure testing specified in paragraph 6a, the following data will be recorded continuously:

- (1) Vehicle mileage.
- (2) Vehicle enclosure temperature.
- (3) Accelerometer readings.
- (4) Strain gage readings
- (5) Nature of terrain crossed.
- (6) Time.
- (7) Vehicle speed, or aircraft flight and operational conditions.

NOTE: Record the results of the inspection upon completion of transportation cycle. Results of visual inspection conducted between cycles should be recorded as applicable.

c. Analytical Plan.

(1) Present data as indicated for storage exposure.

(2) Summarize graphically the acceleration and route data recorded for storage exposure to show accelerometer readings, vehicle bed temperature, test item temperature and air temperature. Graphs shall show time of day and start and finish of terrain courses.

(3) Present profiles of routes followed including surface conditions and other significant data.

(4) Describe malfunctions as for storage exposure.

(5) Compare values as for storage exposure.

7. Performance Tests. Data will be recorded as indicated in the applicable MTP/TOP selected for the test item. Record meteorological data during performance test days, and terrain conditions at test sites.

8. Maintenance Tests. Maintenance actions, both preventive and corrective, will be required throughout the entire test. These actions will be performed in accordance with the proper technical manuals and lubrication orders using the prescribed tools and test equipment.

b. Special attention will be given to the compatibility of the entire maintenance system (test item, maintenance instructions, tools and test equipment and personnel) with the desert environment. Particular consideration will be given to the following:

(1) The scheduled maintenance intervals for cleaning, lubrication, and adjustment must be sufficient to allow for proper operation in hot, dusty areas.

(2) Environment-related maintenance actions must be performed at the proper echelon, with consideration for available facilities.

(3) The effectiveness of lubricants must be evaluated with respect to extreme temperature breakdown, contamination, and possible suitability of dry lubricants.

(4) Tools, test equipment, and personnel must be capable of handling environment-related maintenance problems at the proper echelon levels. Personnel performing maintenance tests shall be familiar with TECOM Regulation 750-15.

(5) Wherever possible, protective gloves shall be used as directed by maintenance instructions, unless they interfere with the performance of intricate tasks.

(6) Maintenance data such as time to failure, report time, service

2 October 1972

time, replaced parts, and part life shall be accurately recorded and included in reports to support maintenance analyses:

(a) Record action taken to ensure serviceability of the test item.

(b) Record the need for special tools or equipment for the accomplishment of maintenance tasks.

(c) Record environment-related maintenance actions and corrective actions taken.

(d) Present a narrative statement of results and observations relating to maintenance which is fully supplemented by tabular data, drawings, and photographs, as required.

9. Human Factors Engineering Tests. Record data as described in MTP 2-3-516. Particular attention will be given to the temperature, solar radiation and dust conditions present during desert testing and its effect on personnel and equipment.

10. Safety Tests.

a. Identify data relating to test item safety and record in the test log.

b. In addition to normal safety operation procedures, the following observations shall be noted during the entire environmental test cycle. Photographs shall be made of deficiencies whenever possible.

(1) Interior and exterior temperatures of test item relative to ambient conditions.

(2) Clarity of test item identification.

(3) Presence of safety warnings.

(4) Safety of handling instruction procedures.

(5) Presence and adequacy of safety devices.

(6) Sharp or projecting edges, controls, etc.

(7) Accessibility to emergency cut-off controls.

(8) Replaceable safety devices and on-hand replacements.

(9) Adequacy of instructions for handling emergencies.

2 October 1972

TOP 7-1-005

(10) Adequacy of personnel operating instructions, particularly in view of temperature solar radiation and dust conditions present during desert testing.

c. Safety deficiencies noted during conduct of safety tests and environmental tests shall be recorded and corrected whenever possible to eliminate all unsafe conditions.

d. Safety Observations.

(1) Record all safety discrepancies and deficiencies noted during the conduct of all subtests, including unsafe conditions and methods of correction.

(2) Present a narrative statement summarizing the observations relating to safety which is fully supplemented by photographs, drawings, and data, as required.

(3) Safety standards will be identified in accordance with MIL-STD-822.

Recommended changes to this publication should be forwarded to Commanding General, U.S. Army Test and Evaluation Command, ATTN: AMSTE-ME, Aberdeen Proving Ground, Maryland 21005. Technical information related to this publication may be obtained from the preparing agency: Yuma Proving Ground, ATTN: STEYP-MMI, Yuma, Arizona 85364. 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. AR 70-38, "RDT&E of Materiel for Extreme Climatic Conditions."
3. AR 705-50, "Army Materiel Reliability and Maintainability."
4. AR 705-6, "Maintenance Support Planning."
5. AMCP 706-177, "Engineering Design Handbook, Explosives Series, Properties of Explosives of Military Interest."
6. AMCR 385-12, "Verification of Safety of Materiel from Development Through Testing, Production and Supply to Disposition."
7. AMCR 705-15, "Integrated Logistics Support."
8. TECR 385-2, "Safety Responsibilities."
9. TECR 385-6, "Verification of Safety of Materiel During Testing."
10. TECR 70-23, "Equipment Performance Reports."
11. TECR 70-24, "Documenting Test Plans and Reports."
12. TECR 750-15, "Maintenance Evaluation During Testing."
13. Brooks, Wahner E., "The Influence of Terrain of Desert Environmental Testing," U.S. Army, Yuma Proving Ground Technical Memorandum MI-9-68, April 1968.
14. Elias, Michael E., SP4, "Temperature Criteria for Desert Environmental Testing," U.S. Army, Yuma Proving Ground Technical Memorandum MI-18-72, 1972.
15. Frost, Robert E., et al., "Terrain Study of the Yuma Test Station Area, Arizona," Purdue University Engineering Experiment Station, Lafayette, Indiana, March 1955.
16. Bagnold R. A., "The Physics of Blown Sand and Desert Dunes," Dover Publications Inc., New York, New York, 1954.
17. MIL-STD-882, "System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for," 15 July 1969.

2 October 1972

TOP 7-1-005

APPENDIX B  
ASSOCIATED MTP/TOP DOCUMENTS

1. TOP 1-1-006, Desert Environmental Considerations. (To be Published)
2. TOP 1-1-007, Desert Maintenance Considerations. (To be Published)
3. TOP 1-1-012, Classification of Deficiencies and Shortcomings.
4. TOP 1-2-500, Transportability. (To be Published)
5. TOP 1-2-501, Maintenance Evaluation. (To be Published)
6. TOP 1-2-503, Reliability. (To be Published)
7. TOP 1-3-504, Physical Characteristics.
8. TOP 1-3-505, Preoperational Inspection.
9. MTP 3-1-002, Confidence Intervals and Sample Size.
10. MTP 3-4-001, Desert Environmental Test of Armament and Individual Weapons.
11. MTP 4-1-001, Testing Ammunition and Explosives.
12. MTP 4-2-016, Ammunition, Small Arms. (To be Published)
13. MTP 4-2-503, Safety Evaluation - Close Support Rocket Missiles.
14. MTP 4-2-604, Range Firing of Small Arms Ammunition.
15. MTP 4-2-819, Sand and Dust Testing of Ammunition.
16. MTP 4-3-010, Ammunition, Aircraft.
17. MTP 4-3-016, Ammunition, Small Arms. (To be Published)
18. MTP 4-4-001, Desert Environmental Test of Ammunition and Explosives.
19. MTP 5-2-589, Dust Tests.
20. MTP 5-2-593, High Temperature with Solar Radiation.
21. MTP 5-2-594, High Temperature Tests.

B-1

2 October 1972

22. MTP 5-3-046, Launcher, Rocket.
23. MTP 5-4-001, Desert Environmental Test of Missile and Rocket Systems.
24. MTP 6-2-531, Temperature Tests.
25. MTP 6-2-537, Dust Tests.
26. MTP 6-4-001, Desert (Field) Environmental Test of Communication, Surveillance and Avionic Electronics.
27. MTP 7-1-004, Army Aircraft Armament.
28. MTP 7-2-009, Rocket Subsystems, Aircraft.
29. MTP 7-2-010, Machine Gun Subsystems.
30. MTP 7-2-011, Guided Missile Subsystems Aircraft.
31. MTP 7-2-013, Mine and Munitions Dispensing Subsystems, Aircraft.
32. MTP 7-2-014, Multiple Armament Subsystems, Aircraft.
33. MTP 7-3-015, Aircraft Armament.
34. MTP 7-3-510, Human Factors.