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US ARMY TEST & EVALUATION COMMAND



USATECOM PROJECT NO. 8-4-0230-02-F

FINAL REPORT OF COMPARISON TEST OF

RIFLE, 5.56-MM, XM16E1

REPORT NO. DPS-1541

JANUARY 1965

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

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RDT&E PROJECT NO. None

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THIS REPORT SHOULD BE MADE
TO COMMANDING GENERAL,
US ARMY WEAPONS COMMAND.

PREPARED BY: ERIC J. KEELE

FOR THE DIRECTOR:



B. M. SENN
Lt Col, Ord Corps
Deputy Director for
for Engineering Testing

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ABSTRACT

Five 5.56-mm, XM16E1 rifles were submitted to Development and Proof Services, Aberdeen Proving Ground, Maryland, for a comparison test. The test was conducted between 8 September and 13 November 1964. The rifles functioned satisfactorily and met all the requirements of SAPD-253A except for one rifle which had an excessive number of failures to feed in the reliability test. The same rifle also developed an oval-shaped bulge at the outer surface of the receiver, forward of the bolt-assist assembly, which was classified as a shortcoming.

DEVELOPMENT AND PROOF SERVICES
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FINAL REPORT OF COMPARISON TEST OF
RIFLE, 5.56-MM, XM16E1
8 SEPTEMBER TO 13 NOVEMBER 1964

SECTION 1. GENERAL

1.1 REFERENCES

1. Hendricks, G. E. "Comparison Test of Rifle, 5.56-mm, M16." USATECOM Project No. 8-4-0230-01-F. Aberdeen Proving Ground. Report No. DPS-1471, October 1964.
2. Springfield Armory Purchase Description SAPD-253A, Acceptance Testing Specification for Rifle, 5.56-mm: M16 and XM16E1, 5 August 1964.
3. TECP 700-700, Interim Pamphlet, Volume I, Arms and Ammunition Testing.
4. TM 9-1005-249-14 for Rifle, 5.56-mm, M16, and Rifle, 5.56-mm, XM16E1, 15 June 1964.

1.2 AUTHORITY

This test was authorized by first indorsement to USAWECOM letter, 28 July 1964 (Appendix I).

1.3 OBJECTIVE

This test was conducted to provide an evaluation of production XM16E1 rifles to assure that they conform to the technical requirements of Reference 2 and to detect any design, manufacturing, or inspection deficiencies that would adversely affect the operation of the rifles.

1.4 RESPONSIBILITIES

Development and Proof Services was responsible for testing and test reporting.

1.5 DESCRIPTION OF MATERIEL

A description of the XM16E1 rifle is contained in paragraph B of the test directive (Appendix I) and in paragraphs 1 through 7 of Reference 4. A photograph of the rifle is contained in Appendix VIII. ~~IX~~.

1.6 BACKGROUND

Production samples of M16 and XM16E1 rifles are subjected to comparison tests in accordance with a continuing program under the jurisdiction of the US Army Weapons Command to assure the quality of production items and to disclose any major design deficiencies.

1.7 FINDINGS

The test items, accessories and repair parts were well packed and were received in good condition.

Prior to the beginning of the test, all rifles were function-fired, as outlined in paragraph 10 of Reference 3, without the occurrence of malfunctions or unserviceability of parts.

The average trigger pull of the rifles ranged from 7.4 to 8.3 pounds; 5.5 to 8.5 pounds is specified as acceptable (Reference 2, paragraph 7.1).

The extreme spreads of the 10-round groups in the 100-yard machine rest accuracy test ranged from 2.8 to 4.4 inches; 4.8 inches is specified as acceptable (Reference 2).

The average 10-round group measurements obtained in the semiautomatic accuracy tests are given in Table I.

Table I. Average Semiautomatic Accuracy
Target Measurements

Condition	Range, meters	Group Center from Target Center, in.		Mean Radius, in.	Extreme Spread, in.
		Hor	Vert		
Benchrest	100	+1.1	+0.1	1.4	4.8
Benchrest with bayonet attached to rifle	100	+0.7	+0.4	1.2	4.2
Prone position from bipod	100	+1.1	-4.9	1.7	5.4
Prone position from bipod	300	-	-	4.3	15.4
Prone position from bipod	500	-	-	6.6	22.3

No adverse effects on accuracy and no significant shifts in the center of impact were experienced as a result of attaching the M7 bayonet to the rifle.

The average target measurements obtained in the automatic accuracy test are given in Table II. Firing was conducted in 3-round bursts from the prone position with the rifle mounted on an M3 bipod.

Table II. Average Automatic Accuracy
Target Measurements

Range, meters	Mean Radius, in.	Extreme Spread, in.
50	4.7	16.7
100	7.9	32.7
200	14.9	51.8

In the 6000-round reliability test, rifle 102033 had a total of six failures to feed with the cartridge visible; a maximum of four are permitted in Reference 2.

The average loss of velocity as a result of firing the reliability test was 81 fps.

During the 6000-round reliability test, a shortcoming resulted with rifle 102033 when an oval-shaped bulge developed at the outer surface of the receiver forward of the bolt-assist assembly (ref Appendix VI).

In the extreme cold test (-65°F) a failure of the bolt to go fully forward and lock occurred with each of the two rifles tested. No other malfunctions occurred.

In the rain test one failure to feed, two failures to eject, and three failures to fire occurred with the one rifle tested.

In the unlubricated test the bolt failed to strip the first round from the first magazine. No other malfunctions occurred.

No malfunctions occurred in the mud, dust, or high temperature and high humidity test.

In the repair parts interchange test, one rifle fired satisfactorily. The other rifle had an excessively low rate of fire (607 rounds per minute; 650 minimum is required in Reference 2) and during the 20-round burst phase of the function firing, the bolt failed to engage the base of the eleventh round in the magazine (ref par. 2.14).

During the tests, 12 attempts were made to use the bolt-assist assembly in clearing failures to feed. Eight of the malfunctions were cleared successfully with the bolt-assist assembly. On the remaining attempts, the malfunctions could not be cleared with the bolt-assist assembly and other means had to be employed. Further discussion of the bolt-assist assembly is contained in paragraph 2.15.

The bolt-assist assembly was not detrimental with regard to the safety, ease of carrying, handling, aiming, and firing the rifle.

During the tests all the failures to feed, failures to strip, and failures to lock occurred with the first round from a fully loaded magazine.

More efficient cleaning of the XM16E1 rifle could be accomplished if special brushes were provided for cleaning the chamber, the inside of the barrel extension forward of the locking lugs, and the inside of the bolt carrier.

1.8 CONCLUSIONS

It is concluded that:

- a. With the exception of one rifle which failed to meet performance specifications because of excessive failures to feed with the cartridge visible, all the rifles tested met the performance requirements outlined in Reference 2 (ref par. 1.7).
- b. In the adverse conditions testing (no performance requirements delineated in Reference 2) no significant design or operational deficiencies were encountered (ref pars. 2.7.3, 2.8.3, 2.9.3, 2.10.3, 2.11.3, and 2.12.3).
- c. Attachment of the M7 bayonet to the rifle did not change the center of impact of the groups fired or adversely affect the accuracy of the rifle (ref par. 2.4.4).
- d. The bolt-assist assembly provides a ready means of clearing failures to lock and failures to strip malfunctions, and was not detrimental in any way to the use and operation of the rifle during the test (ref par. 2.15).

1.9 RECOMMENDATION

It is recommended that adequate cleaning equipment as defined in paragraph 2.13.4 be designed and issued with the XM16E1 rifle.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

The XM16E1 rifles were tested in accordance with the test directive (Appendix I) except in some phases where minor changes were made in accordance with the request of Mr. Shanahan, representative of USAWECOM, who observed the testing.

The ammunition used in this test was cartridge, ball, caliber .223 (5.56-mm), lots RA-5027 and RA-5022.

Prior to the start of the test all magazines were numbered so the total number of malfunctions resulting with a given magazine could be recorded.

Lubricant, PL special lubricating oil, general purpose, preservative, MIL-L-644B, was used in all phases of testing except the extreme cold, rain, and unlubricated tests. Lubricant MIL-L-14107 was used in the extreme cold test and MIL-G-46003 (lubriplate) was used in the rain test.

The riflemen employed in this test each hold a current National Rifle Association Master classification in high-power rifle competition.

2.2 INITIAL INSPECTION

2.2.1 Objective

To determine the completeness and serviceability of the test items.

2.2.2 Method

The materiel received was examined for the following:

- a. Adequacy and clarity of marking.
- b. Damage in shipment.
- c. General condition.

A list was made of accessories and repair parts received.

The rifles were disassembled, inspected, weighed, and measured. Bore measurements were determined by the Physical Test Laboratory (Appendix III). The weights and measurements of the rifles and accessories are given in Table III.

The rifles were function fired as outlined in paragraph 10 of Reference 2.

Table III. Weights and Measurements

	Rifle Serial No.				
	101525	101537	101679	101876	102033
Weights, lb					
Rifle, without magazine or accessories	6.49	6.47	6.49	6.49	6.51
Empty magazine (average of five)	0.18	-	-	-	-
Loaded magazine (20 rounds)	0.68	-	-	-	-
Sling (average of five)	0.31	-	-	-	-
Bipod, M3 (average of five)	0.59	-	-	-	-
Recoiling parts ^a	0.84	0.84	0.85	0.84	0.85
Trigger pull, (average of five)	7.72	7.38	7.57	8.05	8.29
Bayonet, M7 (average of three)	0.67	-	-	-	-
Measurements, in.					
Over-all length	38.8	38.8	38.8	38.8	38.8
Barrel length (face of closed bolt to muzzle)	20.0	20.0	20.0	20.0	20.0
Sight radius	19.8	19.8	19.8	19.8	19.8
Line of sight above bore	2.5	2.5	2.5	2.5	2.5
Butt to trigger	12.8	12.9	12.8	12.9	12.8
Firing pin protrusion	0.033	0.032	0.032	0.033	0.032
Head space ^b	Satis	Satis	Satis	Satis	Satis

^aWeight of action spring guide assembly and spring not included.

^bThe head space gages were furnished by Mr. Shanahan, AWC. They were stamped T-34674 ORD MAX HEADSPACE and T-27738 MIN HEADSPACE.

2.2.3 Results

There was no damage to the packing and crating or the test items and accessories. The clarity of marking was good.

The accessories received with each rifle included a web sling, an M3 bipod and case, a cleaning rod, a cleaning brush, a plastic capsule of lubriplate, and seven magazines. Repair parts were well packed. Two each of the following repair parts were received: automatic sear, bolt cam, bolt assembly, bolt stop spring, disconnect, disconnect spring, ejector pin, ejector spring, extractor, extractor pin, extractor spring, firing pin, firing pin retaining pin, hammer, hammer spring, gas tube, selector, and trigger spring. Also, 15 bolt rings were received.

The bolts assembled in rifles 101525 and 101876 did not have an escape hole in the bottom of the ejector spring well.

The rifles were function fired without the occurrence of malfunctions or unserviceability of parts. The cyclic rate of fire for all rifles was within 650 to 850 rounds per minute as specified in Reference 2.

2.2.4 Analysis

Not applicable.

2.3 MACHINE REST ACCURACY TEST

2.3.1 Objective

To determine the semiautomatic accuracy of the XM16E1 rifles when fired from a machine rest.

2.3.2 Method

Each rifle was fired in an enclosed range from a universal accuracy cradle supported in a V-block mounted in a Frankford Arsenal machine rest. A 10-round group was fired from each rifle at a range of 100 yards.

2.3.3 Results

The results are given in Table IV.

Table IV. Machine Rest Accuracy

All measurements are given in inches. Figures are for one 10-round group.

<u>Rifle No.</u>	<u>MR</u>	<u>MHD</u>	<u>MVD</u>	<u>EHD</u>	<u>EVD</u>	<u>ES</u>
101525	0.9	0.7	0.3	3.2	1.8	3.2
101537	1.4	1.0	.8	3.0	2.8	3.4
101679	1.3	1.1	.6	3.7	2.8	4.4
101876	0.9	0.4	.7	2.2	2.5	2.8
102033	1.1	0.5	.9	1.7	3.5	3.5

2.3.4 Analysis

The extreme spread of the 10-round groups for the rifles was within accuracy requirements; 4.8 inches is specified as acceptable in Reference 2

2.4 BENCHREST ACCURACY TEST

2.4.1 Objective

To determine the semiautomatic accuracy of the XM16E1 rifle when fired from a benchrest and the accuracy and change in center of impact resulting from attachment of the M7 bayonet to the rifle.

2.4.2 Method

Three riflemen each fired three 10-round groups with each of three rifles at a range of 100 meters. The sights on each rifle were adjusted prior to the record firing by one rifleman and were not again adjusted until all semiautomatic 100-meter accuracy firing had been completed. The standard A target with a 12-inch bull's-eye was used for an aiming point.

2.4.3 Results

The results are given in Table V.

Table V. Benchrest Accuracy Data

All target measurements are given in inches and are an average of nine 10-round groups.

Rifle No.	Group Center		MR	Deviations				EHD	EVD	ES
	From Target Center			Horizontal		Vertical				
	Hor	Vert		Mean	Std	Mean	Std			
Without Bayonet										
101525	+2.5	-1.6	1.1	0.7	0.8	0.7	1.0	2.7	3.1	3.7
101537	+1.0	+1.4	1.5	1.0	1.3	0.8	1.1	4.6	3.6	5.2
101679	-0.1	+0.5	1.6	0.8	1.1	1.2	1.5	3.5	4.8	5.4
Average	+1.1	+0.1	1.4	0.8	1.1	0.9	1.2	3.6	3.8	4.8
With Bayonet Attached										
101525	+2.3	-1.1	1.2	0.8	1.0	0.8	1.0	3.2	3.1	3.9
101537	+0.2	+1.8	1.3	.9	1.2	.8	1.1	3.7	3.4	4.4
101679	-0.5	+0.6	1.2	.7	0.9	.8	1.2	2.7	3.8	4.2
Average	+0.7	+0.4	1.2	.8	1.0	.8	1.1	3.2	3.4	4.2

The change in center of impact resulting from the attachment of the bayonet is given in Table VI.

Table VI. Change in Center of Impact Resulting with Attachment of Bayonet

Rifle No.	Location of Center of Impact with Bayonet ^a		Distance between CI, in.
	Hor	Vert	
101525	-0.2	+0.5	0.5
101537	- .8	+ .4	.9
101679	- .4	+ .1	.4
Average	- .5	+ .3	.6

^aRelative to center of impact without bayonet, inch.

The changes in group location resulting with the attachment of the bayonet were not greater than variations among individual groups, demonstrating that the attachment of the bayonet has no significant effect upon group location.

2.4.4 Analysis

Three M16 rifles were subjected to a 100-meter benchrest accuracy test in June 1964, using the same lot of ammunition. The average mean radius and extreme spread obtained with the three rifles were 1.1 and 3.6 inches, respectively (paragraph 2.4.3 of Reference 1).

2.5 PRONE ACCURACY TEST

2.5.1 Objective

To determine the semiautomatic accuracy of the XM16E1 rifles when fired from the prone position at various ranges with the rifle mounted on the M3 bipod.

2.5.2 Method

Three riflemen each fired three 10-round groups from the prone position at ranges of 100, 300, and 500 meters with the

same three rifles formerly fired in the benchrest accuracy test. The rifles were fired in the 100-meter phase using the same sight settings used in the 100-meter benchrest accuracy test. Sighting rounds were fired and the sights were adjusted on each rifle by each rifleman prior to firing at ranges of 300 and 500 meters. The standard A target with a 12-inch bull's-eye was used for an aiming point at 100 and 200 meters and the standard B target with a 20-inch bull's-eye was used at 500 meters. All firing was conducted with the rifles mounted on M3 bipods.

2.5.3 Results

The results are given in Table VII.

Table VII. Prone Accuracy Data

All target measurements are given in inches, averages of nine 10-round groups.

Rifle No.	Group Center From Target Center		MR	Deviations				EHD	EVD	ES
	Hor	Vert		Hor		Vert				
				Mean	Std	Mean	Std			
Range: 100 Meters										
101525	+2.6	-5.6	1.7	1.1	1.3	1.1	1.4	4.1	4.2	5.5
101537	+1.1	-4.4	1.6	1.1	1.4	0.9	1.1	4.4	3.5	5.1
101679	-0.5	-4.0	1.8	1.0	1.4	1.2	1.5	4.2	4.7	5.6
Average	+1.1	-4.7	1.7	1.1	1.4	1.1	1.3	4.2	4.1	5.4
Range: 300 Meters										
101525	-2.2	+3.3	4.0	2.7	3.6	2.4	3.4	12.2	11.8	15.5
101537	+7.0	-0.1	4.4	2.8	3.6	2.8	3.8	11.5	13.2	15.6
101679	+3.4	-4.9	4.4	2.8	3.8	2.8	3.8	12.4	12.7	15.1
Average			4.3	2.8	3.7	2.7	3.7	12.0	12.6	15.4
Range: 500 Meters										
101525	-1.5	-3.1	5.6	3.4	4.4	3.8	5.0	13.3	16.2	19.5
101537	-4.7	-1.3	8.0	5.6	7.3	4.9	6.3	24.0	20.8	27.4
101679	-1.7	-9.8	6.3	4.1	5.1	4.1	5.3	16.0	17.1	20.1
Average			6.6	4.4	5.6	4.3	5.5	17.8	18.0	22.3

The dispersion when firing from the prone position with the rifle mounted on the bipod was slightly greater than when firing from the benchrest (ref par. 2.4.3). The change in center of impact resulting when firing was shifted from the benchrest to the prone position is shown in Table VIII.

Table VIII. Change in Center of Impact
Resulting with Shift from Benchrest
to Prone Position

Rifle No.	Location of Center of Impact with Bayonet ^a , in.		Distance between CI, in.
	Hor	Vert	
101525	+0.1	-4.0	4.0
101537	+0.1	-5.8	5.8
101679	-0.4	-4.5	4.5
Average	-0.1	-4.8	4.8

^aRelative to center of impact without bayonet.

2.5.4 Analysis

Comparison of data with those from prototype rifles fired at APG is not possible since no other semiautomatic accuracy tests have been conducted with the rifle mounted on a bipod.

The change in center of impact resulting with the shift from the benchrest to the prone position is similar to that resulting with other model rifles, such as the M1 and M14.

2.6 AUTOMATIC ACCURACY TEST

2.6.1 Objective

To determine the automatic accuracy of the XM16E1 rifle when fired from the prone position at various ranges with the rifle mounted on an M3 bipod.

2.6.2 Method

Ten 3-round bursts were fired from the prone position at ranges of 50, 100, and 200 meters by each of three riflemen with each of three rifles. All firing was conducted using the M3 bipod for rifle support.

A 6-inch bull's-eye was used for an aiming point at 50 meters and the standard A target with a 12-inch bull's-eye was used at 100 and 200 meters. The mean radius was determined by measuring from the center of impact of the 30-round group.

2.6.3 Results

Results are given in Table IX.

Table IX. Automatic Accuracy Data

All target measurements are given in inches, average of three 30-round groups.

Rifle No.	Group Center From Target Center		MR	Deviations				EHD	EVD	ES
	Hor	Vert		Hor		Vert				
				Mean	Std	Mean	Std			
Range: 50 Meters										
101525	-2.9	-1.6	4.0	3.2	3.7	2.0	2.8	11.9	13.6	16.6
101537	-3.8	0.0	4.9	3.9	4.5	2.5	3.1	14.7	12.1	16.9
101679	-3.3	+0.5	5.1	4.6	5.3	1.5	1.9	16.3	8.0	16.7
Average			4.7	3.9	4.5	2.0	2.6	14.3	11.2	16.7
Range: 100 Meters										
101525	-10.3	-2.1	7.8	6.6	8.2	2.9	3.8	32.3	16.0	33.3
101537	- 8.8	+3.1	8.1	6.3	7.4	4.1	4.8	25.5	17.1	27.7
101679	- 6.2	-1.4	7.9	5.8	7.1	4.1	5.6	27.2	25.0	37.2
Average			7.9	6.2	7.6	3.7	4.7	28.3	19.4	32.7
Range: 200 Meters										
101525	-19.2	-5.6	16.8	14.6	16.8	5.8	7.4	52.2	28.3	53.7
101537	-12.0	+3.4	12.7	8.2	9.8	8.7	10.5	33.6	39.4	47.1
101679	- 9.9	-9.1	15.2	12.1	14.3	7.7	9.3	48.6	33.3	54.5
Average			14.9	11.6	13.6	7.4	9.1	44.8	33.7	51.8

2.6.4 Analysis

Comparison of data with those from prototype rifles fired at APG is not possible since similar firings have not been previously conducted.

2.7 EXTREME COLD TEST

2.7.1 Objective

To determine the ability of the XM16E1 rifle to function after being subjected to extreme cold conditions.

2.7.2 Method

Two rifles and eight magazines were disassembled and lubricated. The rifles, loaded magazines, and extra ammunition were then subjected to a temperature of -65°F for a 12-hour period prior to firing. The test consisted of firing 40 rounds semiautomatically, 20 rounds in 3- to 5-round bursts, and 20 rounds in one burst. After an additional conditioning period of 2 hours, the firing schedule was repeated.

In accordance with the test directive, an M7 bayonet was attached to one rifle and an M3 bipod was attached to the other and both were subjected to the -65°F temperature. One rifle was fired from a spring-loaded rest and the other from the M3 bipod.

2.7.3 Results

Results are given in Table X.

Table X. Extreme Cold Test Data

<u>Conditioning Time, hr</u>	<u>No. Rds Fired</u>	<u>Function</u>	<u>Remarks</u>
			Rifle No. 101537
12	80	Satis	
2	80	1-FL	The bolt failed to go fully forward and lock. The bolt-assist assembly was used to close the bolt. The malfunction occurred with the first round from the first magazine.

Table X (Cont'd)

Conditioning Time, hr	No. Rds Fired	Function	Remarks
Rifle No. 101679			
12	80	Satis	
2	80	1-FL	The bolt failed to go fully forward and lock. The bolt-assist assembly was used to close the bolt. The malfunction occurred with the first round from the first magazine.

Satis = Satisfactory.

FL = Failure of bolt to go fully forward and lock.

Visual inspection of the bipod and bayonet after the test showed no significant wear or damage from use during the cold test.

2.7.4 Analysis

Both rifles were conditioned with bolts closed for the 12-hour period. Prior to firing, the bolts were retracted by hand to charge the rifle. No malfunctions occurred during firing. Both rifles were conditioned for 2 additional hours with the bolts locked in the open position and therefore were not hand-operated prior to firing. A failure of the bolt to go fully forward and lock with the first round from the first magazine occurred with both rifles. To lessen the chance of having failures to lock when at low temperatures, the bolt should be operated by hand prior to loading the rifle.

2.8 HIGH TEMPERATURE AND HIGH HUMIDITY TEST

2.8.1 Objective

To determine the ability of the XM16E1 rifle to function after being subjected to high temperature and high humidity.

2.8.2 Method

One rifle and eight magazines were disassembled, cleaned, and lubricated. The rifle and loaded magazines were then subjected to a temperature of +125°F and approximately 90% relative humidity for a 12-hour period prior to firing. The test consisted of firing 40 rounds semiautomatically, 20 rounds in 3- to 5-round bursts, and 20 rounds in one burst. After an additional conditioning period of 2 hours, the firing procedure was repeated. The rifle was fired from a spring-loaded rest.

2.8.3 Results

No malfunctions occurred.

2.8.4 Analysis

Not applicable.

2.9 DUST TEST

2.9.1 Objective

To determine the ability of the XM16E1 rifle to function after being subjected to adverse dust conditions.

2.9.2 Method

One rifle and one magazine were disassembled, cleaned, and lightly lubricated.

The fully loaded rifle with dust cover closed, muzzle taped, and selector set on the safe position was placed in the dust box and exposed to the dust for 1 minute top side up and for 1 minute upside down. The dust mixture was poured at a rate of 5 pounds per minute through the pour hole while the blower was turned at an approximate handle speed of 60 rpm. The dust mixture consisted of 9 pounds of Grade 0 Albany sand and 1 pound of clean silica core sand which passed 100% through a 30-mesh sieve. Before firing, the shooter removed the tape from the muzzle and attempted to clean the excess dust from the congested areas by wiping with his bare hands and shaking the rifle. The selector was set on the semiposition and the rifle was fired 20 rounds semiautomatically. The rifle was fired with

the buttstock resting on the ground and with the rifle held at an angle approximately 30° to the horizontal.

2.9.3 Results

No malfunctions occurred.

2.9.4 Analysis

Not applicable.

2.10 MUD TEST

2.10.1 Objective

To determine the ability of the XM16E1 rifle to function after being subjected to adverse mud conditions.

2.10.2 Method

One rifle and one magazine were disassembled, cleaned, and lubricated.

The fully loaded rifle with dust cover closed, muzzle taped, and selector set on the safe position was immersed completely in the mud for 15 seconds. The mud mixture was made in the proportion of 10 pounds of red clay and 2 pounds of clean river sand with 8 quarts of water. Before firing, the shooter removed the tape from the muzzle and attempted to clean the excess mud from the rifle by wiping with his bare hands and shaking the rifle. The selector was placed in the semi position and 20 rounds were fired semiautomatically. All firing was conducted with the butt of the rifle resting on the ground and with the rifle held at an angle approximately 30° to the horizontal.

2.10.3 Results

No malfunctions occurred.

2.10.4 Analysis

Not applicable.

2.11 RAIN TEST

2.11.1 Objective

To determine the ability of the XM16E1 rifle to function while being subjected to adverse conditions of rain.

2.11.2 Method

One rifle and ten magazines were disassembled and lubricated. The rifle and loaded magazines were then subjected to a spray of water by means of a special shower head positioned about 3 feet above the rifle. The spray of water fell at an average of 0.4 inch per minute or 24 ± 3 inches per hour. The average water and air temperature were 63 and 65°F, respectively. Firing was conducted with the rifle mounted in a spring-loaded rest. The following procedure was used:

- a. The rifle, in a horizontal position, and five loaded magazines were exposed to the spray 5 minutes with the bolt open and for 5 minutes with the bolt closed. A magazine was inserted and the rifle loaded when the bolt was closed. The rifle was then fired 100 rounds semiautomatically.
- b. The preceding procedure was repeated, except that 100 rounds were fired automatically in 20-round bursts.
- c. The procedure in paragraph a was repeated except the rifle was exposed to the spray with the muzzle down. The rifle was fired from a horizontal position. Before firing, the muzzle of the rifle was depressed and the bolt was partially retracted to permit water accumulating in the bore to run out.
- d. The procedure in paragraph c was repeated, except that the rifle was fired automatically in 20-round bursts.
- e. The procedure in paragraph c was repeated, except that the rifle was exposed to the spray with the muzzle up.
- f. The procedure in paragraph e was repeated, except that the rifle was fired automatically in 20-round bursts.

2.11.3 Results

Results are given in Table XI. A round-by-round record of the test is contained in Appendix II.

Table XI. Rain Test Data

Legend:

FF = Failure to feed. S = Semiautomatic.
FFR = Failure to fire. A = Automatic.
FJ = Failure to eject. Satis = Satisfactory.

<u>Exposure Position</u>	<u>Type of Fire</u>	<u>No. Rds Fired</u>	<u>Function</u>	<u>Remarks</u>
Horizontal	S	100	Satis	
Horizontal	A	100	1-FF	The nose of the first round from the magazine stubbed on the receiver below the right-hand bullet guide.
			3-FFR	The primers were lightly indented. The rounds were reloaded and fired.
			1-FJ	
Muzzle down	S	100	1-FJ	
Muzzle down	A	100	Satis	
Muzzle up	S	100	Satis	
Muzzle up	A	100	Satis	

2.11.4 Analysis

Not applicable.

2.12 UNLUBRICATED TEST

2.12.1 Objective

To determine the ability of the XM16E1 rifle to function in an unlubricated condition.

2.12.2 Method

One rifle was disassembled and cleaned with trichloromethane (quick-drying solvent). The rifle, in an unlubricated condition, was assembled and fired 60 rounds semiautomatically and 40 rounds in 3- to 5-round bursts.

2.12.3 Results

The bolt failed to strip the first round from the first magazine. The malfunction was cleared by striking the side of the stock assembly with the heel of the hand. No other malfunction occurred.

2.12.4 Analysis

Not applicable.

2.13 RELIABILITY TEST

2.13.1 Objective

To determine the reliability of the XM16E1 rifle through 6000 rounds of firing.

2.13.2 Method

Two rifles were each fired 6000 rounds for a reliability test. The firing schedule consisted of firing 100 rounds semiautomatically, a cooling period, and then firing 100 rounds in 20-round bursts or in 3- to 5-round bursts. Of the 6000 rounds fired, 2000 rounds were fired from the prone position with the rifle mounted on an M3 bipod and 1000 rounds were fired with the M7 bayonet attached to the rifle.

At the request of Mr. Shanahan, representative of USAWECOM, 100 rounds were fired under each of the following conditions:

- a. Semiautomatically with the rifle held loosely in the hands.
- b. Automatically with the rifle held loosely in the hands.

- c. Semiautomatically with the rifle held right side up.
- d. Automatically with the rifle held right side up.
- e. Semiautomatically with the rifle held left side up.
- f. Automatically with the rifle held left side up.
- g. Semiautomatically with the rifle held normally at an elevation of 80° .
- h. Automatically with the rifle held normally at an elevation of 80° .
- i. Semiautomatically with the rifle held loosely at an elevation of 80° .
- j. Automatically with the rifle held loosely at an elevation of 80° .
- k. Semiautomatically with the rifle held normally at a depression of minus 80° .
- l. Automatically with the rifle held normally at a depression of minus 80° .
- m. Semiautomatically with the rifle held loosely at a depression of minus 80° .
- n. Automatically with the rifle held loosely at a depression of minus 80° .

The rifles were disassembled, cleaned, inspected, and lubricated after each 1000 rounds. The cyclic rate of fire was determined at the beginning and end of each 1000-round phase. Semiautomatic firing was conducted at a rate of approximately 30 rounds per minute.

Fully loaded magazines were used at all times and the magazines were rotated so approximately the same number of rounds were fed from each. If a given magazine was being used when a certain type of malfunction occurred more than once, the magazine was removed from the test, tagged, and examined for defects.

Both rifles were star-gaged and borescoped before and after the reliability test. Measurements and inspection results are contained in Appendix III.

The velocity performance of each rifle was determined before and after the reliability test. Detailed results are contained in Appendix V.

To determine the effects of the 6000-round reliability test on the accuracy of the rifles, both rifles were subjected to a benchrest accuracy test before and after the reliability test. The results are contained in Appendix IV.

2.13.3 Results

A summary of the reliability test data is given in Table XII (page 24).

A detailed description of malfunctions, when applicable, and a chronological order of occurrence are contained in Appendix II.

Rifle No. 102033 had six failures to feed with the cartridge visible that were assessed as chargeable to rifle performance in the 6000-round reliability test. Acceptable specifications in Reference 2 state that a total of four will be permitted.

No broken or unserviceable parts resulted; however, after firing 2109 rounds with rifle No. 102033, visual inspection revealed an oval-shaped bulge at the outer surface of the right side of the receiver, forward of the bolt-assist assembly, and two surface cracks on the inside of the receiver opposite the bulge. The rifle was subjected to a Zyglo inspection and returned to test. A more complete description is contained in Appendix VI. In accordance with teletype AMSWE-QAV No. 9379 (Appendix I) the rifle was shipped to Springfield Armory for appropriate metallurgical tests.

Visual inspection of the M3 bipods and M7 bayonets after the test showed no significant wear or other damage from use during the reliability test.

Table XII. Reliability Test Data

Legend:

- FJ = Failure to eject.
- FF = Failure to feed.
- ppp = Bolt remained to rear in middle of burst.
- FS = Failure of bolt to strip first round from magazine.
- FBR = Failure of bolt to remain to rear after firing last round from magazine.
- FL = Failure of bolt to go fully forward and lock.
- IV = Instrumental Velocity

IV 20 Feet from Muzzle,		Cyclic Rate of Fire, rd/min	No. Rds Fired	Remarks
Reliability Test Before	After			
Average	3072	3012	6109	
Maximum	3135	3067		
Minimum	3017	2967		
Extreme variation	118	100		
Mean variation	22.7	22.2		
Rifle No. 101876				
	4-FJ			On three occasions, the nose of the first round from the magazine stubbed on the receiver below the right-hand bullet guide.
	3-FF	782		
	2-BRRA			On two occasions, while firing automatically, the bolt stop engaged the bolt and held it to the rear.
In firing 6000 rounds, one stretched case occurred.				
Rifle No. 102033				
Average	3096	2994	6108	
Maximum	3150	3053		
Minimum	3044	2920		
Extreme variation	106	133		
Mean variation	25.4	27.6		
	2-FF	748		On two occasions, the nose of the first round from the magazine stubbed on the receiver below the right-hand bullet guide.
	6-FSa			On six occasions, the bolt failed to strip the first round from the magazine.
	3-FBR			On three occasions, the bolt stop failed to hold the bolt to the rear after firing the last round.
	1-FL			On one occasion, the bolt failed to go fully forward and lock in feeding the first round from the magazine.
In firing 6000 rounds, 14 stretched cases occurred.				

In both instances, two malfunctions occurred with each rifle in firing rounds 6008 to 6109. Since these rounds are in excess of the 6000 rounds specified for the reliability test, these malfunctions should not be included in the total number of malfunctions occurring in the 6000-round reliability test.

2.13.4 Analysis

Rifle No. 102033 failed to meet the provisions of Reference 2 with respect to the number of failures to feed permitted with the cartridge visible.

All failures to feed, failures to strip, and failures to lock occurred with the first round from a fully loaded magazine (ref Appendix II).

More efficient cleaning of the rifles could be accomplished if special brushes were provided for cleaning the chamber, the inside of the barrel extension forward of the locking lugs, and the inside of the bolt carrier where carbon accumulation readily occurs.

2.14 REPAIR PARTS INTERCHANGE TEST

2.14.1 Objective

To determine if the repair parts supplied for the test could be interchanged with like parts from the weapon without causing adverse effects on rifle function.

2.14.2 Method

Two rifles were disassembled, cleaned, and lubricated. Repair parts furnished by the contractor were lubricated and interchanged with like parts from the weapons. The following parts were interchanged and assembled to each rifle:

- a. Bolt assembly (received completely assembled from the manufacturer).
- b. Bolt cam pin.
- c. Firing pin.
- d. Firing pin retaining pin.
- e. Automatic sear.
- f. Bolt catch spring.

- g. Disconnect.
- h. Disconnect spring.
- i. Gas tube.
- j. Hammer.
- k. Hammer spring.
- l. Selector lever.
- m. Trigger spring.

After the parts were interchanged an attempt was made to fire five rounds semiautomatically, 15 rounds in bursts of approximately five round each, and 20 rounds in one burst.

2.14.3 Results

Rifle No. 101537 functioned satisfactorily with a cyclic rate of fire on the 20-round burst of 744 rounds per minute.

Rifle No. 101679 was fired without malfunctions, five rounds semiautomatically and the 15 rounds in short bursts. In an attempt to fire a 20-round burst, the bolt failed to engage the base of the eleventh round in the magazine. The cyclic rate of the burst was not determined. A second 20-round burst was fired.

The cyclic rate was 607 rounds per minute, which is below the acceptance specifications stated in Reference 2.

The bolt assembly was disassembled from the bolt carrier and visually inspected. The inspection revealed that the tight fit of the bolt rings within the bolt carrier caused a binding of the bolt assembly within the bolt carrier.

Later, an additional 80 rounds were fired in four 20-round bursts using the repair bolt assembly. No malfunctions occurred and the cyclic rates of the bursts were 686, 685, 767, and 789 rounds per minute.

2.14.4 Analysis

Not applicable.

2.15 EVALUATION OF BOLT-ASSIST ASSEMBLY

2.15.1 Objective

To determine the effectiveness and handiness of the bolt-assist assembly in clearing malfunctions.

2.15.2 Method

Throughout all tests, instances in which the bolt-assist assembly was required and was used were recorded.

In an attempt to cause feeding malfunctions, which the bolt-assist assembly was designed to overcome, additional tests were conducted in accordance with paragraph F2b of the test plan (Appendix I). These tests were as follows:

- a. Additional Dust Test. An additional 80 rounds were fired under the conditions of the regular dust test (ref par. 2.9). The additional rounds were fired with the same rifle used in the regular dust test and were fired immediately upon completion of the regular test. An additional 100 rounds were also subjected to the dust and were fired in a clean and lubricated rifle.
- b. Special Cold Test. Rifle No. 101876 was subjected to the extreme cold test (-65°F) after completion of the 6000-round reliability test. The rifle was not cleaned or properly lubricated and since being cleaned had been fired 1073 rounds. Prior to the test, the magazines used were cleaned and properly lubricated. The rifle was conditioned for the 12-hour period prior to firing and for an additional 2-hour period with the bolt locked in the open position.

2.15.3 Results

The bolt-assist assembly was used satisfactorily in eight instances throughout all tests. It was used satisfactorily as follows:

- a. Three times in the reliability test (ref Appendix II).
- b. Two times in the extreme cold test (ref Table X, par. 2.7.3).

- c. Two times in the evaluation test of the bolt-assist assembly (ref par. 2.15.2).

In four other instances the bolt-assist assembly was actuated but failed to clear the malfunctions (ref Appendix II, Reliability Test and Rain Test)

In two instances in the additional dust test (paragraph 2.15.2a) the bolt failed to strip the first round from the magazine. Both malfunctions were cleared by striking the side of the stock assembly with the heel of the hand. The bolt-assist assembly was not required to clear these malfunctions. No other malfunctions occurred.

In the special cold test (paragraph 2.15.2b) two failures of the bolt to go fully forward and lock occurred with the first round from the first magazine after the conditioning periods. In both instances, the bolt-assist assembly was used and satisfactorily cleared the malfunctions.

2.15.4 Analysis

To evaluate the use of the bolt-assist assembly throughout the test, the failure-to-feed type of malfunctions were divided into three categories:

- a. Failure of the bolt to strip the round from the magazine (FS). With this feeding malfunction, the bolt engages the base of the round and moves it forward sufficiently to start the nose of the round into the barrel extension but not far enough to release the round from the lips of the magazine.
- b. Failure of the bolt to go fully forward and lock (FL). With this malfunction, the bolt strips the round from the magazine and usually travels forward to where the locking lugs start to engage the barrel extension lugs.
- c. Failure to feed due to stubbing of the nose of the round on the bullet guide ramp or the rear of the receiver (FF).

Of the three types of failures to feed, the FL was the only one on which the bolt-assist assembly was required in order to readily clear the malfunction. The FS may be cleared by either actuating the bolt-assist assembly, retracting and releasing the bolt, by striking the stock assembly with the heel

of the hand, or by applying forward or rearward pressure on the bottom of the magazine. The FF can sometimes be cleared with the bolt-assist assembly, but usually the bolt has to be retracted and released or the round must be reloaded into the magazine and the rifle recycled.

Throughout all tests, five FL occurred and in all instances were cleared satisfactorily with the bolt-assist assembly. A total of nine FS occurred, of which two were cleared with the bolt-assist assembly, six were cleared by merely striking the stock assembly with the heel of the hand and one was cleared by retracting and releasing the bolt. A total of six FF occurred. One of these was cleared by actuating the bolt-assist assembly and another was cleared by retracting and releasing the bolt. In the remaining four instances, the bolt-assist was actuated but failed to clear the malfunctions. Of these four instances, three were cleared by retracting and releasing the bolt and the other had to be cleared by reloading the round into the magazine and recycling the rifle.

The bolt-assist assembly was not detrimental to safety, ease of carrying, handling, aiming, and firing the rifle.

2.16 OBSERVERS

<u>Name</u>	<u>Representing</u>
Mr. C. Pelcharsky	US Army Weapons Command
Mr. C. Shanahan	US Army Weapons Command
Mr. W. Rzeszutek	Springfield Armory

SECTION 3. APPENDICES

APPENDIX I - TEST DIRECTIVE

AMSTE-BC (28 Jul 64) 1st Ind
SUBJECT: Quality Assurance Comparison Test of Rifle, 5.56mm, XM16E1

Headquarters, U. S. Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 21005 19 AUG 1964

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-DS,
Aberdeen Proving Ground, Maryland 21005

1. References:

- a. USATECOM TT 13319, 062000Z, Aug 1964.
- b. USAWECOM TT 3849, 111950Z, Aug 1964.

2. For necessary action. In accordance with ref 1b, Test No. 6 (Incl 1) is deleted and the following substituted therefor:

Test No. 6 - Suitability of Forward Bolt Assist Device.

a. Objective: To determine effectiveness and handiness of Forward Bolt Assist Device in reducing malfunctions.

b. Method:

(1) Throughout all tests record instances in which use of the Forward Bolt Assist Device is required and results achieved in reducing malfunctions.

(2) If deemed appropriate, set up malfunctions which the Forward Bolt Assist Device was designed to overcome and determine its effectiveness in reducing such malfunctions. Record results.

(3) Record reaction of test personnel to the Forward Bolt Assist Device on the rifle with respect to handiness, and to ease of carrying, aiming, firing and safety of the rifle.

3. This project is assigned USATECOM Project No. 8-4-0230-02F.

19 AUG 1964

AMSTE-BC (28 Jul 64)

SUBJECT: Quality Assurance Comparison Test of Rifle, 5.56mm, XM16E1

4. Request that this headquarters be informed as soon as possible as to when testing can be initiated in order that the USA Weapons Command can be notified. Telephone call (ext. 48208) will be satisfactory.

FOR THE COMMANDER:

James J. Smith
EARL R. EICHENBERGER
Major, AGC
Asst. Admin. Officer

3 Incls

1 & 2 - nc (wd cy incl 1)

Added 1 incl

3. TEAMS

Copies furnished: (w/o incls)

CG USAWECOM, ATTN: AMSWE-QA (Mr Shanahan)

AMCPM-AR15 (Lt Col Yount)

CO Springfield Armory, ATTN: SWESP-RE (Mr Hassett)

CDC Lno (USATECOM)

USMC Lno (USATECOM)

HEADQUARTERS
U. S. ARMY WEAPONS COMMAND

ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS

IN REPLY REFER TO
AMSWE - QA

61202

28 July 1964

SUBJECT: Quality Assurance Comparison Test of Rifle, 5.56mm, XM16E1

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

1. Category II test services, as defined in USATECOM Regulation No. 705-11, are requested at the earliest practicable time for a QA Comparison Test of the Rifle, 5.56mm, XM16E1 in accordance with the inclosed plan of test.
2. Five (5) XM16E1 Rifles, with Basic Issue Items and supporting repair parts, from Colt's Patent Fire Arms Co., Contract DA-11-199-AMC-508(Y) have been received by D&PS for requested test. Part of the ammunition to support this test is on hand at D&PS and the balance is on the way.
3. Funds are provided to D&PS for conduct of this test under PRON NR. 45-4-76316-(01)-45-K2 (copy of funding document attached).
4. Technical coordination will be effected directly with D&PS, APG.
5. It is requested that reports of equipment failure be submitted to this Command, ATTN: AMSWE-QA, and to the Project Manager, ATTN: AMCPM-AR-15, with distribution being limited to that stated in paragraph 5c, USATECOM Regulation 705-4. Ten (10) copies of the final report of test are required by this Headquarters, ATTN: AMSWE-QA. Disposition instructions for test materiel will be provided upon completion of tests.
6. Representative(s) of this Command will observe tests. It is, therefore, requested that information as to starting date be furnished as soon as possible.

FOR THE COMMANDER:

2 Incl

1. Plan of test (dupe)
2. Cy of Funding Document

B. C. Gerke
B. C. GERKE

Chief, Quality Assurance Office

Copy furnished:

- CO, Aberdeen Proving Ground
ATTN: STEAP-DS-TI, Mr. Doinney (w/incl 1)
CO, Springfield Armory
ATTN: SWESP-P, Mr. Hassett (w/incl 1)

C O P Y/tsp

HEADQUARTERS
U.S. ARMY WEAPONS COMMAND
Comparison Test Plan, Rifle, 5.56mm, XM16E1

21 July 1964

I. GENERAL

A. Objective. The objective of this Comparison Test is to provide a basis for an impartial and objective evaluation of the Rifle, 5.56mm, XM16E1, to assure that:

1. It conforms to the technical requirements of SAPD 253 as revised and in effect at the time of test.

2. It is at a level of quality which, by comparison, is equal to or better than the prototype accepted by the user.

B. Description. The Rifle, 5.56mm, XM16E1 is a light weight, air cooled, gas operated, magazine fed, shoulder weapon capable of semi-automatic or full automatic fire at a cyclic rate of approximately 750 rounds per minute. It may also be fired from a bipod. The XM16E1 Rifle has a forward assist assembly, which when actuated, forces the bolt forward to the locked position. Otherwise it has the same components and parts as the M16 Rifle.

C. References.

1. TECP 700-700 (Ordnance Proof Manual) Volume I - Arms & Ammunition Testing.

2. Springfield Armory Purchase Description SAPD 253 - Acceptance Testing Specification for Rifle, AR-15 (Rifle, 5.56mm, M16), as amended.

3. TM 9-1005-249-14, Operation, Maintenance, Repair and Replacement Parts, Rifle, 5.56mm, M16 and Rifle, 5.56mm, XM16E1.

4. Specification MIL-W-13855 - General Specification for Small Arms Weapons.

D. Reports.

1. When a serious deficiency or defect is revealed during testing, Hqs, U.S. Army Weapons Command, ATTN: AMSWE-QA and AMCPM-AR-15 will be notified by electrical means. This notification will be followed immediately by a serially numbered written record describing the deficiency and circumstances in detail.

C O P Y/tsp

2. At the conclusion of tests, a formal written report will be forwarded to Hqs, U.S. Army Weapons Command, ATTN: AMSWE-QA, in 10 copies. No further distribution is authorized. Request preparation of final report in D&PS report format.

E. General Test Instructions.

1. Five XM16E1 Rifles will be provided for tests. A complete record of test findings, by rifle serial number, substantiated by physical data, photos and written description as applicable will be maintained.

2. Data requested in the test plan is a minimum requirement. Additional test data, as deemed appropriate by the test agency, may be provided.

3. Determine cause-and-effect relationships for malfunctions and failures, when possible.

4. Procedures outlined in TM 9-1005-249-14 will be followed for disassembly, assembly, inspection, cleaning, lubrication and adjustment of weapons. Any recommended changes to the manual should be included in the final report.

5. Lubricate rifles as prescribed in TM 9-1005-249-14 using following lubricants for stated conditions.

- a. MIL-L-644B - General Purpose Lubricating Oil (Normal Conditions).
- b. MIL-L-14107 - Weapons Lubricating Oil, Low Temperature Type (Extreme Cold Conditions).
- c. Rifle Grease - Lubriplate (as required).

6. Throughout all tests identify and record magazine, ammunition and weapon malfunctions separately, when these can be determined.

7. Throughout all tests observe and record the effectiveness and suitability of the Bolt Assist Device.

II. DESCRIPTION OF TESTS

A. Test Nr. 1 - Initial Inspection.

1. Objective: To determine completeness and serviceability of test items.

2. Method:

a. Examine materiel as received for:

(1) Adequacy and clarity of marking.

(2) Damage in shipment.

(3) General Condition - Visually examine all test items and accessories for general quality, cleanliness and completeness as well as legibility of markings.

b. Manually check the functioning of operating parts.

c. Weight and measure test item and record tabulated data.

d. Function fire all rifles as outlined in paragraph 10, SAPD-253. Record results.

B. Test Nr. 2 - Targeting and accuracy.

1. Objective: To determine the targeting and accuracy capabilities of the test items at various ranges.

2. Method:

a. Semi-Automatic fire:

(1) From Machine Rest (using ammunition with a Mean Radii within 1.1-1.3 inches at 200 yards).

(a) Fire a group of ten (10) rounds each from all rifles at a range of 100 yards.

(b) Check sight setting for hold and adjust as necessary after each shot.

(c) Record results and compute extreme spread (ES) of each shot group.

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(2) From Bench Rest, by three expert riflemen with each of three (3) rifles:

(a) Fire three (3) groups of ten (10) rounds each at a range of 100 meters.

(b) Record results and compute center of impact (CI), extreme spread (ES) and mean radius (MR) of each shot group and average for each rifle.

(3) From M3 Bipod, prone position, by three expert riflemen with each of three (3) rifles and bipod:

(a) Fire three (3) groups of ten (10) rounds each at ranges of 100, 300, and 500 meters.

(b) Record results and compute CI, ES and MR of each shot group and average for each rifle.

(4) From Bench Rest, with M7 Bayonet attached, by three expert riflemen on each of three (3) rifles:

(a) Fire three (3) groups of ten (10) rounds each at a range of 100 meters.

(b) Record results and determine CI, ES and MR of each shot group and average for each rifle. Compare results with those obtained in firing at 100 meters without the Bayonet attached (2a(2)(a) above) and determine changes in CI, ES and MR caused by attachment of bayonet.

b. Automatic fire:

(1) From Bipod, prone position, by three expert riflemen, with each of three (3) rifles and bipod:

(a) Fire ten (10) 2-3 round bursts at 50, 100 and 200 meters.

(b) Record results and compute CI, ES and MR for each shot group and average for each rifle.

C. Test Nr. 3 - Adverse Conditions.

1. Objective: To determine ability of test items to function under various adverse conditions.

C O P Y/tsp

2. Method:

a. Conduct extreme cold test (-65°F) as outlined in TECP 700-700 with two rifles. Attach M3 Bipod to one rifle and M7 Bayonet to other rifle.

b. Conduct extreme hot test (125°F and 90% relative humidity) outlined in TECP 700-700 with one rifle.

c. Conduct dust test outlined in TECP 700-700 with one rifle.

d. Conduct mud test outlined in TECP 700-700 with one rifle.

e. Conduct rain test outlined in TECP 700-700 with one rifle. Conduct "muzzle up" portion of this test last.

f. Conduct unlubricated test outlined in TECP 700-700 with one rifle.

g. Record results of above tests.

D. Test Nr. 4 - Reliability.

1. Objective: To determine the reliability of the test item through 6,000 rounds of firing.

2. Method:

a. Two test items that have completed accuracy firing will be subjected to the Reliability Test specified in SAPD-253 and TECP 700-700, as modified below.

b. Rounds fired in prior tests will be counted as part of the 6,000 round total for the reliability firing.

c. Fire 2,000 rounds of this test with the rifles mounted on an M3 Bipod and attach an M7 Bayonet to the rifles for 1,000 rounds of firing.

d. Record results.

E. Test Nr. 5 - Repair Parts Interchange.

1. Objective: To determine if selected repair parts can be used without adverse effect upon rifle functioning.

2. Method:

a. Perform test upon completion of all firing tests, except that specified as part of the interchange test.

b. Using two (2) clean and lubricated rifles, interchange repair parts furnished for test with like parts of selected rifles.

c. After interchange of parts, function fire rifles in accordance with paragraph 10, SAPD-253.

d. Record results.

F. Test Nr. 6 - Suitability of Forward Bolt Assist Assembly.

1. Objective: To determine need for and suitability of Forward Bolt Assist Assembly.

2. Method:

a. Throughout all tests closely observe for conditions requiring use of the Forward Bolt Assist Assembly, the effectiveness of this device for its intended use, and reaction of test personnel to its position on the rifle with respect to ease of aiming, firing and carrying, as well as safety.

b. If deemed appropriate, set up malfunctions which device was designed to overcome and determine effectiveness in reducing malfunction.

c. Record results.

d. Based on analysis of all tests related to the Forward Bolt Assist Device, make recommendation as to need and/or suitability of this feature.

C O P Y/tsp

NNNNVV EUA542MED420

RR RUEPAP

DE RUCMRK 9379A 08/13459

4 072115Z

FM CGUSAWECOM ROCK ISLAND ILL

TO RUEPAP/CGAPG ABERDEEN MD

RUEPSM/CO SPRINGFIELD ARMORY SPRINGFIELD MASS

INFO RUEPBM/CO BSN PROC DIST USARMY BSN

BT

UNCLAS TT 9379 FOR STEAP-DS-TI DOILNEY AND SWESP-CPM
HASSETT; INFO SWESP-QA ROWLEY AND AMXBO-NH KELLER; FROM AMSWE-QAV
HENNAN

SUBJ: SHIPMENT OF QA COMPARISON TEST RIFLE, 5.56MM, XM16H1

SERIAL NR 102033

THIS MESSAGE IS IN TWO PARTS.

PART I IS FOR ABERDEEN PROVING GROUND.

1. CONFIRMING A TELEPHONE CONVERSATION BETWEEN MESSRS.
KEELE, ABERDEEN PROVING GROUND, AND MR, SHANAHAN, THIS COMMAND,
2 OCTOBER 1964.

2. REQUEST THAT ON COMPLETION OF QA COMPARISON TEST,
SUBJECT RIFLE, SN102033, WITH EQUIPMENT REPORT, BE SHIPPED TO:

C O P Y/tsp

PAGE 2 RUCMRK 9379A UNCLAS

COMMANDING OFFICER

SPRINGFIELD ARMORY

ATTN: SWESP-CPM

SPRINGFIELD, MASSACHUSETTS

M/F MR. R. J. HASSETT

PART II IS FOR SPRINGFIELD ARMORY.

1. REQUEST THAT ON RECEIPT OF THE RIFLE AND THE EQUIPMENT REPORT, APPROPRIATE METALLURGICAL EXAMINATION AND TESTS BE PERFORMED, JOINTLY WITH COLT'S, TO DETERMINE CAUSE AND IMPORTANCE OF CRACKS OCCURRING JUST FORWARD OF THE BOLT CLOSURE DEVICE WELL IN THE UPPER RECEIVER.

2. THESE CRACKS WERE FIRST NOTICED IN THE EARLY STAGES OF THE 6,000 ROUND RELIABILITY TEST. WEAPON WAS FIRED THROUGH THE 6,000 ROUNDS.

3. A REPORT ON THE ANALYSIS OF CAUSE, AND RECOMMENDATION OF CORRECTIVE ACTION TO PREVENT RECURRENCE SHOULD BE FURNISHED THIS HEADQUARTERS, ATTN: AMSWE-QA

BT

APPENDIX II - FUNCTION REPORTS

LEGEND

- A - Automatic.
- S - Semiautomatic
- SB - Fired in 3- to 5-round bursts.
- SS - Single shot.
- BRR - Bolt remained to the rear in the middle of a burst.
- FBR - Failure of bolt to remain to the rear after firing the last round from the magazine.
- FS - Failure of bolt to strip the first round from the magazine.
- FF - Failure to feed due to stubbing of the nose of the round on the receiver or the front of the magazine.
- FL - Failure of bolt to go fully forward and lock.
- BOB - Bolt overrode the base of the round.
- FFR - Failure to fire.
- FJ - Failure to eject.

Note:

Function was satisfactory except when noted otherwise.

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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Rifle, 5.56-mm, XM16E1, No. 101525.

Cartridge, ball, 5.56-mm, lots RA-5027 and RA-5022 (lot RA-5027 was fired in the function and accuracy tests and lot RA-5022 in the remainder of the tests).

Function Test

Date Fired: 9 September 1964.

5	5	S
15	20	SB
20	40	A

Cyclic rate: 794 rounds per minute.

Machine Rest Accuracy

Range: 100 yards.

13	53	SS
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Benchrest and Prone Accuracy

Range: 100 meters.

Dates Fired: 10 through 14 September 1964.

288	341	S
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Automatic Accuracy

Range: 50, 100, and 200 meters.

Dates Fired: 14 through 21 September 1964.

88	429	S and A
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Date Fired: 15 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle.

278	707	S and A
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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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Prone Accuracy

Range: 300 and 500 meters.

Dates Fired: 18 through 28 September 1964.

264	971
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Unlubricated Test

The rifle was disassembled, cleaned, inspected, and assembled in an unlubricated condition.

Date Fired: 29 September 1964.

60	1031	S	1-FS	The bolt failed to strip the first round from magazine 34. The malfunction was cleared by striking the side of the stock assembly with the heel of the hand.
40	1071	SB		

Rain Test

The rifle was disassembled, cleaned, inspected, and lubricated with MIL-G-46003 (MR) grease (lubriplate) and reassembled.

Date Fired: 2 October 1964.

Horizontal Position

100	1171	S		The nose of the first round from magazine 26 stubbed on the receiver below the right-hand bullet guide. The bolt-assist assembly would not clear the malfunction. The bolt was retracted and released, clearing the malfunction.
100	1271	A	1-FF 1-FJ	
			3-FFR	

Muzzle-Down Position

100	1371	S	1-FJ
100	1471	A	

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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
			Muzzle-Up Position	
100	1571	S		
100	1671	A		

High Temperature - High Humidity Test

The rifle was disassembled, cleaned, inspected, lubricated with MIL-L-644B lubricant and reassembled.

Date Fired: 9 October 1964.

The rifle was conditioned with the bolt in the closed position.

40	1711	S		
20	1731	SB		
20	1751	A		

The rifle was reconditioned with the bolt in the closed position.

40	1791	S		
20	1811	SB		
20	1831	A		Two primer punch outs.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.

Rifle, 5.56-mm, XM16E1, No. 101537.

Cartridge, ball, 5.56-mm, lots RA-5027 and RA-5022 (lot RA-5027 was fired in the function and accuracy tests and lot RA-5022 in the remainder of the tests).

Function Test

Date Fired: 9 September 1964.

5	5	S		
15	20	SB		
20	40	A		Cyclic rate: 764 rounds per minute.

Machine Rest Accuracy

Range: 100 yards.

13	53	SS		
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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
Bench Rest and Prone Accuracy				
Range: 100 meters.				
Dates Fired: 10 through 14 September 1964.				
289	342	S		Two circumferentially stretched cases.

Automatic Accuracy

Range: 50, 100, and 200 meters.

Dates Fired: 14 through 21 September 1964.

68	410	S and A		One circumferentially stretched case which occurred while firing automatically.
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Date Fired: 15 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle.

242	652	S and A		
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Prone Accuracy

Range: 300 and 500 meters.

Dates Fired: 18 through 28 September 1964.

147	799	S		
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Date Fired: 28 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle.

79	878	S		
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Dust Test

The rifle was disassembled, cleaned, inspected, and lightly lubricated.

Date Fired: 2 October 1964.

20	898	S		
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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
Additional Dust Test				
80	978	S	2-FS	The bolt failed to strip the first round from magazines 2 and 16. Both malfunctions were cleared by striking the side of the stock assembly with the heel of the hand.

Extreme Cold Test

Date: 5 October 1964.

The rifle was disassembled, cleaned, inspected, and lightly lubricated with MIL-L-14107 lubricant. An M7 bayonet was attached to the rifle.

Date Fired: 6 October 1964.

The rifle was conditioned with the bolt in the closed position.

40	1018	S
20	1038	SB
20	1058	A

The rifle was reconditioned with the bolt locked in the open position.

40	1098	S	1-FL	The bolt failed to go fully forward and lock. The bolt-assist assembly was used to close the bolt. The malfunction occurred with the first round from the first magazine.
20	1118	SB		
20	1138	A		

The rifle was disassembled, cleaned, and inspected.

Repair Parts Interchange Test

Date Fired: 7 October 1964.

All parts were lubricated before assembly.

5	1143	S	
15	1158	SB	
20	1178	A	Cyclic rate: 744 rounds per minute.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled,

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
Rifle, 5.56-mm, XM16E1, No. 101679.				

Cartridge, ball, 5.56-mm, lots RA-5027 and RA-5022 (lot RA-5027 was fired in the function and accuracy tests and lot RA-5022 in the remainder of the tests).

Function Test

Date Fired: 9 September 1964.

5	5	S
15	20	SB
20	40	A

Cyclic rate: 801 rounds per minute.

Machine Rest Accuracy

Range: 100 yards.

13	53	SS
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Benchrest and Prone Accuracy

Range: 100 meters.

Dates Fired: 10 through 14 September 1964.

289	342	S
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Automatic Accuracy

Range: 50, 100, and 200 meters.

Dates Fired: 14 through 21 September 1964.

68	410	S and A
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Date: 15 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle.

255	665	S and A
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Prone Accuracy

Range: 300 and 500 meters.

Dates Fired: 18 through 28 September 1964.

142	807	S
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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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Date: 28 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle.

89	896	S		
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Mud Test

The rifle was disassembled, cleaned, inspected, and lubricated.

Date Fired: 1 October 1964.

20	916	S		
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Additional Dust Test

The rifle was disassembled, cleaned, inspected, and lightly lubricated.

Date Fired: 2 October 1964.

80	996	S		
20	1016	SB		

Extreme Cold Test

Date: 5 October 1964.

The rifle was disassembled, cleaned, inspected, and lightly lubricated. An M3 bipod was attached to the rifle.

Date Fired: 6 October 1964.

The rifle was conditioned with the bolt in the closed position.

40	1056	S		
20	1076	SB		
20	1096	A		

The rifle was reconditioned with the bolt locked in the open position.

40	1136	S	1-FL	The bolt failed to go fully forward and lock. The bolt-assist assembly was used to close the bolt. The malfunction occurred with the first round from the first magazine.
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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
20	1156	SB		
20	1176	A		

The rifle was disassembled, cleaned, and inspected.

Spare Parts Interchange Test

Date Fired: 7 October 1964.

All parts were lubricated with MIL-L-644B lubricant before assembly.

5	1181	S		
15	1196	SB		
10	1206	A	1-BOB	The bolt failed to engage the base of the eleventh round in magazine 32.
20	1226	A		Magazine 31 was used. Cyclic rate: 607 rounds per minute.

The bolt assembly was disassembled from the bolt carrier and inspected. The repair bolt assembly rings fit very tight within the bolt carrier prohibiting free movement of the bolt.

Date Fired: 25 October 1964.

4	1230	A		
20	1250	A		Cyclic rate: 686 rounds per minute.
20	1270	A		Cyclic rate: 685 rounds per minute.

The repair bolt assembly was disassembled from the bolt carrier and the original bolt assembly assembled.

4	1274	A		
20	1294	A		Cyclic rate: 731 rounds per minute.
20	1314	A		Cyclic rate: 765 rounds per minute.

The original bolt assembly was disassembled from the bolt carrier and the repair bolt assembled.

20	1334	A		Cyclic rate: 767 rounds per minute.
20	1354	A		Cyclic rate: 789 rounds per minute.

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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The rifle was disassembled, cleaned, inspected, and lubricated. Inspection revealed an indentation approximately 1/2 inch in diameter in the right-hand hand-guard. The cause or time of occurrence of the indentation could not be determined.

Rifle, 5.56-mm, XM16E1, No. 101876.

Cartridge, ball, 5.56-mm, lots RA-5027 and RA-5022 (lot RA-5027 was used unless otherwise stated).

Date Fired: 9 September 1964.

Function Test

5	5	S
15	20	SB
20	40	A

Cyclic rate: 809 rounds per minute.

Machine Rest Accuracy

Range: 100 yards.

13	53	SS
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Benchrest Accuracy

Range: 100 meters.

Date Fired: 16 September 1964.

35	88	S
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Velocity Measurements

Date Fired: 17 September 1964.

20	108	S
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Reliability Test

Date Fired: 18 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle.

The rifle was fired from the shoulder with the muzzle elevated to an angle of approximately 80 degrees from the horizontal.

100	208	S
100	308	A

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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The rifle was held loosely and fired with the muzzle elevated to an angle of approximately 80 degrees from the horizontal.

100	408	S		
100	508	A		

Date Fired: 21 September 1964.

The rifle was held loosely in the hands and fired.

100	608	S		
100	708	A		

The rifle was held right side up and fired from the shoulder.

100	808	S		
100	908	A		

The rifle was fired from a benchrest.

100	1008	S		
100	1108	A		

Cyclic rate of rounds 1008 to 1028: 825 rounds per minute.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.

100	1208	S		
100	1308	A		

Cyclic rate of rounds 1208 to 1228: 863 rounds per minute.

Date Fired: 22 September 1964.

The rifle was held left side up and fired from the shoulder.

100	1408	S		
100	1508	A		

The rifle was fired from a benchrest.

100	1608	S		
100	1708	A		
100	1808	S		
100	1908	A		
100	2008	S		

Date Fired: 23 September 1964.

100	2108	A		
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Cyclic rate of rounds 2008 to 2028: 773 rounds per minute.

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
The rifle was disassembled, cleaned, inspected, lubricated, and reassembled. The locking surface on one locking lug was chipped approximately 1/16 inch on the chamfered corner.				
The extractor spring was deformed.				

An M7 bayonet was attached to the rifle. The bayonet fit loosely.

100	2208	S		
100	2308	A		Cyclic rate of rounds 2208 to 2228: 776 rounds per minute.

Date Fired: 24 September 1964.

100	2408	S		
100	2508	A		
100	2608	S		
100	2708	A	1-FF	The nose of the first round from magazine 17 stubbed on the receiver below the right-hand bullet guide. The bolt was retracted and released, clearing the malfunction.
100	2808	S		
100	2908	A		Two circumferentially stretched cases.
100	3008	S		
100	3108	A		One circumferentially stretched case. Cyclic rate of rounds 3008 to 3028: 781 rounds per minute.

Date Fired: 25 September 1964.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled. The bayonet was removed and inspected.

100	3208	S		
100	3308	A		Cyclic rate of rounds 3208 to 3228: 791 rounds per minute.

The rifle was held loosely and fired with the muzzle depressed at an angle of approximately -80 degrees from the horizontal.

100	3408	S		
100	3508	A		

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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The rifle was held loosely and fired with the muzzle depressed at an angle of approximately -80 degrees from the horizontal.

100	3608	S		
100	3708	A		

The rifle was fired from the prone position with the rifle mounted on an M3 bipod.

100	3808	S		
100	3908	A		

Date Fired: 28 September 1964.

100	4008	S		
100	4108	A		

Two circumferentially stretched cases.

Cyclic rate of rounds 4008 to 4028:
765 rounds per minute.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.

100	4208	S		
100	4308	A		
100	4408	S		
100	4508	SB		
100	4608	S		

Two circumferentially stretched cases.

Cyclic rate of rounds 4208 to 4228:
775 rounds per minute.

Date Fired: 29 September 1964.

100	4708	SB	1-FF	
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The nose of the first round from magazine 18 stubbed on the receiver below the right-hand bullet guide. The bolt-assist device would not clear the malfunction. The bolt was retracted and released, clearing the malfunction.

100	4808	S		
100	4908	SB		
100	5008	S		
100	5108	A		

Cyclic rate of rounds 5008 to 5028:
744 rounds per minute.

Date: 30 September 1964.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
100	5208	S		
100	5308	A		Cyclic rate of rounds 5208 to 5228: 737 rounds per minute.
100	5408	S		One circumferentially stretched case.
100	5508	SB		One circumferentially stretched case.
100	5608	S		
100	5708	SB		Five circumferentially stretched cases.
100	5808	S	1-FJ	
100	5908	SB	3-FJ 1-FF	The ejector was lubricated. The nose of the first round from magazine 17 stubbed on the receiver below the right-hand bullet guide. Neither the bolt- assist device nor retracting and releasing the bolt would clear the malfunction. The magazine was removed and the round re- loaded into the magazine.

Lot RA-5022 was fired in the remainder of the reliability test.

100	6008	S		
100	6108	A	2-BRR	Two times during a 20-round burst with magazine 18 the bolt stop engaged the bolt, locking it to the rear. Inspection revealed no apparent cause for the mal- function. An unsuccessful attempt was manually made to recreate the malfunctions. An additional 20- round burst was fired with maga- zine 18 in an unsuccessful attempt to determine the cause of the mal- function. Cyclic rate of rounds 6008 to 6028: 743 rounds per minute.
20	6128	A		Fired with magazine 18.

Date Fired: 1 October 1964

Benchrest Accuracy

33	6161	S		
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Velocity Measurements

20	6181	S		
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<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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Date : 5 October 1964.

The ejector and spring were disassembled from the bolt and inspected. The bolt stop and spring were disassembled and inspected. Inspection revealed no apparent causes for the malfunctions which occurred in the latter phases of the reliability test.

Special Cold Test

Date Fired: 6 October 1964.

The rifle was conditioned with the bolt in the open position.

40	6221	S	1-FL	The bolt failed to go fully forward and lock with the first round from the first magazine. A small part of cartridge was still visible. The bolt-assist assembly was actuated once and the bolt closed and locked.
20	6241	SB		
20	6261	A		

The rifle was reconditioned with the bolt in the open position.

40	6301	S	1-FL	The bolt failed to go fully forward and lock. The bolt-assist assembly was used to close the bolt. The malfunction occurred with the first round from the first magazine.
20	6321	SB		
20	6341	A		

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled. The locking surface of one locking lug was deformed slightly on the right-hand corner.

Rifle, 5.56-mm, XM16E1, No. 102033.

Cartridge, ball, 5.56-mm, lots RA-5027 and RA-5022 (lot RA-5027 was used unless otherwise stated).

Date Fired: 9 September 1964.

Function Test

5	5	S		
15	20	SB		
20	40	A		

Cyclic rate: 720 rounds per minute.

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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Machine Rest Accuracy

13	53	SS		
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Benchrest Accuracy

Date Fired: 16 September 1964.

36	89	S		
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Velocity Measurements

Date Fired: 17 September 1964.

20	109	S		
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Reliability Test

Date Fired: 18 September 1964.

The bolt carrier was removed from the rifle and the bolt disassembled from the carrier. Both the carrier and bolt were wiped clean, lubricated, and reassembled to the rifle. MIL-L-644B lubricant was used in all phases of the reliability test.

The rifle was fired from the shoulder with the muzzle elevated to an angle of approximately 80 degrees from the horizontal.

100	209	S		
100	309	A		

The rifle was held loosely and fired with the muzzle elevated to an angle of approximately 80 degrees from the horizontal.

100	409	S		
100	509	A		

Date Fired: 21 September 1964.

The rifle was held loosely in the hands and fired.

100	609	S		
100	709	A		

The rifle was held right side down and fired from the shoulder.

100	809	S		
100	909	A		

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
The rifle was fired from a benchrest.				
100	1009	S		
100	1109	A		Cyclic rate of rounds 1009 to 1029: 776 rounds per minute.
The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.				
100	1209	S		
100	1309	A		Cyclic rate of rounds 1109 to 1129: 773 rounds per minute.
Date Fired: 22 September 1964.				
The rifle was held left side up and fired from the shoulder.				
100	1409	S		
100	1509	A		
The rifle was fired from a benchrest.				
100	1609	S		
100	1709	A		
100	1809	S	1-FS	The bolt failed to strip the first round from magazine 4. The malfunction was cleared by actuating the bolt-assist assembly.
100	1909	A		
100	2009	S		
Date Fired: 23 September 1964.				
100	2109	A		Cyclic rate of rounds 2009 to 2029: 737 rounds per minute.
The rifle was disassembled, cleaned, inspected, lubricated, and reassembled. The inspection revealed an oval-shaped bulge on the outer surface of the right side of the receiver, forward of the bolt-assist assembly. The bulge was approximately 0.3 inch in length by 0.1 inch in width by 0.02 inch in height. A visual inspection of the inside of the receiver, in the area of the bulge, did not show any corresponding depression. A Zyglo inspection showed two surface cracks on the inside of the receiver opposite the bulge. One crack was approximately 0.8 inch and the other 0.5 inch in length. A small sliver of the receiver had chipped from the approximate center of the longer crack.				
Date Fired: 24 September 1964.				
An M7 bayonet was attached to the rifle. The bayonet fit loosely.				
100	2209	S	1-FF	The nose of the first round from magazine 4 stubbed on the

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
100	2309	A		receiver below the right-hand bullet guide. The bolt-assist assembly was actuated clearing the malfunction. The magazine was replaced with magazine 35. Cyclic rate of rounds 2209 to 2229: 700 rounds per minute.
100	2409	S		
100	2509	A		
100	2609	S		
100	2709	A		
100	2809	S		
100	2909	A		

Date Fired: 25 September 1964.

100	3009	S		
100	3109	A		Cyclic rate of rounds 3009 to 3029: 767 rounds per minute.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled. The M7 bayonet was removed and inspected.

100	3209	S	1-FBR	Resulted with magazine 35.
100	3309	A		Cyclic rate of rounds 3209 to 3229: 767 rounds per minute.

The rifle was fired from the shoulder with the muzzle depressed at an angle of approximately -80 degrees from the horizontal.

100	3409	S		
100	3509	A		

The rifle was held loosely and fired with the muzzle depressed at an angle of approximately -80 degrees from the horizontal.

100	3609	S		
100	3709	A		

The rifle was fired from the prone position with the rifle mounted on the M3 bipod.

100	3809	S		
100	3909	A		

Date Fired: 28 September 1964.

100	4009	S		
100	4109	A		Cyclic rate of rounds 4009 to 4029: 727 rounds per minute.

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
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The rifle was disassembled, cleaned, inspected, lubricated and reassembled.

100	4209	S		
100	4309	A		Cyclic rate of rounds 4209 to 4229: 772 rounds per minute.
100	4409	S	1-FBR	Resulted with magazine 6.
100	4509	SB		
100	4609	S	1-FS	The bolt failed to strip the first round from magazine 7. The mal- function was cleared by striking the stock assembly with the heel of the hand.

Date Fired: 29 September 1964.

100	4709	SB	1-FBR	Resulted with magazine 6. Magazine 6 was replaced with magazine 34.
100	4809	S	1-FS	The bolt failed to strip the first round from magazine 35. The mal- function was cleared by striking the stock assembly with the heel of the hand.
100	4909	SB	1-FF	The nose of the first round from magazine 7 stubbed below the right-hand bullet guide. The bolt-assist assembly would not clear the malfunction. The bolt was retracted and released, clearing the malfunction.
100	5009	S		
100	5109	A		Cyclic rate of rounds 5009 to 5029: 740 rounds per minute.

Date Fired: 30 September 1964.

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.

100	5209	S		
100	5309	A		Cyclic rate of rounds 5209 to 5229: 778 rounds per minute.
100	5409	S		
100	5509	SB		
100	5609	S	1-FS	The bolt failed to strip the first round from magazine 1. The bolt closed feeding the round when the shooter turned the rifle to strike the stock assembly.
100	5709	SB		One circumferentially stretched case.
100	5809	S		
100	5909	SB		

<u>No. Rds Fired</u>	<u>Total No. of Rds Fired on Test</u>	<u>Type Fire</u>	<u>Function</u>	<u>Remarks</u>
Lot RA-5022 was fired in the remainder of the reliability test.				
100	6009	S	1-FL	The bolt failed to go fully forward and lock with the first round from magazine 2. The bolt-assist assembly was used to close the bolt.
100	6109	A	2-FS	The bolt failed to strip the first round from magazines 7 ^a and 10. Striking the stock assembly with the heel of the hand failed to clear either malfunction. The bolt-assist assembly was used to clear the first and the bolt was retracted and released, clearing the second malfunction. Cyclic rate of rounds 6009 to 6029:: 723 rounds per minute.

Date Fired: 1 October 1964.

Benchrest Accuracy

Range: 100 meters.

33	6142	S
----	------	---

Velocity Measurements

21	6163	S
----	------	---

The rifle was disassembled, cleaned, inspected, lubricated, and reassembled.

^aTwo previous malfunctions had been encountered with this magazine; however, because no additional unused magazines were available the magazine was retained in the test in this instance.

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.5(79) (3) REF 1: X1116E1

CASTING NUMBER	MANUFACTURER	MODEL	NUMBER OF ROUNDS	FIRING STATUS (Check One) BEFORE AFTER	DATE OF GAUGING	MEAS. IN 1-1000 INCH				
						LANDS .2190		GROOVES .2235		
						FACE OF FLASH SUPPRESSOR	VERT	HOR	VERT	HOR
						1.25	7.0004	7.0005	7.0001	7.0001
						2.00	3	4	0	0
						3.00	4	3	0	0
						4.00	4	4	0	0
						5.00	4	5 +	1 +	1
						6.00	6	4	1	2
						7.00	4	4	0	1
						8.00	3	4	0	0
						9.00	4	4 +	1 +	1
						10.00	4	4	0	0
						11.00	3	4	0	0
						12.00	4	4	0	0
						13.00	4	4	0	0
						14.00	4	4	0	0
						15.00	4	4	0	0
						16.00	5	4	0	0
						17.00	5	5	0	0
						18.00	5	5	0	0
						18.35	5	5	0	0
						18.85	4	5	0	0
						19.10	7.0004	7.0004	7.0000	7.0000
PROOF OFFICER KEELER W.O. 324 - 707 - 40						TWIST OF RIFLING = 1 TURN IN 12"				
B.F. AT APG						BORE SCOPED -				
						LIGHT CIRCUMFERENTIAL TOOL MARKS THRU OUT BORE -				
						LIGHT TO MODERATE PITTING IN LANDS & GROOVES				
						THRU OUT BORE - LIGHT EROSION ON FORWARD EDGE				
						OF GAS PORT HOLE -				
NUMBER	101876									
MODEL	X1116E1									
MANUFACTURER										
CASTING NUMBER										
5.5(79) REF 1: X1116E1						BY - DAVIS - KING BLDG. 432				

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.5677 BARREL-XM16E1		Casting Number	
102033		Manufacturer	
XM16E1		Model	
B.F. AT APC		Number of Rounds	
Firing Status (check one)		Proof Officer	
BEFORE	AFTER	K.E.L.K. - 110.374-707-40	
DATE OF GAUGING H-1001-64		Flash Suppressors	
		LANDS - 2190 GROOVES - 2235	
		(INCHES) 1-10000	
		VERT	HOR
		VERT	HOR
		1.25	7.0008
		2.00	8
		3.00	8
		4.00	8
		5.00	7
		6.00	7
		7.00	6
		8.00	3
		9.00	4
		10.00	5
		11.00	5
		12.00	5
		13.00	5
		14.00	5
		15.00	5
		16.00	5
		17.00	6
		18.00	7
		18.35	6
		18.85	6
		19.10	7.0006
			7.0006
			7.0008
			7.0009
TWIST OF RIFLING = 1 TURN IN 12"			
DOVE SLAPED -			
VERY LIGHT CIRCUMFERENTIAL TOOL MARKS			
ENCIRLING LANDS & GROOVES THRU OUT BORE			
LIGHT EROSION ON FORWARD EDGE OF GAS PART			
By - DAVIS - KICK			
BLDG - 100			

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 7m BARREL - XM16E1										
CASTING NUMBER	MANUFACTURER	MODEL	NUMBER OF ROUNDS	FIRING STATUS (Check One)	DIST. IN INCHES FROM -		MEAS. IN 1-10000 INCH			
					FACE OF FLASH SUPPRESSOR	LANDS, 2190	GROOVES, 2235	VERT	HOP	VERT
X	KEELE	XM16E1	6142	BEFORE	AFTER	1.25	±.0011	±.0012	±.0012	±.0014
						2.00	10	12	12	13
						3.00	12	12	14	14
						4.00	13	13	15	13
						5.00	13	13	13	13
						6.00	11	11	15	13
						7.00	10	10	13	12
						8.00	10	10	13	17
						9.00	13	12	18	20
						10.00	17	15	22	22
						11.00	16	14	22	22
						12.00	19	16	22	22
						13.00	19	18	21	21
						14.00	21	23	19	20
						15.00	27	25	17	18
						16.00	*	*	20	19
						17.00	*	*	20	21
						18.00	*	*	24	24
						18.35	*	*	25	24
18.85	*	*	22	23						
19.10	*	*	±.0016	±.0019						
<p>* = OUT OF RANGE OF GAGE - LAND GAGE MIN. RANGE = .0028" -</p> <p>BORESKOPED -</p> <p>HEAVY TO LIGHT GASEROSION ENCIRCLING BORE FROM REAR OF BULLET SEAT TO (APPROX) 6" FORWARD - HEAVY TO LIGHT HEAT CHECKING & PITTING ENCIRCLING BORE THROUGHOUT THIS AREA - LIGHT HEAT CHECKING EXTENDING THROUGHOUT BORE - NUMEROUS LIGHT STRESS CRACKS ENCIRCLING BORE FROM REAR OF BULLET SEAT TO (APPROX) 2" FORWARD - FORWARD EDGE OF GAGE PART MODERATELY ERODED - LIGHT DEPOSITS OF METAL EXTENDING THROUGHOUT BORE -</p>										
5.56 7m	Barrel									
102033										
19 Oct 64										
										OSBORNE KIRK 400

APPENDIX IV - ACCURACY DATA

Semiautomatic Accuracy Data (Fired from a Benchrest)

All measurements are in inches.

Target No.	Group Center from Target Center		MR	Deviation				EVD	ES
	Hor	Vert		Horizontal		Vertical			
				Mean	Std	Mean	Std		

Dates Fired: 10 through 14 September 1964.
 Range: 100 meters.
 Rifle: 5.56-mm, XM16E1, No. 101525.

Rifleman: Miller.

1	+1.7	+0.4	1.1	0.5	0.6	0.8	1.1	1.8	3.3	3.5
2	+1.8	0.0	1.0	0.6	0.7	0.7	1.0	2.3	3.5	3.6
3	+1.8	+0.6	1.1	0.6	0.8	0.8	1.1	2.5	3.6	3.8

Rifleman: Keele.

1	+2.2	-5.5	1.2	0.9	1.1	0.8	1.0	3.5	3.2	4.1
2	+2.2	-5.5	1.0	0.5	0.8	0.6	0.8	3.0	2.8	3.0
3	+1.5	-4.6	1.2	0.7	0.9	0.8	1.2	2.8	3.8	4.3

Rifleman: Staley.

1	+4.0	-0.6	1.2	0.9	1.1	0.7	0.8	3.3	2.5	3.8
2	+3.8	+0.6	1.2	0.8	1.0	0.7	1.2	2.9	4.1	4.8
3	+3.1	+0.5	0.6	0.5	0.6	0.4	0.5	2.0	1.5	2.4
Average	+2.46	-1.57	1.07	0.67	0.84	0.70	0.97	2.68	3.14	3.70

Target No.	Group Center from Target Center		MR	Deviation				EHD	EVD	ES
	Hor	Vert		Horizontal		Vertical				
				Mean	Std	Mean	Std			

Rifle: 5.56-mm, XM16E1, No. 101525, with bayonet attached.

Rifleman: Miller.

1	+0.5	+1.9	1.6	1.0	1.2	1.1	1.3	4.1	3.4	4.8
2	0.0	+1.3	1.2	0.7	0.8	0.8	1.1	2.3	3.4	3.8
3	+0.4	+1.0	0.9	0.6	0.8	0.6	0.7	2.7	2.1	2.9

Rifleman: Keele.

1	+3.0	-4.7	1.3	0.9	1.1	0.8	1.1	3.6	3.1	3.8
2	+2.2	-4.6	1.3	0.7	1.0	1.0	1.3	3.1	3.9	4.4
3	+3.7	-4.3	1.2	0.9	1.1	0.6	0.7	3.3	2.2	3.5

Rifleman: Staley.

1	+3.7	-0.5	1.3	1.0	1.3	0.7	0.9	3.9	3.0	4.5
2	+4.1	+0.3	1.0	0.6	0.8	0.8	1.0	2.1	3.1	3.2
3	+3.2	-0.3	1.2	0.7	1.0	0.7	1.0	3.8	3.6	4.3
Average	+2.31	-1.10	1.22	0.79	1.01	0.79	1.01	3.21	3.09	3.91

Target No.	Group Center from Target Center		MR	Deviation				EVD	ES	
	Hor	Vert		Horizontal		Vertical				
				Mean	Std	Mean	Std			
Rifle: 5.56-mm, XM16E1, No. 101537, with bayonet attached.										
Rifleman: Miller.										
1	-0.6	+4.5	1.5	1.2	1.3	0.8	1.0	3.8	2.8	4.4
2	0.0	+2.7	1.4	0.8	1.1	0.9	1.4	4.1	5.0	5.3
3	+0.2	+3.6	1.6	1.0	1.3	1.1	1.5	4.4	4.8	6.1
Rifleman: Keele.										
1	-2.2	-2.0	1.6	1.2	1.6	0.8	1.2	5.2	4.5	5.9
2	-0.9	-1.0	1.3	1.0	1.3	0.7	0.9	3.7	2.9	4.1
3	-0.5	-2.1	1.0	0.8	1.1	0.5	0.6	3.7	2.0	3.8
Rifleman: Staley.										
1	+1.7	+3.9	1.3	0.9	1.2	0.7	1.0	3.9	3.1	3.9
2	+1.1	+3.3	1.1	0.7	0.8	0.8	1.0	2.2	2.8	3.3
3	+2.7	+3.5	1.1	0.8	1.0	0.7	0.9	2.7	2.8	3.0
Average	+0.17	+1.83	1.32	0.93	1.19	0.78	1.06	3.74	3.41	4.42

Target No.	Group Center from Target Center		MR	Deviation				EVD	ES	
	Hor	Vert		Horizontal		Vertical				
			Mean	Std	Mean	Std				
Rifle: 5.56-mm, XM16E1, No. 101679.										
Rifleman: Miller.										
1	-0.4	+2.7	1.8	0.7	0.9	1.5	1.9	2.5	6.5	6.6
2	-2.0	+1.1	2.4	1.0	1.3	1.8	2.4	3.8	7.6	7.7
3	-0.5	+0.8	1.4	0.6	0.9	1.2	1.4	3.1	4.2	5.2
Rifleman: Keele.										
1	-1.6	-3.2	1.6	0.7	1.0	1.3	1.8	3.4	6.4	6.4
2	-0.9	-2.4	1.2	0.7	0.9	0.9	1.1	3.1	3.3	4.0
3	-0.5	-1.9	1.5	1.0	1.2	0.9	1.3	3.4	4.4	4.6
Rifleman: Staley.										
1	+2.6	+2.9	1.3	0.7	1.0	0.9	1.2	3.2	4.0	4.1
2	+1.3	+2.5	1.4	0.7	1.0	1.2	1.4	3.7	3.8	4.3
3	+1.4	+1.8	1.5	1.1	1.5	0.7	0.9	5.3	3.2	5.4
Average	-0.07	+0.48	1.57	0.80	1.08	1.16	1.49	3.50	4.82	5.37

Target No.	Group Center from Target Center		MR	Deviation				EHD	EVD	ES
	Hor	Vert		Horizontal Mean	Horizontal Std	Vertical Mean	Vertical Std			
Rifle: 5.56-mm, XM16E1, No. 101679 with bayonet attached.										
Rifleman: Miller.										
1	-1.7	+3.3	1.5	0.6	0.8	1.2	1.8	2.4	6.1	6.1
2	-2.0	+2.3	1.2	0.6	0.8	0.9	1.2	2.0	3.7	4.1
3	-2.5	+1.7	1.2	0.7	1.0	0.7	0.9	3.0	2.7	3.3
Rifleman: Keele.										
1	0.0	-3.0	1.3	0.9	1.2	0.8	1.0	3.5	3.1	4.0
2	-0.8	-3.0	1.4	0.5	0.6	1.2	1.7	1.9	5.7	5.9
3	-0.7	-2.0	1.5	0.8	1.1	0.9	1.2	3.9	3.7	4.2
Rifleman: Staley.										
1	+1.2	+2.8	0.9	0.3	0.4	0.7	1.0	1.3	3.7	3.7
2	+1.7	+2.1	1.1	0.7	0.9	0.7	1.0	2.8	3.4	3.5
3	+0.4	+1.4	1.0	0.8	1.1	0.4	0.6	3.4	2.1	3.4
Average	-0.49	+0.62	1.23	0.66	0.88	0.83	1.16	2.69	3.80	4.24

Target No.	Group Center from Target Center		MR	Deviation			
	Hor	Vert		Horizontal		Vertical	
				Mean	Std	Mean	Std

Date Fired: 16 September 1964.
 Range: 100 meters.
 Rifle: 5.56-mm, XM16E1, No. 101876.

Rifleman: Keele.

Before Reliability Test

1	-1.2	-1.4	1.4	0.5	0.6	1.3	1.5	2.2	4.2	4.2
2	-0.5	-0.3	1.4	0.6	0.8	1.2	1.5	2.6	4.5	4.5
3	-0.9	-0.6	1.1	0.5	0.6	0.9	1.2	1.8	3.9	3.9
Average	-0.87	-0.77	1.30	0.53	0.67	1.13	1.40	2.20	4.20	4.20

Date Fired: 1 October 1964.

After Reliability Test

1	-2.0	-0.8	1.1	0.8	1.0	0.7	1.0	2.9	3.7	4.5
2	-1.7	-1.6	0.9	0.5	0.7	0.6	0.8	2.5	2.2	2.5
3	-2.2	-0.4	1.5	0.9	1.1	1.0	1.3	2.9	4.0	4.5
Average	-1.97	-0.93	1.17	0.73	0.93	0.77	1.03	2.77	3.30	3.83

Target No.	Group Center from Target Center		MR	Deviation				EHD	EVD	ES
	Hor	Vert		Horizontal		Vertical				
				Mean	Std	Mean	Std			

Date Fired: 16 September 1964.
Rifle: 5.56-mm, XM16E1, No. 102033.

Before Reliability Test

1	-0.4	-1.5	1.3	0.8	1.1	0.9	1.2	3.8	3.5	4.1
2	-0.7	0.0	1.6	1.0	1.2	1.1	1.6	3.5	5.1	5.9
3	-0.4	-0.2	1.1	0.5	0.7	0.9	1.0	2.3	3.2	3.2
Average	-0.50	-0.57	1.33	0.77	1.00	0.97	1.27	3.20	3.93	4.40

Date Fired: 1 October 1964.

After Reliability Test

1	-1.1	+2.8	1.2	0.7	0.9	0.8	1.1	2.6	4.0	4.0
2	-1.7	+3.5	1.6	0.9	1.4	1.1	1.5	4.8	5.1	6.5
3	-1.6	+2.9	1.3	0.7	0.9	1.0	1.1	2.7	3.2	3.6
Average	-1.47	+3.07	1.37	0.77	1.07	0.97	1.23	3.37	4.10	4.70

Semiautomatic Accuracy Data (Rifle Mounted on M3 Bipod)

All target measurements are in inches.

Target No.	Group Center from Target Center		MR	Deviation				EHD	EVD	ES
	Hor	Vert		Horizontal		Vertical				
				Mean	Std	Mean	Std			

Dates Fired: 10 through 14 September 1964.
 Range: 100 meters.
 Rifle: 5.56-mm, XM16E1, No. 101525.

Rifleman: Miller.

1	+3.1	-3.6	1.6	1.0	1.3	1.2	1.4	4.3	3.3	5.2
2	+3.9	-6.8	3.3	3.1	3.7	1.1	1.6	10.6	6.0	12.2
3	+0.0	-7.1	1.3	0.9	1.0	0.8	1.1	2.8	3.5	4.0

Rifleman: Keele.

1	+1.6	-4.6	1.3	0.8	1.1	0.7	0.9	3.6	2.8	3.8
2	+1.4	-6.1	1.6	0.9	1.2	1.2	1.6	4.2	4.9	4.9
3	+1.6	-7.5	1.1	0.8	1.0	0.6	0.8	2.9	2.1	3.3

Rifleman: Staley.

1	+2.8	-4.9	2.0	0.4	0.6	1.9	2.3	1.6	7.1	7.1
2	+4.1	-6.2	1.4	1.0	1.3	0.6	0.9	4.1	3.3	4.2
3	+5.2	-4.0	1.6	0.6	0.9	1.4	1.6	3.1	4.9	4.9
Average	+2.63	-5.64	1.69	1.06	1.34	1.06	1.36	4.13	4.21	5.51

Target No.	Group Center from Target Center		MR	Deviation						
	Hor	Vert		Horizontal		Vertical		EHD	EVD	ES
				Mean	Std	Mean	Std			
Rifle: 5.56-mm, XM16E1, No. 101537.										
Rifleman: Miller.										
1	+1.2	-3.7	1.7	1.2	1.7	0.9	1.1	6.6	3.3	7.0
2	+0.2	-7.0	1.8	1.3	1.6	0.8	1.1	4.3	3.5	4.3
3	-3.2	-7.0	1.5	0.7	0.9	1.2	1.4	2.6	4.4	4.6
Rifleman: Keele.										
1	+1.4	-3.7	1.8	1.2	1.6	1.2	1.7	5.2	5.7	7.5
2	-0.2	-5.1	1.5	1.1	1.4	0.9	1.0	4.3	2.8	4.4
3	+0.5	-3.7	1.6	1.4	1.7	0.5	0.7	5.3	2.3	5.3
Rifleman: Staley.										
1	+1.9	-5.1	1.3	0.9	1.1	0.8	1.0	3.1	3.1	4.0
2	+5.3	-2.9	1.9	1.5	1.9	1.0	1.3	6.0	3.6	6.3
3	+3.0	-1.7	0.9	0.7	0.8	0.5	0.8	2.6	2.9	2.9
Average	+1.12	-4.43	1.56	1.11	1.41	0.87	1.12	4.44	3.51	5.14

Target No.	Group Center from Target Center			Deviation						
	Hor	Vert	MR	Horizontal		Vertical		EHD	EVD	ES
				Mean	Std	Mean	Std			
Rifle: 5.56-mm, XM16E1, No. 101679.										
Rifleman: Miller.										
1	-1.4	-10.5	1.7	1.1	1.4	1.1	1.4	3.8	4.3	5.5
2	-1.5	- 6.3	1.8	1.1	1.5	1.2	1.5	5.3	4.7	5.7
3	-2.9	- 9.1	2.2	0.8	1.2	1.8	2.1	4.3	6.3	6.3
Rifleman: Keele.										
1	-1.9	- 4.6	1.8	1.3	1.8	1.1	1.3	5.9	3.7	6.3
2	0.0	- 0.9	1.8	0.9	1.2	1.5	1.7	3.8	5.4	6.0
3	-2.7	- 8.1	1.4	0.7	0.9	1.2	1.3	2.7	3.2	3.7
Rifleman: Staley.										
1	+2.5	+ 3.3	1.3	0.5	0.7	1.1	1.5	1.9	5.0	5.0
2	+2.6	0.0	1.8	1.3	1.7	1.1	1.4	5.2	4.6	5.6
3	+1.1	+ 0.3	2.2	1.7	2.0	1.1	1.5	5.0	5.2	6.1
Average	-0.47	- 3.99	1.78	1.04	1.38	1.24	1.52	4.21	4.71	5.58

Target No.	Group Center from Target Center		Deviation				EVD	ES
	Hor	Vert	Horizontal		Vertical			
			Mean	Std	Mean	Std		
	MR							

Range: 300 meters.
 Direction of Fire: South.
 Rifle: 556-mm, XM16E1, No. 101525.
 Date Fired: 18 September 1964.
 Wind: NNE, 3 to 4 meters per second.
 Sky Condition: Overcast.
 Temperature: 17.8 to 23.2°C.

Rifleman: Miller.

1	+11.4	+ 2.0	4.7	3.3	4.2	2.8	4.6	15.1	16.7	20.9
2	+ 6.9	- 3.7	2.6	1.9	2.5	1.3	1.7	8.3	5.3	8.9
3	+ 2.4	- 9.6	2.3	1.2	1.7	1.7	2.2	6.3	7.0	7.8

IV-12

Date Fired: 28 September 1964.
 Wind: WSW, 0 to 2 meters per second.
 Temperature: 11.2 to 12.2°C.

Rifleman: Keele.

1	- 5.8	- 4.0	4.4	3.2	3.7	2.3	3.4	9.9	13.2	14.4
2	- 5.1	+ 7.7	3.7	1.3	1.8	3.3	4.4	5.8	15.1	15.1
3	-10.0	- 6.3	4.5	2.8	4.9	2.5	3.6	19.6	13.5	19.6

Rifleman: Staley.

1	- 3.6	+17.3	3.9	3.3	4.1	1.6	2.3	13.7	7.2	13.8
2	- 6.8	+15.6	6.3	4.0	5.0	4.1	6.1	15.6	21.0	23.5
3	- 8.8	+11.1	4.0	3.0	4.4	1.7	2.3	15.5	7.5	15.6
Average	- 2.16	+ 3.34	4.04	2.67	3.59	2.37	3.40	12.20	11.83	15.51

Group Center
from Target
Center

Target No.	Center		MR
	Hor	Vert	

Rifle: 5.56-mm, XM16E1, No. 101537.
Date Fired: 18 September 1964.
Wind: NNE, 3 to 4 meters per second.
Temperature: 17.8 to 23.2°C.

Rifleman: Miller.

	Hor	Vert	MR	Deviation						
				Horizontal Mean	Horizontal Std	Vertical Mean	Vertical Std	EHD	EVD	ES
1	+13.1	-4.4	4.5	2.9	3.9	3.0	4.0	12.7	13.3	17.9
2	+22.0	+4.8	5.9	2.8	3.3	4.8	6.0	10.0	19.6	21.1
3	+20.2	+0.7	5.9	4.4	5.7	3.3	5.3	18.7	19.8	26.3

IV-13

Date Fired: 28 September 1964.
Wind: WSW, 0 to 2 meters per second.
Temperature: 11.2 to 12.2°C.

Rifleman: Keele.

1	+ 1.6	+6.9	3.6	1.6	2.2	2.6	3.6	7.9	12.6	12.6
2	- 7.2	+4.6	4.2	2.5	3.4	2.7	3.9	11.3	13.5	13.5
3	+ 0.1	-2.6	4.9	3.1	3.8	3.2	3.9	11.3	12.8	13.5

Rifleman: Staley.

1	+ 1.8	-8.6	4.5	3.2	4.2	2.1	2.8	14.0	8.6	14.0
2	+ 6.5	-2.4	3.1	1.8	2.4	2.3	3.3	8.6	12.3	12.5
3	+ 5.1	+0.3	3.1	2.7	3.1	1.2	1.7	8.6	6.1	9.4
Average	+ 7.02	-0.08	4.41	2.78	3.56	2.80	3.83	11.46	13.18	15.64

Target No.	Group Center from Target Center		Deviation				EHD	EVD	ES
	Hor	Vert	Horizontal		Vertical				
			Mean	Std	Mean	Std			

Rifle: 5.56-mm, XM16E1, No. 101679.
 Date Fired: 18 September 1964.
 Wind: NNE, 3 to 4 meters per second.
 Temperature: 17.8 to 23.2°C.

Rifleman: Miller.

1	+5.5	+ 3.0	5.4	3.3	3.8	3.9	5.1	9.7	17.3	17.6
2	+1.7	+ 0.6	4.4	3.2	4.1	2.5	3.5	12.7	12.4	14.2
3	+2.4	- 4.0	5.0	2.9	4.4	3.1	4.2	15.7	13.7	16.2

IV-14

Date Fired: 28 September 1964.
 Wind: WSW, 0 to 2 meters per second.
 Temperature: 11.2 to 12.2°C.

Rifleman: Keele.

1	+1.7	+ 3.7	4.4	2.8	3.7	2.7	3.4	11.9	9.6	12.3
2	+8.3	- 1.1	4.6	3.8	5.2	2.1	3.6	16.8	14.1	20.7
3	+4.8	- 2.3	3.0	2.1	3.0	1.7	2.3	10.8	7.5	10.8

Rifleman: Staley.

1	+4.4	-15.7	5.1	2.7	3.8	3.6	5.0	13.8	17.7	17.7
2	-1.0	- 6.5	3.8	2.2	3.2	2.8	3.2	11.4	9.0	13.3
3	+2.5	-22.1	4.1	2.4	3.0	3.1	3.9	8.4	12.8	12.8
Average	+3.37	- 4.93	4.42	2.82	3.80	2.83	3.80	12.36	12.68	15.07

Target No.	Group Center from Target Center		Deviation								
	Hor	Vert	Horizontal		Vertical						
			Mean	Std	Mean	Std					
	MR										

Range: 500 meters.
 Rifle: 5.56-mm, XM16E1, No. 101525.
 Date Fired: 28 September 1964.
 Wind: NNE, 0 to 1.3 meters per second.
 Sky Condition: Overcast.
 Temperature: 10 to 12°C.

Rifleman: Miller.

1	- 5.4	+ 7.6	5.6	4.3	5.1	2.9	3.8	14.4	13.1	16.4
2	-16.6	+ 0.8	4.3	2.5	3.1	3.1	4.0	9.9	12.0	12.4
3	+ 0.9	+ 2.7	6.5	3.4	4.1	4.9	6.2	11.1	19.8	21.0

Date Fired: 23 September 1964.
 Wind: SSW, 0 to 3 meters per second.
 Sky Condition: Scattered clouds.
 Temperature: 25 to 29°C.

Rifleman: Keele.

1	+ 6.4	- 3.6	9.2	6.3	7.9	6.0	8.0	24.7	28.2	35.2
2	+ 2.7	+ 1.5	5.0	2.2	3.0	4.4	5.4	11.1	15.9	19.4
3	- 1.8	+ 0.7	4.8	2.3	3.0	3.7	5.8	8.6	22.6	23.8

Rifleman: Staley.

1	+ 2.6	- 3.3	3.9	1.7	2.2	3.1	3.8	7.1	10.3	10.7
2	- 2.4	-21.0	6.1	4.5	6.2	3.2	4.3	18.4	13.6	20.5
3	+ 0.4	-13.4	5.0	3.6	4.6	2.8	3.6	14.4	10.3	15.9
Average	- 1.47	- 3.11	5.60	3.42	4.36	3.79	4.99	13.30	16.20	19.48

Target No.	Group Center from Target Center		MR	Deviation			
	Hor	Vert		Horizontal		Vertical	
				Mean	Std	Mean	Std

Rifle: 5.56-mm, XM16E1, No. 101537.
 Date Fired: 28 September 1964.
 Wind: NNE, 0 to 1.3 meters per second.
 Sky Condition: Overcast.
 Temperature: 10 to 12°C.

Rifleman: Miller.

1	-17.5	+ 9.3	10.6	7.4	9.0	6.6	8.5	29.8	26.5	34.5
2	-27.0	-11.0	6.5	4.4	5.8	4.0	5.9	18.7	20.3	22.5
3	-15.4	-15.2	10.1	6.9	9.0	6.3	7.1	29.1	18.5	29.4

Date Fired: 23 September 1964.
 Wind: SSW, 0 to 3 meters per second.
 Sky Condition: Scattered clouds.
 Temperature: 25 to 29°C.

Rifleman: Keele.

1	- 1.2	- 8.5	6.0	4.1	5.7	3.8	4.8	20.5	16.4	24.9
2	- 3.7	- 5.4	5.9	3.8	4.9	3.9	5.3	15.4	19.6	20.4
3	- 5.2	- 4.7	9.7	7.2	8.6	5.0	6.7	26.5	23.7	26.5

Rifleman: Staley.

1	+ 5.7	+12.8	8.3	5.4	7.5	5.2	6.8	23.1	22.4	30.4
2	+16.0	+ 6.9	7.9	5.7	8.0	4.6	5.9	27.8	17.9	32.1
3	+ 6.1	+ 3.8	7.3	5.3	7.1	4.4	6.0	24.9	22.2	26.2
Average	- 4.69	- 1.33	8.03	5.58	7.29	4.87	6.33	23.98	20.83	27.43

Target No.	Group Center from Target Center		MR	Deviation															
	Hor	Vert		Horizontal		Vertical													
	Mean	Std		Mean	Std	Mean	Std												

Rifle: 5.56-mm, XM16E1, No. 101679.
 Date Fired: 28 September 1964.
 Wind: NNE, 0 to 1.3 meters per second.
 Sky Condition: Overcast.
 Temperature: 10 to 12°C.

Rifleman: Miller.

1	- 9.0	-10.3	8.1	6.0	7.0	4.6	6.1	21.5	20.4	23.1
2	-10.2	-14.7	8.0	4.6	6.4	5.2	7.1	22.6	23.9	27.4
3	-14.8	-30.9	4.1	2.6	3.5	2.5	3.4	11.7	11.9	12.1

Date Fired: 23 September 1964.
 Wind: SSW, 0 to 3 meters per second.
 Sky Condition: Scattered clouds.
 Temperature: 25 to 29°C.

Rifleman: Keele.

1	+ 3.9	+ 2.3	5.9	3.6	4.2	3.9	4.9	12.3	14.4	15.3
2	+ 1.4	+13.6	6.7	4.0	5.3	5.0	6.8	16.2	22.8	26.8
3	+ 4.3	+11.4	6.6	5.1	6.3	3.7	4.5	17.6	13.2	20.6

Rifleman: Staley.

1	- 0.8	-14.7	6.8	4.4	5.3	4.8	6.5	14.1	21.1	23.2
2	+ 6.6	-21.4	4.4	2.8	3.6	3.1	3.7	10.8	10.6	12.9
3	+ 3.6	-23.4	5.9	3.4	4.7	3.9	5.1	17.4	16.0	19.4

Average - 1.67 - 9.79 6.28 4.06 5.14 4.08 5.34 16.02 17.14 20.09

Automatic Accuracy Data

All target measurements are in inches.

Rifleman	Group Center from Target Center		MR	Deviation		EHD	EVD	ES		
	Hor	Vert		Horizontal Mean	Vertical Mean				Horizontal Std	Vertical Std
Date Fired: 14 through 21 September 1964.										
Range: 50 meters.										
Rifle: 5.56-mm, XM16E1, No. 101525.										
Miller	-3.7	-0.4	5.7	4.7	5.5	2.6	4.0	17.5	21.2	26.0
Keele	-1.1	-4.0	2.4	1.6	2.0	1.6	2.0	7.4	8.9	9.5
Staley	-4.0	-0.3	4.0	3.2	3.7	1.9	2.5	10.8	10.7	14.3
Average	-2.93	-1.57	4.03	3.17	3.73	2.03	2.83	11.90	13.60	16.60
Rifle: 5.56-mm, XM16E1, No. 101537.										
Miller	-2.0	-0.8	4.2	2.6	3.1	3.1	3.6	9.0	13.6	14.5
Keele	-4.2	-0.2	5.6	4.7	5.3	2.3	3.1	17.7	13.4	18.9
Staley	-5.3	+1.3	5.0	4.3	5.1	2.1	2.6	17.4	9.2	17.4
Average	-3.83	+0.01	4.93	3.87	4.50	2.50	3.10	14.70	12.07	16.93
Rifle: 5.56-mm, XM16E1, No. 101679.										
Miller	-3.0	-0.1	5.5	5.2	6.0	1.3	1.7	19.2	7.2	19.2
Keele	-1.6	+2.1	4.6	3.7	4.3	2.0	2.5	13.5	10.2	14.1
Staley	-5.3	-0.5	5.1	4.9	5.6	1.2	1.5	16.3	6.7	16.7
Average	-3.3	+0.5	5.07	4.60	5.30	1.50	1.90	16.33	8.03	16.67

Rifleman	Group Center from Target Center		MR	Deviation				EHD	EVD	ES
	Hor	Vert		Horizontal		Vertical				
				Mean	Std	Mean	Std			
Range: 100 meters.										
Rifle: 5.56-mm, XM16E1, No. 101525.										
Miller	-12.9	-2.3	9.9	9.2	10.3	2.6	3.4	27.2	13.5	28.2
Keele	-9.8	-7.4	7.8	5.7	8.6	4.0	5.4	50.7	23.7	52.6
Staley	-8.1	+3.5	5.7	4.8	5.7	2.0	2.6	18.9	10.8	19.0
Average	-10.27	-2.07	7.80	6.57	8.20	2.87	3.80	32.27	16.00	33.27
Rifle: 5.56-mm, XM16E1, No. 101537.										
Miller	-11.8	+3.2	4.1	3.5	3.9	1.7	2.2	12.6	8.8	13.4
Keele	-12.0	-0.2	11.5	9.6	11.6	5.1	6.0	43.8	23.4	44.0
Staley	-2.7	+6.3	8.6	5.9	6.8	5.6	6.3	20.0	19.1	25.8
Average	-8.83	+3.1	8.07	6.33	7.43	4.13	4.83	25.47	17.10	27.73
Rifle: 5.56-mm, XM16E1, No. 101679.										
Miller	-5.9	+3.0	8.4	4.9	5.5	6.0	8.9	16.2	44.1	44.7
Keele	-6.7	-6.7	8.1	6.4	8.6	3.7	4.5	39.7	17.8	39.9
Staley	-6.1	-0.5	7.1	6.0	7.2	2.7	3.4	25.7	13.1	26.9
Average	-6.23	-1.40	7.87	5.77	7.10	4.13	5.60	27.20	25.00	37.17

Rifleman	Group Center from Target Center		Deviation				EVD	ES		
	Hor	Vert	Horizontal		Vertical					
			Mean	Std	Mean	Std				
	MR									
Range: 200 meters.										
Rifle: 5.56-mm, XM16E1, No. 101525.										
Miller	-16.6	- 7.7	10.1	7.7	8.8	4.6	6.5	25.4	26.4	27.9
Keele	-24.1	- 6.0	19.3	16.1	18.8	8.6	10.2	59.1	35.3	60.2
Staley	-17.0	- 3.2	21.0	20.1	22.8	4.3	5.5	72.0	23.3	73.1
Average	-19.23	- 5.63	16.80	14.63	16.80	5.83	7.40	52.17	28.33	53.73
Rifle: 5.56-mm, XM16E1, No. 101537.										
Miller	- 6.5	- 9.7	13.9	6.8	8.1	11.2	13.4	30.1	46.0	51.7
Keele	-17.3	+ 9.6	9.2	6.7	8.0	5.4	7.1	26.7	32.3	35.5
Staley	-12.1	+10.2	15.0	11.0	13.2	9.4	11.0	44.0	39.9	54.0
Average	-11.97	+ 3.37	12.70	8.17	9.77	8.67	10.50	33.60	39.40	47.07
Rifle: 5.56-mm, XM16E1, No. 101679.										
Miller	- 8.6	- 7.9	12.5	10.1	11.5	6.4	7.7	35.3	28.8	44.0
Keele	-12.3	-14.2	16.5	14.0	16.1	7.0	8.8	50.2	32.4	52.8
Staley	- 8.8	- 5.1	16.7	12.3	15.4	9.7	11.3	60.2	38.6	66.8
Average	- 9.90	- 9.07	15.23	12.13	14.33	7.70	9.27	48.57	33.27	54.53

APPENDIX V - VELOCITY MEASUREMENTS

Instrumental velocities are in feet per second at 20 feet.

Round No.	Before Reliability Test		After Reliability Test	
	<u>101876</u>	<u>102033</u>	<u>101876</u>	<u>102033</u>
	Date Fired: 17 Sep 64		Date Fired: 1 Oct 64	
	Range Temperature: 82°F		Range Temperature: 65°F	
Cartridge, ball, caliber .223, lot RA-5027.				
1	3026	3125	3030	3040
2	3106	3067	2976	3003
3	3072	3101	3049	3030
4	3017	3086	2985	2963
5	3077	3044	3030	3008
6	3096	3063	2985	2990
7	3072	3115	2967	3017
8	3086	3145	3008	2941
9	3063	3115	2990	2920
10	3072	3135	3067	3053
11	3072	3082	3012	2999
12	3077	3150	3026	2941
13	3115	3091	3021	2976
14	3053	3086	3008	2999
15	3106	3053	3053	3012
16	3021	3063	3044	2954
17	3053	3110	3008	3008
18	3135	3096	2999	3003
19	3044	3110	3008	2994
20	3067	3058	2967	3035
Average	3072	3096	3012	2994
Maximum	3135	3150	3067	3053
Minimum	3017	3044	2967	2920
Extreme variation	118	106	100	133
Mean variation	22.7	25.4	22.2	27.6

APPENDIX VI - EQUIPMENT FAILURE REPORT

Agency D&PS APG MD Ofc. Sym. STEAP-DS-TI		<h2 style="margin:0;">EQUIPMENT FAILURE REPORT</h2>		Date: Trans: 30 Sept 64 EFR.No. 1	
1. To. Commanding General U.S. Army Weapons Command ATTN: AMSWE-QAV Rock Island, Illinois 61200			2. USATECOM Proj.No. 8-4-0230-02F Da Project No. 45-4-763/6-(01)-45-82 Contract No. DA-11-199-AMC-508(Y)		
			3. Test Title Quality Assurance Comparison Test of Rifle, 5.56-mm, XM16E1		
			4. Specific Sub Test Sub test No. 4		
I. MAJOR ITEM DATA					
5. Model XM16E1 Rifle			6. Serial No. 102033		
7. Quantity one (1)			8. Life Period (HR, CYC, MI, ETC.) NA		
9 MFGR. Colt's Patent FireArms Co.			10. USA No. NA		
II. PART DATA					
11. Nomenclature Receiver		13. MFGR. Part No. 102033			
12. FSN 102033		15. MFGR. Colt's Patent FireArms Co.			
14. Drawing No.		17. Next Assembly			
16. Quantity 1 (one)		19. Part Test Life			
18. STD. Govt. GRP.					
20. Description					
III. INCIDENT DATA					
21. OBSERVED DURING		22. TEST ENVIRONMENT		23. ACTION TAKEN	
a. Operation		a. Paved Road		a. Replaced	
b. Maintenance		b. Secondary Road		b. Repaired	
x c. Inspection		c. Cross Country		c. Adjusted	
d.		d. Water		d. Disconnected	
e.		e. Rifle Range		e. Removed	
				x f. None	
				f. Other	
25. Incident Description During reliability test of rifle No. 102033, after 2109 rounds, inspection revealed an oval-shaped bulge on the outer surface of the right side of the receiver, forward of the bolt-assist device. The bulge was approximately 0.3-inch in length by 0.1-inch in width by 0.02 inch in height. A visual inspection of the inside of the receiver in the area of the bulge, did not show any corresponding depression. A zygllo inspection showed two surface cracks, on the inside of the receiver opposite the bulge. One crack was approximately 0.8-inch and the other 0.5-inch in length. A small sliver of the receiver had chipped from the approximate center of the longer crack. The rifle was returned to test and has since been fired an additional 3000 rounds without extending the cracks. Defective Material Sent To: (returned to test)					
26. Indicated Action: NA Copy furnished: CG, USATECOM, ATTN: AMSTE-BC (3 cys)					
Continuation Sheet Attached () Yes (x) No Sketch Attached () Yes, (x) No Photo Attached () Yes (x) No					
27. a. Date Signed 30 Sept 64		b. Name, Rank, Title E. KEELE, Test Director		c. Signature	
d. Date & Hr. of Incident					

APPENDIX VII - FINDINGS

Acceptance Testing Specification
Requirement (SAPD-253A, 5 August 1964)

Performance

Failures to feed with the cartridge
visible not to exceed four in a
6000-round reliability test.

A total of six failures to
feed occurred with rifle
No. 102033 in the 6000-
round reliability test
(ref par. 2.13.3,
Table X).

APPENDIX VIII - SHORTCOMINGS

<u>Shortcoming</u>	<u>Remarks</u>
Inspection during the 6000-round reliability test revealed an oval-shaped bulge on the outer surface forward of the bolt-assist assembly (ref Appendix VI).	As directed in teletype AMSWE-QAV No. 9379, the rifle was shipped to Springfield Armory for appropriate metallurgical tests.

APPENDIX IX - PHOTOGRAPH



Figure IX-1: Rifle, Caliber .223 (5.56-mm), XM16E1.

APPENDIX X - DISTRIBUTION LIST

Initial Distribution

USATECOM Project No. 8-4-0230-02-F

<u>ADDRESSEE</u>	<u>FINAL REPORT</u>
Commanding General US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005 ATTN: AMSTE-BC AMSTE-TA	1 1
Commanding General US Army Weapons Command Rock Island, Illinois 61202 ATTN: AMSWE-QA	20
Commanding Officer Aberdeen Proving Ground, Maryland 21005 ATTN: STEAP-TL	2

Secondary distribution is controlled by the US Army Weapons Command.

AD _____ Accession No. _____

D&PS, Aberdeen Proving Ground, Maryland
Final Report of Comparison Test of Rifle, 5.56-mm, XM16E1, USATECOM Project No.
8-4-0230-02-F, January 1965, Eric J. Keele
RDT&E Project No. None, Report No. DPS-1541
99 pages, 1 illustration

Unclassified Report

Five 5.56-mm, XM16E1 rifles were submitted to Development and Proof Services, Aberdeen Proving Ground, Maryland, for a comparison test. The test was conducted between 8 September and 13 November 1964. The rifles functioned satisfactorily and met all the requirements of SAPD-253A except for one rifle which had an excessive number of failures to feed in the reliability test. The same rifle also developed an oval-shaped bulge at the outer surface of the receiver, forward of the bolt-assist assembly, which was classified as a shortcoming.

AD _____ Accession No. _____

D&PS, Aberdeen Proving Ground, Maryland
Final Report of Comparison Test of Rifle, 5.56-mm, XM16E1, USATECOM Project No.
8-4-0230-02-F, January 1965, Eric J. Keele
RDT&E Project No. None, Report No. DPS-1541
99 pages, 1 illustration

Unclassified Report

Five 5.56-mm, XM16E1 rifles were submitted to Development and Proof Services, Aberdeen Proving Ground, Maryland, for a comparison test. The test was conducted between 8 September and 13 November 1964. The rifles functioned satisfactorily and met all the requirements of SAPD-253A except for one rifle which had an excessive number of failures to feed in the reliability test. The same rifle also developed an oval-shaped bulge at the outer surface of the receiver, forward of the bolt-assist assembly, which was classified as a shortcoming.

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8-4-0230-02-F, January 1965, Eric J. Keele
RDT&E Project No. None, Report No. DPS-1541
99 pages, 1 illustration

Unclassified Report

Five 5.56-mm, XM16E1 rifles were submitted to Development and Proof Services, Aberdeen Proving Ground, Maryland, for a comparison test. The test was conducted between 8 September and 13 November 1964. The rifles functioned satisfactorily and met all the requirements of SAPD-253A except for one rifle which had an excessive number of failures to feed in the reliability test. The same rifle also developed an oval-shaped bulge at the outer surface of the receiver, forward of the bolt-assist assembly, which was classified as a shortcoming.

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8-4-0230-02-F, January 1965, Eric J. Keele
RDT&E Project No. None, Report No. DPS-1541
99 pages, 1 illustration

Unclassified Report

Five 5.56-mm, XM16E1 rifles were submitted to Development and Proof Services, Aberdeen Proving Ground, Maryland, for a comparison test. The test was conducted between 8 September and 13 November 1964. The rifles functioned satisfactorily and met all the requirements of SAPD-253A except for one rifle which had an excessive number of failures to feed in the reliability test. The same rifle also developed an oval-shaped bulge at the outer surface of the receiver, forward of the bolt-assist assembly, which was classified as a shortcoming.