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USATECOM PROJECT NO. 4-WE-300-200-003

USACDC AC NO. ____________________

AD870137

SERVICE TEST
of
XM200 2.75-INCH AIRCRAFT ROCKET LAUNCHER

Final Report
by
LTC John O. Gilliland
October 1969

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DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BG

17 APR 1970

SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch FFAR, USATECOM Project No. 4-MR-300-200-001/003

Project Manager for 2.75-Inch Rocket
U. S. Army Munitions Command
ATTN: AMCPM-RK
Dover, New Jersey 07801

1. References:

a. RDT&E Project No. 1X141806D134.

b. Letter, CDCMR-V, USACDC, 14 April 1969, subject: Department of the Army Approved Advanced Development Objective (ADO) for Selective Effects Armament Subsystem for Army Aircraft.

c. Letter, AMSTE-BG, USATECOM, 13 November 1969, subject: Conditional Release of Rocket Launcher for 2.75-Inch FFAR, XM200.

d. Letter, AMSTE-BG, USATECOM, 13 January 1970, subject as above.

e. Letter, AMSTE-BG, USATECOM, 27 February 1970, subject as above.

2. Approval Statement:

a. Subject reports are approved except as stated herein.

b. Reference 1d forwarded final reports of the engineering and service tests (ET/ST) of subject launcher, however, the ET report contained data that was in error. The data was corrected and revised reports submitted by reference 1e. Subsequently, further revision to the ET report was deemed necessary to preclude misinterpretation of the data contained in the ET report. This letter and the inclosed reports supersede reference 1d and reference 1e and the reports inclosed therewith. Request reports forwarded by reference 1d and reference 1e be destroyed. The revisions made to the engineering test report have had no effect on the TECOM suitability position.

AMSTM-KG 17 APR 1970

SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch FFAR, USATECOM Project No. 4-VE-300-200-001/003

3. Background:

a. The XM3, a 24-tube reuseable/repairable rocket launcher, provided the Army with its first 2.75-inch folding fin aerial rocket (FFAR) capability for helicopters. An additional rocket capability was effected with the development of the M16 and M21 armament subsystems which provided a 7-tube launcher (M158A1) and a machine gun capability.

b. When it was decided that the XM3 launcher would not be standardized and would no longer be produced, the need for a launcher with a capacity larger than the M158A1 became apparent. Consequently, the Army turned to a 19-tube rocket launcher which was being used by the Navy and Air Force (LAU-3/A). These launchers which were designed for a one-time use were modified to provide a reuseable capability and identified as the XM159.

c. An initial production test (IPT) of the XM159C, a later version of the launcher, revealed problems with detents and firing contacts which made the launcher unsuitable for full release. This in addition to other circumstances led to the development of the XM200, which is a 19-tube reuseable/repairable rocket launcher.

d. An engineering test and service test of the XM200 launcher was conducted by Aberdeen Proving Ground (APG) and U. S. Army Aviation Test Board respectively from July 1969 to October 1969. The results of those tests are contained in the inclosed reports.

e. An IPT on an improved version of the XM200 is also being conducted by APG. Testing has been completed and a final report is being written. On 13 November 1969, prior to the completion of all testing, this headquarters interposed no objection to the conditional release of the IPT XM200 launcher (reference 1c).

4. Test Results:

a. The XM200 rocket launcher met 33 of 36 applicable requirements. A total of 2 deficiencies and 2 shortcomings were reported. After analysis and reclassification, 2 deficiencies and 1 shortcoming remain.

DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BG 17 APR 1970

SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch FFAR, USATECOM Project No. 4-MS-300-200-001/003

Project Manager for 2.75-Inch Rocket
U. S. Army Munitions Command
ATTN: AMCPM-MR
Dover, New Jersey 07801

1. References:

a. RDTE Project No. 1X1418060134.

b. Letter, CRCMA-V, USAMC, 14 April 1969, subject: Department of the Army Approved Advanced Development Objective (ADO) for Selective Effects Armament Subsystem for Army Aircraft.

c. Letter, AMSTE-BG, USATECOM, 13 November 1969, subject: Conditional Release of Rocket Launcher for 2.75-Inch FFAR, XM200.

d. Letter, AMSTE-BG, USATECOM, 13 January 1970, subject as above.

e. Letter, AMSTE-BG, USATECOM, 27 February 1970, subject as above.

2. Approval Statements:

a. Subject reports are approved except as stated herein.

b. Reference 1d forwarded final reports of the engineering and service tests (ET/ST) of subject launcher, however, the ET report contained data that was in error. The data was corrected and revised reports submitted by reference 1e. Subsequently, further revision to the ET report was deemed necessary to preclude misinterpretation of the data contained in the ET report. This letter and the inclosed reports supersede reference 1d and reference 1e and the reports inclosed therewith. Request reports forwarded by reference 1d and reference 1e be destroyed. The revisions made to the engineering test report have had no effect on the TECOM suitability position.

AMSTA-RG 17 APR 1970

SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch FFAR, USATECOM Project No. 4-MG-300-200-001/003

3. Background:

a. The XM3, a 24-tube reuseable/repairable rocket launcher, provided the Army with its first 2.75-inch folding fin aerial rocket (FFAR) capability for helicopters. An additional rocket capability was effected with the development of the M16 and M21 armament subsystems which provided a 7-tube launcher (M158A1) and a machine gun capability.

b. When it was decided that the XM3 launcher would not be standardized and would no longer be produced, the need for a launcher with a capacity larger than the M158A1 became apparent. Consequently, the Army turned to a 19-tube rocket launcher which was being used by the Navy and Air Force (LAU-3/A). These launchers which were designed for a one-time use were modified to provide a reuseable capability and identified as the XM159.

c. An initial production test (IPT) of the XM159C, a later version of the launcher, revealed problems with detents and firing contacts which made the launcher unsuitable for full release. This in addition to other circumstances led to the development of the XM200, which is a 19-tube reuseable/repairable rocket launcher.

d. An engineering test and service test of the XM200 launcher was conducted by Aberdeen Proving Ground (APG) and U. S. Army Aviation Test Board respectively from July 1969 to October 1969. The results of those tests are contained in the inclosed reports.

e. An IPT on an improved version of the XM200 is also being conducted by APG. Testing has been completed and a final report is being written. On 13 November 1969, prior to the completion of all testing, this headquarters interposed no objection to the conditional release of the IPT XM200 launcher (reference 1c).

4. Test Results:

a. The XM200 rocket launcher met 33 of 36 applicable requirements. A total of 2 deficiencies and 2 shortcomings were reported. After analysis and reclassification, 2 deficiencies and 1 shortcoming remain.

AMSMI-RKI 17 APR 1975

SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch HVAR, USATECOM Project No. 4-EC-300-200-001/003

b. Deficiencies (2):

(1) The failure of the rocket launcher to meet the reliability requirements is classified as a deficiency. Two of the 36 applicable requirements were not met because of this deficiency. The requirements state that each tube will be reliably reuseable through 100 rocket firings without repair and 500 rocket firings without major parts replacement. At a 90% confidence level one can expect to fire no more than 35 rounds prior to repair and 82 rounds prior to a major parts replacement. This deficiency is attributed to the following two conditions which were classified as deficiencies in both the ET and ST reports.

(a) The electrical wiring arrangement permitted numerous pinch points, resulting in severed wires and/or insulation damage which in turn caused misfires.

(b) The cocking pin on the tube firing-arm detent assembly broke frequently during firing making the tube unuseable.

(2) The excessive amount of unscheduled maintenance manhours required to keep the launcher operational is classified as a deficiency. Although personnel at the organization maintenance level have the technical ability to perform the unscheduled maintenance on the XM200 launcher, the number of manhours required to disassemble, repair, and assemble the launcher (15 to 21 manhours) will place an undue burden on the user. There is no prescribed level of maintainability stated in the technical requirements; however, the following maintenance characteristic is stated in reference 1b (an advanced development objective for a future armament subsystem): "At the organizational level, the probability of restoring the subsystem to operational status in 30 minutes when a failure has occurred should be .9 based on two mechanics with a standard armament repairman's tool kit authorized in the time frame of the weapons subsystem utilization." The excessive amount of unscheduled maintenance manhours was not classified as a deficiency or shortcoming in either report, however, maintainability features were identified as unacceptable in the ST report (page 3, paragraph 1.5.8).

c. Shortcoming: (1) The excessive amount of time required to load rockets into the launcher is classified as a shortcoming. One of the 36 applicable requirements was not met because of this shortcoming. The excessive amount of time was due to the following conditions which were classified as two shortcomings in the ET report:

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SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch FFAR, USATECOM Project No. 4-MM-300-200-001/003

(1) Difficulty was experienced during front-end loading of rockets assembled with warheads other than the XM229. Due to the shorter overall rocket length, with M151 or similar warheads it was a problem to position the rocket to lock in the detent. In most cases it was necessary to go to the aft-end of the launcher to effect the locking of the rocket in the detent.

(2) Difficulty was experienced while loading rockets into the aft-end of the launcher. In order to load rockets into the aft-end the firing arm must be turned out of the way. This action causes the stop part of the detent to be carried away from the inside of the tube, therefore, the rocket must be seated by trial and error.

d. A potential safety hazard associated with the breaking of the camming pin is identified in the ET report. It is stated that a broken camming pin could result in the unexpected firing of an adjacent rocket, if the firing arm is accidentally rotated to a position behind an adjacent tube and power is inadvertently applied to the firing arm. A potential safety hazard exists any time power is inadvertently applied to the launcher. This is an operational hazard associated with ammunition. The fact that an adjacent round may be fired instead of the round which is set to fire does not increase the operational safety hazard which already exists, therefore, the breaking of the camming pin is not classified as a potential safety hazard. No other unsafe conditions were reported.

e. A comparison between the reliability of the XM200 and the XM159C launcher to complete a 19-round mission is provided below:

RELIABILITY TO COMPLETE A 19-ROUND MISSION

Type Launcher	No. of Rds Fired	Chargeable Failures	Minimum Reliability @ 90% Conf Level
XM159C	109	3	32.0
XM200	2054	69	47.3

The above is based on aerial firing data obtained during ET and ST of the XM200 and IPT of the XM159C.

f. Night firing without artificial illumination restricted the pilot's vision outside the helicopter because of rocket burnout.

AMSTE-LG 17 APR 1972

SUBJECT: Final Report, Engineering and Service Test, XM200 Rocket Launcher for 2.75-inch HVAR, USATECOM Project No. 4-VC-300-200-001/003

5. Comments:

a. A stronger canning pin has been incorporated into the production launcher and there have been no reported failures of this pin during the IPT. Evaluation of this correction will be made upon review of the final IPT report.

b. It is the opinion of this headquarters that the launcher will meet the reliability requirements if the canning pin and wiring harness failures are corrected.

c. A direct exchange of the XM200 launcher at direct-support maintenance level would alleviate the maintenance burden placed on the user when disassembly of the launcher is required.

6. Conclusions:

a. The common tool set and equipment with the maintenance package is adequate to perform maintenance on the launcher at the organizational level.

b. The maintenance instructions in the manual were adequate.

c. The skill level and background of an armorer (MOS 45J) is sufficient to maintain the launcher.

d. The maintainability of the rocket launcher is inadequate due to an excessive amount of unscheduled maintenance manhours.

e. The reliability of the XM200 launcher is inadequate due to an excessive number of canning pin and electrical failures.

f. The XM200, 2.75-inch rocket launcher submitted for IT and ST is unsuitable for Army use.

7. Recommendation: The deficiencies and the shortcoming be corrected.

FOR THE COMMANDER:

MICHAEL PAULICK
Brigadier General, USA
DCG/CofS

2 Incl
as

AMSTE-ME 17 APR 1970

SUBJECT: Final Reports, Engineering and Service Test, XM200 Rocket Launcher for 2.75-Inch FFAR, USATECOM Project No. 4-MP-300-200-001/003

CF:
CG, USAMC, AMCRD-Q - 2 cys
AMCRD-C - 2 cys
AMCRD-U - 1 cy
CG, USAMDC, USACDC LnO, USAMUCOM (w/o incl)
CG, USCONARC, ATIT-RD-MO (w/o incl)
CO, USAADSRA, ECSLOG-ADSRA-MS (w/o incl)
CO, ANG, STEAP-ME-TI - w incl 1
Pres, USAAVNTBD, STEBG-MO - w incl 2

RDTE PROJECT NO. _____

USATECOM PROJECT NO. 4-WE-300-200-003

USACDC AC NO. _____

SERVICE TEST
of
XM200 2.75-INCH AIRCRAFT ROCKET LAUNCHER

Final Report
by
LTC John O. Gilliland
October 1969

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION TEST BOARD
Fort Rucker, Alabama 36360

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ABSTRACT

The US Army Aviation Test Board service tested the XM200 2.75-Inch Rocket Launcher to determine its suitability for Army use. The test was conducted at Yuma Proving Ground, Arizona, in July 1969. The XM200 was installed on UH-1C and AH-1G Helicopters and ground and flight tested day and night, with an expenditure of 1,864 aerial rockets. The XM200 generally met the Technical Requirements, except in the area of reliability. Two deficiencies were discovered--one in the electrical wiring and one in the contact detent assembly. These deficiencies resulted in excessive unscheduled maintenance and decreased operational reliability. It was concluded that the XM200, in its present configuration, is not suitable for Army use, and that it is not an acceptable replacement for the XM159( ) launcher. It was recommended that the XM159( ) not be replaced by the XM200; that immediate action be taken to correct the deficiencies; and that after the deficiencies are corrected, a check test be conducted.

FOREWORD

The Commanding General, US Army Test and Evaluation Command (USATECOM), directed this service test by letter, AMSTE-BG, Headquarters, USATECOM, 5 September 1968, subject: "Test Directive, Engineering and Service Test of Rocket Launcher, 2.75-Inch, XM200."

The US Army Aviation Test Board (USAAVNTBD) was responsible for planning and conducting the test and for reporting the test results. USAAVNTBD personnel, other than the author, who participated in and are knowledgeable in the details of the test include: Mr. Joseph E. Givens (Project Officer); LTC Raymond P. Bosworth (Planner); CW2 David F. Minner (Maintenance); Mr. Clarence J. Carter (Armament Equipment Specialist).

The US Army Aeromedical Research Laboratory conducted gas-contamination studies and provided a report on that subject.

All data concerning this test are on file at the USAAVNTBD under USATECOM Project No. 4-WE-300-200-003. The RDTE Project No. is unknown.

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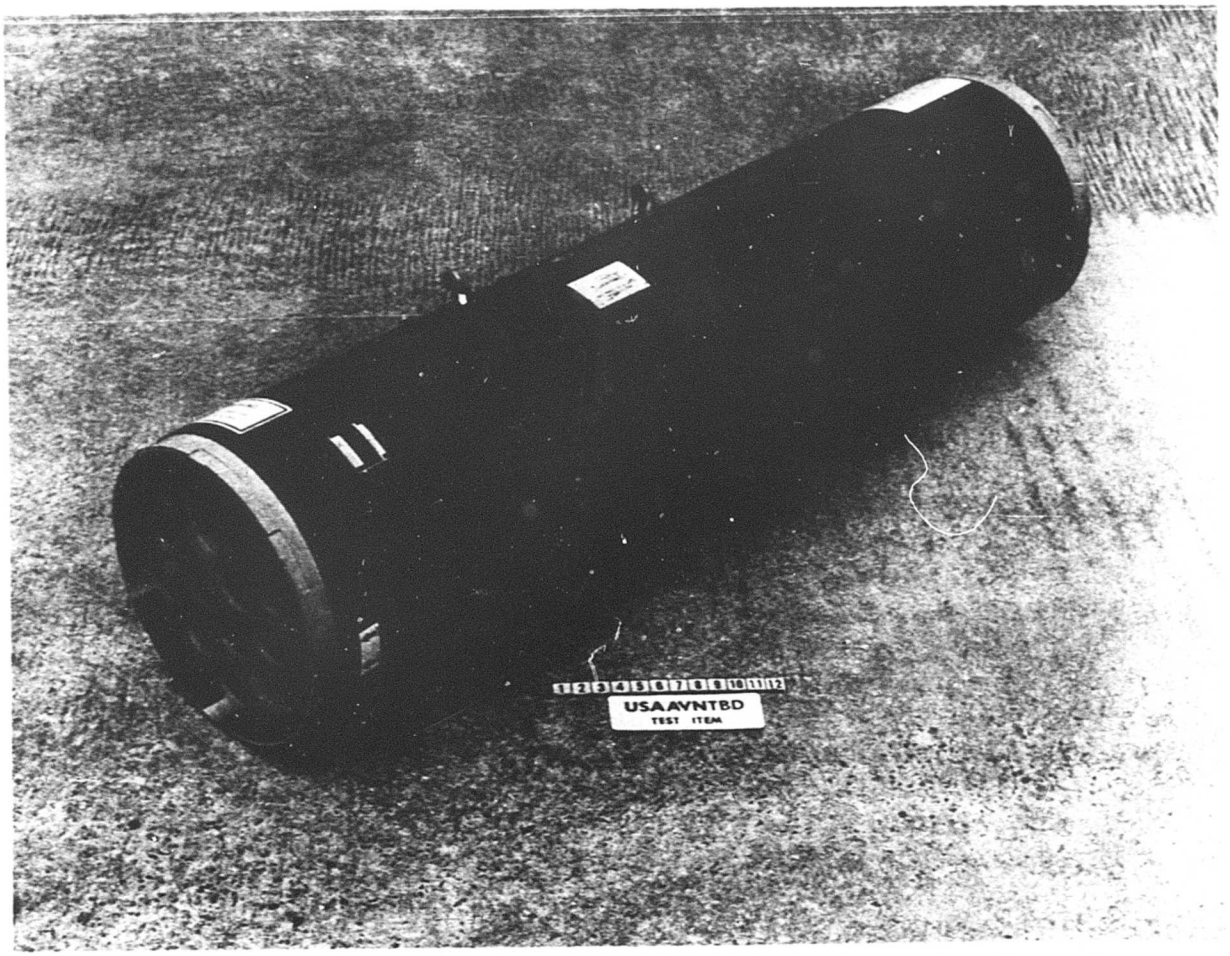

Figure 1. XM200 2.75-Inch Rocket Launcher

SECTION 1. SUMMARY

1.1 BACKGROUND

A requirement exists for an additional armament subsystem with a larger capacity for 2.75-inch rockets than that of the present M158 seven-tube, reusable, repairable rocket launcher. The XM159 nineteen-tube rocket launcher was developed to satisfy this requirement. The engineering test and initial-production test of the XM159A and XM159C rocket launchers indicated considerable problems with indents and firing contacts which made the launcher marginally acceptable for Army issue. The M158 has proven to be reliable and trouble free. The XM200 rocket launcher was developed in an effort to provide a 19-tube, reusable, repairable launcher comparable to the M158. On 5 September 1968, USATECOM directed the USAAVNTBD to service test the XM200 2.75-inch rocket launcher (ref 7, app V).

1.2 DESCRIPTION OF MATERIEL

The XM200 rocket launcher was designed for the 2.75-inch Limited-Spin Folding-Fin Aerial Rocket (LSFFAR). It is a 19-tube, reloadable, reusable, and repairable launcher. The launcher consists of a cluster of 19 tubes packaged in a round configuration encased by a cylindrical shroud. The launcher is 58 inches long and 15.7 inches in diameter, and weighs 140 pounds empty. It is capable of being loaded from the front and rear. The rocket is released from the launcher tube by pressure generated by the firing motor overcoming a restraining detent. The XM200 was designed to be compatible with the firing subsystems on the UH-1B/C, AH-1G, and AH-56A Helicopters.

1.3 TEST OBJECTIVE

To determine the suitability of the XM200 2.75-inch rocket launcher and its maintenance package for Army use.

1.4 SCOPE

1.4.1. The USAAVNTBD conducted this service test during July 1969 at Yuma Proving Ground, Arizona. Ground and flight testing was conducted with the UH-1C and AH-1G Helicopters during both day and night with the expenditure of 1,864 2.75-inch LSFFAR's (using the MK40

motor with mods through MOD 3 and the modified XM229 warhead with both the M423 and XM429 fuzes) over a 30-day period. Four XM200 launchers as test items and one launcher as spare parts were used during the test.

1.4.2. The criteria used during this test were the technical requirements for Launcher, Rocket, Aircraft, 2.75-Inch, XM200 (ref 6), the Qualitative Materiel Requirements for Armed Helicopter Weapons Systems (ref 2), appropriate technical manuals, and the qualitative judgment of project personnel. Special attention was given to design deficiencies and the elimination of unnecessary features which would not adversely affect the essential performance, reliability, compatibility, or safety of the subsystem.

1.5 SUMMARY OF RESULTS

1.5.1. Weights and dimensions were similar to those for the XM159( ) launcher. Cluster arrangement and design configuration were adequate.

1.5.2. The XM200 was physically compatible with the UH-1( ) and AH-1G Helicopters. The design gross weight and center-of-gravity (c.g.) limitations of the UH-1( ) were not exceeded with the XM200 installed and loaded; however, the design gross weight of the AH-1G could be exceeded in the HOG configuration if more than 1,330 pounds of fuel were used, when conforming to the flight safety release for this test (part D, app. I).

1.5.3. Only the Aircraft Armament Repairman's Organizational Maintenance Tool Set was required for a "fly-away" kit to support the XM200 in the field. The XM200 was adequately boresighted and harmonized using standard equipment. Loading and unloading were performed without difficulty. Reloading procedures were adequate and the turnaround times were not excessive.

1.5.4. Operation was compatible with the UH-1( ) and AH-1G Helicopters and the aircraft subsystems and no adverse effects on aircraft flight control or stability were encountered. The XM200 was operationally suitable and was compatible with other armament subsystems and the pilot's gunsight on both aircraft.

1.5.5. Effective and minimum safe ranges of the rockets were comparable to those when launched from an XM159( ) launcher. Operation resulted in a high degree of kill probability on simulated area targets.

1.5.6. Ripple firing during the hours of darkness, without artificial illumination, was hazardous because rocket burnout restricted the pilot's vision outside the helicopter.

1.5.7. Rocket noise levels were acceptable and no apparent damage to personnel resulted. Rocket gas s were no more detectable than those from other wing-mounted subsystems when fired under similar conditions.

1.5.8. Maintainability features were unacceptable and unscheduled maintenance was excessive.

1.5.9. Operational reliability was unsuitable. Logistical support requirements were excessive and the maintenance reliability features were inconsistent with like features found in similar armament subsystems. Although the tubes should meet their intended service life, parts usage was excessive. The calculated MRTS was 23 to 37 rounds at a 90-percent confidence level.

1.5.10. Maintenance instructions contained in the manual were adequate for the level of maintenance required.

1.5.11. Operational safety was acceptable.

1.5.12. The XM200 generally met the criteria as stated in the technical requirements, except in the area of reliability. (See appendix II.)

1.6 DISCUSSION

The unscheduled maintenance of the launcher was excessive, thus decreasing the operational reliability. The excessive maintenance was attributed to two deficiencies, the electrical wiring and an unreliable pin located in the contact detent assembly. Approximately 15 man-hours were required for each disassembly, repair, and reassembly of the launcher. (See Maintenance and Reliability Analysis Charts, app IV.) If both deficiencies are corrected, there should be practically no unscheduled maintenance.

1.7 CONCLUSIONS

a. The XM200 2.75-inch rocket launcher, in its present configuration, is not suitable for Army use.

b. The XM200 launcher is not an acceptable rep'acement for the XM159( ) launcher.

1.8 RECOMMENDATIONS

a. The XM159( ) launcher not be replaced with the XM200 launcher for Army use.

b. Immediate action be taken to correct the deficiencies listed in appendix III.

c. After the deficiencies listed in appendix III are corrected, a check test be conducted to determine suitability for Army use.

SECTION 2. DETAILS OF TEST

2.1 DESIGN CHARACTERISTICS

2.1.1. Objective

To determine the design characteristics of the XM200 rocket launcher.

2.1.2. Criteria

a. The 19 tubes shall be clustered in a minimum volume package which shall be essentially cylindrical. Fore or aft aerodynamic fairings are not required, but accommodations for fairings must be provided. (Para 3.1.3.2, ref 6)

b. The launcher shall have 19 round tubes cylindrically shrouded in a maximum 15.72-inch diameter package. The launcher tubes are to be compatible with the maximum length combination of motors and warheads. (Para 3.1.3.3, ref 6)

c. The empty weight of one complete 19-tube launcher shall be minimum weight compatible with performance. (Para 3.1.3.4, ref 6)

d. The rocket will utilize the 17-pound warhead with either the M423 or XM429 fuze. The rocket weight is 28.22 pounds with the M423 fuze. The overall length of the MK40 rocket motor with the XM229 warhead and M423 fuze is 67.72 inches. The c.g. is located 26.90 inches from the rocket nose. (Para 3.1.3.7, ref 6)

e. POMM 9-1090-204-12/2 (XM200).

2.1.3. Method

The rocket launchers were inspected, weighed, measured, and photographed. The c.g. was determined. The weights and measurements were compared with those of the XM159 launcher. The cluster arrangement of the tubes and the accommodations for fairing were evaluated. The spring tension on each contact was measured. The fire control panel and location of the panel were inspected and photographed.

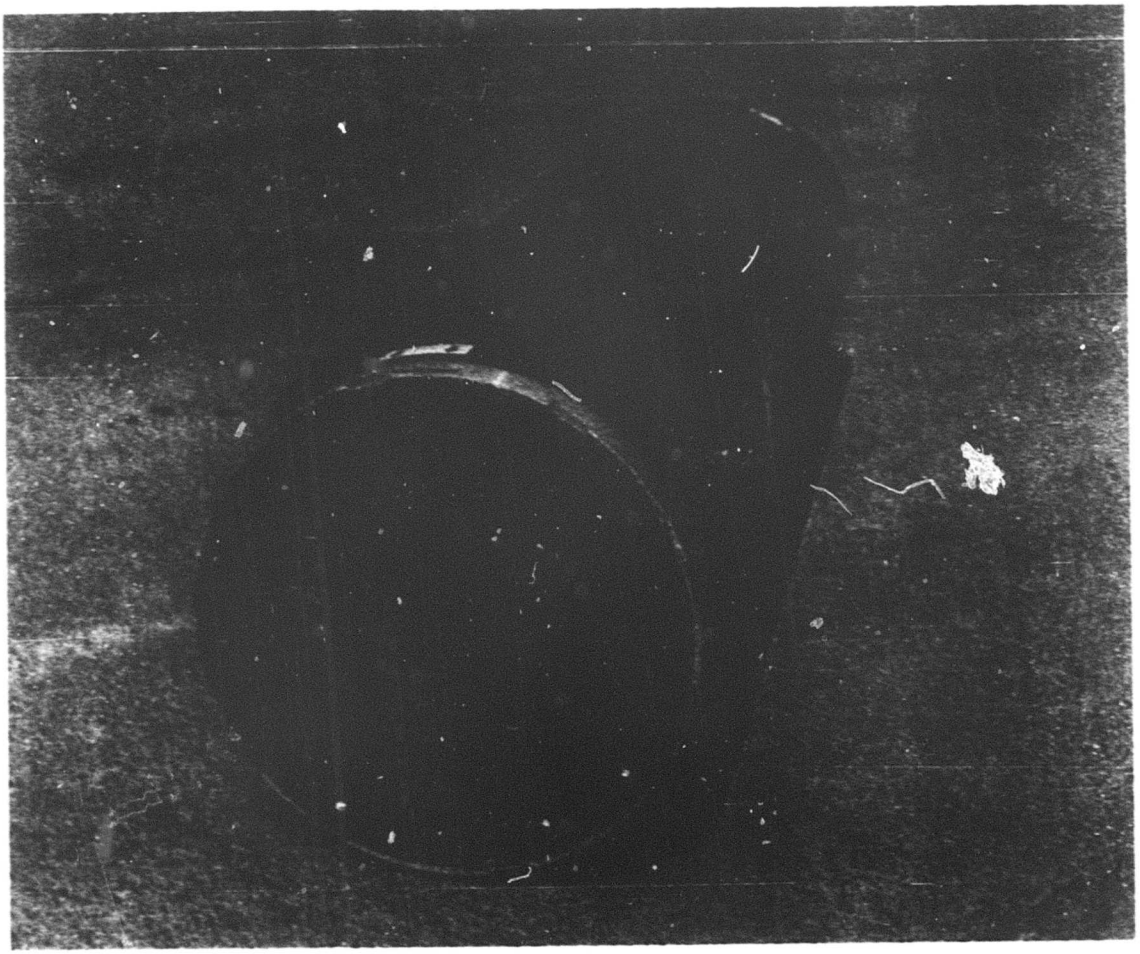

Figure 2. Rear View of XM200.

2.1.4. **Results**

2.1.4.1. **Condition on Receipt.** The four launchers that were used as test items were new and were in excellent condition upon receipt (fig 1 and 2). The one launcher that was used for spare parts was not in operational condition and was stenciled "do not fire." The launcher had been used during the vibration test at Redstone Arsenal by US Army Missile Command (USAMICOM) and internal damage had resulted. Later, when the launcher was disassembled, cracks in the forward and inner bulkhead and numerous damaged wires were discovered. The hardback, tie rods, spacer sleeves, tubes, and contacts were usable. The launchers were fired using the standard fire control panels in the AH-1G and UH-1C Helicopters.

2.1.4.2. **Weight and Dimensions.** The weights and dimensions of the XM200 launcher and the XM159 launcher and components are listed below:

	XM200	XM159
Weight without rockets	140.0 lb.	138.0 lb.
Weight with 19 rockets	672.9 lb.	670.7 lb.
Weight of tube	4.0 lb.	4.0 lb.
Length of launcher	60.5 in.	59.8 in.
Length of launcher and rockets installed	63.6 in.	63.1 in.
Length of tube	58.0 in.	56.0 in.
Horizontal diameter of launcher	15.5 in.	15.2 in.

	XM200	XM159
Vertical diameter of launcher	15.5 in.	15.5 in.
Tube inside diameter	2.8 in.	2.8 in.
Tube outside diameter	2.9 in.	2.9 in.

2.1.4.3. Center of Gravity. The c.g. of the launcher empty was 31.2 inches and loaded was 23.8 inches from the front.

2.1.4.4. Cluster Arrangement. The arrangement of the tube cluster was compact, yet the contacts could be placed so as not to interfere with loading and/or unloading. The cluster was inclosed in a metal fairing and accomodations for "break away" nose and tail fairings were provided. The average tension on the contact springs was 18 pounds (high, 22 pounds; low, 14 pounds) prior to the launching of rockets.

2.1.5. Analysis

2.1.5.1. The weight and dimensions of the XM200 launcher were similar to those for the XM159 launcher and met the criteria.

2.1.5.2. The cluster arrangement and design configuration of the launcher were adequate and met the criteria.

2.2 INSTALLATION CHARACTERISTICS

2.2.1. Objective

To determine the installation characteristics of the XM200 rocket launcher when installed on and removed from the UH-1( ) and AH-1G Helicopters.

2.2.2. Criteria

a. The launcher will be compatible with the AH-1G sway braces and ejector. The stores support will have 14-inch lug spacing and will be compatible with the standard aircraft MA-4A bomb rack, the AH-1G RPI rack, the UH-1B XM156 mount, and the Aero 65A1 bomb rack on AH-56A Helicopter. (Para 3.1.2, ref 6)

b. The launcher support lugs will be spaced 14 inches apart to be compatible with the MA-4A bomb rack. The lug location will be such that a fully loaded rocket package will have the c.g. located at a point approximately midway between the lugs. (Para 3.1.3.5, ref 6)

c. Preliminary Operating and Maintenance Manual (POMM) 9-1090-204-12/2.

d. Technical Manual (TM) 55-1520-221-10.

e. TM 55-1520-211-10.

2.2.3. Method

2.2.3.1. Installation and Removal. The launchers were installed and removed in accordance with instructions contained in the technical publications using various numbers of personnel. Motion and still photographic documentation was obtained during the operation. The combinations of equipment and tools, the minimum and optimum number of personnel, and times required for installation and removal of a launcher and combinations of launchers were recorded. The capability for manual and emergency jettison and the compatibility of the support lugs with the MA-4A bomb rack were determined. Clearances between launchers, launchers and airframe, and launchers and surface were measured.

2.2.3.2. Boresighting and Harmonizing Procedures. With the aircraft in the static position, each launcher was boresighted and harmonized. Still and motion photographic documentation was obtained during the operation. The times, optimum number of personnel, and equipment required to boresight and harmonize the launchers were recorded.

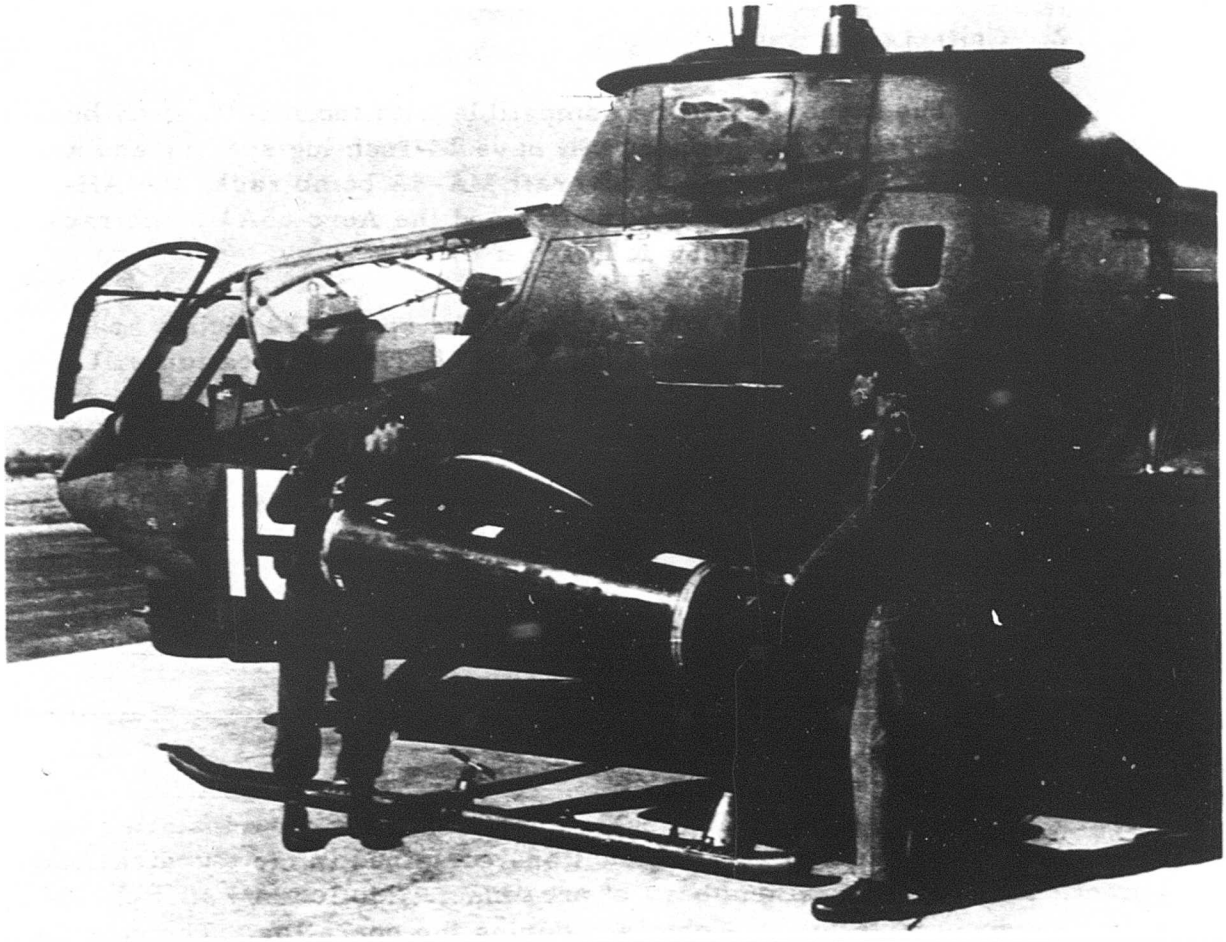

Figure 3. Installing the XM200 on the AH-1G.

2.2.4. Results

2.2.4.1. Installation and Removal. Installation and removal of the XM200 consisted of attaching and removing the launchers from the bomb rack assemblies. The support lugs were compatible with the bomb rack (fig 3). No special tools or equipment were required. The minimum and optimum number of personnel required to install and remove each unloaded launcher was three (fig 4) using only those tools contained in the Organizational Maintenance Tool Set. Three men required an average of 10 minutes to attach and 5 minutes to detach a launcher to or from the AH-1G Helicopter. Approximately 30 minutes were required for installation on the UH-1( ). This was attributed to more awkward working conditions because when the launcher was mounted on the helicopter, it was extremely close to the surface. A manual jettison capability was provided in the UH-1( ), but was not provided in the AH-1G crew compartments. Electrical jettison was provided on both helicopters. On the AH-1G, the minimum clearance between launchers was 3 inches, between the inboard launcher and airframe 17 1/2 inches, between the inboard launcher and surface 22 1/8 inches, and between the outboard launcher and surface 28 1/4 inches (fig 3). On the UH-1( ), the clearance between the launcher and airframe was 13 1/4 inches, and between the launcher and the surface 3 3/4 inches (fig 4).

2.2.4.2. Boresighting and Harmonizing. Three persons and 30 minutes were required to boresight and harmonize one launcher on each helicopter. Standard equipment was adequate. Procedures were not provided in the POMM 9-1090-204-12/2. To obtain maximum effective range, the launchers were adjusted to 5 degrees above the waterline on both helicopters.

2.2.5. Analysis

2.2.5.1. The launcher was physically compatible with each helicopter.

2.2.5.2. Only the Aircraft Armament Repairman's Organizational Maintenance Tool Set (FSN 4933-987-9816) was required to support operations in a remote area.

2.2.5.3. Standard equipment was adequate for boresighting and harmonizing the launcher.

Figure 4. Installing the XM200 on the UH-1C.

2.3 COMPATIBILITY

2.3.1. Objective

To determine the compatibility of the XM200 rocket launcher and firing system with the UH-1( ) and AH-1G Helicopters.

2.3.2. Criteria

a. The detent shall allow both front end and aft end loading. The detent shall not incorporate an item which must be replaced for each rocket firing. The detent shall be designed to require a forward force of from 175 to 250 pounds to release the rocket. (Para 3.1.3.8, ref 6)

b. The launcher electrical connector shall be compatible with the UH-1B, AH-1G, AH-56A, and the UH-1C Helicopter firing systems. The electrical power for firing rockets and jettisoning shall be drawn from the aircraft's own 24-28 v.d.c. system under operational conditions. No intervalometer is required or desired. (Para 3.1.3.9, ref 6)

c. The electrical wiring shall be such that each tube is wired to fire individually and to be safely grounded and shielded. (Para 3.1.3.10, ref 6)

d. Human factors design criteria shall conform to specifications on human factors. The design shall be compatible with the use of arctic mittens. The firing contact can be rotated to cam up the detent and allow easy field loading or removal of the rocket from both fore and aft end. (Para 3.1.3.12, ref 6)

e. POMM 9-1090-204-12/2.

f. TM 55-1520-221-10.

g. TM 55-1520-211-10.

2.3.3. Method

2.3.3.1. Pre-Fire Check. The compatibility of the launcher and aircraft electrical connectors was evaluated. A continuity check of each launcher was performed with the aircraft power source off and then an

electrical power check of each launcher (less rockets) with all electrical and avionics equipment on, while operating the aircraft at normal rotor operating speed, to determine whether stray voltage existed. Flights were then conducted in clear and contaminated atmospheric conditions. Upon landing, electrical continuity checks were again conducted and the results were compared with the data previously obtained. The capability of each tube to fire individually was determined.

2.3.3.2. Weight and Balance. The gross weight and c.g. for the UH-1( ) and AH-1G Helicopters were computed in accordance with the flight release for this test (part D, app I) with minimum and maximum fuel, with and without ordnance, to determine the minimum and maximum aircraft gross weights, the most forward and rearward c.g. displacement of the aircraft, and whether any operating limitations could be exceeded.

The weights and c.g.'s for the UH-1( ) were computed with the M5 armament subsystem and two launchers installed.

The weights and c.g.'s of the AH-1G were computed with four launchers installed for the HOG configuration (four launchers and the XM28 armament subsystem with XM134 guns), and for the HEAVY SCOUT configuration (two launchers, XM28 subsystem, and two XM18 pods).

2.3.3.3. Loading and Unloading. The launchers were loaded and unloaded from the front and rear in accordance with instructions contained in the technical publications. Still and motion photographic documentation was obtained during the operation. The times, optimum number of personnel and equipment required, and any difficulties encountered were recorded.

2.3.3.4. Static Fire. With the helicopters on the ground and rotors at normal operating speed, a sufficient number of rockets was launched in predetermined combinations of pairs and ripples from each individual launcher and combination of launchers to determine the electrical requirements and the reliability and adequacy of the single or combination tube firing capability and selector. Boresighting and harmonizing were confirmed and the adequacy of the fire control system was evaluated. Cameras were mounted on the test helicopters and high-speed motion photographic documentation of the debris pattern in relation to the helicopter airframes was obtained. Upon completion of static firing, the helicopters, mounts, and launchers were inspected for

damage or adverse effects. All data obtained were analyzed prior to in-flight firing.

2.3.4. Results

2.3.4.1. Pre-Fire Check. The launcher and aircraft electrical connectors were compatible, and a lock collar was provided on the male adapter to prevent the connector from becoming loose in flight. Stray voltage did not exist during initial static electrical power checks. The capability was provided to fire each tube separately. The electrical pins and firing order of each corresponding rocket tube were easily identified.

2.3.4.2. Weight and Balance. Computed weight and balance sample forms (DD 365F) are contained in part A, appendix I. The weights and c.g.'s were:

Helicopter Configuration	Weight (lb.)		C.G. (in.)	
	Takeoff*	Landing**	Takeoff*	Landing**
UH-1C	8,789.7	6,319.2	130.1	128.9
AH-1G with 4 launchers	9,462.7	6,107.5	200.1	200.3
AH-1G HOG	9,500.0	6,531.6	197.1	200.5
AH-1G HEAVY SCOUT	9,358.3	6,389.5	196.2	198.4

With 30 pounds of ballast (lead shot) located in the extreme rear of the tail boom, the flight characteristics of the UH-1C were enhanced and the design gross weight and c.g. limitations were not exceeded.

C.g. limitations of the AH-1G were not exceeded in either configuration with the battery located in the avionics compartment. To enhance personnel safety, the battery was not installed in the nose compartment. Ballast was not required in either configuration to remain within c.g. limits. The design gross weight of the AH-1G in the HOG configuration could be exceeded if the fuel cell was filled with more than 1,330 pounds of fuel.

*Maximum fuel and full load of ordnance.
**Minimum fuel and ordnance expended.

Figure 5. Loading the XM200 from the front, when mounted on the UH-1C.

2.3.4.3. Loading and Unloading. The average time for loading four rocket launchers (AH-1G) was 30 minutes (15 minutes per two launchers) and for unloading was 18 minutes (9 minutes per two launchers). Times were the same for loading and unloading from either front or rear. Times were comparable for the UH-1( ); however, loading and unloading from the front were more easily accomplished (fig 5). Two men, both minimum and optimum, were required to load and unload either side of either helicopter.

2.3.4.4. Static Fire. The electrical systems of both helicopters provided sufficient power to operate the aircraft, avionics subsystems, and the launchers simultaneously. The launcher did not require hydraulic power. The capability of selecting and firing a single or various combinations of rockets was adequate and the selector and combinations selected were compatible and reliable. The boresight and harmonizing alignment was determined to be accurate. There was no skin or structural damage to either aircraft. Minor debris hit the AH-1G fuselage when rockets were fired from launchers mounted on either the inboard or outboard wing stations. No damage occurred to the mounts or launchers.

2.3.4.5. Hover Fire. No adverse effects on the control and stability of either helicopter or aircraft subsystems were encountered when launching rockets during hover flight. The engine and flight instruments were unaffected by the rocket blasts. Antitorque control was adequate when launching various numbers of rockets during ripple fire, symmetrically or asymmetrically. Debris patterns were similar to those during static fire, and no damage occurred to the mount or launchers.

2.3.5. Analysis

2.3.5.1. Stray voltage in the launcher was not encountered. Electrical connectors and wiring met the criteria; however, an intervalometer was required for firing.

2.3.5.2. The UH-1( ) design gross weight and c.g. limitations were not exceeded. The AH-1G c.g. limitations were not exceeded; however, the design gross weight could be exceeded in the HOG configuration.

2.3.5.3. No difficulties were encountered when loading or unloading the launcher. The detent allowed both front and rear loading and met the criteria.

2.3.5.4. The operation of the launcher, the helicopters, and aircraft subsystems was compatible. No adverse effects on aircraft flight control and stability were encountered.

2.4 OPERATIONAL SUITABILITY

2.4.1. Objective

To determine the operational suitability of the XM200 rocket launcher when employed from the UH-1( ) and AH-1G Helicopters.

2.4.2. Criteria

a. This technical requirement outlines the objectives and describes a program for the detail design of prototype hardware for a nineteen-tube reusable and maintainable launcher for firing 2.75-inch rockets, composed of the MK40, MOD3 motor, and the XM229 warhead with the XM429 fuze (hereafter referred to as the rocket). The nineteen-tube launcher shall consist of a cluster of tubes packaged in a round configuration and essentially encased by a cylindrical shroud. The launcher is to be compatible with the firing subsystems on the UH-1B, AH-1G, AH-56A, and the UH-1C Helicopters. The launcher shall be compatible with the rocket MK40 motor and MOD5 through MOD3 and the modified XM229 warhead with either the M423 or the XM429 fuze. (Para 1.1, ref 6)

b. The primary design goals will be reliability, lightweight, and safety. The nineteen-tube launcher shall be designed so that each tube will be reliably reusable through one-hundred rocket firings without repair. It is desired that each tube reliably fire 250 rounds without repair. It is required that each tube fire 500 rounds without major parts replacement. (Para 3.1.3.1, ref 6)

c. No seals will be required to protect the launcher against applicable environmental conditions of AR 705-15 with Change 1, during transportation, storage, and service. No aerodynamic fairings, neither fore nor aft, nor individual tube end closures are required. (Para 3.1.3.15, ref 6)

d. POMM 9-1090-204-12/2.

e. TM 55-1520-221-10.

f. TM 55-1520-211-10.

2.4.3. Method

2.4.3.1. Inflight Firing. Rockets with various types of warheads were launched from the launchers throughout the established flight limitations of each aircraft using dive angles of 5, 10, 15, 20, and 25 degrees; altitudes of 1,000, 1,500, 2,000, and 2,500 feet above ground level (AGL), entry airspeeds of 80, 100, 120, and 140 knots indicated airspeed (KIAS), and slant ranges of 500, 1,000, 1,500, 2,000, 2,500, and 3,000 meters to determine optimum delivery techniques and whether any adverse effects on stability and control of the aircraft or aircraft subsystems could be encountered. Flight conditions were determined from the aircraft indicators. The rockets were launched at a bull's-eye target with a 10-meter center and 20-, 40-, and 60-meter circles from known distances in uncoordinated and coordinated flight, symmetrically and asymmetrically, in predetermined combinations of pairs and ripples from individual and combinations of launchers. Sufficient data were obtained to determine the maximum engagement, effective, and minimum safe ranges. The compatibility of the sights and launchers was evaluated and an attempt was made to determine whether any unsafe conditions existed. Then rockets were launched at automobile bodies and silhouette targets spaced at known distances to simulate area targets. Center-of-impact deviations and dispersion patterns were determined by aerial observation and film. Normal and high speed motion photographic documentation of the firing results and debris patterns were obtained. One launcher electrical cannon plug was deactivated to conduct asymmetrical launching. The compatibility of the XM200 launcher with the other armament subsystems normally employed on the AH-1G and UH-1( ) Helicopters was evaluated. Prior to loading all rockets were inspected for external damage, bent or damaged fins, and adequate tightness of the warhead and motor. After each flight, the firing contacts were inspected for damage, and the launchers were inspected after each day's operation for damage and wear.

2.4.3.2. Night Effectiveness. Rockets were launched in predetermined combinations of pairs and ripples during the hours of darkness, with and without artificial illumination, to determine the effects of rocket

burnout on the flight personnel, night visual detection from the ground, and whether any special flight techniques were required. The adequacy of the sights and the fire control systems was evaluated. High speed motion photographic documentation of rocket burnout was obtained.

2.4.3.3. Turnaround Time. Following each mission, the launchers were serviced as required and the times to return the launchers to an operational status were recorded. Various numbers of personnel were used to determine minimum and optimum turnaround time. The turnaround time for the UH-1( ) was determined with two launchers installed. The turnaround times for the AH-1G were determined with four launchers installed, then for the HOG (four launchers and the XM28 armament subsystem with two XM134 guns) and the HEAVY SCOUT (two launchers, XM28 armament subsystem, and two XM18 pods) configurations. The reloading procedures were evaluated and compared with the prescribed procedures and any difficulties were recorded.

2.4.3.4. Noise Levels. Internal and external noise levels during static, hover, and inflight firing were qualitatively evaluated.

2.4.3.5. Gas Contamination. US Army Aeromedical Research Laboratory (USAARL) personnel measured and recorded gas levels in the crew compartment during static, hover, and inflight firing.

2.4.4. Results

2.4.4.1. Inflight Firing. Best results were obtained using a dive angle of 15 degrees, an entry airspeed of 80-100 KIAS, and an altitude of 1,500 feet AGL. No difficulties or problems were encountered which adversely affected the flight characteristics of either the UH-1( ) or AH-1G Helicopters, when rockets were asymmetrically launched singly, in pairs, or in ripple from either wing station. When rockets were launched symmetrically from either wing station in ripples, a slight tuck was evident in the flight attitude. During asymmetrical ripple firing, the aircraft yawed approximately five degrees toward the side from which the rockets were launched.

The maximum effective range was approximately 2,000 - 2,500 meters and the most effective range was approximately 1,500 meters. Minimum safe range was approximately 500 meters. That distance was sufficient to permit a breakaway maneuver for the aircraft, at all airspeeds, and would allow the pilot to use evasive action, if necessary.

The mil-increment references on the sight reticle were adequate and were compatible with the harmonization of the launchers to allow sufficient elevation adjustment, including maximum effective range.

Accuracy depended upon flight and weather conditions and the proficiency of flight personnel; however, when using the optimum delivery techniques previously discussed, center-of-impact deviations were unaffected. An estimated 90-percent kill probability constantly resulted in the simulated area targets. When the rockets were ripple fired, the dispersion was elongated in an effective pattern.

The operation of the launcher was compatible with the XM28, XM18, and M5 armament subsystems normally employed on the AH-1G and UH-1( ) Helicopters. No abnormal operational difficulties or problems were encountered.

2.4.4.2. Night Effectiveness. Night operations with artificial illumination presented no unusual problems. Without artificial illumination, the rocket burnout restricted the pilot's vision outside the helicopter to the extent that instrument flight was required during recovery from firing runs. The helicopters could be detected from the ground when rockets were launched. The operation and location of the fire controls were adequate and the intensity of the brightness of the sight could be decreased sufficiently to permit night targets to be engaged effectively with or without artificial illumination.

2.4.4.3. Turnaround Time. The personnel and times required for turnaround between missions were:

Helicopter/Configuration	Minimum and Optimum No. of Personnel	Lapsed Time (Min.)
UH-1C	3	15
AH-1G/four launchers	4	30
AH-1G/HOG	4	50
AH-1G/HEAVY SCOUT	4	50

The required and prescribed reloading procedures were similar and adequate.

2.4.4.4. Noise Levels. When rockets were launched singly, in pairs, or in ripple, the noise did not exceed the acceptable level, and had no apparent damaging effects on personnel.

2.4.4.5. Gas Contamination. Rocket gases were noticeable from both crew stations in both helicopters when rockets were launched from a static position, during hover, and in flight. Results of the USAARL evaluation are contained in part E, appendix I.

2.4.5. Analysis

2.4.5.1. No difficulties or problems were encountered which adversely affected the control and stability of the helicopters.

2.4.5.2. The effective and minimum safe ranges of the rockets when launched from the XM200 launcher were comparable to the ranges when launched from the XM159 launcher.

2.4.5.3. The harmonization of the launcher and sight was compatible and a high degree of kill probability resulted on the area targets.

2.4.5.4. The launcher was compatible with other armament subsystems.

2.4.5.5. Night firing without artificial illumination was hazardous because rocket burnout restricted the pilot's vision outside the helicopters.

2.4.5.6. The reloading procedures were adequate and the turnaround times were not excessive.

2.4.5.7. Noise levels were acceptable with no apparent damage to personnel.

2.4.5.8. Rocket gases were no more detectable than those from other wing-mounted subsystems when fired under the same conditions.

2.5 MAINTAINABILITY

2.5.1. Objective

To determine whether the test item meets the maintainability requirements as defined in the technical requirements for the aircraft rocket launcher, 2.75-inch, XM200.

2.5.2. Criteria

a. The primary design goals will be reliability, light weight, and safety. The nineteen-tube launcher shall be designed so that each tube will be reliably reusable through 100 rocket firings without repair. It is desired that each tube reliably fire 250 rounds without repair. It is required that each tube fire 500 rounds without major parts replacement (Para 3.1.3.1, ref 6)

b. The wiring harness shall conform to the wire routing table. All launchers will be identical, i.e., no right hand or left hand peculiar features. (Para 3.1.3.11, ref 6)

c. Special tools shall not be required for maintenance of the launcher. Failed parts of the launcher shall be removable and replaceable at organizational level. (Para 3.1.3.13, ref 6)

d. No seals will be required to protect the launcher against applicable environmental conditions of AR 705-15 with Change 1, during transportation, storage, and service. No aerodynamic fairings, neither fore nor aft, nor individual tube end closures are required. (Para 3.1.3.15, ref 6)

e. POMM 9-1090-204-12/2.

f. USATECOM Regulation 750-15.

g. USAAVNTBD Memorandum 750-2.

2.5.3. Method

2.5.3.1. The XM200 launcher was maintained in accordance with USATECOM Regulation 750-15 as implemented by reference 5, appendix V.

2.5.3.2. The scheduled and unscheduled maintenance performed during the test period was recorded and compared with the prescribed procedures contained in the technical manuals. All maintenance was performed using only the Aircraft Armament Repairman's Organizational Tool Set (FSN 4933-987-9816). After expending 855 rockets from the four launchers, each of the launchers was completely disassembled, repaired, and reassembled. After expending a total of 1,380 rockets,

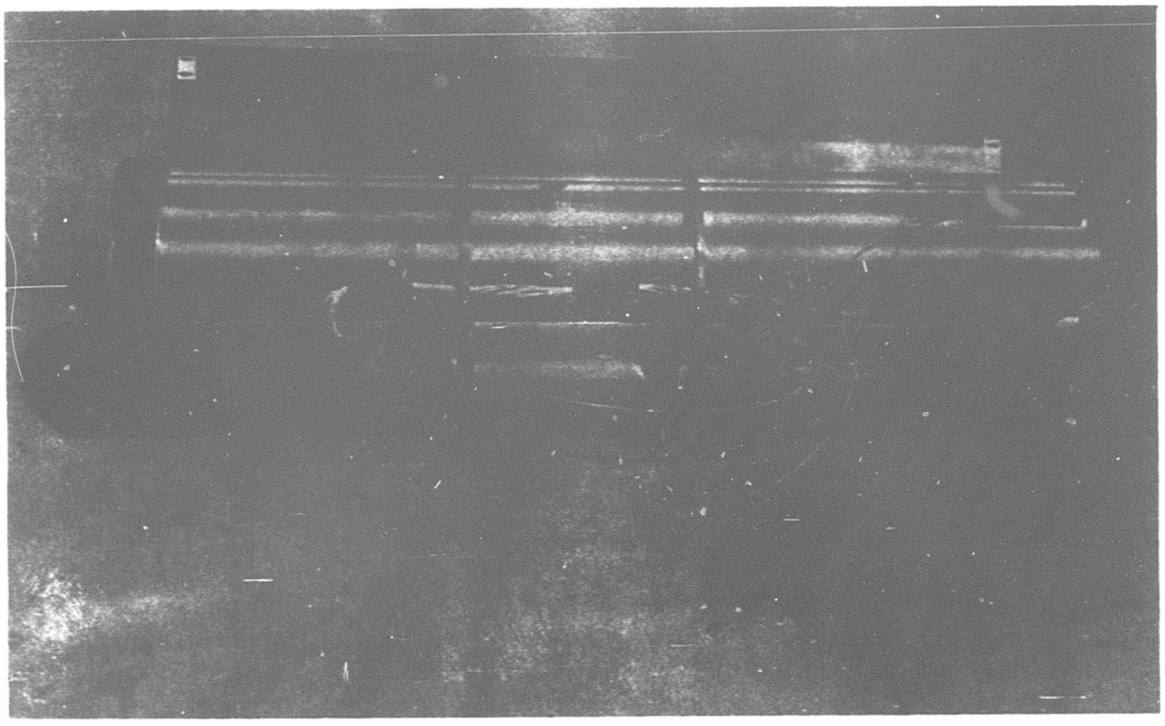

Figure 6. XM200 partially disassembled to show routing of electrical wiring.

the four launchers were again disassembled, repaired, and reassembled. The metal covering was removed from and replaced around the frame. Numerous tube assemblies were removed and replaced and the launchers were re-wired and/or the wires repaired, as appropriate. Numerous contacts were re-wired. The ease of removal and/or replacement of the components and wiring, the conformity of the wiring harness to those contained in the technical requirements, and the need for special tools were determined. Two launchers were compared to determine that all launchers were identical.

2.5.4. Results

2.5.4.1. No problems were encountered when cleaning or servicing the launchers. The required and prescribed procedures were similar and adequate. Ten maintenance man-hours were expended on scheduled maintenance (cleaning).

2.5.4.2. The wiring harness conformed to the routing table contained in the technical requirements. All launchers were identical and there were no left or right peculiarity features. No special tools were required. The Aircraft Armament Repairman's Organizational Tool Set was adequate and the prescribed procedures in the technical manual were appropriate.

2.5.4.3. Unscheduled maintenance required 128 man-hours. Excessive maintenance requirements were attributed to the magnitude of electrical shorts within the launchers and number of contact locking pins that broke.

The electrical wires from the individual firing contacts to the aircraft quick-disconnect were routed through a channel in the launcher frame between the rocket tubes and around the supporting structure (fig 6). Due to lack of space, the insulation on the wires was easily pinched and/or damaged. In addition, the exposed wires at the electrical firing contacts were damaged from the rocket blast and deteriorated with use (fig 7). Stray voltage, electrical shorts, and misfires resulted from both conditions, thus requiring partial disassembly of the launcher for outside tubes and complete disassembly for the center tubes within the cluster to correct the situation. During reassembly of the launcher, the end play of the wires at the contact end allowed the wires to flex resulting in wires being bound between the tubes and launcher rear bulkhead again causing damage to the insulation. Stray voltage and electrical shorts were encountered after reassembly.

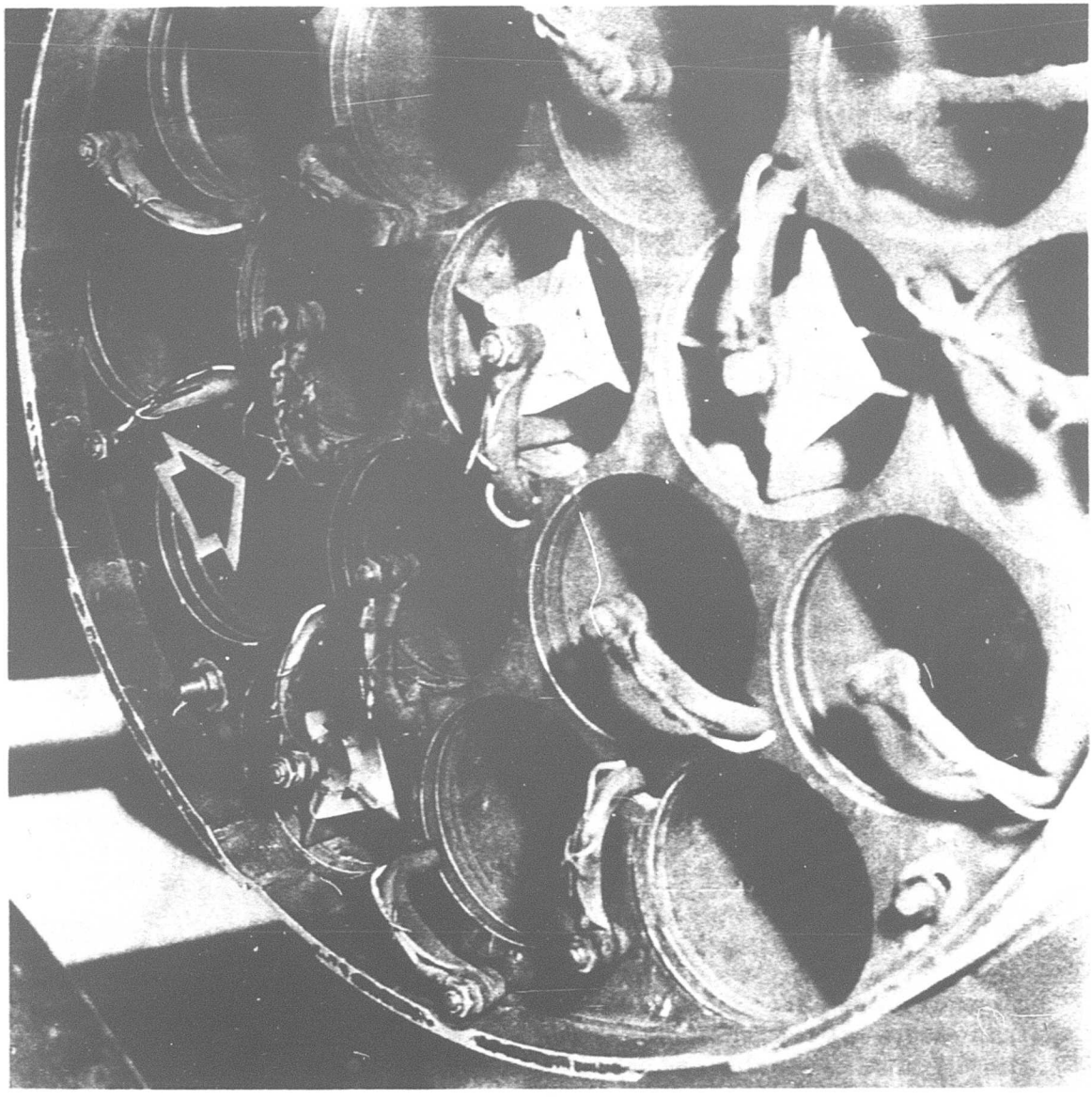

Figure 7. Rear view of XM200 showing wires damaged by rocket blast.

The small pin which locked the contact shaft in the clear or armed detent broke on numerous occasions. The shaft required rotating when loading, arming, and unloading a rocket from the tube. Wear on the pin was caused during this operation; however, the pins were broken when the rocket was launched. This was attributed to the rocket blast. The pin could not be replaced. The tube and contact assembly required replacing, thus requiring partial disassembly of the launcher for outside tubes and complete disassembly for center tubes to correct the problems.

2.5.4.4. Equipment Performance Reports (EPR's) submitted during the test are summarized in part C, appendix I.

2.5.5. Analysis

The electrical wire damage and the breaking of the contact locking arms caused excessive unscheduled maintenance, and were thus considered deficiencies. Should these problems be corrected, practically no unscheduled maintenance would be required.

2.6 RELIABILITY

2.6.1. Objective

To assess the reliability of the test item under normal operations and derive information regarding expected service life and required logistical support.

2.6.2. Criteria

a. The primary design goals will be reliability, light weight, and safety. The nineteen-tube launcher shall be designed so that each tube will be reliably reusable through one-hundred rocket firings without repair. It is desired that each tube reliably fire 250 rounds without repair. It is required that each tube fire 500 rounds without major parts replacement. (Para 3.1.3.1, ref 6)

b. USATECOM Regulation 750-15.

c. USAAVNTBD Memorandum 750-2.

2.6.3. Method

2.6.3.1. Maintenance, Reliability, and Spare Parts Analysis Charts were prepared in accordance with USAAVNTBD Memorandum 750-2 (ref 5) from the record of scheduled and unscheduled maintenance and parts usage.

2.6.3.2. The launcher reliability is expressed in terms of Mean Rounds to Stoppage (MRTS) per launcher. The following factors were utilized to measure achieved launcher reliability: cumulative operating time, cumulative operating time, cumulative rockets launched per tube, and net chargeable failures to launch.

2.6.3.3. The number of rockets expended for each launcher varied because of the number of malfunctions and the test requirements. The number two and three launchers were used on both the UH-1C and AH-1G Helicopters and tubes number 1, 4, 6, 8, 11, and 15 of the number two launcher were used in an attempt to determine whether the tubes would meet the service life requirement of a minimum of 100 launches. The numbers 1, 4, and 6 tubes were originally selected and 242 rockets were programmed to be launched through the tubes in addition to the rockets previously expended. These rockets were fired statically. An auxiliary power unit was applied to the helicopter prior to each launching and removed from the helicopter during loading. Approximately ten rockets per tube were launched in sequence and the launcher was allowed twenty-five minutes to cool prior to the next launches.

2.6.3.4. The tension of each contact spring was recorded at the conclusion of the test.

2.6.4. Results

2.6.4.1. A Maintenance and Reliability Chart and a Parts Analysis Chart are contained in appendix IV. Parts usage was considered excessive.

2.6.4.2. During the test, 1,864 rockets were expended from four launchers. Sixty-four chargeable stoppages occurred. The majority of the stoppages were attributed to electrical wiring and contact pin malfunctions (para 2.5.4.3.). The location of the launcher, number of rockets expended, chargeable stoppages, and MRTS per launcher are listed below.

Launcher No.	Aircraft/Side Mounted	Rockets Expended	Chargeable Stoppages	MRTS
1	AH-1G/left outboard	279	6	46.5
2	UH-1C/left AH-1G/left inboard	792	19	41.5
3	UH-1C/right AH-1G/right inboard	419	25	16.1
4	AH-1G/right outboard	374	14	26.7
	TOTAL	1,864	64	----

The calculated MRTS was 23 to 37 rounds at a 90-percent confidence level.

2.6.4.3. Tube damage was not encountered throughout the test. The total number of rockets expended from the selected tubes is stated below:

a. Tube No. 1. The contact pin broke after a total of 86 rockets had been launched. Since it was the center tube and was fired first by the intervalometer, the firing contact was placed on the rocket contact each time thereafter and a total of 118 rockets was launched.

b. Tube No. 4. The contact pin broke after a total of 85 rockets had been launched. The No. 8 tube was then selected to fire in lieu of the No. 4 tube. The No. 8 contact pin broke after 45 rockets were launched. The No. 11 tube was then selected to fire in lieu of No. 8 tube. The No. 11 contact pin broke after 36 rockets were launched. After breaking the No. 11 pin, the contact was placed on the rocket contact each time thereafter and a total of 42 rockets was launched through the tube.

c. Tube No. 6. The contact pin broke after a total of 57 rockets had been launched. The No. 15 tube was then selected to fire in lieu of the No. 6 tube. The No. 15 tube was still firing at the conclusion of the test and a total of 75 rockets had been launched.

2.6.4.4. The average tension on the contact springs at the conclusion of the test was 21.5 pounds (high - 26 pounds; low - 16 pounds).

2.6.4.5. A detailed firing schedule for each launcher, malfunctions, action taken, and chargeable failures summary per launcher are contained in part B, appendix I.

2.6.5. Analysis

2.6.5.1. The logistical support requirements were excessive and the maintenance reliability features of the launcher were inconsistent with like features of similar armament subsystems. Parts usage was excessive.

2.6.5.2. The operational reliability of the launcher was unsuitable.

2.6.5.3. It appears that the tubes will meet their life requirement.

2.6.5.4. Contact spring tension did not deteriorate with use.

2.7 SUITABILITY OF TOOLS AND TEST EQUIPMENT

2.7.1. Objective

To determine whether appropriate common tools and test equipment are suitable for the intended purpose and maintenance category.

2.7.2. Criteria

a. Special tools shall not be required for maintenance of the launcher. Failed parts of the launcher shall be removable and replaceable at organizational level. (Para 3.1.3.13, ref 8)

b. Organizational maintenance should be performed using only the common tool set issued to the individual armorer (MOS 45J( )) and the test equipment issued with the maintenance package. (USAAVNTBD)

2.7.3. Method

2.7.3.1. Organizational maintenance was performed using only the common tool set issued to the individual armorer (MOS 45J( )).

2.7.3.2. Common tools and test equipment were utilized in accordance with prescribed maintenance procedures to assure that procedures and tools were adequate.

2.7.4. Results

All maintenance on the launcher could be adequately performed at the organizational level, by the armorer, using the common tool set

and equipment issued with the maintenance package, when used in accordance with the prescribed maintenance procedures. Special tools were not required.

2.8 TECHNICAL MANUSCRIPTS AND MANUALS

2.8.1. Objective

To ascertain whether the maintenance instructions in technical manuscripts and manuals and maintenance charts are adequate for the intended maintenance category.

2.8.2. Criteria

Published maintenance literature provided with the test item.

2.8.3. Method

2.8.3.1. The technical manual (preliminary operating and maintenance manual (POMM) 9-1090-204-12/2) was analyzed throughout the test for all applicable operations including the preparation of the maintenance package literature charts, as outlined in USAAVNTBD Memorandum 750-2 (ref 5).

2.8.3.2. The maintenance records were analyzed to determine the need for and/or the adequacy of special training.

2.8.3.3. The maintenance instructions were analyzed for simplicity and clarity. Troubleshooting procedures, instrumentation, and aids were observed during the test. Preventive maintenance procedures were evaluated for completeness. The adequacy of safety instructions, including environmental protection during operation and maintenance, was evaluated and analyzed.

2.8.3.4. Errors or omissions in nomenclature and stock numbers repair parts lists were noted.

2.8.3.5. Equipment serviceability criteria were compared at various intervals during the test with published criteria to determine the adequacy of the published criteria.

2.8.3.6. Maintenance operations actually performed were closely observed in an effort to determine whether instructions were clear and

the sequence of operations was adequate for the level of training possessed by the maintenance personnel. Desirable changes or comments were reported.

2.8.4. Results

The technical maintenance manual was complete and adequate. The manual will require only minor corrections. Boresighting procedures for the AH-1G and AH-56 are to be included when the information becomes available. Appropriate recommended changes were submitted. The instructions were simple and clear and the sequence of operations was adequate for the level of training possessed by the armorer. Troubleshooting and preventive maintenance procedures and safety instructions were adequate and complete. No errors or omissions in nomenclature, stock, or parts numbers were found. The published equipment serviceability criteria compared favorably with the test results. A maintenance package literature chart is contained in appendix IV.

2.8.5. Analysis

The maintenance instructions in the manual were adequate for the intended category.

2.9 PERSONNEL AND TRAINING

2.9.1. Objective

To determine personnel and training requirements.

2.9.2. Criteria

Appropriate technical manuals.

2.9.3. Method

Military personnel of various skill levels (MOS 45J( )) and background were used for testing the XM200 rocket launcher and determining the level of performance required to maintain the launcher.

2.9.4. Results

The skill level and background of an armorer (MOS 45J) were sufficient to maintain the launcher. On-the-job training was easily accomplished and no additional instruction or special training was considered necessary.

2.10 SAFETY CHARACTERISTICS

2.10.1. Objective

To determine any unsafe features of the XM200 rocket launcher and to obtain operational safety data.

2.10.2. Criteria

a. The primary design goals will be reliability, light weight, and safety. (Para 3.1.3.1, ref 6)

b. The electrical wiring shall be such that each tube is wired to fire individually and be safely grounded and shielded. (Para 3.1.3.10, ref 6)

c. POMM 9-1090-204-12/2.

d. USATECOM Regulation 385-6.

e. USATECOM Regulation 385-7.

2.10.3. Method

The test item was observed throughout the test and all safety hazards were recorded.

2.10.4. Results

2.10.4.1. Personnel. No safety hazards or features unsafe to personnel were noted when loading or unloading and arming or dearming the launcher or launching rockets from the launcher if safety procedures normally required for the handling of the ordnance were adhered to. Personnel passed in front of the launchers when leaving or entering either crew station on both the UH-1( ) and AH-1G Helicopters, however:

the launchers were not connected to the aircraft electrical system or the ground removed from the aircraft until after personnel had entered the crew station. No injuries to personnel were encountered during the test.

2.10.4.2. Flight. There were no adverse effects on aircraft control or stability or aircraft subsystems that would cause unsafe flight conditions. Rocket blast damaged the AH-1G Helicopter, but the damage was insignigicant. No damage occurred to the UH-1C.

2.10.5. Analysis

The operational safety of the launcher was acceptable.

SECTION 3. APPENDICES

APPENDIX I. TEST DATA

Part A. Weight and Balance Computations

Sample Form No. 1

WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T.O. 1-1B-40 AR & 1-1B-40 & TM 55-40 5-9

DATE	AIRCRAFT TYPE	FROM	HOME STATION
1 Aug 1969	UH-1C	Armt Sys & Mun Div	USAAVNTBD
MISSION/TRIP/FLIGHT/NO.	SERIAL NO.	TO	PILOT
Service Test/XM200	64-14101		Givens

REMARKS

Basic acft weight includes 2 XM156 mounts, 2 XM200 launchers, XM5 grenade launcher with components and 30 pounds ballast located at station 385.

Empty	5196.4	Index 7159.3
mts	136.0	184.7
XM200	278.0	377.5
XM5	250.8	93.7
Ballast	30.0	105.5
Basic	5891.2	7920.7

COMPUTER PLATE NO. (If used)

REF	ITEM	WEIGHT	INDEX OR MOM/
1	BASIC AIRCRAFT (From Chart C)	5892	7920
2	OIL (3.8 Gal.)	28	44
3	DISTRIBUTION OF LOAD		
	Pilot (CREW NO. 1)	200	930
	Copilot (CREW NO. 1)	200	930
4	OPERATING WEIGHT	6319	8150
5	AMMUNITION — M-5, 150 rds, 40mm	107	519
6	BOMBS, ROCKETS, ETC. — 28 ea-2.75 rkts @ 28.22 pounds	790	1082
7	FUEL — BUILT IN (242 Gal.)	1573	2150
8	WATER INJ. FLUID (Gal.)		
9	ZERO FUEL WT.	8789	11437
10	TAKEOFF CONDITION (Determined)		
11	CORRECTIONS (If required)		
12	TAKEOFF CONDITION (Corrected)	8789	11437
13	TAKEOFF C. G. IN % M. A. C. OR IN.	130.1	
14	ZERO FUEL WT.		
	LOAD (EXPENDABLES) — BOMBS		
	AMMUNITION 40mm	107	519
	FUEL 242 gal.	1573	2150
	28 rockets	790	1082
		2470	3751
15	ESTIMATED LANDING CONDITION	6319	8150
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	128.9	

CORRECTIONS (Ref. 11)

COMPT.	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) INDEX OR MOM/
	TOTAL WEIGHT REMOVED	−	−
	TOTAL WEIGHT ADDED	+	+
	NET DIFFERENCE (Ref. 11)		

LIMITATIONS

*GROSS WT. TAKEOFF (lb.)	*GROSS WT. LANDING (lb.)
9500	9500

	FROM	TO (% M. A. C. IN.)
*PERMISSIBLE C. G. TAKEOFF	126.0	133.0
*PERMISSIBLE C. G. LANDING	125.0	138.0

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above.

COMPUTED BY (Signature)	
WEIGHT AND BALANCE AUTHORITY (Signature)	
PILOT (Signature)	

* Enter constants used.
* Enter values from current applicable T.O./ TM
* Applicable to gross weight (Ref. 12).
* Applicable to gross weight (Ref. 12).

DD FORM 1 SEPT 64 365F

Sample Form No. 2

WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T.O. 1-1B-40 AN 01-1B-40 & TM 55-40 5-9

DATE	AIRCRAFT TYPE	FROM	HOME STATION
1 August 1969	AH-1G	Armt Sys & Mun Div	USAAVNTBD
MISSION/TRIP/FLIGHT/NO.	**SERIAL NO.**	**TO**	**PILOT**
Service Test/XM200	15355		Givens

REMARKS

XM200 only. Basic acft weight used is the weight indicated on DD Form 365B, dated 12 June 1968, including the bomb racks, XM28 armament subsystem without machine guns, the XM20 grenade launcher mounted in the lower fuselage and four XM200 rocket launchers mounted on the bomb racks.

REF	ITEM	WEIGHT	INDEX OR MOM/
1	BASIC AIRCRAFT (From Chart C)	55350	114929
2	OIL (3 Gal)	2300	5400
3	DISTRIBUTION OF LOAD		

COMPT.	CREW NO	CREW WEIGHT	BAGGAGE	CARGO AND MISC.	WEIGHT	INDEX OR MOM/
Pilot	1	200.0			20000	16600
Gunner	1	200.0			20000	27000

COMPUTER PLATE NO. (If used)

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above.

			WEIGHT	INDEX OR MOM/
4	OPERATING WEIGHT		59580	119829
5	AMMUNITION	COMPT. / ROUNDS / CALIBER		
6	BOMBS, ROCKETS, ETC.	FORWARD 24 ea.-2.75 rkts & 28.22 outboard, AFT- 38 ea.-2.75 rkts & 28.22 inboard	67730	152000
		EXTERNAL ROCKETS	10724	196004
7	FUEL	BUILT IN (270 Gal.)	17550	347700
		BOMB BAY (Gal.)		
		EXTERNAL (Gal.)		
8		WATER INJ. FLUID (Gal.)		
9		JATO OR RATO		
10		TAKEOFF CONDITION (Uncorrected)	94627	189403
11		CORRECTIONS (If required)		
12		TAKEOFF CONDITION (Corrected)	94627	189403
13		TAKEOFF C. G. IN % M. A. C. OR IN.	200.1	
14	LESS EXPENDABLES	JATO OR RATO		
		BOMBS		
		AMMUNITION		
		FUEL 247 gal.	16055	322250
		62 rockets	17497	348044
			33552	670554
15		ESTIMATED LANDING CONDITION	61075	122349
16		ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	200.3	

CORRECTIONS (Ref 11)

COMPT	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) INDEX OR MOM/
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE (Ref. 11)			

LIMITATIONS

*GROSS WT. TAKEOFF (lb.)	*GROSS WT. LANDING (lb.)
9500	9500

	FROM	TO (% M. A. C. or I.N.)
*PERMISSIBLE C. G. TAKEOFF	192.0	201.3
*PERMISSIBLE C. G. LANDING	190.0	201.3

* Enter constant used.
* Enter values from current applicable T.O. TM
* Applicable to gross weight (Ref. 12).
* Applicable to gross weight (Ref. 13).

COMPUTED BY (Signature) Givens

WEIGHT AND BALANCE AUTHORITY (Signature) Givens

PILOT (Signature) Givens

DD FORM 1 SEPT 54 365F

Sample Form No. 3

WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T.O. 1-1B-40 AN 01-1B-40 & TM 55-405-9

DATE	AIRCRAFT TYPE	FROM	HOME STATION
1 August 1969	AH-1G	Armt Sys & Mun Div	USAAVNTBD
MISSION/TRIP/FLIGHT NO.	**SERIAL NO.**	**TO**	**PILOT**
Service Test/XM200	15355		Givens

REMARKS

Heavy Scout. Basic acft weight used is the weight indicated on DD Form 365B dated 12 June 1968, including the bomb racks, the XM28 armament subsystem with two XM134 machine guns installed, the XM20 grenade launcher mounted in the lower fuselage, two XM200 launchers outboard and two XM18 gun pods (with XM134 guns) mounted inboard.

REF	ITEM	WEIGHT	INDEX OR MOM/
1	BASIC AIRCRAFT (From Chart C)	5 8 1 7 0	1 1 9 3 6 9
2	OIL (3 Gal.)	2 3 0	5 4 0
3	DISTRIBUTION OF LOAD		

COMPT.	CREW NO.	CREW WEIGHT	BAGGAGE	CARGO AND MISC.		
Pilot	1	200.0			2 0 0 0	1 6 6 0
Gunner	1	200.0			2 0 0 0	2 7 0 0

COMPUTER PLATE NO. (If used)

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above.

CORRECTIONS (Ref. 11)

COMPT.	ITEM	CHARGES (+ or −) WEIGHT	INDEX OR MOM/

TOTAL WEIGHT REMOVED	−	−		
TOTAL WEIGHT ADDED	+	+		
NET DIFFERENCE (Ref. 11)				

LIMITATIONS

[1] GROSS WT. TAKEOFF (LB.)	[1] GROSS WT. LANDING (LB.)
9500	9500

	FROM	TO (% M.A.C. or IN.)
[2] PERMISSIBLE C. G. TAKEOFF	192.0	201.3
[2] PERMISSIBLE C. G. LANDING	190.0	201.3

REF				WEIGHT	INDEX OR MOM/
4	OPERATING WEIGHT			6 2 4 0 0	1 2 4 2 6 9
5	AMMUNITION	COMPT.	ROUNDS	CALIBER	
		XM-28	8000	7.62	5 2 0 0	6 0 9 0
		XM-18	3000	"	1 6 6 0	3 3 4 0
6	BOMBS, ROCKETS, ETC.	FORWARD 24 ea. 2.75 rkts @ 28.22 outboard			6 7 7 3	1 5 2 0 0
		AFT				
		EXTERNAL				
		ROCKETS				
7	FUEL	BUILT IN (270 Gal.)			1 7 5 5 0	3 4 7 7 0
		BOMB BAY (Gal.)				
		EXTERNAL (Gal.)				
8	WATER INJ. FLUID (Gal.)					
9	JATO OR RATO					
10	TAKEOFF CONDITION (Uncorrected)				9 3 5 8 3	1 8 3 6 6 9
11	CORRECTIONS (If required)					
12	TAKEOFF CONDITION (Corrected)				9 3 5 8 3	1 8 3 6 6 9
13	TAKEOFF C. G. IN % M. A. C. OR IN.				196.2	
14	LESS EXPENDABLES	JATO OR RATO				
		GUNS- 24 rockets			6 7 7 3	1 5 2 0 0
		AMMUNITION 11000 7.62			6 8 6 0	9 4 3 0
		FUEL 247 gal.			1 6 0 5 5	3 2 2 5 0
					2 9 6 8 8	5 6 8 8 0
15	ESTIMATED LANDING CONDITION				6 3 8 9 5	1 2 6 8 9 9
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.				198.4	

[1] Enter constant used.
[2] Enter values from current applicable T.O. or TM
[3] Applicable to gross weight (Ref. 13).
[4] Applicable to gross weight (Ref. 15).

COMPUTED BY (Signature) Givens
WEIGHT AND BALANCE AUTHORITY (Signature) Givens
PILOT (Signature) Givens

DD FORM 1 SEPT 54 365F

Sample Form No. 4

WEIGHT AND BALANCE CLEARANCE FORM F

TACTICAL

(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T.O. 1-1B-40 AN 01-1B-40 & TM 55-40 5-9

DATE	AIRCRAFT TYPE	FROM	HOME STATION
1 August 1969	AH-1G	Armt Sys & Mun Div	USAAVNTBD

MISSION/TRIP/FLIGHT/NO.	SERIAL NO.	TO	PILOT
Service Test/ XM200	15355		Givens

REMARKS

Hog. Basic acft weight used is the weight indicated on the DD Form 365B, dated 12 June 1968, including the bomb racks, the XM28 armament with two XM134 machine guns installed, the XM20 grenade launcher in the lower fuselage, and four XM200 launchers mounted on the bomb racks.

COMPUTER PLATE NO. (*If used*)

REF	ITEM	WEIGHT	INDEX OR MOM/
1	BASIC AIRCRAFT (*From Chart C*)	5 6 0 7 0	1 1 5 4 4 9
2	OIL (3 Gal)	2 3 0	5 4 0
3	DISTRIBUTION OF LOAD .		

COMPT.	CREW NO	CREW WEIGHT	BAGGAGE	CARGO AND MISC.	WEIGHT	INDEX OR MOM/
Pilot	1	200.0			2 0 0 0	1 6 6 0
Gunner	1	200.0			2 0 0 0	2 7 0 0

Pertinent instructions to the pilot for shifting load and crew during takeoff and landing should be noted above.

CORRECTIONS (*Ref II*)

COMPT.	ITEM	CHARGES (+ or −) WEIGHT	INDEX OR MOM/
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE (*Ref. II*)			

4	OPERATING WEIGHT			6 0 3 0 0	1 2 0 3 4 9
5	AMMUNITION	COMPT.	ROUNDS	CALIBER	
		XM28	6000	7.62	3 9 0 0 / 4 5 7 0
6	BOMBS, ROCKETS, ETC.	FORWARD 24 ea. 2.75 rockets			
		@ 28.22 outboard			6 7 7 3 / 1 5 2 0 0
		AFT 38 ea. 2.75 rockets			
		@ 28.22 inboard			1 0 7 2 4 / 1 9 6 0 4
		EXTERNAL ROCKETS			
7	FUEL	BUILT IN (204.66 Gal.)			1 3 3 0 3 / 2 7 5 0 2
		BOMB BAY (Gal.)			
		EXTERNAL (Gal.)			
8		WATER INJ. FLUID (Gal.)			
9		JATO OR RATO			
10		TAKEOFF CONDITION (*Uncorrected*)			9 5 0 0 0 / 1 8 7 2 2 5
11		CORRECTIONS (*If required*)			
12		TAKEOFF CONDITION (*Corrected*)			9 5 0 0 0 / 1 8 7 2 2 5
13		TAKEOFF C. G. IN % M. A. C. OR IN.			197.1
14	LESS EXPENDABLES	JATO OR RATO			
		BOMBS			
		AMMUNITION 6000 7.62			3 9 0 0 / 4 5 7 0
		FUEL 127 gal.			8 2 8 7 / 1 6 8 4 9
		62 rockets			1 7 4 9 7 / 3 4 8 0 4
					2 9 6 8 4 / 5 6 2 2 3
15		ESTIMATED LANDING CONDITION			6 5 3 1 6 / 1 3 1 0 0 2
16		ESTIMATED LANDING C. G. IN % M. A. C. OR IN.			200.5

LIMITATIONS

¹GROSS WT. TAKEOFF (LB.)	¹GROSS WT. LANDING (LB.)
9500	9500

	FROM	TO (% M. A. C. or IN.)
²PERMISSIBLE C. G. TAKEOFF	192.0	201.3
²PERMISSIBLE C. G. LANDING	190.0	201.3

¹ *Enter constant used.*
² *Enter values from current applicable T.O. TM*
³ *Applicable to gross weight (Ref. II).*
⁴ *Applicable to gross weight (Ref. III).*

COMPUTED BY (*Signature*) J. Givens

WEIGHT AND BALANCE AUTHORITY (*Signature*) J. Givens

PILOT (*Signature*) J. Givens

DD FORM 1 SEPT 54 365F

Part B. Armament Profiles, Configuration and Malfunctions

The flights, aircraft, flight conditions, rockets expended, malfunctions, and action taken pertaining to the XM200 rocket launchers used during the test are listed below:

LEGEND:

D - Day	LO - Left Outboard	E - Electrical
N - Night	LI - Left Inboard	Sy - Symmetrical
1 - Launcher No. 1	RI - Right Inboard	Asy - Asymmetrical
2 - Launcher No. 2	RO - Right Outboard	Comb - Combination
3 - Launcher No. 3	C - Chargeable	Rip - Ripple
4 - Launcher No. 4	NC - Non Chargeable	GC - Gas Contamination
		S/D Var - Speed/Dive Angle Variations

NOTE: Split loads of 9 and 10 rockets only were loaded in the launchers on the outboard stations of the AH-1G and no more than 14 per launcher on the UH-1C to conform to the flight safety release.

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
1	1	AH-1G	D	Static/Sy/Asy Comb	9/9 10/10	19/19		19/19	9/9 10/10	0	None	N/A
2	1A	AH-1G	D	Static/Compatibility XM28 subsystem Comb.	9/9 10/10	19/19	XM129 XM129	19/19	9/9 10/10	0	None	N/A
3	2	AH-1G	D	Static/Compatibility XM28 subsystem Comb.	9/9 10/10	19/19	XM134 XM134	19/19	9/9 10/10	0	None	N/A
4	4	AH-1G	D	Hover/Sy/Comb. XM28 Subsystem	9/9 10/10	0/0	XM134 XM134	19/19	2/2	0	None	N/A
5	10	AH-1G	D	Inflight/Sy/S/D Var/Comb.	9/9 10/10	19/18		19/19	9/9 10/10	0	LI-2 No. 6 firing contact pushed through rocket contact during loading.	NC: Contact relocated on rocket contact
6	11	AH-1G	D	Inflight/Sy/S/D Var/Comb.	9/9	10/10		10/10	9/9	0	None	N/A

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
7	12	AH-1G	D	Inflight/Sy/S/D Var/Comb.	9/9 10/10	19/19		19/19	9/9 10/10	3	LI-2 No. 15 contact pin failed No. 2 contact pin failed RI-3 No. 5 contact pin failed	None
8	14	AH-1G	D	Inflight/Asy/ Uncoordinated	9/9 10/10	19/19		19/19	9/9 10/10	2	RI-3 No. 13 contact pin failed RO-4 No. 1 contact pin failed	None
9	15	AH-1G	D	Inflight/Asy/Rip	9/9 10/10	19/19		19/19	9/9 10/10	1	LO-1 No. 3 contact pin failed	None. Note: Since the No. 1 tube fired first the firing contact was set on the rocket contact and the rocket was launched.
10	5	AH-1G	D	Hover/Asy/Comb.	9/9 10/10	19/17		19/14	9/9 10/7	10	LI-2 No. 18 misfired (E) No. 19 misfired (E) RI-3 No. 11 misfired (E) No. 13 misfired (E) No. 17 misfired (E) No. 18 misfired (E) No. 19 misfired (E) RO-4 No. 11 misfired (E) No. 12 misfired (E) No. 14 misfired (E)	None
11	16	AH-1G	D	Inflight/Sy/Rip	9/9 10/10	19/18		19/16	9/9 10/7	5	LO-1 No. 10 contact pin failed No. 6 contact pin failed LI-2 No. 11 misfired (E)	None. *NC: Loaded to verify previous data. RI-3 No. 11 charged on Flt 10

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
											RI-3 No. 8 misfired (E) No. 2 contact pin failed No. 11 misfired (E)* RO-4 No. 11 misfired (E)* No. 12 misfired (E)* No. 14 misfired (E)*	*NC: Loaded to verify previous data. RO-4 No. 11, 12, 14 charged on Flt 10
12	17	AH-1G	D	Inflight/Asy/Rip	11/11	12/12		12/12	12/11	0	RI-3 No. 2 misfired (E)* No. 8 misfired (E)* RO-4 No. 12 misfired (E)*	None. *NC: Loaded to verify previous data. RI - 3 No. 2 and 8 charged on Flt 11 RO - 4 No. 12 charged on Flt 10
13	25	AH-1G	D	Inflight/Sy/Comb/ Area Target	9/9 10/7	19/18		19/12	9/9 10/8	5	LO-1 No. 12 misfired (E) LI-2 No. 11 misfired (E)* RI-3 No. 3 misfired (E) No. 5 misfired (E) No. 8 misfired (E)* No. 12 misfired (E) No. 13 misfired (E)* No. 4 contact pin failed	Upon completion of flight No. 13, all launchers were disassembled, repaired, and reassembled. *NC: Loaded to verify previous data. LI-2 No. 11 charged on Flt 11 RI-3 No. 8 charged on Flt 11 No. 13 charged on Flt 10
14	3	AH-1G	D	Static/Sy Compatibility with XM18 subsystem	9/9 10/6	XM18 XM18		XM18 XM18	9/9 10/5	0	LO-1 Intervalometer did not cycle Tubes 16, 17, 18, 19* RO-4 Intervalometer did not cycle	*NC: Intervalometers removed, disassembled, cleaned, reassembled, and reinstalled. Broken wire was replaced after Flt 30.

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
											Tubes 16, 17, 18, 19* No. 11 contact wire was broken by maintenance personnel.*	*NC: Intervalometers removed, disassembled, cleaned, reassembled, and reinstalled. Broken wire was replaced after Flt 30.
15	8	AH-1G	D	Hover/Asy/Comb		10/10		10/10		0	None	N/A
16	6	UH-1C	D	Static/Asy/Comb		9/9 10/9		9/6 10/10		5	LI-2 No. 18 misfired (E) RI-3 No. 1 misfired(E) No. 6 misfired (E) No. 7 misfired (E) and wire burned off firing contact No. 15 wire burned off firing contact	None
17	24	AH-1G	D	Inflight/Sy/Rip		19/19		19/15		2	RI-3 No. 6 misfired (E)* No. 7 misfired (E)* and was shorted with debris. No. 8 misfired (E) No. 3 contact sprung	Relocated sprung contact. *NC: Loaded to verify previous data. RI-3 No. 6 and 7 charged on Flt 16.
18	26	AH-1G	D	Inflight/Sy/Comb/Area Target		19/18		5/4		1	LI-2 No. 18 misfired (E)* RI-3 No. 3 misfired (E)	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged to Flt 16.
19	26A	AH-1G	D	Inflight/Sy/Comb/Area Target		19/17		19/15		2	LI-2 No. 18 misfired (E)* No. 19 misfired (E) RI-3 No. 6 misfired (E)* No. 7 misfired (E)* No. 8 misfired (E)* No. 9 misfired (E)	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. RI-3 No. 6, 7 charged on Flt 16. No. 8 charged on Flt 17.

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
20	28	AH-1G	D	Inflight/GC		19/17		19/17		0	LI-2 No. 18 misfired (E)* No. 19 misfired (E)* RI-3 No. 6 misfired (E)* No. 7 misfired (E)*	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. No. 19 charged on Flt 19. RI-3 No. 6 and 7 charged on Flt 16.
21	28A	AH-1G	D	Inflight/GC		19/18		19/16		1	LI-2 No. 18 misfired (E)* RI-3 No. 7 misfired (E)* No. 8 misfired (E)* No. 10 misfired (E)	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. RI-3 No. 7 and 8 charged on Flt 16 and 17.
22	27	AH-1G	D	Inflight/Sy/ Rip/Area Target		19/18		19/15		1	LI-2 No. 18 misfired (E)* RI-3 No. 7 misfired (E)* No. 8 misfired (E)* No. 10 misfired (E)* No. 18 misfired (E)	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. RI-3 No. 7 and 8 charged on Flt 16 and 17 No. 10 charged on Flt 21.
23	23	AH-1G	D	Inflight/Sy/ Comb		19/17		19/18		0	LI-2 No. 18 misfired (E)* No. 19 misfired (E)* RI-3 No. 8 misfired (E)*	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. No. 19 charged on Flt 19. RI-3 No. 8 charged on Flt 17.

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
24	9	AH-1G	D	Hover/Sy/Comb.		19/18		X ←	19/17	3	LI-2 No. 18 misfired (E)* No. 19 misfired (E)* No. 3 contact pin failed RI-4 No. 11 misfired (E) No. 15 misfired (E)	Due to the magnitude of electrical shorts, the No. 4 launcher was used to replace the No. 3 launcher. For the purpose of this report the arrow indicates mounting on the AH-1G RI and UH-1C right. The total rockets per launcher is correctly indicated. *NC: LI-2 No. 18 and 19 are charged on Flt 16 and 19.
25	9A	AH-1G	D	Hover/Sy/Comb		19/18		X ←	19/17	0	LI-2 No. 18 misfired (E)* RI-4 No. 11 misfired (E)* No. 15 misfired (E)* and snap ring broke.	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. RI-4 No. 11 and 15 charged on Flt 24.
26	13	AH-1G	D	Inflight/Sy/S/D Var		19/18		X ←	19/17	1	LI-2 No. 18 misfired (E)* No. 2 contact pin failed No. 3 contact pin failed* RI-4 No. 11 misfired (E)* No. 15 misfired attributed to broken snap ring*	None. *NC: Loaded to verify previous data. LO-1 No. 18 charged on Flt 16. No. 3 charged on Flt 24. RI-4 No. 11 and 15 charged on Flt 24.
27	13A	AH-1G	D	Inflight/Sy/S/D Var		10/10		X ←	10/9	1	RI-4 No. 9 rocket knocked off contact from blast.	None

Flt No.	Card No.	Acft	D/N	Flt Conditions	LO-1	2.75 Rockets Loaded/Expended LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
28	18	AH-1G	D	Inflight/Sy/Rip		19/19		X	19/18	0	RI-4 No. 11 misfired (E)* No. 15 misfired (E)*	None. *NC: Loaded to verify previous data. RI-4 No. 11 and 15 charged on Flt 24.
29	19	AH-1G	N (flares)	Inflight/Sy/Comb/ Rip		18/17		X ←	19/16	1	LI-2 No. 18 misfired (E)* RI-4 No. 11 misfired (E)* No. 15 misfired (E)* No. 16 contact pin failed	None. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. RI-4 No. 11 and 15 charged on Flt 24.
30	20	AH-1G	N (no flares)	Inflight/Sy/Comb/ Rip		19/18		X ←	19/16	2	LI-2 No. 18 misfired (E)* No. 19 knocked off contact from blast RI-4 No. 11 misfired (E)* No. 15 misfired (E)* No. 14 contact pin failed	Upon completion of Flt 30, all launchers were disassembled, repaired and reassembled. *NC: Loaded to verify previous data. LI-2 No. 18 charged on Flt 16. RI-4 No. 11 and 15 charged on Flt 24.
31	7	UH-1C	D	Static/Comb/ Compatibility XM5		9/8 10/10	XM5	9/9 10/10		1	LI-2 No. 8 misfired (E)	None
32	30	AH-1G	D	Inflight/Sy/Rip/ Lateral C.G.	0/0 0/0	0/0 0/0		0/0 0/0	9/9 10/8	5	RO-4 No. 11 misfired (E) No. 15 misfired (E) No. 5 contact pin failed No. 9 contact pin failed No. 16 contact pin failed	None

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
33	29	UH-1C	D	Hover/GC/Comb		10/9 9/9		10/10 9/9		1	LI-2 No. 8 misfired (E)* RI-3 No. 19 contact pin failed	None. *NC: Loaded to verify previous data. LI-2 No. 8 charged on Flt 31.
34	22	AH-1G	D	Inflight/Sy/ Comb	9/9 10/9				9/7 10/7	1	LO-1 No. 8 misfired (E) RO-4 No. 11 misfired (E)* No. 15 misfired (E)* No. 5 contact pin inop* No. 9 contact pin inop* No. 16 contact pin inop*	None. *NC: Loaded to verify previous data. RO-4 No. 11, 15, 5, 9, 16 charged on Flt 32.
35	32	AH-1G	D	Inflight/Asy/ Rip	9/9 10/9				9/7 10/7	1	LO-1 No. 18 misfired (E)* No. 8 contact pin failed RO-4 No. 11 misfired (E)* No. 15 misfired (E)* No. 5 contact pin inop* No. 9 contact pin inop* No. 16 contact pin inop*	None. *NC: Loaded to verify previous data. LO-1 No. 18 charged on Flt 34. RO-4 No. 11, 15, 5, 9, 16 charged on Flt 32.
36	33	UH-1C	D	Inflight/Sy/ Comb/Rip		14/13 6/6		14/14 7/7		2	LI-2 No. 2 contact pin failed No. 19 contact pin failed No. 8 misfired (E)*	None. *NC: Loaded to verify previous data. LI-2 No. 8 charged on Flt 31.
37	21	UH-1C	N (flares)	Inflight/Sy/ Comb		9/8		9/8		2	LI-2 No. 3 contact pin failed No. 2 contact pin inop* RI-3 No. 2 contact pin failed	None. *NC: Loaded to verify previous data. LI-2 No. 2 charged on Flt 36.
38	21A	UH-1C	N (no flares)	Inflight/Sy/ Comb		10/10		10/10		0	RI-3 No. 19 contact pin inop*	None. *NC: Loaded to verify previous data. RI-3 No. 19 charged on Flt 33.

Flt No.	Card No.	Acft	D/N	Flt Conditions	2.75 Rockets Loaded/Expended LO-1	LI-2	Center	RI-3	RO-4	C	Malfunction	Action Taken/Remarks
39	31	AH-1G	D	Static/Tube evaluation		242	—	—	X	5	LI-2 No. 1 contact pin failed No. 4 contact pin failed No. 6 contact pin failed No. 11 contact pin failed No. 8 contact pin failed	No. 2 launcher was mounted on AH-1G RI for this phase of the test.
Total 2.75 Rockets Expended (1,864)					279	792		419	374			
Total Chargeable Failures										64	(See Summary/Per Launcher)	

CHARGEABLE FAILURES SUMMARY

Launcher No.	1	2	3	4	Total per type of failure
Contact Pin Failures	4	12	6	5	27
Tube Electrical Short Circuits	2	6	17	7	32
Wires Burned Off Contacts			1		1
Sprung Contacts			1		1
Snap Ring Failures				1	1
Off Contacts		1		1	2
Total per launcher	6	19	25	14	
Total Chargeable Failures					64

Part C. Equipment Performance Reports (EPR's)

1. EPR KF-1: Electrical Firing Contact Locking Pin. The small pin which locks the contact shaft in the clear or armed detent breaks. The shaft must be rotated to arm, load, and unload the rocket. Wear on the pin is caused by the rotation of the shaft; however, the pins are broken when the rocket is launched. This breaking is attributed to the rocket blast. The pin could not be replaced. The tube and contact assembly required replacement, thus requiring excessive maintenance. This condition occurred 11 times while firing 855 rockets from 4 launchers.* The mean number of rockets launched per tube per failure was approximately 11. Recommend a more rugged, replaceable pin be provided.

2. EPR KF-2: Electrical Wiring. Insulation on the electrical wire to electrical firing contact deteriorated when the rockets were launched. The wire was then exposed or damaged, thus causing electrical shorts to the tube, resulting in misfires. Also, during operation of the contacts while loading, unloading, and arming, the wire was damaged. The present arrangement requires inspection after each launching, and excessive maintenance and repairs are required. This condition occurred 32 times while firing 855 rockets from 4 launchers.** The mean number of rockets launched per tube per failure was approximately seven. Recommend a wire protected with a more durable insulation be provided.

3. EPR KF-3: Electrical Wiring. The electrical wiring within the launcher from the individual firing contact to the aircraft quick-disconnect was routed between the rocket tubes. The rockets when launched created enough heat to damage the wiring insulation. Stray voltage occurred. The launcher required component disassembly for maintenance of the wiring. During reassembly of the launcher, the end-play of the wires allowed the wires to flex, resulting in wires being bound between the tubes and/or the launcher and the rear bulkhead, and causing damage to the insulation. Stray voltage could again be encountered. Recommend the wires be rerouted from the rear of the launcher aircraft quick-disconnect through a conduit mounted externally on the launcher.

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*At the conclusion of the test, this condition had occurred 27 times while firing 1,864 rockets from 4 launchers.

**At the conclusion of the test, chargeable electrical malfunctions had occurred 32 times while firing 1,864 rockets from 4 launchers.

Part D. Flight Safety Release

C-O-P-Y

DEPARTMENT OF THE ARMY
US ARMY AVIATION SYSTEMS COMMAND
P.O. Box 209, St. Louis, Missouri 63166

AMSAV-R-F 11 Jun 1969

SUBJECT: Flight Release for Testing the XM-200 Rocket Launcher

Commanding General
U.S. Army Test and Evaluation Command
Aberdeen, Md. 21005

1. Reference: AMSMI-XBT letter 5 June 69, subject: Safety Statement for Launcher, Rocket, Aircraft 2.75 inch XM-200.

2. This letter constitutes a Safety of Flight release for flight testing the XM-200 rocket launcher on the AH-1G and the UH-1C aircraft.

3. The aircraft shall be flown in accordance with the flight envelope and operating instructions of TM's 55-1520-220-10. and 55-1520-221-10.

4. The XM-200 loaded with 27.85 lb rockets, will be restricted to 14 rockets when mounted on the UH-1C and 12 rockets when mounted on the outboard wing stores of the AH-1G.

5. The XM-200 shall be mounted on the XM-156 multi-armament mount with the 4 inch spacer when used with the UH-1C.

C-O-P-Y

AMSAV-R-F
SUBJECT: Flight Release for Testing the XM-200 Rocket Launcher

6. Test results shall be provided AMSAV-R-F upon completion of the test program.

FOR THE COMMANDER:

s/Robert D. Jubbard
for t/CHARLES C. CRAWFORD, JR.
Director of Flight Standards
and Qualification

C-O-P-Y

DEPARTMENT OF THE ARMY
HEADQUARTERS, U.S. ARMY TEST AND EVALUATION COMMAND
Aberdeen Proving Ground, Maryland 21005

AMSTE-BG
4-4-1542-23/24

7 Jul 1969

SUBJECT: Interim Safety Release for Service Test of Launcher, XM200 for 2.75-Inch FFAR

President
US Army Aviation Test Board
ATTN: STEBG-PO-M

1. References:

a. Letter, AMSMI-XBT, dated 5 June 1969, subject: Safety Statement for Launcher, Rocket, Aircraft, 2.75-Inch, XM200, Inclosure 1.

b. Letter, AMSAV-R-F, dated 11 June 1969, subject: Flight Release for Testing the XM200 Rocket Launcher, Inclosure 2.

c. Letter, AMSTE-BG, dated 5 September 1968, subject: Test Directive, Engineering and Service Test of Rocket Launcher, 2.75-Inch, XM200.

2. This letter constitutes an interim safety release for conduct of the service test directed by reference 1c.

3. A review of the test data collected during the coordinated development/engineering test program indicates subject launcher is safe for conducting the service test directed by reference 1c. The restrictions outlined

C-O-P-Y

C-O-P-Y

AMSTE-BG
4-4-1542-23/24

SUBJECT: Interim Safety Release for Service Test of Launcher, XM200 for 2.75-Inch FFAR

in reference 1b are to be observed. All flight tests are to be conducted such that no firings are conducted over the heads of personnel. This release is interim since results of all ET are not yet available.

FOR THE COMMANDER:

2 Incls
as

s/Richard H. Miller
t/RICHARD H. MILLER
Acting Director
Avn Mat Testing

C-O-P-Y

Part E. Gas Contamination Report

ANALYSIS OF MISSILE EXHAUST OF 2.75 ROCKET SYSTEM ON AH-1G COBRA FOR CARBON MONOXIDE

(Letter Report - Not for Publication)

MAJ DONALD T. BUTTS

September 1969

Aviation Medicine Research Division
U. S. ARMY AEROMEDICAL RESEARCH UNIT
FORT RUCKER, ALABAMA 36360

ANALYSIS OF MISSILE EXHAUST OF 2.75 ROCKET SYSTEM ON AH-1G COBRA FOR CARBON MONOXIDE

INTRODUCTION

Analyses for carbon monoxide in the missile exhaust from firing 2.75 rockets from the AH-1G Cobra in flight were conducted at Yuma Proving Grounds, Yuma, Arizona, by US Army Aeromedical Research Laboratory personnel.

METHOD

Data was obtained by means of a Co Det carbon monoxide analyzer mounted in the cockpit with air samples taken from the level of the pilot's head. Samples were taken continuously during the firing of various numbers of rockets on different firing runs with the cockpit vents open.

RESULTS

Figure #1 shows the number of rockets fired, the exposure of carbon monoxide in terms of carbon monoxide parts per million X minutes which the crew received, and the calculated rise in blood levels of carboxyhemoglobin which could be expected from that level of exposure.

COMMENT

A review of the data in Figure #1 shows very low carbon monoxide exposure levels and very small increases in the percentage of blood carboxyhemoglobin. Bearing in the mind that one would not be in danger of carbon monoxide intoxication until a blood level of 10% is reached, it becomes obvious that a crew could not fire enough missiles in a twenty four hour period to risk carbon monoxide poisoning.

It is further obvious by looking at the data, that many factors influence the carbon monoxide exposure besides number of missiles. In several cases a smaller number of missiles appears to have yielded a higher CO exposure. This discrepancy can be explained on the basis of variation in wind speed and direction relative to the gunship, variation in length of time the gunship flies toward the target after firing, and possibly many other factors.

CONCLUSION

In summary, the 2.75 rocket system tested on the AH-1G Cobra does not appear to present a hazard in terms of carbon monoxide exposure to the crew during firing operations.

NUMBER OF MISSILES	CARBON MONOXIDE EXPOSURE PPM. MIN	CALCULATED % INCREASE IN CARBOXYHEMOGLOBIN
4	41.56 PPM. MIN	.01386
8	87.5	.02916
14	125.31	.04166
10	164.06	.05466
34	156.56	.05216

Figure No. 1

APPENDIX II. FINDINGS

Item	Source	Requirement	Applicable Subtest	Remarks
1	Para 1.1, ref 6	The nineteen tube launcher shall consist of a cluster of tubes packaged in minimum volume in a round configuration and encased in a cylindrical shroud.	2.1	Met.
2	Para 1.1, ref 6	The launcher shall be compatible with the firing subsystems on the UH-1B, AH-1G, AH-56A Helicopters.	2.3	Met. AH-56A not determined.
3	Para 1.1 and 3.1.3.7, ref 6	The launcher shall be compatible with the rocket MK40 motor with Mods thru Mod 3 and the modified XM229 warhead (17 pounds) with either the M423 or the XM429 fuze. The overall length of the rocket is 64.72 inches. The CG is located 26.90 inches from the nose.	2.1 2.3 2.4	Met.
4	Para 1.2, ref 6	The requirement depicts the design of the launcher to be used as an integral component of the armament fire subsystem on the UH-1B, AH-1G, UH-1C and AH-56A Helicopters.	2.2 2.3 2.4	Met. AH-56A not determined.

Item	Source	Requirement	Applicable Subtest	Remarks
5	Para 3.1.2, ref 6	The launcher hardback will be compatible with the AH-1G sway braces and ejector.	2.2	Met.
6	Para 3.1.2 and 3.1.3.5, ref 6	The stores support will have 14 inch lug spacing and will be compatible with the Standard MA-4A bomb rack, the AH-1G RP1 rack, the UH-1B XM156 mount and AERO 65A1 bomb rack on the AH-56A.	2.2	Met. AH-56A not determined.
7	Para 3.1.2, ref 6	The launcher shall be designed for minimum weight.	2.1	Met.
8	Para 3.1.3.1, ref 6	The primary design goals will be reliability, light weight, and safety.	2.1 2.6 2.10	Met.
9	Para 3.1.3.1, ref 6	The secondary design goal will be low cost with mass production capability.		Undetermined. Not within the scope of this test.
10	Para 3.1.3.1, ref 6	The launcher shall be designed so that each tube will be reliably reusable through 100 rocket firings without repair.	2.5 2.6	Not met because of excessive contact pin and electrical wiring failures. See para 2.5.4.2, sec 2, and Deficiencies 1.1 and 1.2, app III.

Item	Source	Requirement	Applicable Subtest	Remarks
11	Para 3.1.3.1, ref 6	It is desired that each tube reliably fire 250 rockets without repair. It is required that each tube fire 500 rockets without major parts replacement.	2.5 2.6	Not met. See item 10.
12	Para 3.1.3.2, ref 6	Fore or aft aerodynamics are not required, but accommodations for fairing must be provided.	2.1	Met.
13	Para 3.1.3.3, ref 6	Maximum diameter of the launcher shall not exceed 15.72".	2.1	Met.
14	Para 3.1.3.3, ref 6	The launcher tubes are to be compatible with the maximum length combination of motors and warheads.	2.1	Met.
15	Para 3.1.3.4, ref 6	The empty weight of one launcher shall be minimum weight compatible with performance.	2.1	Met.
16	Para 3.1.3.5, ref 6	The support lug location will be such that when the launcher is fully loaded the CG will be located approximately midway between the lugs.	2.1	Met.

Item	Source	Requirement	Applicable Subtest	Remarks
17	Para 3.1.3.6, ref 6	All launcher parts will be structurally designed to handle the ultimate AH-56A Aircraft design loads of 9 g's forward, 4.5 g's upward, 4.5 g's downward, and .15 g's inboard and outboard. These loads are to be considered to act both separately and in combination to determine the maximum critical load.		Met, as stated by USAMICOM representative.
18	Para 3.1.3.6, ref 6	The launcher shall be designed to withstand rocket firing loads of 700 pounds for 0.15 seconds duration for one individual rocket in combination with the flight load.		Met, as stated by USAMICOM representative.
19	Para 3.1.3.6, ref 6	The launcher shall be capable of structurally withstanding a minimum firing interval of 0.075 second.		Met, as stated by USAMICOM representative.
20	Para 3.1.3.8, ref 6	The detent shall allow both front and rear loading.	2.3	Met.
21	Para 3.1.3.8, ref 6	The detent shall not incorporate an item which must be replaced for each rocket firing.	2.3	Met.

Item	Source	Requirement	Applicable Subtest	Remarks
22	Para 3.1.3.8, ref 6	The detent shall be designed to require a forward force of from 175 to 200 pounds to release the rocket.		Met, as stated by USAMICOM representative.
23	Para 3.1.3.9, ref 6	The launcher electrical connector shall be compatible with the UH-1B, AH-1G, AH-56A and UH-1C Helicopter firing systems.	2.3	Met. AH-56A not determined.
24	Para 3.1.3.9, ref 6	The electrical power for firing rockets and jettisoning the launcher shall be drawn from the aircraft's own 24-28 VDC system under operational conditions.	2.3	Met.
25	Para 3.1.3.9, ref 6	No intervalometer is required or desired.	2.3	Not met. Intervalometer was required.
26	Para 3.1.3.10, ref 6	The electrical wiring shall be such that each tube is wired to fire individually and be safely grounded and shielded.	2.3 2.10	Met.
27	Para 3.1.3.11, ref 6	The wiring harness shall conform to the wire routing table.	2.5	Met.

Item	Source	Requirement	Applicable Subtest	Remarks
28	Para 3.1.3.11, ref 6	All launchers will be identical, with no left or right peculiar feature.	2.5	Met.
29	Para 3.1.3.12, ref 6	The design will be compatible with the use of arctic mittens.	2.3 2.5	Met.
30	Para 3.1.3.12, ref 6	The firing contact can be rotated to cam up the detent and allow easy field loading or removal of the rocket from either end.	2.3	Met.
31	Para 3.1.3.13, ref 6	Special tools shall not be required for maintenance of the launcher.	2.5 2.7	Met.
32	Para 3.1.3.13, ref 6	Failed parts of the launcher shall be removable and repairable at organizational level.	2.5	Met.
33	Para 3.1.3.14, ref 6	Over packing shall be provided for shipment and depot storage.	2.1	Met.
34	Para 3.1.3.15, ref 6	No seals will be required to protect the launcher against environmental conditions during transportation, storage, and service.	2.4	Met.

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
1.1 The electrical wiring was unsatisfactory because: a. The insulation on the wires was easily pinched and/or damaged due to lack of space and the way the wires were routed. b. The exposed wires at the electrical firing contacts were damaged from rocket blast and deteriorated with use. c. During reassembly of the launcher, the end play of the wires at the contact end allowed the wires to flex resulting in wires being bound between the tubes and launcher rear bulkhead.	Reroute the wires from the rear of the launcher to the aircraft quick disconnect through a conduit assembly mounted externally on the launcher. Provide a more durable insulation.	The electrical wires from the individual firing contacts to the aircraft quick-disconnect were routed through a channel in the launcher frame, between the rocket tubes and around the supporting structure. When condition a or b occurred, stray voltage, electrical shorts, and misfires resulted, requiring either partial or complete disassembly of the launcher. When condition c occurred, stray voltage and electrical shorts were encountered after reassembly. EPR's KF-2 and KF-3 were submitted.
1.2 The small pin which locked the firing contact shaft in the clear or armed detent broke on numerous occasions.		The shaft required rotating when loading, arming, and unloading a rocket from the tube. Wear on the pin was caused during

Deficiency	Suggested Corrective Action	Remarks
		this operation; however, the pins were broken by the rocket blast. The pin could not be replaced. The tube and contact assembly required replacing, thus requiring partial disassembly of the launcher for outside tubes and complete disassembly for center tubes. EPR KF-1 was submitted.

2. SHORTCOMINGS

There were no shortcomings discovered during the test.

APPENDIX IV. MAINTENANCE EVALUATION

MAINTENANCE AND RELIABILITY ANALYSIS CHART

INSTRUCTION SHEET - SECTION I

COLUMN	DESCRIPTION
1	Entry number of each item.
2	Group number as indicated in the Maintenance Allocation Chart.
3	Component and related operations as indicated in the Maintenance Allocation Chart. Operations indicated as in Depot Category are not shown.
4	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 or crew; O - Organizational; DS - Direct Support; GS - General Support.
5	Maintenance Level, Recommended. Letters O/C, O, DS, or GS indicate the category recommended by the test agency.
6	TM Instructions, Adequate. An X in this column indicates the TM instructions are considered adequate.
7	TM Instructions, Inadequate. The test agency reference number used on DA Forms 1598/2028 is indicated in this column, if the instructions are considered inadequate.
8	Active Maintenance Time. Man-hours used to the closest tenth. If the operation was not actually performed but was reviewed, 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.
9	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.
10	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 result 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.

COLUMN	DESCRIPTION
11	Remarks. If the operation is related to any other sub-test covered in the body of the test report, the paragraph number is inserted for cross reference. If the 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.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION IV)

ENTRY NO	GROUP NO	COMPONENT AND RELATED OPERATIONS	O/C - Oper/Crew, O - Organ, DS - Direct, GS - General: Pre-scribed	O/C - Oper/Crew, O - Organ, DS - Direct, GS - General: Recom-mended	TM INSTRUCTIONS: Ade-quate	TM INSTRUCTIONS: Inade-quate (DS/GS)	ACTIVE MAINT TIME	LIFE M - Miles H - Hours R - Rounds	REASON PERFORMED	REMARKS
1	2	3	4	5	6	7	8	9	10	11
1	10	Tube Assembly - Replace Center Tube	O	O	X		2.0		Unscheduled	Average time required per operation.
2	10	Tube Assembly - Replace Outside Tube	O	O	X		1.0		Unscheduled	Average time required per operation.
3	1	Launcher - Rewire and rebuild	O	O	X		15.0		Unscheduled	Average time required per operation.
4	4	Harness Assembly - Replace	O	O	X		3.0		Unscheduled	Average time required per operation.
5		Launcher - Cleaning	O/C	O/C	X		2.0		Scheduled	Average time required per operation.

MAINTENANCE AND RELIABILITY ANALYSIS CHART

INSTRUCTION SHEET - SECTION 2

COLUMN	DESCRIPTION
1	Entry number which will correspond to the same item entry in Section 1.
2-5	Appropriate man-hours used to the closest tenth. If man-minutes are a more appropriate unit of measure, so stipulate in Column 8, Remarks.
6	Total man-hours as recorded in Columns 2 through 5.
7	Man-hours used to the closest tenth.
8	Remarks as appropriate.

MAINTENANCE AND RELIABILITY ANALYSIS CHART
(SECTION 2)

ENTRY NO	PREPARATION TIME	FAULT CORRECTION TIME	ADJUSTMENT AND CALIBRATION TIME	FINAL TEST TIME	TOTAL TIME	FAULT LOCATION TIME	REMARKS
1	2	3	4	5	6	7	8
1	0.8	N/A	0.2	1.0	2.0	0.1	Replace center tube.
2	0.5	N/A	0.2	0.3	1.0	0.1	Replace outside tube.
3	3.0	8.0	1.0	3.0	15.0	4.0	Rewire/rebuild one launcher.
4	1.0	N/A	1.0	1.0	3.0	1.0	Replace harness assembly.

PARTS ANALYSIS CHART

INSTRUCTION SHEET

GENERAL: Parts will be assembled on this chart by functional groups and in numerical order within groups.

COLUMN	DESCRIPTION
1	Record one of the following: Federal Stock Number, Technical Service Part Number, Manufacturer's Part Number, or Drawing Number in this order of preference.
2	Noun Nomenclature. Self-explanatory.
3	Maintenance Level, Prescribed. Maintenance level as prescribed by the parts list under review: O/C - Operator/Crew; O - Organizational; DS - Direct Support; GS - General Support.
4	Maintenance Level, Recommended. O/C, O, DS, or GS indicate Maintenance Level recommended by the test agency.
5	Life. The number of hours, miles, or rounds accumulated before or since this part was replaced. An entry in this column is made for each part used followed by the appropriate life unit; i.e., M, H, or R.
6	Reason Used. The symbol "Unsched" will be shown in this column if the part was used as a result of unscheduled maintenance. If the part used was the result of scheduled maintenance, the symbol "Sched" will be used. If the part was consumed to verify procedures or tools, not as a result of breakdown, the symbol "Sim" will be used.
7	Group Number, Cross Reference. Parts usage by maintenance operation is indicated by cross referencing to the group number from Column 2 of the Maintenance and Reliability Analysis Chart.
8	Remarks. If the part usage is related to any other subtest covered in the body of the test report, the paragraph number for cross reference is indicated. If an EPR is related to the part used, the EPR number will be inserted in this column.

PARTS ANALYSIS CHART

FEDERAL STOCK NUMBER	NOUN NOMENCLATURE	MAINTENANCE LEVEL O/C - Operator/Crew O - Organ DS - Direct GS - General		LIFE M - Miles H - Hours R - Rounds	REASON USED	GP NO CROSS REFERENCE	REMARKS
		Pre-scribed	Recom-mended				
1	2	3	4	5	6	7	8
10240636	Tube assembly	O	O	6R	Unsched	10	Replace Tube No. 15 Launcher No. 2.
10240636	Tube assembly	O	O	6R	Unsched	10	Replace Tube No. 2 Launcher No. 2.
10240636	Tube assembly	O	O	7R	Unsched	10	Replace Tube No. 5 Launcher No. 3
10240636	Tube assembly	O	O	8R	Unsched	10	Replace Tube No. 13 Launcher No. 3.
10240636	Tube assembly	O	O	8R	Unsched	10	Replace Tube No. 1 Launcher No. 4.
10240636	Tube assembly	O	O	8R	Unsched	10	Replace Tube No. 3 Launcher No. 1.
10240636	Tube assembly	O	O	10R	Unsched	10	Replace Tube No. 10 Launcher No. 1.
10240636	Tube assembly	O	O	11R	Unsched	10	Replace Tube No. 6 Launcher No. 1.
10240636	Tube assembly	O	O	10R	Unsched	10	Replace Tube No. 2 Launcher No. 3.
10240636	Tube assembly	O	O	13R	Unsched	10	Replace Tube No. 4 Launcher No. 3.
10240636	Tube assembly	O	O	22R	Unsched	10	Replace Tube No. 3 Launcher No. 2.
10240636	Tube assembly	O	O	24R	Unsched	10	Replace Tube No. 2 Launcher No. 2.
10240636	Tube assembly	O	O	18R	Unsched	10	Replace Tube No. 16 Launcher No. 4.
10240636	Tube assembly	O	O	19R	Unsched	10	Replace Tube No. 14 Launcher No. 4.
10240636	Tube assembly	O	O	21R	Unsched	10	Replace Tube No. 5 Launcher No. 4.
10240636	Tube assembly	O	O	21R	Unsched	10	Replace Tube No. 9 Launcher No. 4.
10240636	Tube assembly	O	O	18R	Unsched	10	Replace Tube No. 16 Launcher No. 4.
10240636	Tube assembly	O	O	20R	Unsched	10	Replace Tube No. 19 Launcher No. 3.
10240636	Tube assembly	O	O	16R	Unsched	10	Replace Tube No. 8 Launcher No. 1.

NOTE: Tube assemblies were replaced because of broken contact pins; EPR KF-1 was submitted to cover all chargeable malfunctions. An insufficient number of tubes were available to replace 8 additional malfunctions.

SPECIAL TOOL ANALYSIS CHART

INSTRUCTION SHEET

GENERAL: All special tools provided with the test item will be evaluated to determine their function, adequacy, category of use and desirability. Any requirement for additional special tools or recommendation for deletion of special tools will also be reported.

COLUMN	DESCRIPTION
1	List all special tools, their noun nomenclature, and identifying part number.
2	Give function of special tool.
3,4	List maintenance category that special tool was designed to be used at in column 3. In column 4 indicate confirmation or recommendation for usage.
5,6	Indicate the adequacy/inadequacy of the special tool in relation to its intended use.
7	Include information as to change in category of use (column 4) or inadequacy of the tool (column 6). Refer to paragraph in report that contains substantiating data.

SPECIAL TOOL ANALYSIS CHART

SPECIAL TOOL	FUNCTION	MAINTENANCE LEVEL O - Organ DS - Direct GS - General		EVALUATION		REMARKS
		Pre-scribed	Recom-mended	Ade-quate	Inade-quate	
1	2	3	4	5	6	7
NONE REQUIRED						

MAINTENANCE PACKAGE LITERATURE CHART

INSTRUCTION SHEET

COLUMN	DESCRIPTION
1	Give Army publication or draft manual number.
2	Number of copies received. Insert "O" if none were supplied. Use Para IIIi, Chapter 9, of AR 310-3 as a guide to determine those manuscripts and publications that should accompany the test item. Manuscripts and publications contained in the maintenance package should cover operation functions through general support maintenance and should specify the categories involved.
3	Complete title.
4	Fill in date manuscript (MSS) or publication was received.
5	Fill in date test item or materiel was received.
6,7	Insert "X" in appropriate block. Minor errors on 1598/2028 forms are not in themselves sufficient reason to term a manuscript inadequate. Evaluation may be omitted if fewer than 25 percent of the specified maintenance operations were performed.
8	Insert date 1598 form was forwarded.
9	In addition to appropriate remarks, explain if manuscript was not evaluated.

MAINTENANCE PACKAGE LITERATURE CHART

MANUSCRIPT			DATE RECEIVED		EVALUATION		FORM 1598/2028	
NUMBER	QNTY	TITLE	LIT	MATERIEL	ADQT	INADQT	DATE FWD'D	REMARKS
1	2	3	4	5	6	7	8	9
POMM 9-1090-204-12/2	1	"Preliminary Operating and Maintenance Manual; Launcher, Rocket, Aircraft: 2.75-Inch XM200," June 1969	27 May 1969	16 Jun 1969	X			Boresight procedures not provided.
Chart No. 10240650	1	Preliminary Maintenance Allocation Chart (including Tool Pages); Launcher, Rocket, Aircraft: 2.75-Inch XM200; dated 30 April 1969	27 May 1969	16 Jun 1969	X			
TM 9-1090-204-35	1	Extract only.	27 May 1969	16 Jun 1969	X			
MSP 9-1090-203/204	1	"Maintenance Support Plan; Launcher, Rocket, Aircraft: 2.75-Inch, XM200," June 1969	27 May 1969	16 Jun 1969	X			

APPENDIX V. REFERENCES

1. USATECOM Regulation 385-6, "Safety Release," 2 October 1962.

2. Letter, CDCMR-O, US Army Combat Developments Command, 24 October 1962, subject: "Approved Qualitative Materiel Requirement (QMR)," (U), with 1 Inclosure, QMR for Armed Helicopter Weapons Systems.

3. USATECOM Regulation 385-7, "Safety Confirmation," 18 December 1962.

4. USATECOM Regulation 750-15, "Maintenance of Supplies and Equipment," 10 July 1965.

5. USAAVNTBD Memorandum 750-2, "Maintenance of Supplies and Equipment," 25 January 1966.

6. Technical Requirements for Launcher, Rocket, Aircraft, 2.75-Inch, XM200, 16 August 1968, AMSMI-RLR, US Army Missile Command.

7. Letter, AMSTE-BG, US Army Test and Evaluation Command, 5 September 1968, subject: "Test Directive, Engineering and Service Test of Rocket Launcher, 2.75-Inch, XM200, USATECOM Project No. 4-4-1542-23/24."

8. Test Plan, "Service Test of the XM200 2.75-Inch Aircraft Rocket Launcher," USATECOM Project No. 4-4-1542-24, US Army Aviation Test Board, November 1968.

9. Chart No. 10240650, "Preliminary Maintenance Allocation Chart; Launcher, Rocket, Aircraft: 2.75-Inch, XM200," (including tool pages), 30 April 1969.

10. Maintenance Support Plan 9-1090-203/204, "Launcher, Rocket, Aircraft: 2.75-Inch XM200," June 1969.

11. Preliminary Operating and Maintenance Manual 9-1090-204-12/2, "Launcher, Rocket, Aircraft: 2.75-Inch, XM200," June 1969.

12. Technical Manual 9-1090-204-35 (Extract).

APPENDIX VI. ABBREVIATIONS

AC No. - Action Control Number
AGL - above ground level
app - appendix(es)
AR - Army Regulation
c.g. - center of gravity
EPR - Equipment Performance Report
fig - figure(s)
FSN - Federal Stock Number
in. - inch(es)
KIAS - knots indicated airspeed
lb. - pound(s)
LSFFAR - Limited-Spin Folding-Fin Aerial Rocket
MAC - Maintenance Allocation Chart
min. - minute(s)
MOS - Military Occupational Specialty
MRTS - Mean Rounds to Stoppage
No. - number
para - paragraph(s)
POMM - Preliminary Operator and Maintenance Manual
QMR - Qualitative Materiel Requirement
ref - reference(s)
RDTE - Research, Development, Test, and Evaluation
TM - technical manual
USAAVNTBD - United States Army Aviation Test Board
USAARL - United States Army Aeromedical Research Laboratory
USACDC - United States Army Combat Developments Command
USAMICOM - United States Army Missile Command
USATECOM - United States Army Test and Evaluation Command
v.d.c. - volts direct current

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13. ABSTRACT

The US Army Aviation Test Board service tested the XM200 2.75-Inch Rocket Launcher to determine its suitability for Army use. The test was conducted at Yuma Proving Ground, Arizona, in July 1969. The XM200 was installed on UH-1C and AH-1G Helicopters and ground and flight tested day and night, with an expenditure of 1,564 aerial rockets. The XM200 generally met the Technical Requirements, except in the area of reliability. Two deficiencies were discovered--one in the electrical wiring and one in the contact detent assembly. These deficiencies resulted in excessive unscheduled maintenance and decreased operational reliability. It was concluded that the XM200, in its present configuration, is not suitable for Army use, and that it is not an acceptable replacement for the XM159( ) launcher. It was recommended that the XM159( ) not be replaced by the XM200; that immediate action be taken to correct the deficiencies; and that after the deficiencies are corrected, a check test be conducted.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
XM200 2.75-Inch Aerial Rocket Launcher						