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Report No. DPS-2598

FINAL REPORT ON

PRODUCT IMPROVEMENT TEST (CONCURRENT)

OF

30-ROUND MAGAZINES AND MODIFIED

HAND-GUARD AND HAND-GUARD CAP

FOR 5.56-MM, M16A1 (XM16E1) RIFLES

BY

FRANKLIN H. MILLER

DECEMBER 1967

ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND

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

AMSTE-BC

21 FEB 1968

SUBJECT: Product Improvement Test Reports on 30 Round Magazine and Modified Handguard and Handguard Cap for M16A1 Rifle, USATECOM Project Nos. 8-6-0200-02, 03

TO: Commanding General
US Army Materiel Command
ATTN: AMCPM-RS
Rock Island, Illinois 61201

1. References:

a. Final Report, DPS-2598, dated Dec 1967, USATECOM Project No. 8-6-0200-02, subject as above, Inclosure 1.

b. Final Letter Report, USAIB, STEBC (P-3159), USATECOM Project No. 8-6-0200-03, dated 10 Apr 1967, subject as above, Inclosure 2.

c. Message, AMSTE-BC 9252, dated 25 Sep 1967 and corrected message 9552, dated 10 Oct 1967, subject: 30 Round Magazine for M16A1 Rifle.

2. Forwarded herewith are approved copies of subject reports. Reference 1a contains results of engineering type tests conducted by Development & Proof Services of Aberdeen Proving Ground. Reference 1b contains results of service type tests conducted by US Army Infantry Board at Fort Benning, Georgia. Reference 1c forwarded a brief summary of test results and recommended that 30 Round Magazines fabricated by production methods be provided this command for an Initial Production Test.

3. For additional information, subject reports also include limited tests by the US Army Infantry Board to assess performance of the 5.56mm Submachine Gun, XM177E1, using 30 Round Magazines with ammunition pouches and the Redesigned Handguard with 40mm Grenade Launcher XM148 attached to the M16A1 Rifle, As tested, the Submachine Gun, XM177E1 performed acceptably when using the 30 Round Magazines but the Redesigned Handguard did not adequately cover the lower portion of the rifle barrel. Firers are subject to severe burns if the fingers gripping the launcher extend into the space between rifle barrel and launcher. The US Army Infantry Board considered

this condition a shortcoming but its significance is diminished due to the decision not to field the XM148 Launcher. For future consideration relative to attaching a 40mm Launcher to the M16A1 Rifle, the need for a handguard to adequately cover the lower portion of the barrel is pertinent.

4. Reference 1a summarizes test results and problem areas, paragraph 1.4, pages 4, 5 and 6. It should be noted that some test weapons did not perform acceptably when using either test or control magazines. The test results vary but the Type II malfunctions are approximately equal to the Type I malfunctions in weapons with the electrolized bolt carrier group, Table 1.4-I. Previously, this frequency of Type II malfunctions has not been found to be characteristic of the system using 20 Round Magazines. Test results are summarized on pages 3 through 8, reference 1b.

5. The conclusions and recommendations of the reports are revised by this command as follows:

a. It is concluded that:

(1) The 30 Round Magazine has demonstrated a potential for satisfactory performance when used with both the M16A1 Rifle and Submachine Gun XM177E1, notwithstanding specification shortcomings.

(2) The 30 Round Magazine offers an increase in fire power capability.

(3) The 30 Round Magazine pouch is an acceptable carrying media.

(4) The Redesigned Handguards and Handguard Caps are as durable as the standard items and have the additional advantages of interchangeability and more positive gripping surfaces.

(5) The heat transfer from the barrel to both test and standard handguards is comparable.

b. It is recommended that:

(1) The 30 Round Magazine, along with the redesigned ammunition pouch, be fabricated by production methods and subjected to a comprehensive Initial Production Test with M16A1 Rifles prior to release for field use in accordance with AMCR 700-34.

21 FEB 1968

AMSTE-BC

SUBJECT: Product Improvement Test Reports on 30 Round Magazine and Modified Handguard and Handguard Cap for M16A1 Rifle, USATECOM Project Nos. 8-6-0200-02, 03

(2) The 30 Round Magazine be subjected to an engineering and service test with the XM177E2 Submachine Gun.

(3) The Redesigned Handguard and Handguard Cap be considered suitable for adoption to replace the standard components.

FOR THE COMMANDER:

Robert B Tully

ROBERT B. TULLY
Colonel, GS
Dir, Inf Mat Test

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USATECOM PROJECT NO. 8-6-0200-02

PRODUCT IMPROVEMENT TEST (CONCURRENT) OF 30-ROUND MAGAZINES AND MODIFIED HAND-GUARD AND HAND-GUARD CAP FOR 5.56-MM, M16A1 (XM16E1) RIFLES

FINAL REPORT

BY

FRANKLIN H. MILLER

DECEMBER 1967

ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND
21005

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ABSTRACT

Two product improvement items for the M16A1 rifle were concurrently tested at Aberdeen Proving Ground from 13 April to 16 October 1967. Under evaluation were a 30-round magazine and a modified hand-guard and hand-guard cap. Both items were subjected to high- and low-temperature (+155°F and -65°F) and endurance tests (function and durability). The magazine was subjected to test in a dust environment. The hand-guard was evaluated for the effects of thermal radiation and conductivity, and for compatibility with solvents, lubricants, and insect repellant. The modified hand-guard and cap were recommended for consideration as substitute components for the M16A1 rifle. The 30-round magazine was recommended for release to production with final acceptance being held in abeyance pending completion of a stringent initial production test.

FOREWORD

Development and Proof Services was responsible for preparation of the test plan outline, conduct of the test, and preparation of the test report.

ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

USATECOM PROJECT NO. 8-6-0200-02

FINAL REPORT ON PRODUCT IMPROVEMENT TEST (CONCURRENT) OF 30-ROUND MAGAZINES AND HAND-GUARD AND HAND-GUARD CAP FOR 5.56-MM, M16A1 (XM16E1) RIFLES

13 APRIL TO 16 OCTOBER 1967

SECTION 1. INTRODUCTION

1.1 BACKGROUND

Initial development and testing of 30-round magazines for the XM16E1 rifle occurred during the SAWS evaluation conducted in 1965 (Report DPS-1851, USATECOM Project No. 8-5-0400-03). In the SAWS test, the magazines were used in the Colt automatic rifle (heavy-barrel version of the XM16E1) and the XM177 submachine gun. At the conclusion of that test, although there was no specific military requirement for a 30-round magazine for the XM16E1 rifle, it was suggested (based upon test results) that, if such a requirement developed, the SAWS design could be considered for acceptance.

With the heavy usage of the M16A1 (XM16E1) rifle in combat areas, a requirement developed and the manufacturer submitted a quantity of redesigned magazines for test.

The modified hand-guard and cap were developed by the manufacturer to eliminate the need for right- and left-hand components, to improve the surface of the grip area without decreasing performance or increasing cost, and to allow a half-section of the rifle hand-guard to be used in conjunction with the XM148 grenade-launcher attachment instead of the special aluminum guard presently required.

1.2 DESCRIPTION OF MATERIEL

The 30-round-capacity magazine presently undergoing tests consists of the following components: rectangular coiled follower spring, magazine body, floor plate, and follower. This design differs from the SAWS-evaluation magazines in the thickness of the material in the magazine body, configuration of the feed-lips and body curvature, and construction and composition of the follower. Figure 1.2-1 compares the SAWS, test, and control (20-round) magazines.

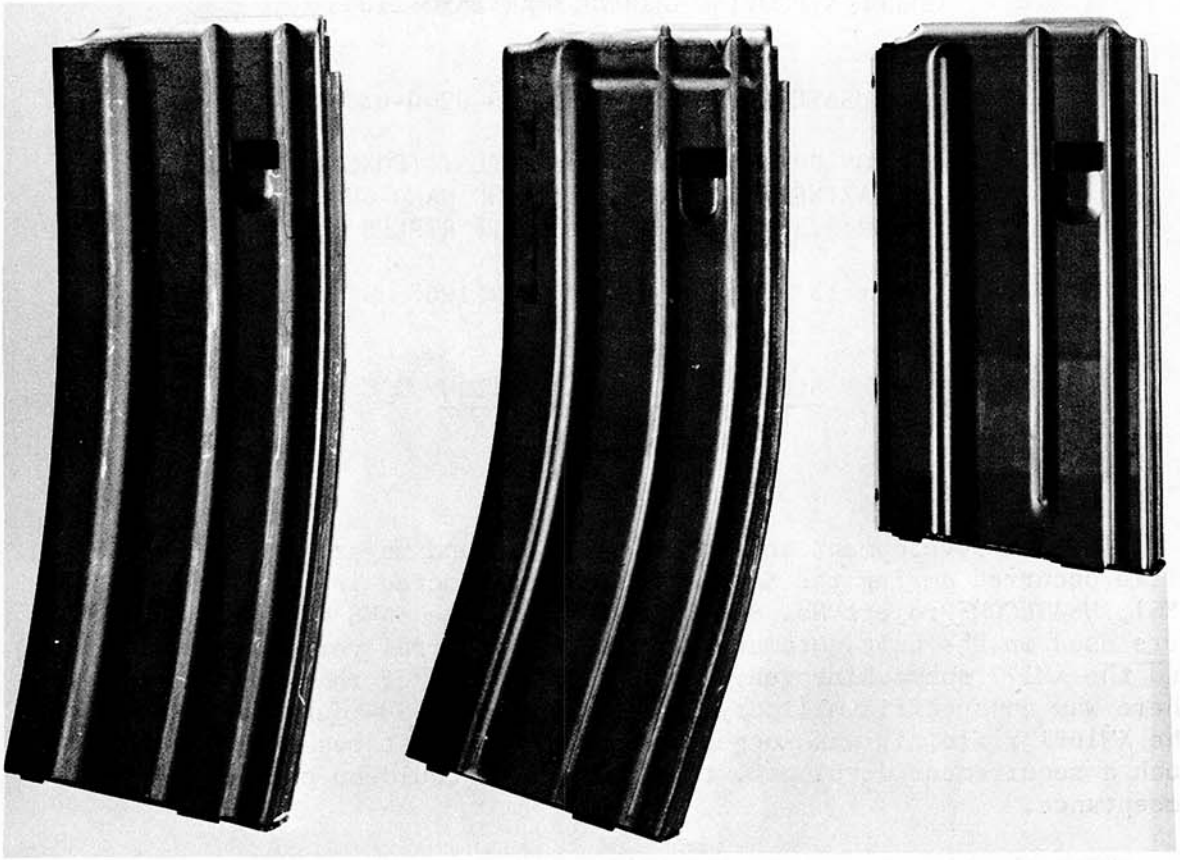

Figure 1.2-1. From Left to Right; the SAWS 30-Round, Test 30-Round, and Control 20-Round (Standard) Magazines.

The modified hand-guard consists of two identical half-sections, which, when assembled to the M16A1 rifle, are separated on a horizontal plane. Each section contains an aluminum heat shield and nine 3/8-inch-diameter holes which reduce the peak temperature of the hand-guard created during firing of the weapon. Figure 1.2-2 shows the outside and inside configuration of the modified hand-guard. One half-section of the test item is used in conjunction with the XM148 grenade launcher attachment for the M16A1 rifle and replaces the special aluminum hand-guard previously required. Figure 1.2-3 compares these two items.

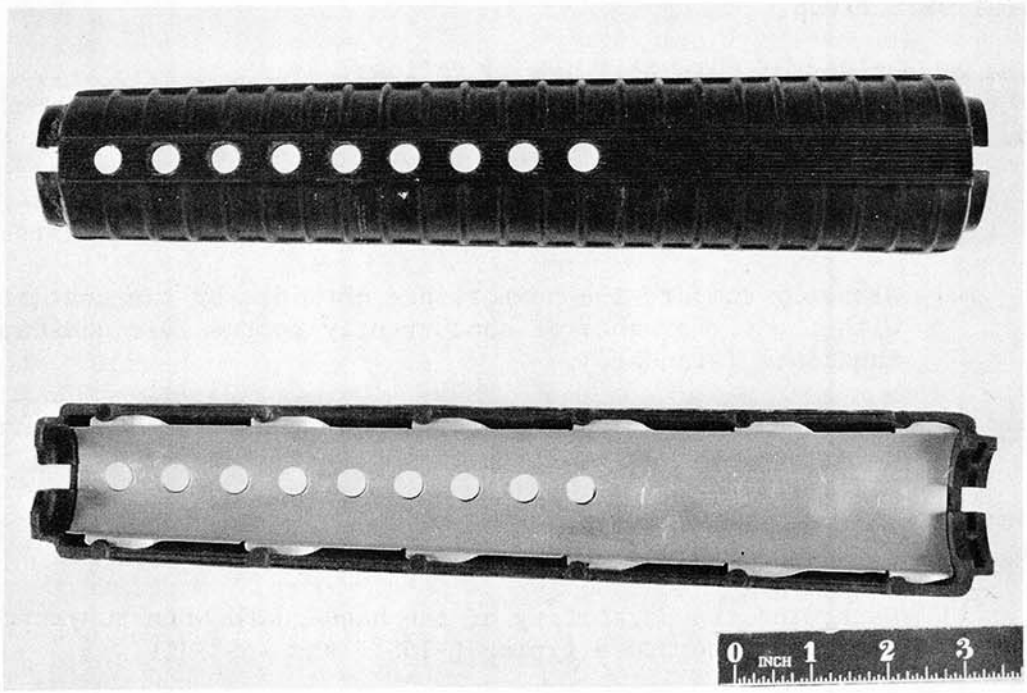

Figure 1.2-2. Modified Hand-Guard Showing Outside and Inside Views.

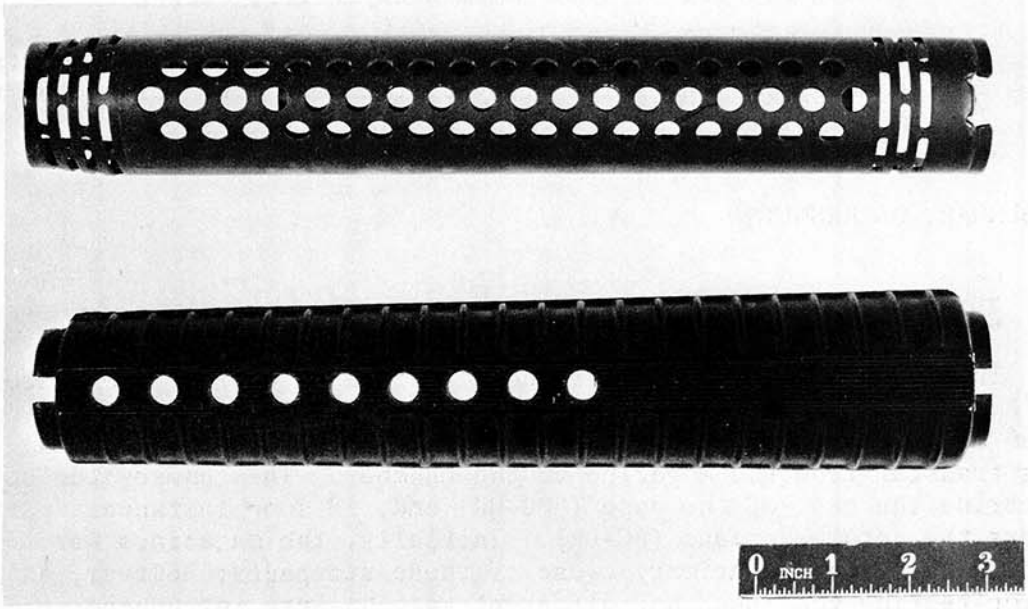

Figure 1.2-3. Special Aluminum Hand-Guard Used in Conjunction with XM148 Grenade Launcher (TOP), Compared with a Half-Section of the Test Hand-Guard (BOTTOM).

1.3 TEST OBJECTIVES

The objectives of this test are as follows:

a. Thirty-round magazines

1) Determine the magazine reliability during environmental, adverse-condition, and ambient-temperature firing tests.

2) Directly compare the performance obtained by the test items with the performance of concurrently tested 20-round-capacity magazines (standard).

3) Determine by comparative analysis of the 20- and 30-round magazines, the suitability of the test item for use in the M16A1 rifle.

b. Modified hand-guard and cap

1) Determine the durability of the hand-guard when subjected to extreme temperature firing (+155°F and -65°F).

2) Determine the material compatibility of the hand-guard to various solvents, lubricants, and insect repellant.

3) Determine the thermal dissipation characteristics of the hand-guard during, and immediately after, firing.

4) Determine by comparative analysis of the standard and test hand-guards the suitability of the test item for use on the M16A1 rifle.

1.4 SUMMARY OF RESULTS

1.4.1 Thirty-Round Magazines

Initial testing of the 30-round magazines at extreme temperatures (+155°F and -65°F) gave indications that a serious feeding malfunction problem might exist, wherein the feeding cartridge becomes deformed during transfer from the magazine to the chamber. This causes the bolt to override the base of the case (BOB-DR) and, in some instances, partially chambers the deformed round (FC-DR). Initially, the magazines were suspected as being the primary cause of these stoppages; however, as function-testing continued and different weapons were introduced into the test, it became apparent that the malfunctions occurred predominantly in two weapons. The weapons which exhibited the damaged-round stoppages also had excessive failures of the bolt to remain rearward after the last round was fired (FBR). The other weapons, utilizing the same

magazines, did not exhibit BOB-DR, FC-DR, or FBR type malfunctions. The use of old- and new-design buffers (action-spring guides), cartridges loaded with ball and IMR propellants, and the interchange of bolt and carrier assemblies in the weapons, which gave unacceptable malfunction rates, did not totally eliminate the stoppages, although, in some instances, the frequency of occurrence was decreased.

During the function and durability phase of testing, rifle No. 137686 was shipped to the manufacturer together with ammunition and a selection of test magazines. The subsequent report (Appendix II) was inconclusive as to the actual cause of the malfunctions; however, at that time, the manufacturer stated that the magazines delivered for test were not constructed according to specifications. Part of the 50-magazine test sample was then reworked by the manufacturer in an attempt to bring the dimensions within tolerances. Since the report (Appendix II) indicated that the reworked magazines were still out of tolerance, no testing was conducted on those items. The remainder of the test magazines, previously retained at APG, were returned to the manufacturer for rework, this time without stripping and reapplication of anodizing and dry lubricant which had caused problems with the first reworked items.

Tests of these last reworked magazines were limited to ambient-temperature (+70°F ± 30°F) to ascertain the performance characteristics in four different weapons. At the conclusion of this phase, rifle No. 168693 and the reworked magazines were delivered to the manufacturer in a second attempt to determine the cause of damaged-round stoppages. The limited high-speed photographs obtained did not provide conclusive results from which a determination could be made, although the frequency of damaged-round malfunctions remained high. Initial firing at the manufacturer's range was conducted with the rifle held in a recoiling rest. No stoppages occurred until after the rifle was fired from the shoulder.

The total performance range of each weapon, by subtest, is given in Table 1.4-I. The weapon-magazine combinations which performed without malfunctions were assembled with phosphated bolt and carrier assemblies, while the two unsatisfactory weapon-magazine combinations utilized electroplated bolt and carrier assemblies. New design buffers were installed in all rifles, except where noted in the firing data.

1.4.2 Modified Hand-Guard and Cap

Three sets of modified hand-guards were tested: one set each for +155°F, -65°F, and ambient-temperature durability. In addition, the set subjected to the ambient-temperature phase was used for thermal-conductivity testing. The six half-sections were used for the chemical-compatibility evaluation. The test hand-guard and cap did not degrade the performance capability of the M16A1 rifle.

Table 1.4-I. Range of Weapon Performance

Test	Weapon Serial No.	No. Rds Fired, by Magazine Type: Test	Control	SAWS	Malfunct Type[a]	Malfunct Rate Per 100 Rds, by Magazine Type: Test	Control	SAWS[b]
Dust	[c]141101	300	200	-	I	3.0	4.0	-
					II	0.0	0.0	-
+155°F	[c]137686	690	180	-	I	1.4	1.7	-
					II	1.0	1.1	-
-65°F	[c]137686	690	200	-	I	2.9	1.0	-
					II	0.3	0.0	-
Function and Durability	[c]137686	1800	500	-	I	2.7	1.4	-
					II	2.3	0.0	-
	168693	2880	960	360	I	0.7	0.9	0.6
					II	1.4	1.4	0.6
	[c]197428	1950	400	-	I	0.4	2.5	-
					II	0.0	0.0	-
	55687	1200	-	-	I	0.0	-	-
					II	0.2	-	-
	709760	600	-	-	I	0.0	-	-
					II	0.0	-	-
Subtotal, Reworked Magazines					I	0.4	1.4	0.6
					II	0.8	0.7	0.6
Total, Reworked Magazines		5430	1860	360	I and II	1.2	2.1	1.2

[a]Page 11 contains malfunction definitions. Type I malfunctions (FSI and FBR) are clearable by immediate action (use of bolt closure assist device and retraction of the charging handle, respectively). Type II malfunctions (BOB, BOB-DR, and FC-DR) are not clearable by immediate action and may require disassembly of the weapon and use of tools to correct the problem. The classification of malfunctions by type is based on the clearing action taken by test personnel after the malfunction has been studied, identified, and the correct remedial action determined. These classifications are, therefore, not necessarily indicative of the relative difficulty of clearing the various malfunctions under field conditions or combat stresses. Improper clearing action applied to some type I malfunctions can create a type II malfunction.

[b]The 30-round small arms weapons systems (SAWS) evaluation magazines were fired in weapon No. 168693 only.

[c]Magazines tested in these weapons were as received from the manufacturer, except for weapon No. 197428 which was also tested with 20 factory reworked magazines (750 rounds) (ref Appendix I for description of rework). These reworked magazines gave malfunction-free performance in this rifle. Additional tests were conducted with the same 20 magazines in the other weapons listed.

1.5 CONCLUSIONS

It is concluded that:

a. Thirty-round magazines

1) The 30-round magazines submitted for tests cannot be considered as production samples (ref Appendix II).

2) The 30-round magazines as represented by the final sample tested are comparable in performance to the standard 20-round design (ref Table 2.2-V).

3) Performance of the test and standard magazines is degraded by use in some M16A1 rifles (ref Table 1.4-I). This degradation of performance may not be a function of the magazine alone, but may be attributable to undetermined parts tolerances and wear in critical areas of the weapon (ref Table 2.2-V, parts interchanged).

b. Modified hand-guard and cap

1) The modified hand-guard and cap are not affected by high temperature, or low temperature, by endurance type firing at ambient temperature (ref pars. 2.3.2.5, 2.3.3.5, 2.3.4.5).

2) Heat dissipation and transfer characteristics of the test and standard hand-guard are comparable (ref par. 2.3.5.4 and Appendix I).

3) The modified hand-guard and cap are comparable in performance to the standard items (ref 1 and 2, above).

1.6 RECOMMENDATIONS

It is recommended that:

a. Thirty-round magazine

1) The 30-round magazine undergo additional engineering development to achieve satisfactory function in the spectrum of M16A1-type rifles now in use.

2) Further testing of the 30-round magazine be conducted with samples produced to production tolerances and that the manufacturer not be permitted to alter magazines during the course of the test, and that sufficient magazines, ammunition types, and weapons of various production periods be provided to assure compatibility of the magazines with materiel currently available.

b. Modified Hand-Guard and Cap. The modified hand-guard and cap be considered for adoption as substitutes for the items presently used on the M16A1 rifle.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

The results of concurrently testing two product improvement items have been separated for reporting purposes. Paragraphs 2.2 and 2.3, respectively, give the details for 30-round magazine and hand-guard tests.

2.2 THIRTY-ROUND MAGAZINE PHASE

2.2.1 Inspection

2.2.1.1 Objective. To determine the physical characteristics of the test magazines.

2.2.1.2 Criteria. The test magazines must be capable of containing 30-rounds of ammunition when fully loaded. The magazines must be constructed within manufacturing specifications.

2.2.1.3 Method. Visually inspect the magazines for uniformity of construction. Take weights and measurements, as appropriate, to determine if the items were manufactured according to specifications.

2.2.1.4 Results. The physical characteristics obtained are given in Table 2.2-I. Visual inspection indicates that the test magazines are uniformly constructed with the exception of irregularities in the area of the spot welds which exhibited interior surface roughness for the entire length of the magazine. Refer to the manufacturer's report in Appendix II for information on out-of-tolerance fabrication.

Table 2.2-I. Physical Characteristics of Magazines

Sample Size	Dimensions, in.			Weight, lb
	Length	Width	Height	
20-Round Control Magazine (Standard)				
10	2.530	0.886	4.9	0.19
30-Round Test Magazine				
10	2.526	0.895	7.1	0.28

Table 2.2-I (Cont'd)

Sample Size	Dimensions, in. Length	Width	Height	Weight, lb
	30-Round SAWS Magazine			
10	2.530	0.885	7.1	0.24

2.2.1.5 Analysis. The test magazines cannot be considered as a production item since they do not meet proprietary manufacturing specifications. Irregularities of the spot-weld surfaces, adjacent to the rear of the follower, is a probable trouble source and should be corrected to prevent possible interference with correct follower action.

2.2.2 Dust Test

2.2.2.1 Objective. To determine the performance characteristics of the test magazines and directly compare that performance with concurrently tested control magazines.

2.2.2.2 Criteria. The performance of the test magazines must not be degraded by the dust environment and should be comparable to the standard item.

2.2.2.3 Method. Conduct the dust test in accordance with TECP 700-700, Interim Pamphlet 20-20, 11 April 1966, with the following exceptions:

a. Condition the loaded test and control magazines only.

b. Perform weapon maintenance after every fifth magazine.

c. Test function seven magazines semiautomatically, two in bursts of three to five rounds, and the last magazine in one automatic burst.

2.2.2.4 Results. Table 2.2-II gives the results of dust-test firing. The weapon used in this phase was assembled with old-style buffer and electroplated bolt and carrier assemblies. The following malfunction legend applies to all tables in this report.

Legend

FSI = Failure to strip first cartridge from the magazine.

BOB = Bolt overrides the base of the cartridge during chambering.

BOB-DR = Same as BOB except the cartridge case becomes deformed.

FC-DR = Failure to chamber cartridge which is deformed during chambering.

FBR = Failure of the bolt to remain rearward after the last round is fired.

Table 2.2-II. Dust Test Results

Magazine Type	Magazine Sample Size	No. Rds Fired	Malfunction Rate per 100 Rds	No. Magazines without Malfunction	Malfunction Types	
					FSI	FBR
Test	10	300	3.0	3	5	4
Control	10	200	4.0	3	3	5

The malfunctions encountered were immediately clearable; the first-round failures (FSI), by application of the bolt closure assist device; the last-round failures (FBR), by retracting the charging handle.

2.2.2.5 Analysis. The FSI and FBR malfunctions, although a nuisance, should not be considered as critical as those which cause stoppages during firing. No appreciable difference was noted in the performance of the test and control magazines.

2.2.3 High Temperature Test (+155°F)

2.2.3.1 Objective. To determine the functional performance and material durability of the test magazines in a high-temperature environment and to directly compare the performance with concurrently tested control magazines.

2.2.3.2 Criteria. The functional performance and material durability must not be adversely affected by the high temperature and should be comparable to the standard item.

2.2.3.3 Method. Conduct the high-temperature test in accordance with TECP 700-700, Interim Pamphlet 20-20, 11 April 1966, with the following exceptions:

a. Test three magazines in an M16A1 rifle equipped with an XM148 grenade launcher. With each magazine loaded and inserted in the rifle, fire 25 rounds of XM387E2 ammunition from the launcher and inspect and test fire the magazine.

b. Function ten test magazines in one weapon for a total of 600 rounds (two loadings).

c. Conduct function tests in 5-magazine increments. Alternate the modes of fire from semiautomatic (SA), bursts of three to five rounds (B), and fully automatic bursts (FA). Return the weapon to ambient temperature (+155°F) after every fifth magazine.

d. Clean and lubricate the weapon only prior to introduction into the test environment.

2.2.3.4 Results. The test results are given in Table 2.2-III. The weapon utilized in this test was assembled with the old-style buffer (action-spring guide) and electroplated bolt and carrier assemblies.

Table 2.2-III. High-Temperature (+155°F) Test Results

Magazine Type	Magazine Sample Size	No. Rd Fired	Malfunction Rate per 100 Rds	Total No. Magazines without Malfunction	Malfunction Types		
					BOB	FC-DR	FBR
Test	10	600	2.5	7	4	3	8
Control	9	180	2.8	4	1	1	3
Test[a]	3	90	2.2	1	0	0	2

[a]Results of grenade launcher firing.

2.2.3.5 Analysis. The occurrence of FC-DR malfunctions (failure to chamber cartridge damaged during feeding) indicated that a serious feeding or chambering abnormality existed. Further investigation and analysis on this and other closely related malfunctions are given in par.2.2.5. The test and control magazines were comparable. No magazine performance degradation occurred as a result of firing the XM148 grenade launcher.

2.2.4 Low-Temperature (-65°F) Test

2.2.4.1 Objective. To determine the functional performance and material durability of the test magazines in a low-temperature environment and to directly compare the performance with concurrently tested control magazines.

2.2.4.2 Criteria. The functional performance and material durability must not be adversely affected by low temperature and should be comparable to the standard item.

2.2.4.3 Method. Conduct the low-temperature test in accordance with TECP 700-700, Interim Pamphlet 20-20, 11 April 1966 with the following exceptions:

a. Test three magazines in an M16A1 rifle equipped with an XM148 grenade launcher with each magazine loaded and inserted in the rifle, and fire 25-rounds of XM387E2 ammunition from the launcher and inspect and test fire the magazine.

b. Function ten test magazines (utilize the test weapon from the high-temperature phase) for a total of 600 rounds (two loadings).

c. Conduct function tests in 5-magazine increments. Alternate the modes of fire from semiautomatic (SA), bursts of three to five rounds (B), and fully automatic bursts (FA). Return the weapon to ambient temperature (-65°F) after every fifth magazine.

d. Clean and lubricate the weapon only prior to introduction into the test environment.

2.2.4.4 Results. The test results are given in Table 2.2-IV.

Table 2.2-IV. Low-Temperature (-65°F) Test Results

Magazine Type	Magazine Sample Size	No. Rds Fired	Malfunction Rate per 100 Rds	Total No. Magazines without Malfunctions	Malfunction Types			
					FS1	BOB	FC-DR	FBR
Test	10	600	3.5	1	1	1	1	18
Control	10	200	1.0	8	1	0	0	1
Test[a]	3	90	1.1	2	1	0	0	0

[a]Results of grenade launcher firing.

2.2.4.5 Analysis. There is a slight variance in the performance of test and standard magazines; however, the majority of the malfunctions contributing to this difference are not considered critical (Reference par. 2.2.3.5).

2.2.5 Function and Durability Test

2.2.5.1 Objective. To determine the functional performance and durability characteristics of the test magazines when subjected to repeated loading and function testing at ambient temperature (+70°F ± 30°F) and to directly compare the result with concurrently tested control (20-round) magazines.

2.2.5.2 Criteria. The functional performance and material durability must not be degraded by repeated use. The test and control magazine performance should be comparable.

2.2.5.3 Method. Initially test 20 magazines in two rifles for a total of three loadings in each magazine. Based on the results of this firing, adjust the sample size of magazines and weapons to insure a comprehensive test. Alternate the modes of fire and magazines as prescribed in par. 2.2.3.3.c.

Record cyclic rate of fire. Perform weapon maintenance prior to initiation of each test phase. Allow the weapon to return to ambient temperature after firing a maximum of 160 rounds.

2.2.5.4 Results. During the conduct of this test, modifications of the test procedures were required to trace the function characteristics of weapons which exhibited excessive stoppages, thereby permitting differentiation to be made between magazine and weapon performance abnormalities. Modifications consisted of using cartridges loaded with IMR and ball propellents and interchange of weapon component parts.

The results of this test are summarized in Table 2.2-V.

Table 2.2-V. Results of the Function and Durability Test

Magazine Type	Mag Sample Size	No. Rds Fired[a]	Malfunction Rate per 100 Rds	Total No. Mags without Malfunctions[b]	Weapon Serial No.	Malfunction Types FSI	BOB-DR	FC-DR	FBR	Total Malfunctions	Avg Cyclic Rate of Fire, rds per min	
Test	20	1200	5.5	2	[c]137686	2	8	24	32	66	-	
Test	20	600	4.0	4	[d]137686	0	0	10	14	24	-	
Control	10	500	1.4	18	[c]137686	0	0	0	7	7	-	
Test	20	1200	0.7	32	[e]197428	6	0	0	2	8	-	
Control	10	200	2.5	5	[e]197428	5	0	0	0	5	-	
Control	10	200	2.5	5	[f]197428	5	0	0	0	5	-	
[h]Test	20	1680	3.0	25	[d]168693	1	25	9	15	50	932	
SAWS	6	360	1.1	9	[d]168693	0	2	0	2	4	959	
Control	24	480	2.7	12	[d]168693	0	5	1	7	13	939	
[h]Test	20	600	1.0	14	[g]168693	0	0	1	5	6	953	
[h]Test	20	600	1.0	15	[d]168693	0	5	1	0	6	889	(IMR propellant)
Control	24	480	1.9	15	[d]168693	0	7	0	2	9	913	(IMR propellant)
[h]Test	20	750	0.0	25	[f]197428	0	0	0	0	0	802	
[h]Test	20	600	0.0	20	[f]556787	0	0	0	0	0	857	
[h]Test	20	600	0.3	19	[d]556787	0	2	0	0	2	876	(Bolt and carrier[d] from No. 168693)
[h]Test	20	600	0.0	20	[f]709760	0	0	0	0	0	844	

[a]Disagreement of round count relative to magazine sample size indicates that magazines were reloaded.
[b]Malfunction-free reloadings were included.
[c]Weapon components consist of old-style buffer and electroplated bolt and carrier assemblies.
[d]Weapon components consist of new-style buffer and electroplated bolt and carrier assemblies.
[e]Weapon components consist of old-style buffer and phosphate-coated bolt and carrier assemblies.
[f]Weapon components consist of new-style buffer and phosphate-coated bolt and carrier assemblies.
[g]Weapon components consist of new-style buffer and electroplated bolt (new part) and carrier assemblies.
[h]These 20 magazines were reworked by the manufacturer and are the final configuration tested.

2.2.5.5 Analysis. It is apparent from the performance of 20 test magazines used throughout this exercise that the functional characteristics of weapons assembled with the latest buffer design and phosphate-coated bolt and carrier assemblies are compatible with the magazine design, but that the same magazines exhibit unreliable performance when tested in weapons of earlier manufacture (i.e., assembled with electroplated bolt and carrier assemblies). It is, therefore, evident that a problem exists with certain weapons, irrespective of the type of magazines used, which is adversely affecting the function performance of the system. The data indicate that weapons which do not exhibit a high frequency of FBR type malfunctions will, over-all, perform in a superior manner to those which do.

2.3 HAND-GUARD PHASE

2.3.1 Inspection

2.3.1.1 Objective. To determine the physical characteristics of the test item prior to initiation of performance tests.

2.3.1.2 Criteria. The test items must be uniformly manufactured and free from defects.

2.3.1.3 Method. Visually inspect the test hand-guard and hand-guard caps for uniformity of construction. Weigh and measure the test items.

2.3.1.4 Results. Visual inspection indicated that the test items were of uniform construction. The six half-sections supplied for test weighed 0.30 pound each, were 12.0 inches in over-all length and, when assembled to the M16A1 rifle, formed a forward-tapering cylinder with a frontal diameter of 1.990 inches and a rear diameter of 2.365 inches. The exterior surface is ribbed to improve the grip-surface area.

2.3.1.5 Analysis. The test hand-guard and cap correctly fit the M16A1 rifle and do not interfere with the operation or maintenance of the weapon. The test items are uniformly constructed.

2.3.2 High-Temperature Test (+155°F)

2.3.2.1 Objective. To determine the durability of the test hand-guard and cap during firing in a high-temperature environment.

2.3.2.2 Criteria. The test hand-guard and cap performance must not be adversely affected by the environment (+155°F).

2.3.2.3 Method. Condition the test items in accordance with TECP 700-700, Interim Pamphlet 20-20. Fire a total of 830 rounds of 5.56-mm ammunition in an M16A1 rifle equipped with the test hand-guard and cap (set No. 1). Select one half-section from set No. 1 and attach to an M16A1 rifle equipped with the XM148 grenade launcher. Fire 600 rounds of XM387E2 ammunition from the grenade launcher.

2.3.2.4 Results. The test results indicated that both test hand-guard configurations (rifle and grenade launcher) performed without defect at +155°F.

2.3.2.5 Analysis. Not applicable.

2.3.3 Low-Temperature Test (-65°F)

2.3.3.1 Objective. To determine the durability of the test hand-guard and cap during firing in a low-temperature environment.

2.3.3.2 Criteria. The test hand-guard and cap performance must not be adversely affected by the environment (-65°F).

2.3.3.3 Method. Condition the test items in accordance with TECP 700-700, Interim Pamphlet 20-20. Fire a total of 830 rounds of 5.56-mm ammunition in an M16A1 rifle equipped with the test hand-guard and cap (set No. 2).

Select one half-section from set No. 2 and attach to an M16A1 rifle equipped with the XM148 grenade launcher. Fire 600 rounds of XM387E2 ammunition from the grenade launcher.

2.3.3.4 Results. The test results indicated that both hand-guard configurations (rifle and grenade launcher) perform without defect at -65°F.

2.3.3.5 Analysis. Not applicable.

2.3.4 Ambient-Temperature Durability Test (+70°F ± 30°F)

2.3.4.1 Objective. To determine the durability of the test hand-guard and cap during firing at ambient temperature.

2.3.4.2 Criteria. The test hand-guard and cap performance must not be adversely affected by extended weapon firing.

2.3.4.3 Method. Fire a total of 1900 rounds of 5.56-mm ammunition in an M16A1 rifle equipped with the test hand-guard and cap (set No. 3).

2.3.4.4 Results. The test results indicated that the test items performed without defect during this test phase.

2.3.4.5 Analysis. Not applicable.

2.3.5 Thermal Conductivity Test

2.3.5.1 Objective. To determine by measurement the temperature of the rifle barrel and hand-guard during and after test firing.

2.3.5.2 Criteria. In the role of a rifle hand-guard, the test item must not exhibit characteristics which materially inhibit the use of the weapon because of heat transfer to the shooter's hands. Additionally, when used in conjunction with the XM148 grenade launcher, the hand-guard must not cause heating of the 40-mm cartridge in excess of safe limits of the explosive components. The test and standard hand-guards should exhibit comparable performance.

2.3.5.3 Method. Attach the thermocouples at the following points and record temperature rise, peak, and decay-time duration for the test and standard items in rifle and grenade-launcher configurations.

For the rifle configuration, tests 1, 2,3, and 6 (Table 2.3-I) are conducted with thermocouples at the following locations:

a. On flash suppressor at 7 o'clock, 1/2 inch from the forward end.

b. On barrel at 6 o'clock, 2-1/4 inches from the muzzle end.

c. On barrel at 6 o'clock 10-1/4 inches from the muzzle end (under forward portion of hand-guard).

d. On forward portion of hand-guard at 6 o'clock, 10-1/4 inches from the muzzle end.

e. On barrel at 6 o'clock, 18-1/4 inches from the muzzle end (under rear portion of hand-guard).

f. On rear portion of hand-guard at 6 o'clock, 18-1/4 inches from muzzle end.

For the grenade launcher configuration, tests 4 and 5 (Table 2.3-I) are conducted with thermocouples at the following locations:

a. On the rear face of the rear launcher mount.

b. On the center of the base of the primer.

c. On the rear of the 40-mm projectile.

The thermocouples on the barrels are attached by arc welding. The thermocouples on the hand-guards and the 40-mm projectile are attached by epoxy resin.

Tests No. 1, 3, 4, and 6 are fired with the old type hand-guard. Tests No. 2, and 5 are fired with the new type hand-guard.

Time-versus-temperature curves are recorded autographically for all tests. These curves are given in Appendix I.

2.3.5.4 Results. The results are shown in Table 2.3-I.

Table 2.3-I. Thermal Conductivity Results

Test No.	Total Rd Fired	Firing Rate	Firing Time		Maximum Temperature Reached, °F					
			Min	Sec	TC No. 1	TC No. 2	TC No. 3	TC No. 4	TC No. 5	TC No. 6
1	359	Max	2	32	[a] -	[a] -	[b]1240	252	[b]1400	172
2	240	Max	2	5	714	865	982	215	1107	150
3	235	Max	1	45	[a] -	826	1050	212	1106	140
4	240	Max	1	42	130	130	145	-	-	-
5	238	Max	1	30	136	136	150	-	-	-
6	240	Max	1	35	730	837	1087	232	1133	145

[a]Thermocouple broke during test.
[b]Extrapolated temperature (exceeded range of recorder).

2.3.5.5 Analysis. The test and control hand-guards are comparable in performance although the test item dissipates heat at a slightly lower rate. Severe firing schedules will result in surface temperatures with either hand-guard which are high enough to cause serious burns (ref Appendix I for extract from Reference 4).

The heating of a chambered 40-mm cartridge as a result of firing the M16A1 rifle does not cause cook-off (Ref DPS-1888).

During this and the other firing tests, the shooters made visual comparisons of sight-picture distortion experienced with test and control hand-guards. No disparity in observed conditions was noted.

2.3.6 Chemical Compatibility Test

2.3.6.1 Objective. To determine if the hand-guard material is adversely affected by contact with various solvents, lubricants, and insect repellant.

2.3.6.2 Criteria. The test hand-guard must not be susceptible to damage as a result of contact with the various chemicals used in this test.

2.3.6.3 Method. Immerse one half-section of the hand-guard for ten minutes in the following fluids: bore cleaner (MIL-L-372B), gasoline, kerosene, diesel fuel, dry-cleaning solvent (PS-661B), and lubricants (VV-L-800, MIL-L-14107, and MIL-L-46000). Remove the items from the fluids and allow to drain for 24 hours.

Apply insect repellant (FSN 6840-558-0918) to the hand-guard by coating the hands with repellant, then immediately grasping the test item, insuring that contact is made with the entire exterior surface of the guard. Allow to drain as above. Inspect the test items for cracks, checks, and other signs of material degradation.

Prior to retest of any test item with another fluid, thoroughly clean the part with hot soapy water, dry, and inspect for remaining traces of the previously used test fluid.

2.3.6.4 Results. The test hand-guards were unaffected by the chemicals used.

2.3.6.5 Analysis. Not applicable.

SECTION 3. APPENDICES

APPENDIX I - TEST DATA

This Appendix contains the autographic records of the temperature tests conducted with the test and standard hand-guards and a table of relative values pertaining to effects of skin contact with variations in materiel temperature.

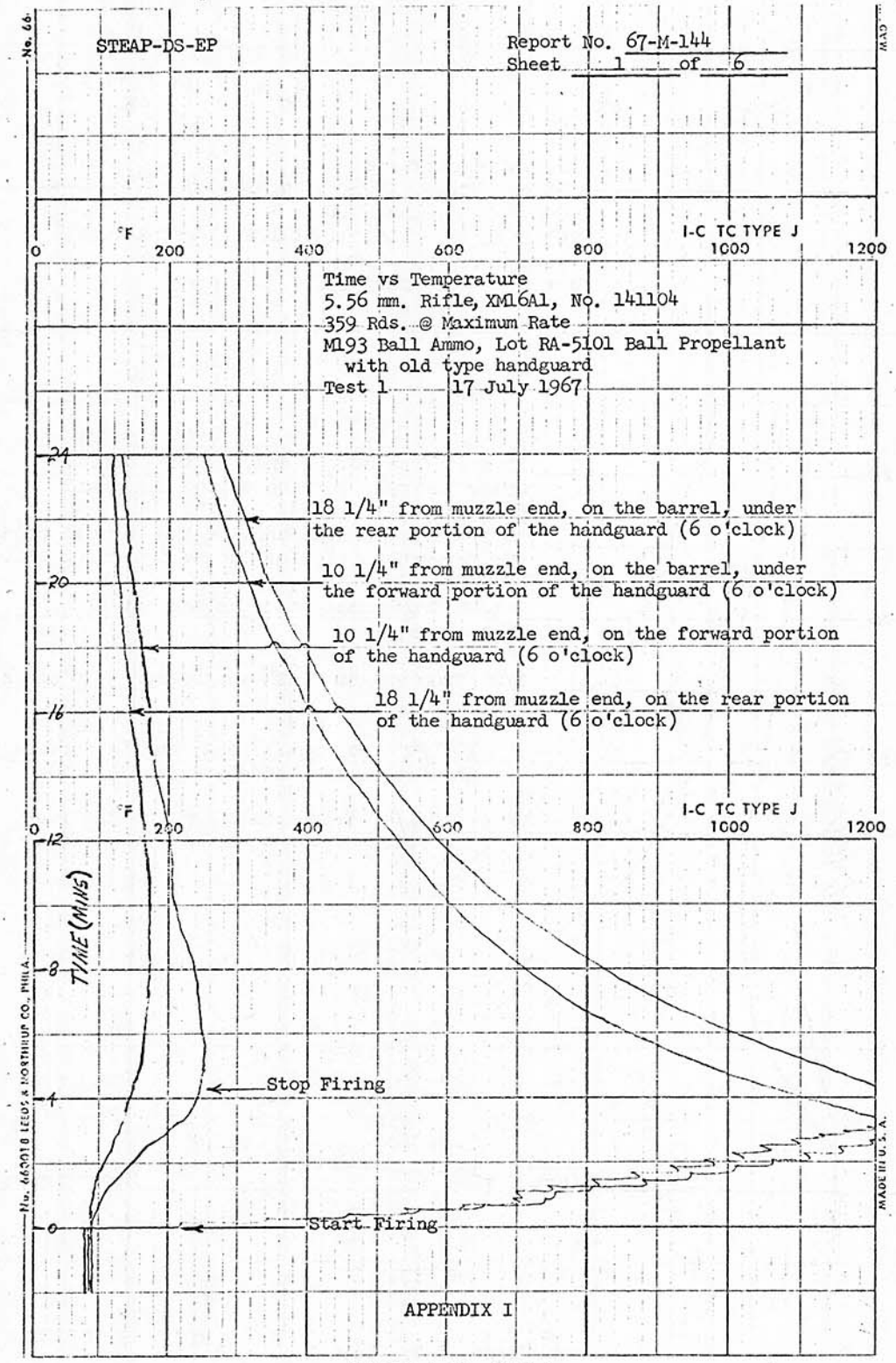

Figure I-1: Test 1.

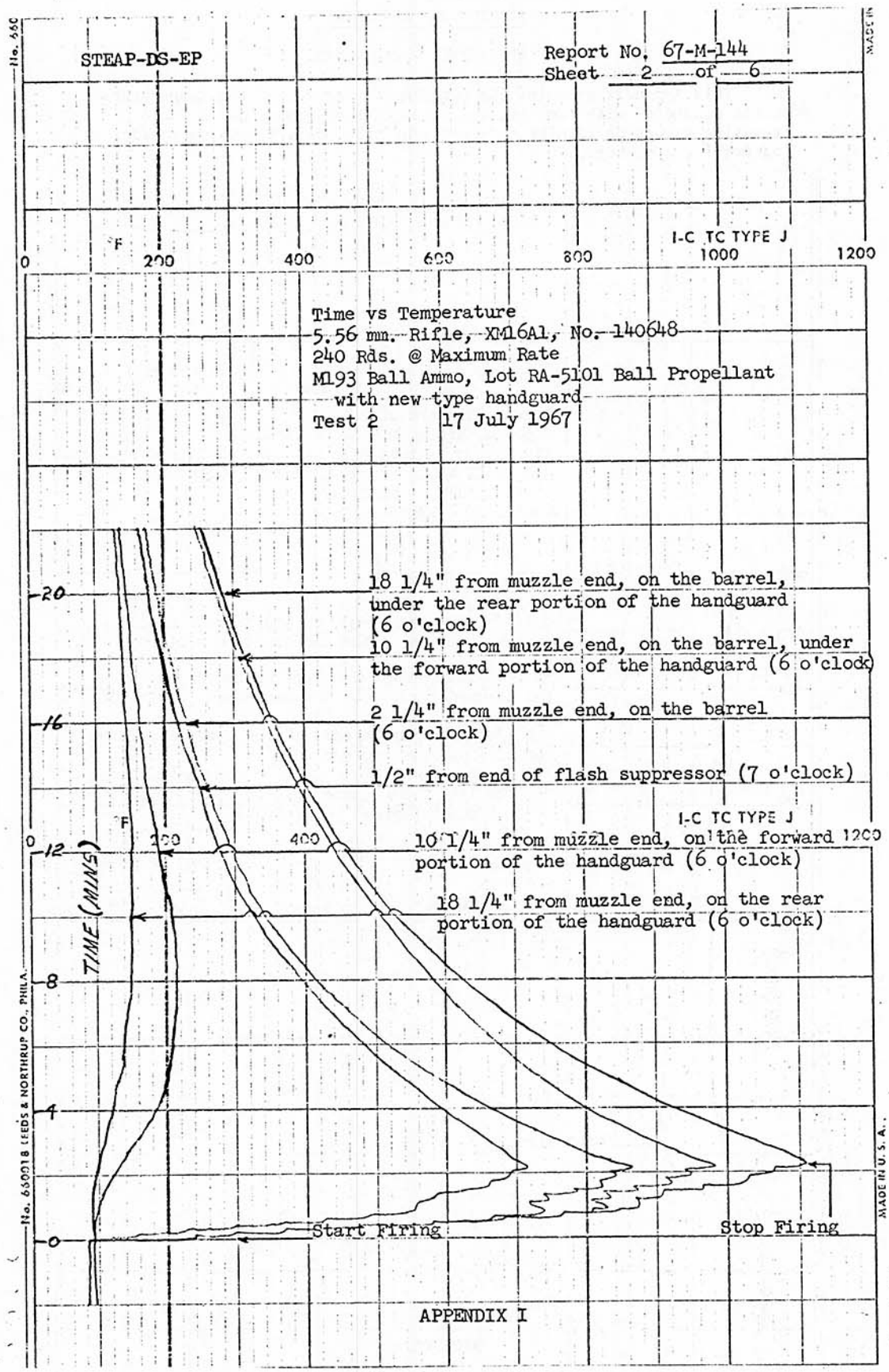

Figure I-2: Test 2.

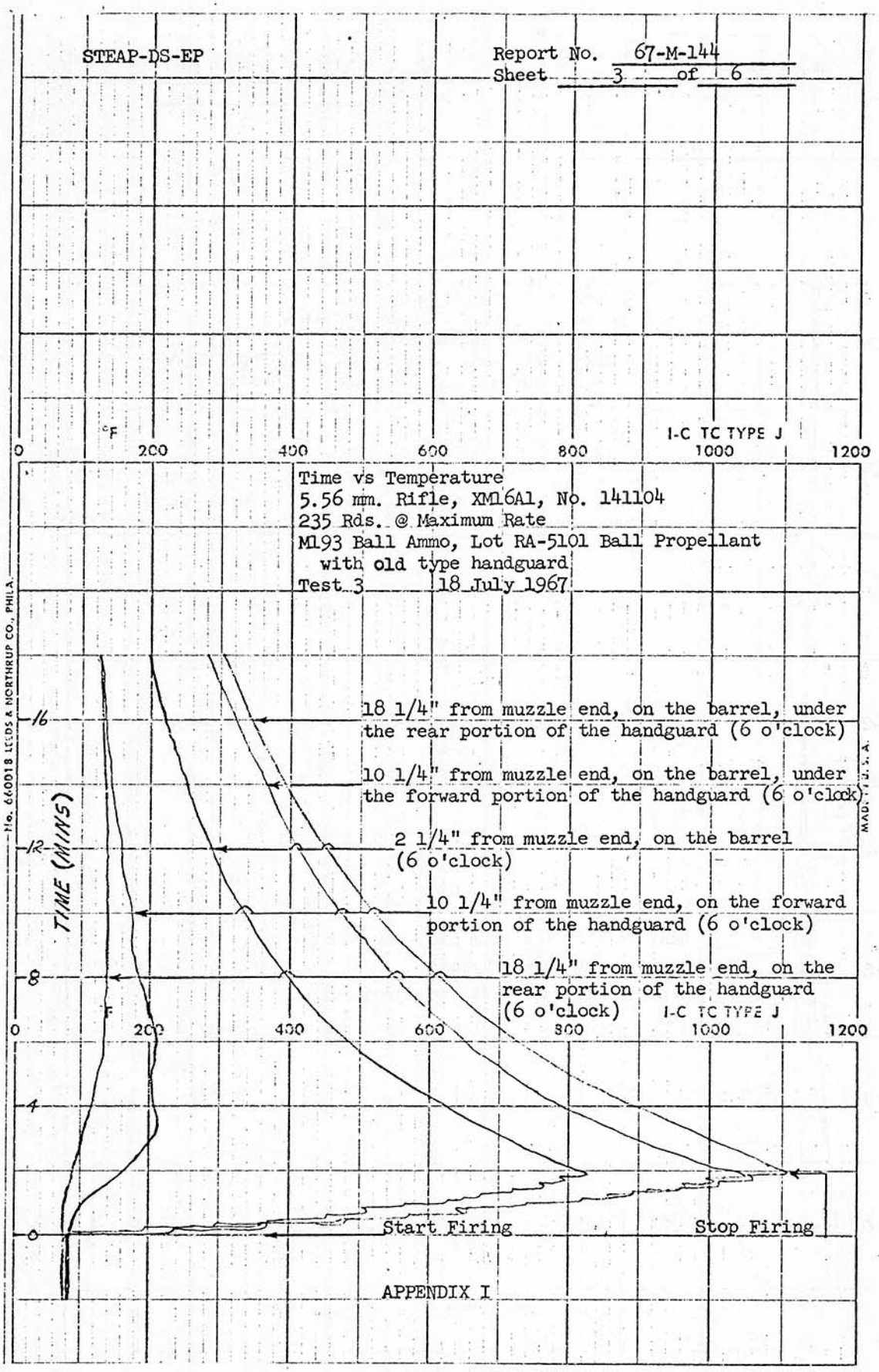

Figure I-3: Test 3.

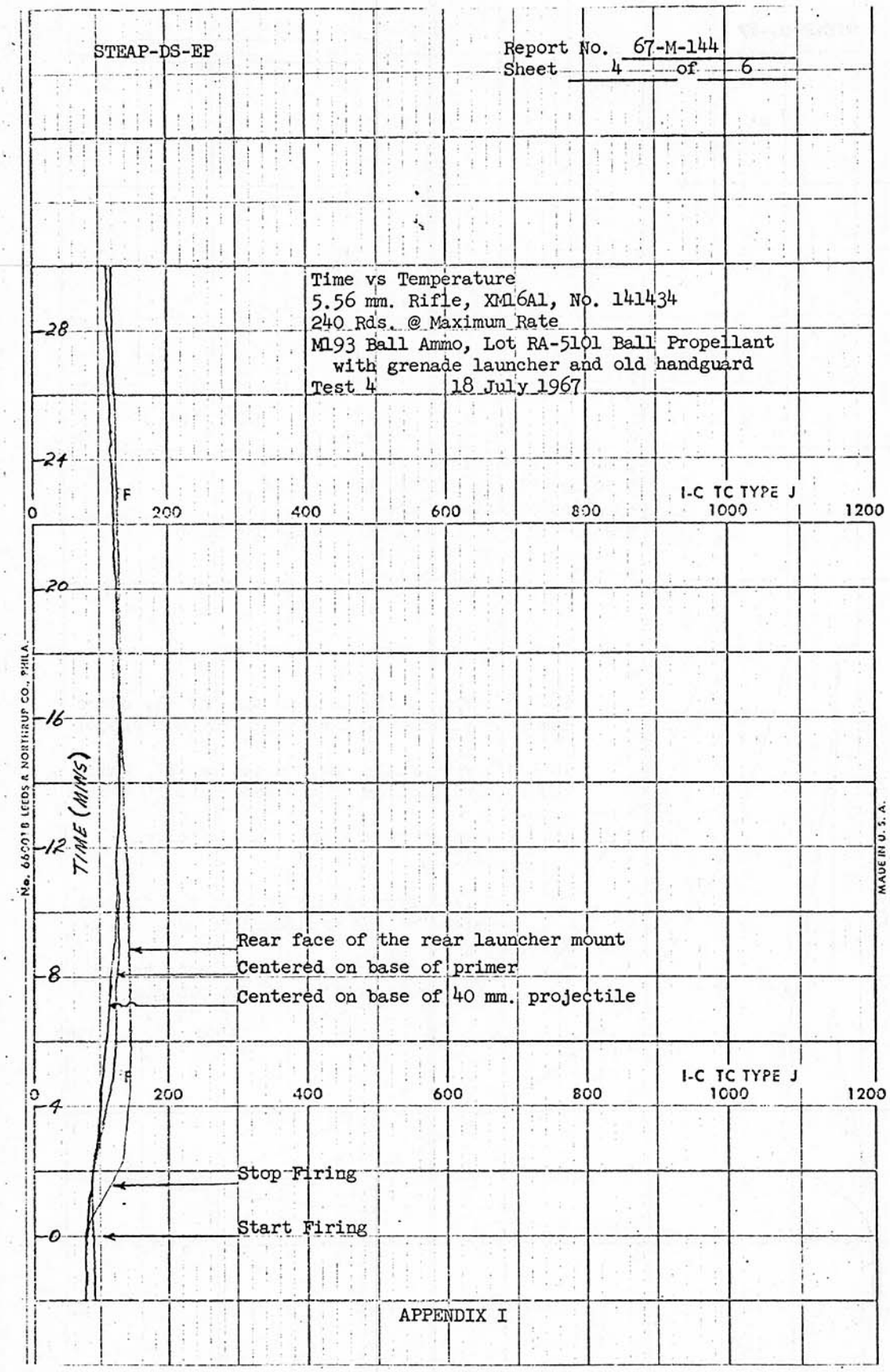

Figure I-4: Test 4.

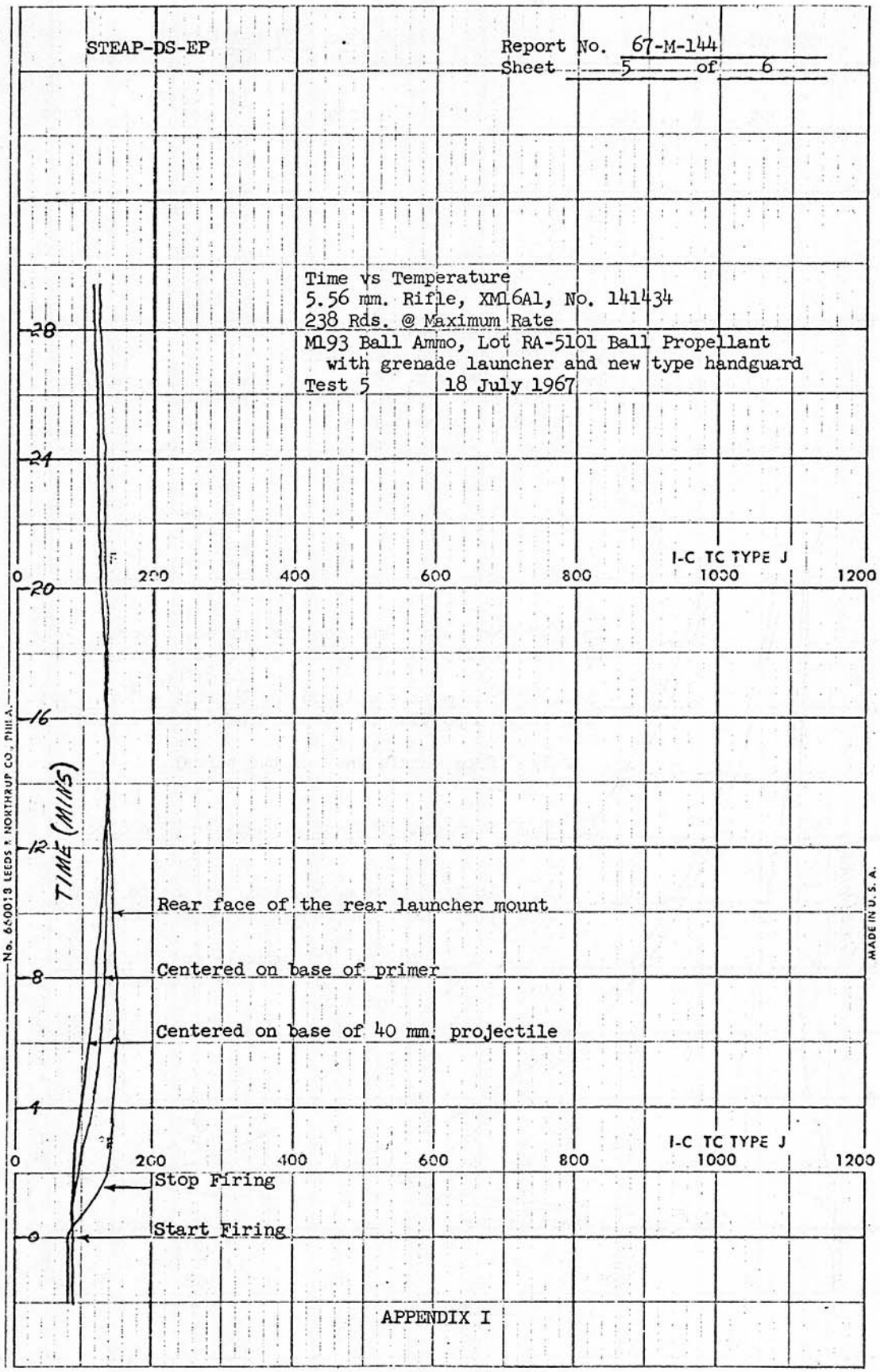

Figure I-5: Test 5.

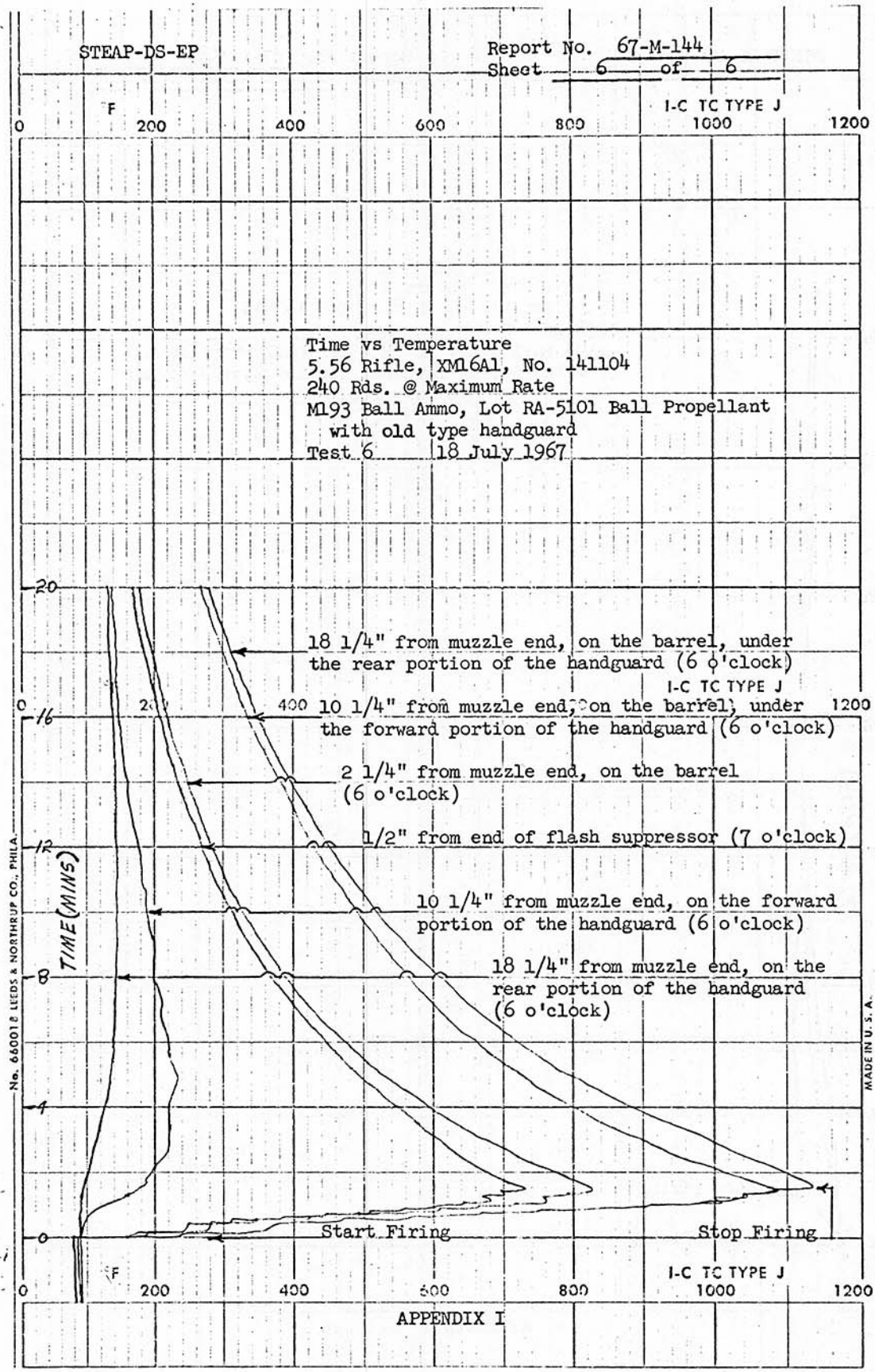

Figure I-6: Test 6.

Surface Temperatures

1. Table 15 provides the effects on the skin of personnel coming in contact with surfaces at different temperatures.

TABLE 15

EFFECTS ON SKIN IN CONTACT WITH SURFACES AT DIFFERENT TEMPERATURES

Temperature (^{o}F)	Sensation or Effect
212	2nd-degree burn on 15-sec contact
180	2nd-degree burn on 30-sec contact
160	2nd-degree burn on 60-sec contact
140	pain; tissue damage (burns)
120	pain; "burning heat"
$91^{+}_{-}4$	warm; "neutral" (physiological zero)
54	cool
37	"cool heat"
32	pain
Below 32	pain; tissue damage (freezing)

2. The highly localized heat from power train components must be insulated from the fighting compartment by design to prevent the imposing of an excessive surface contact or ambient heat load upon the crew members.

This reference extracted from HEL Standard S-2-64 "Human Factors Engineering Design Standard For Vehicle Fighting Compartments."

155

Figure I-7: Table of Relative Values.

DATE: 7 NOV 66
TION: COMT

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

S - 1 Dec 66

8 NOV 1966

AMSTE-BC
8-6-0200-02, 03

SUBJECT: Test Directive for Concurrent Product Improvement Testing of the Handguard and Handguard Cap for the XM16E1 Rifle with the 30-Round Magazine Test for the XM16E1 Rifle and Colt Submachinegun

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-CO-P, Aberdeen Proving Ground, Maryland 21005
President, USA Infantry Board, ATTN: STEBC-SA, Fort Benning, Georgia 31905

1. References:

a. Ltr, AMSTE-BC, dated 18 April 1966, subj: Product Improvement Test of a 30-Round Magazine for XM16E1 Rifles and Colt Submachinegun, USATECOM Project Nos. 8-6-0200-02, 03.

b. Msg 35911, AMCPM-RS, dated 182210Z Oct 66, inclosed.

2. Referenced message requests that a newly designed Handguard and Handguard Cap for the XM16E1 Rifle be concurrently evaluated with the established 30-Round Magazine test. Test objectives are to determine if the product improved materiel is equal to or better than the present design in durability and to determine significance of advantages cited in paragraph 4 of referenced message. Verbal coordination with requestor indicates that the buffer will not be tested at this time.

3. It is requested that addressees prepare a test plan, as an addendum to the 30-Round Magazine plan, to evaluate the Handguard and Handguard Cap with the XM16E1 Rifle and XM148 Launcher and submit to this headquarters for approval by 1 December 1966. A plan similar to the 30-Round Magazine plan is acceptable. In the event that the XM148 Launchers are not available for concurrent testing, it is desired that the test be initiated upon receipt of subject materiel regardless of the XM148 status.

8 NOV 1966

AMSTE-BC

SUBJECT: Test Directive for Concurrent Product Improvement Testing of the Handguard and Handguard Cap for the XM16E1 Rifle with the 30-Round Magazine Test for the XM16E1 Rifle and Colt Submachine-gun

4. Based on distribution of three Handguards and Caps to CO, APG and four to USAIB, your comments as to adequacy of materiel quantities are desired immediately to include costs, as appropriate. Additionally, confirm local availability of the previously established materiel requirements.

5. A final report in letter form is acceptable which includes the following:

a. 30-Round Magazine tested with the XM16E1 Rifle and Colt "Shortie". Suitability is to be based on performance of the rifle only.

b. Handguard and Handguard Caps tested with the XM16E1 Rifle and XM148, 40mm Launcher. If the XM148 Launcher is not available for test upon receipt of Magazines and Handguards, initiate tests and submit to this headquarters only a partial teletype summarized report to include conclusions and recommendations within five days after completion of test.

FOR THE COMMANDER:

JACK W. MORRIS
LTC GS
Actg Dir, Inf Mat Test

1 Incl
as w/d

Copy furnished:
CG USAMC ATTN: AMCPM-RS
(w/o incl)

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY WEAPONS COMMAND
PROJECT MANAGER, RIFLES
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61202

IN REPLY REFER TO:
AMCPM-RS

30 December 1966

SUBJECT: Product Improvement Test of 30-Round Magazine (and Redesigned Handguard) for M16/XM16E1 Rifle and Colt Submachine Gun

TO: Commanding General
U.S. Army Test & Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Md. 21005

1. References:

a. Telephone Conversation between Mr. Crider AMSTE-BC, Major Barrett and Mr. Pelcharsky AMCPM-RS, 28 Dec 1966, Subject: Same as above.

b. AMSTE-BC letter dated 19 Dec 1966, Subject: Addendum to Product Improvement Test of 30-Round Magazine (and Redesigned Handguard) for M16/XM16E1 Rifle and Colt Submachine Gun.

2. The total funds required to conduct subject test in amount of $15,000 is being forwarded to CO, Aberdeen Proving Ground, ATTN: STEAP-CO-P under separate cover.

3. A total of one hundred (100) magazines (30-rd) will be provided for the subject test. It is requested that this office be advised of the number of magazines required by D&PS and U.S. Army Infantry Board for the conduct of the test.

4. Two (2) CAR-15 sub machine guns in lieu of five requested will be provided to U.S. Army Infantry Board for the subject test.

5. The subject test plans were reviewed and the following comments are provided:

a. USATECOM Project No. 8-6-0200-02. It is recommended that all magazine subtests be conducted in the unlubricated condition. Field reports received from SEA attribute excessive malfunctions to heavily lubricated magazines. Troops are being instructed not to lubricate their magazines.

AMCPM-RS 30 December 1966

SUBJECT: Product Improvement Test of 30-Round Magazine (and Redesigned Handguard) for M16/XM16E1 Rifle and Colt Submachine Gun

b. USATECOM Project No. 8-6-0200-03. It is recommended that the method to unload the magazines in subtest No's 2 and 3 be specified. The unloading should be in the same manner and direction as that of the bolt stripping the round from the magazine. The unloading could be done manually or by putting the loaded magazine in the rifle and hand functioning the charging handle. Care should be taken not to distort the magazine lips.

WM C. DAVIS, JR.
Chief, Technical Management Division

AMSTE-BC (30 Dec 66) 1st Ind
SUBJECT: Product Improvement Test of 30-Round Magazine (and Redesigned Handguard) for M16/XM16E1 Rifle and Colt Submachine Gun

DA, Headquarters, US Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 21005 26 JAN 1967

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-DS, Aberdeen Proving Ground, Maryland 21005
President, US Army Infantry Board, ATTN: STEBC-SA, Fort Benning, Georgia 31905

1. Reference USATECOM Project Nos. 8-6-0200-02, 03, subject as above.

2. Basic letter forwarded for your information and attention to comments of paragraph 5.

3. Comments of this command relative to paragraph 5 are as follows:

a. Conduct the test with unlubricated magazines unless any stoppages that occur are directly related to the unlubricated condition.

b. During non-firing exercises in the loading and unloading of magazines, methods representative of actual firing will be utilized.

4. Test plan changes are not required to accomplish the above. However, test agencies should clearly state the conditions and methods used in conducting each subtest.

FOR THE COMMANDER:

GOODWIN MORROW
Actg Dir
Inf Mat Test Dir

Copy furnished:
CG USAMC ATTN: AMCPM-RS

COPY/mm

Colt Industries, Colt's Firearms Division

Report No. 850-1102
Date July 19, 1967
Author Robert E. Roy

30 ROUND MAGAZINE

Background

Seven (7) magazines were returned from Aberdeen after testing by TECOM. They reported overrides from the right side of the magazine. Tests were conducted with the magazines which had the greatest incidences of failure at Aberdeen and results were reported. (See report dated 6/2/67.)

All magazines were returned from Aberdeen and Fort Benning. Examination revealed the following results:

1. There were indications that the follower was catching on projections caused by the spot welding on the rear inside surface of the magazine boxes.

2. Front to rear internal dimension of the magazine box was undersize.

3. Follower springs had set below the minimum free length in many cases.

It was decided to rework the magazines to specs before returning them to the testing agencies. Accordingly, the following operations were performed:

1. File off spot weld projections.

2. Strip dry lube and anodize.

3. Re-anodize and dry lube.

4. Test.

Results

1. 25 magazines were found acceptable out of 58 total magazines. Most magazines were rejected because the stripping operation was not done properly, causing some magazines to be severely etched.

2. 8,000 rounds were fired and results recorded.

3. (7) M16 rifles were used for the test. Included were (2) rifles from A.P.G. and (1) old style model 01 rifle.

4. No malfunctions attributable to the magazine were recorded on 24 of 25 total magazines.

5. All magazines had minimum of 10 cycles.

6. One magazine (#8) was withdrawn after (6) cycles, because of cronic double-feeding. Examination disclosed magazine lips were spread .040 beyond maximum dimensions.

7. Examination after the above test disclosed many of the magazine lips had spread, although not to the same extent as magazine #8. Investigation disclosed that the magazines were softer than specification. All indications point that hardness was lost during the stripping and re-anodizing operation, since magazines from the same lot that were not reworked were within the hardness. Spec minimum hardness is 80 Barcol. The reworked magazines were from 54 to 79.

8. 11 magazines were found to be .485 or less across the lips (.480 is maximum spec). Hardness of these magazines was 73 Barcol or above.

9. Detailed charts of measurements and firing records are included with this report.

Conclusions

1. The 30 round magazine will operate satisfactorily if dimensional and hardness specifications are met.

2. Tests indicate that hardness and lip width specs can be exceeded by a considerable amount before there is an effect on performance.

Recommendations

1. Ten (10) magazines, which are closest to specifications, be forwarded to A.P.G. for testing and evaluation.

/s/ R. E. Roy
/t/ Robert E. Roy

RER/bcw
R. Fremont, W. Goldbach, J. Powers, J. Hall

COPY/mm

Mag No.	Free Length of Spring (New)	Free Length of Spring After 10 Hand Cycles	Width of Lips Before Firing	No. of Cycles/Mag	Width of Lips After Firing	Free Length of Spring After Firing	Barcol Hardness Readings
9	10 3/4	10 5/8	.480	10	.490	10 1/2	64
10	10 3/4	10 5/8	.478	11	.500	10 1/2	64
45	10 11/16	10 9/16	.480	11	.485	10 1/2	75
16	10 3/4	10 5/8	.485	12	.490	10 1/2	73
40	10 3/4	10 5/8	.483	10	.490	10 1/2	70
39	10 13/16	10 11/16	.485	10	.495	10 5/8	65
1	10 3/4	10 5/8	.483	12	.485	10 1/2	74
107	10 3/4	10 5/8	.464	13	.475	10 1/2	73
56	10 3/4	10 5/8	.466	15	.480	10 1/2	74
82	10 3/4	10 5/8	.481	11	.490	10 9/16	75
14	10 3/4	10 5/8	.485	10	.485	10 9/16	79
12	10 3/4	10 5/8	.480	10	.480	10 1/2	73
7	10 13/16	10 11/16	.485	10	.495	10 5/8	64
51	10 3/4	10 5/8	.475	10	.480	10 1/2	75
53	10 3/4	10 5/8	.473	10	.480	10 9/16	74
83	10 3/4	10 5/8	.480	11	.480	10 1/2	73
5	10 3/4	10 5/8	.474	11	.490	10 1/2	65
84	10 3/4	10 5/8	.485	11	.485	10 1/2	75
6	10 3/4	10 5/8	.483	10	.500	10 9/16	63
44	10 3/4	10 5/8	.481	14	.486	10 9/16	75
8	10 3/4	10 5/8	.475	6	.530	10 9/16	58
2	10 3/4	10 5/8	.483	10	.490	10 1/2	71
09	10 13/16	10 11/16	.481	11	.485	10 5/8	76
4	10 3/4	10 5/8	.475	10	.513	10 1/2	54
13	10 3/4	10 5/8	.481	10	.496	10 1/2	62
	10 3/4						
22	10 3/4	10 5/8	.470	3	.471	10 5/8	78
35	10 3/4	10 3/4	.470	3	.473	10 5/8	76
26	10 3/4	10 3/4	.478	3	.480	10 5/8	77
8	10 3/4	10 3/4	.476	3	.476	10 5/8	78
41	10 11/16	10 11/16	.475	3	.475	10 9/16	77

COPY/mm

Mag No.	Free Length of Spring (New)	Free Length of Spring After 10 Hand Cycles	Width of Lips Before Firing	No. of Cycles/Mag	Width of Lips After Firing	Free Length of Spring After Firing	Barcol Hardness Readings
10	10 3/4	10 3/4	.480	3	.481	10 5/8	78
27	10 11/16	10 5/8	.478	3	.478	10 9/16	78
19	10 11/16	10 5/8	.476	3	.477	10 1/2	77
28	10 3/4	10 5/8	.477	3	.480	10 9/16	78
36	10 3/4	10 5/8	.472	3	.472	10 5/8	78

APPENDIX III - REFERENCES

1. TECP 700-700, Interim Pamphlet 20-20, 11 April 1966.

2. Letter Report No. P-3159, 10 April 1967, STEBC-SA, Subject: Letter Report of Product Improvement Test of 30-Round Magazine and Redesigned Handguard for M16/XM16E1 Rifle and Colt Submachine Gun, USATECOM Project No. 8-6-0200-03.

3. USAF Marksmanship School Operational Suitability Test on "Evaluation of New Handguard for the M16 Rifle, Project No. 176-66.

4. HEL Standard S-2-64 "Human Factors Engineering Design Standard for Vehicle Fighting Compartments," Table 15.

5. Report DPS-1888. Engineer Test of 40-MM, XM148 Grenade Launcher.

APPENDIX IV - DISTRIBUTION

USATECOM Project No. 8-6-0200-02

ADDRESSEE	FINAL REPORT
Commanding General US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005 ATTN: AMSTE-BC	30
Commanding General US Army Materiel Command Washington, D. C. 20315 ATTN: AMCRD-WI	2*
AMCAD-S	1*
AMCPP	1*
AMCQA	1*
AMCMA-R	1*
AMCSU	1*
AMCMI	1*
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AMCMS Code No. 4420.25.0132.2.118, Report No. DPS-2598
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Unclassified Report

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