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RDT&E PROJECT NO. OR FSN NOT AVAILABLE
USATECOM PROJECT NO. 8-WE-620-015-001
REPORT NO. APG-MT-3827
TEST SPONSOR PROJECT NO. NOT AVAILABLE
USACDC AC NO. 7571V

CHECK TEST OF

BLANK-FIRING ATTACHMENT, XM15E1

FOR M16A1 RIFLE

FINAL REPORT

BY

DANIEL CHMIEL
PHILIP ORZECH

MAY 1971

ABERDEEN PROVING GROUND

ABERDEEN PROVING GROUND, MARYLAND

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ABSTRACT

The check test of the blank-firing attachment for the M16A1 rifle was conducted by the Materiel Testing Directorate of Aberdeen Proving Ground from 21 December 1970 to 9 April 1971. The purpose of the test was to determine if the XM15E1 attachment with the M200 blank cartridge is suitable for US Army use. The testing covered physical characteristics, safety, durability, climatic operation, and effectiveness of the attachment in simulating firing of standard ammunition. The XM15E1 attachment, with 20-round magazines had stubbing rates up to 22.6%, and 2.9% with 30-round magazines. The XM15E1 attachment met the criteria for physical characteristics, safety, durability, climatic operation, and the simulation of firing standard ammunition. It was determined that the stubbing was due to the short length (when compared to standard M193 ball ammunition) of the M200 blank using standard 20-round magazines. It was concluded that the XM15E1 attachment met the required criteria.

FOREWORD

The Materiel Testing Directorate was responsible for preparing the test plan, conducting the test, and preparing the report.

ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

USATECOM PROJECT NO. 8-WE-620-015-001

FINAL REPORT ON CHECK TEST OF BLANK-FIRING ATTACHMENT, XM15E1 FOR M16A1 RIFLE

21 DECEMBER 1970 TO 9 APRIL 1971

SECTION 1. SUMMARY

1.1 BACKGROUND

It was determined from an evaluation of the final engineering and service test reports for the XM15 BFA and the cartridge, 5.56-mm, blank, XM200, for the M16A1 rifle (USATECOM Project Nos. 8-4-0250-01-01 and -02) that the XM15 BFA, with the XM200 blank cartridge, was unsuitable for US Army use due to fouling of the gas tube of the rifle. Subsequently, only the cartridge was type-classified standard A as a separate item. Tests by Frankford Arsenal indicated that the fouling problem has been corrected.

By direction of the Project Manager, Rifles (AMCPM-RS), competitive tests of BFAs have been conducted by USAWECOM with the objective of selecting a single design for USATECOM tests. The selected BFA design is the XM15E1.

1.2 DESCRIPTION OF MATERIEL

The USAWECOM-designed (XM15E1) BFA tested uses low-carbon steel for the body and a free-machining stainless steel for the restrictor tube. The BFA attaches to the flash hider of the M16A1 rifle. The restrictor tube screws up flush with the muzzle face so as to secure the BFA to the rifle. A perpendicular hole in the restrictor tube restricts the gases, enabling the weapon to function (Figure 1.2-1).

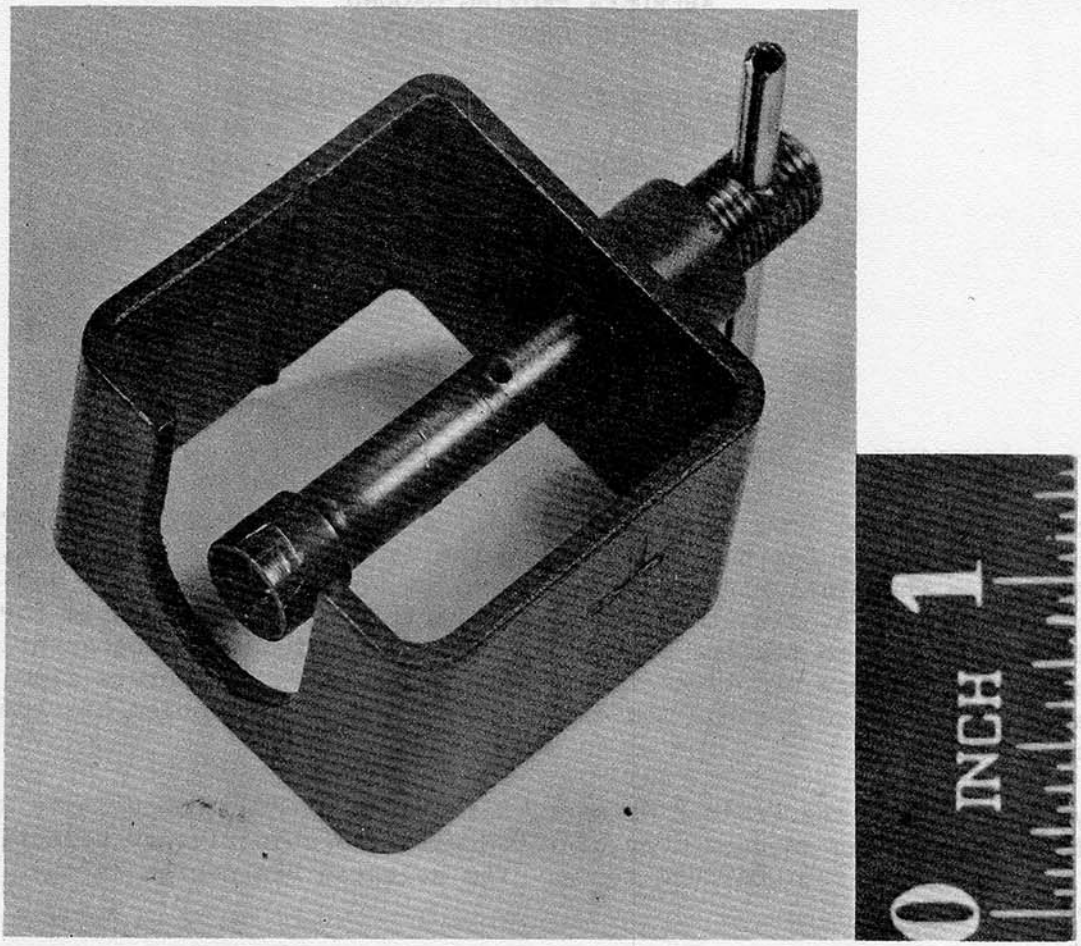


Figure 1.2-1: The XM15E1 BFA for the M16A1 Rifle.

1.3 TEST OBJECTIVES

The test objectives were to determine:

a. Physical and technical characteristics at ambient, intermediate-cold, and hot-dry temperature conditions as defined in Army Regulation 70-38.

b. If the XM15E1 BFA with M200 blank cartridge is suitable for US Army use.

c. If deficiencies and shortcomings previously reported have been adequately corrected.

1.4 SCOPE

Aberdeen Proving Ground was responsible for writing the test plan, and conducting and reporting the check test. Firings were conducted from December 1970 through March 1971. The testing covered physical characteristics, safety, durability, climatic operation, and effectiveness of the BFA in simulating the firing of standard ammunition.

1.5 SUMMARY OF RESULTS

All test BFA's were interchangeable with all test rifles. The average weight of the test BFA's was 2.60 ounces.

A blank cartridge fired through the BFA did not perforate a 0.0025-inch (thick) paper screen 15 feet from the BFA orifice and did not do so until a distance of 36 inches was reached. There was no evidence of excessive residue build-up in the rifle bore. The peak sound - pressure level produced by the M200 blank cartridge fired with the XM15E1 BFA did not exceed the level produced by the M193 ball cartridge.

The XM15E1 BFA satisfactorily operated the M16A1 rifle with 30-round magazines for at least 5000 rounds of M200 blank cartridges. However, firing conducted with 20-round magazines resulted in stubbing rates up to 22%. During feeding from standard 20-round magazines, the blank cartridge jammed on the upper receiver (FSN 1005-017-9542) adjacent to the feed-ramp area of the barrel extension. When the 20-round magazines were pushed toward the muzzle, while firing, the stubbing rate dropped to that of the 30-round magazines, a maximum of 2.9%.

The XM15E1 BFA with M200 blanks successfully simulated the flash produced by M193 ball ammunition, as observed from a distance of 100 yards, under conditions of darkness.

The smoke produced by the firing of the M200 blank cartridge was similar to that produced by firing an equal quantity of M193 ball cartridges.

The XM15E1 BFA and M200 blank operated the M16A1 rifle over the temperature-range limits of -25 to +125°F, as well as during the endurance test conducted at prevailing ambient temperatures.

The firing of blank cartridges, in both semiautomatic and full automatic modes, with the BFA orifice completely plugged, did not damage the rifle or present a safety hazard.

The firing of an M193 ball round in an M16A1 rifle with the XM15E1 BFA attached did not cause fragments to be expelled to the area normally occupied by the rifleman.

1.6 CONCLUSIONS

It was concluded that:

a. The XM15E1 BFA is physically compatible with the M16A1 rifle (ref pars. 2.2, 2.7, and 2.8).

b. The XM15E1 BFA satisfied all requirements for personnel safety, durability, reliability, and simulation of firing standard ball ammunition (ref pars. 2.3, 2.4, 2.5, 2.6, 2.8, and 2.9).

c. The shortcoming (difficulty in assembly and disassembly of the XM15 BFA to and from the M16A1 rifle) noted in APG Report No. DPS-2959, November 1968, has been corrected by the XM15E1 BFA (ref pars. 2.2 through 2.9).

d. The shortcoming of the blanks stubbing, due to the short length of the M200 blank cartridge as compared to that of the M193 ball round, noted in APG Report No. DPS-2959, November 1968, has not been corrected (ref par. 2.4).

1.7 RECOMMENDATIONS

It is recommended that:

a. The XM15E1 BFA, as tested at APG, be considered satisfactory for use with the M16A1 rifle providing that a danger area in excess of 36 inches be observed when firing alongside other personnel.

b. The M200 blank cartridge be increased in length to that of the standard 5.56-mm cartridge (similar to the M82 blank cartridge for the 7.62-mm, M14 rifle) to eliminate stubbing of the short 5.56-mm cartridge on the upper receiver (FSN 1005-017-9542) adjacent to the feed-ramp area of the barrel extension.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

This test was conducted to determine if the XM15E1 BFA would safely and satisfactorily operate the M16A1 rifle.

2.2 PHYSICAL CHARACTERISTICS

2.2.1 Objective

The objective was to determine, by inspection and measurement, the physical characteristics of the BFA.

2.2.2 Criterion

The criterion is that the BFA shall be capable of interchangeability between the M16A1 test weapons.

2.2.3 Method

The method used is shown below:

a. All BFA's were tested for interchangeability with ten M16A1 test rifles.

b. All BFA's were weighed, and measurements were taken of all dimensions which are critical to proper fit and functioning of the BFA.

c. Photographs of the BFA's were taken.

2.2.4 Results

Each of the ten test BFA's was interchangeable with the ten M16A1 test rifles.

The average weight of the test item was 2.60 ounces.

Figure 2.2-1 contains photographs of the XM15E1 and XM15 BFA's.

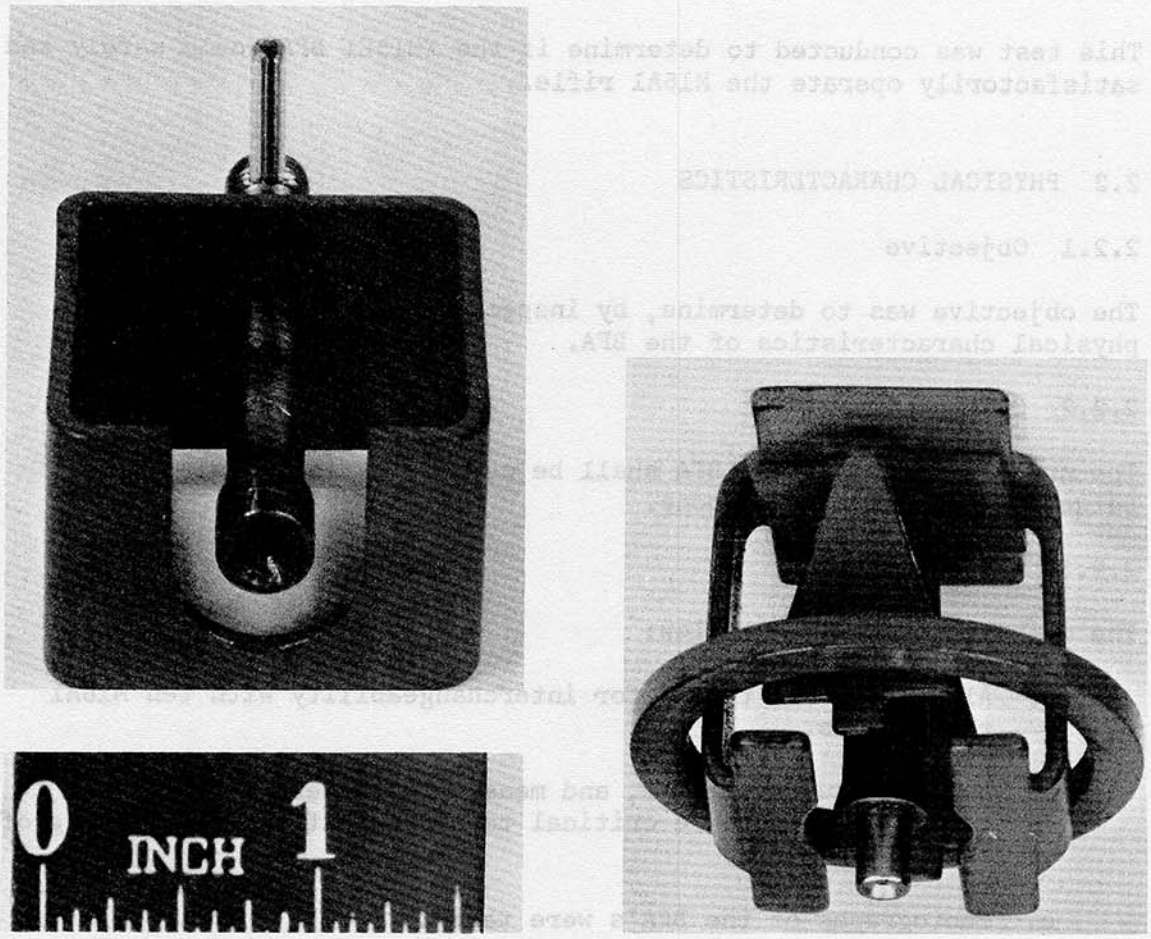


Figure 2.2-1: The XM15E1 (LEFT) and XM15 (RIGHT) BFA's.

2.2.5 Analysis

The criterion was met.

2.3 SAFETY EVALUATION

2.3.1 Objective

The objective was to determine if the BFA would satisfy the requirements for personnel safety.

2.3.2 Criteria

a. A blank cartridge, when fired through the BFA, shall not cause perforation of a paper screen (0.0025 inch in thickness) placed 15 feet from the gun muzzle.

b. The fouling produced by the firing of 1000 blank cartridges shall not cause a build-up of residue in the rifle bore to such an extent that a ball round (M193) cannot be fired, with the BFA removed, without evidence of excess pressure or stripping of the bullet jacket.

c. The peak sound - pressure level produced by the M200 blank cartridge, when fired in the M16A1 rifle with the XM15E1 BFA attached, shall not exceed the level produced by M193 ball cartridges when tested under identical conditions.

2.3.3 Method

Using a new-condition M16A1 rifle and the BFA, the following test procedures were applied:

a. All blank firing was directed at the center of a 6-foot-high U-shaped paper screen (0.0025-inch thick Kraft paper) placed 15 feet forward of the muzzle. The screen extended rearward past the muzzle on both sides to insure that any particles exiting from the sides of the BFA were detected. The distance at which particles exiting from the BFA would penetrate a paper screen (0.0025-inch thick Kraft paper) was determined.

b. A total of 1000 rounds was fired in this phase, alternating between SA and FA fire after each 100 rounds. The cyclic rates of the first and last 20-round burst of each FA cycle were recorded. The SA firing was conducted at a rate of 60 rounds per minute. Natural air cooling and visual inspection of the weapon and fired cases were performed at 200-round intervals. After firing 1000 rounds, 10 M193 ball cartridges were fired at a range of 100 yards for accuracy and dispersion, prior to cleaning. Two witness screens, placed at 15 feet and 50 yards, were also fired through simultaneously for evidence of bullet yaw or jacket stripping. The weapon and the fired cases were subsequently inspected for any indication of damage resulting from excessive pressure.

c. Noise and blast measurements for the M200 blank cartridge and the BFA were measured in accordance with Materiel Test Procedure 3-2-811, at the beginning and end of the test phase outlined in subparagraph 2.3.3.b. Following these firings, and after cleaning, 100 M193 ball cartridges were fired in SA and FA modes for comparison with the blank cartridges.

2.3.4 Results

The blank cartridge, when fired through the BFA, caused perforations in a 0.0025-inch (thick) paper screen out to 36 inches, in line with the orifice of the test item. No particles were projected forward.

Cyclic rates of fire remained constant during the firing of the 1000 blank rounds. Cyclic rates of M193 ball cartridges fired for comparison were within specified limits.

Inspection of the fired M200 blank cartridges revealed no indication of excessive pressure.

No apparent damage to the test BFA due to firing was observed after 1000 rounds.

Results of the firings with M193 ball through the two witness screens placed at 15 feet and 50 yards indicated no yaw or jacket-stripping characteristics due to residue build-up in the rifle bore; there was no statistically significant change in dispersion at the 95% confidence level.

Sound - pressure level measurements of the M200 blank cartridge did not exceed that of the M193 ball cartridge fired for comparison (Table 2.3-I).

Table 2.3-I. Summary of Muzzle-Blast Overpressure[a]

	Position 1				Position 2			
	M200 Blank		M193 Ball		M200 Blank		M193 Ball	
Gun No.	Avg	Std Dev	Avg	Std Dev	Avg	Std Dev	Avg	Std Dev
1	137.6	2.05	161.2	0.16	142.4	2.32	159.2	0.64
2	134.4	1.79	161.3	.31	141.1	2.43	158.9	0.40
3	138.0	4.57	160.6	.22	144.0	2.24	157.5	1.13
4	138.0	2.81	160.8	.26	144.7	1.50	158.8	0.59
5	139.0	3.21	161.0	.40	141.9	1.87	158.5	0.67
6	131.6	1.30	161.2	.31	144.2	1.88	158.9	0.78

[a]All measurements are in decibels.

2.3.5 Analysis

The criteria were met.

2.4 DURABILITY AND RELIABILITY

2.4.1 Objective

The objective was to determine the serviceable life of the BFA for the M16A1 rifle.

2.4.2 Criterion

The criterion is that the modified BFA shall satisfactorily operate the M16A1 rifle for a minimum of 5000 firings of the M200 blank cartridge. Determination of serviceability will be based on examination for erosion and evidence of gas loss which will cause a cyclic-rate reduction in excess of 15%.

2.4.3 Method

Three new BFA's and three new M16A1 rifles with 20-round magazines were fired as follows:

a. Alternate firing of 20 rounds in bursts of 3 to 5 rounds and bursts of 20 rounds at 30-second intervals, with complete cooling after each 100 rounds fired. The firing was continued until 5000 rounds were expended.

b. Three new BFA's and three new M16A1 rifles with 30-round magazines were fired as follows:

   1) Alternate firing of 30 rounds in bursts of 3 to 5 rounds and bursts of 30 rounds at 30-second intervals with complete cooling after 90 rounds fired. The firing was continued until 5040 rounds were expended.

   2) The BFA's and rifles were examined for combustion residue build-up and erosion during the cooling intervals. The rifle bore and chamber were cleaned at 1000-round intervals.

The cyclic rates of the 20- and 30-round bursts were recorded. Peak noise-level measurements were recorded initially and after each 1000-round cleaning period.

After the first 2000-round interval the gas tube of the rifles used for the test were X-rayed to determine if residue build-up was in evidence. Further X rays were taken at 1000-round intervals after the initial X rays.

Firings were conducted from a fixed rest and were directed at a paper witness screen of 0.0025-inch (thick) Kraft paper placed 15 feet from the muzzle and sides of the weapon.

The rifles used for the test were gaged and the bore of each was examined before firing and at 2000-round intervals to determine if erosion or residue build-up (not removed by 1000-round cleanings) was in evidence. Prior to the test, three 10-shot benchrest-accuracy targets were fired over a range of 100 yards with each test weapon, using M193 ball cartridges. This firing was repeated after cumulative firings of 5000 rounds with each weapon.

2.4.4 Results

During feeding from standard 20-round magazines, the blank cartridges jammed on the upper receiver (FSN 1005-017-9542) adjacent to the feed-ramp area of the barrel extension. The stubbing rates are shown in Table 2.4-I.

Table 2.4-I. Stubbing Rates with 20-Round Magazines

Gun Serial No.	Blanks Fired	Stubs	Per Cent Stubs
3335859	5000	46	1.5
3337863	1200	112	9.3
3338094	3000	361	12.0
3339427	500	113	22.6
3339453	1300	273	20.9

These same five rifles, used with 30-round magazines, had a 0% stubbing rate for a 100-round sample used for a check. The five weapons, with 20-round magazines, fired M193 ball ammunition (100-round sample) without malfunctions.

The three rifles used with 30-round magazines had stubbing rates of 1.2, 1.3, and 2.9%. The majority of all stubs occurred as the cartridge was leaving the right side of the magazines; 72.6% with 20-round magazines and 87.2% with 30-round magazines.

A summary of malfunctions is shown in Table 2.4-II.

Table 2.4-II. Summary of Blank-Firing Malfunctions

Gun No.	Serial No.	Total M200 Rds Fired	Type and Number of Malfunctions						Total	Stub Rate[g]	Malfunction Rate
			FF[a]	FJ[b]	FX[c]	FBR[d]	STUB[e]	BOB[f]			
			Using 20-Round Magazines								
1	3335859	5000	0	0	0	0	45	4	49	0.015	-
2	3337863	1200	0	0	1	0	112	16	129	.093	0.108
3	3338094	5000	0	0	0	4	361	12	377	.120	.126
7	3339427	500	0	0	0	1	113	1	115	.226	.230
8	3339453	3300	0	0	0	4	273	4	281	.209	.216
	Total	15000	0	0	1	9	904	37	951	0.100	0.105
			Using 30-Round Magazines								
4	3338383	5000	0	0	0	0	65	11	76	0.013	0.015
5	3338365	5000	0	0	0	0	62	57	119	.012	.024
6	3338859	5000	2	1	0	0	146	6	155	.029	.031
	Total	15000	2	1	0	0	273	74	350	0.018	0.023

[a]Failure to feed.
[b]Failure to eject.
[c]Failure to extract.
[d]Failure of bolt to lock to the rear on the last round.
[e]Failure of the blank round to feed properly; the cartridge caught on the outer edge of the chamber.
[f]Bolt overrode base of round in feeding from magazine.
[g]Based on the first 3000 rounds fired. The magazines were held after 3000 rounds to facilitate testing by reducing stubbing.

An analysis of the rifles used by APG and those used by the Infantry Board at Fort Benning revealed variations in the weapons which could account for the variation in the over-all stubbing rate of 0.026 at Fort Benning and 0.100 at APG. The rifles used by APG and Fort Benning were from different manufacturers. The only applicatory difference noted in the typical weapons supplied for this test is shown in Figures 2.4-1 and 2.4-2.

The location of the feed-ramp lips apparently affects the stubbing rate. The difference of 0.0115 inch in the location of the feed-ramp lips in the H&R and GM rifles could account for the variation of stubbing rates. Figure 2.4-2 shows a 20-power magnification of the H&R and GM feed-ramp lips first shown in Figure 2.4-1.

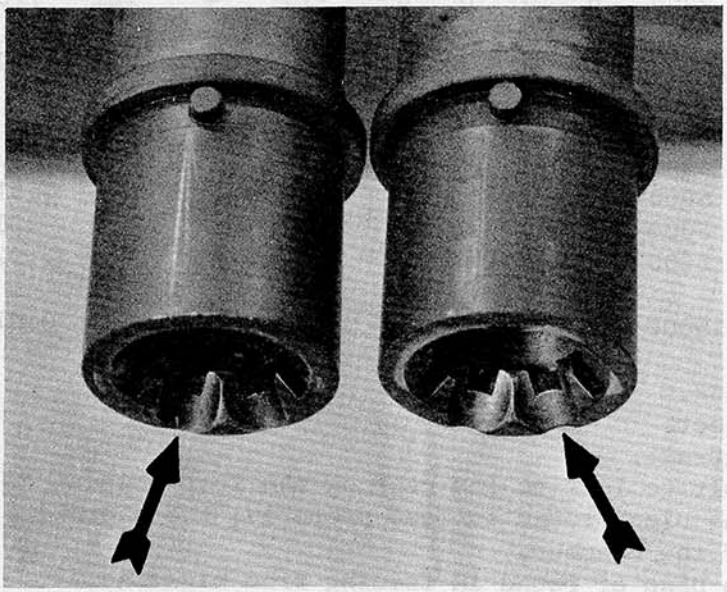


Figure 2.4-1: Barrels of Test Rifles Showing Feed-Ramp Lips Relative to the Rear Face of Barrel Extension. LEFT: Arrow Indicates Typical Barrel Extension Used at APG (GM Rifle). RIGHT: Arrow Indicates Typical Extension Used at Fort Benning (H&R Rifle).

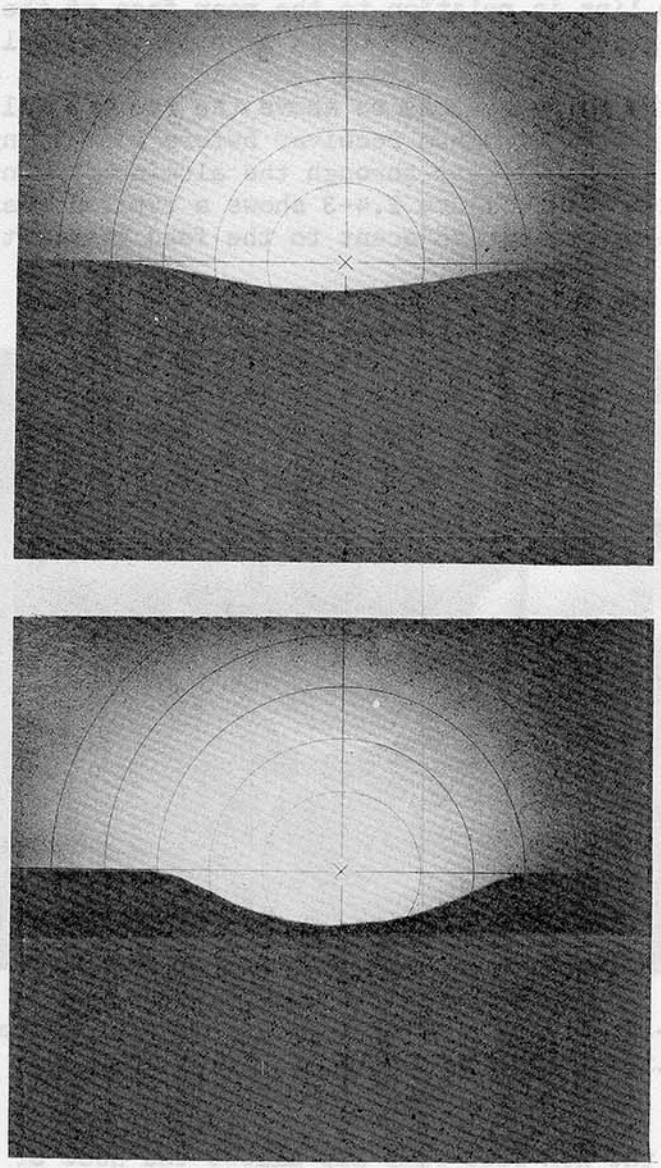


Figure 2.4-2: A 20-Power Magnification Showing the Location of the Feed-Ramp Lips. TOP: Location of Feed-Ramp Lips of Typical GM Rifle in Relation to Rear Face of Barrel Extension, 0.2048 Inch Wide and 0.0140 Inch from Rear Face. BOTTOM: Location of Feed-Ramp Lips of Typical H&R Rifle in Relation to Rear Face of Barrel Extension, 0.1770 Inch Wide and 0.0255 Inch from Rear Face.

The manufacturing drawing calls out 0.010 ± 0.005 inch for the location of the feed-ramp lips in relation to the rear face of the barrel extension. The more distance the blank is able to travel out of the magazine before it contacts the feed ramp the better the chance of the blank entering the barrel extension above the feed-ramp lip. The blank cartridge stubs on the aluminum receiver before contacting the feed-ramp lip. The blank is able to cut through the aluminum but not through the steel barrel extension. Figure 2.4-3 shows a typical wear pattern in the aluminum upper receiver adjacent to the feed ramp after 2000 rounds.

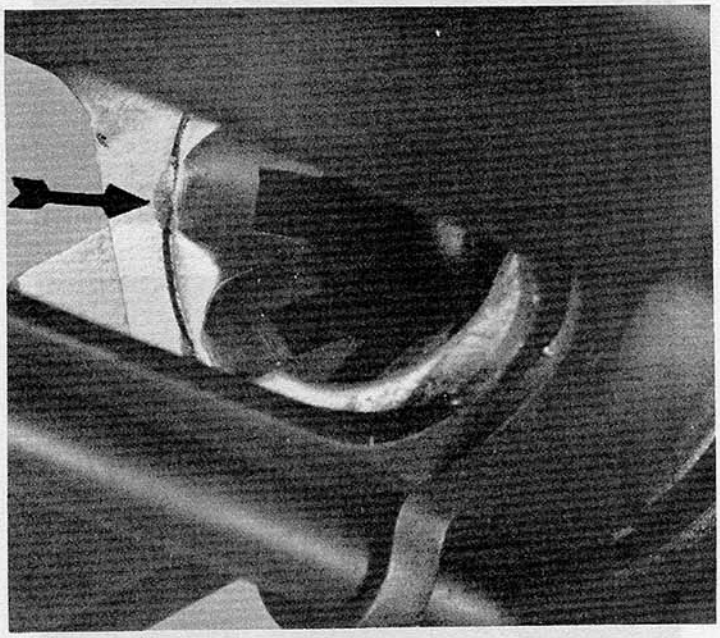


Figure 2.4-3: Typical Wear Pattern in Upper Receiver of Both GM and H&R M16A1 Rifles.

The location of the H&R feed-ramp lip allows the nose of the M200 blank to pass the aluminum upper receiver and be in the proper position for feeding into the feed ramp. In the GM rifles, when the nose of the blank passes the upper receiver it contacts the underside of the feed-ramp lip and stubs (Figure 2.4-4).

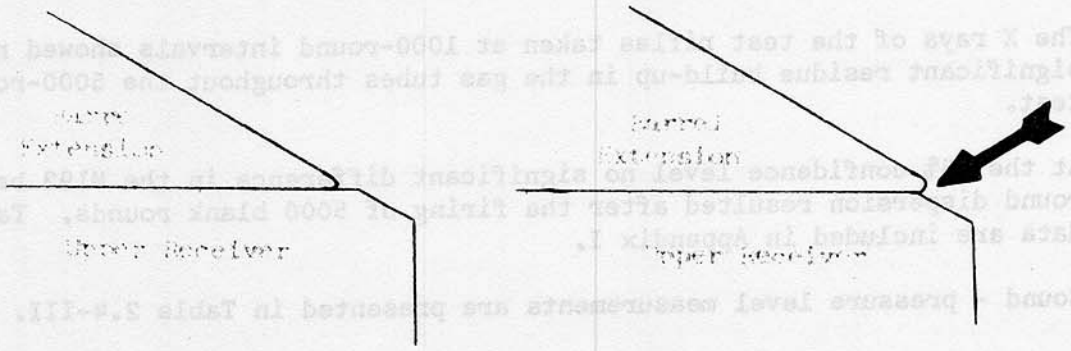


Figure 2.4-4: Section View of Typical Test Weapons Showing Location of Stubbing. LEFT: Typical of H&R Test Rifles. RIGHT: Typical of GM Test Rifles.

An analysis of the 20- and 30-round magazines used by APG determined several variations in the two magazines that could account for the variation in over-all stubbing rates of 0.100 with 20-round magazines and 0.018 with 30-round magazines. The 30-round magazine presents the blank round to the feed ramp higher and more firmly, as the bolt strips the blank cartridge out of the magazine, than the 20-round magazine does. Figure 2.4-5 indicates the magazine dimensions that could affect the performance of the M200 blanks and the M16A1 rifle.

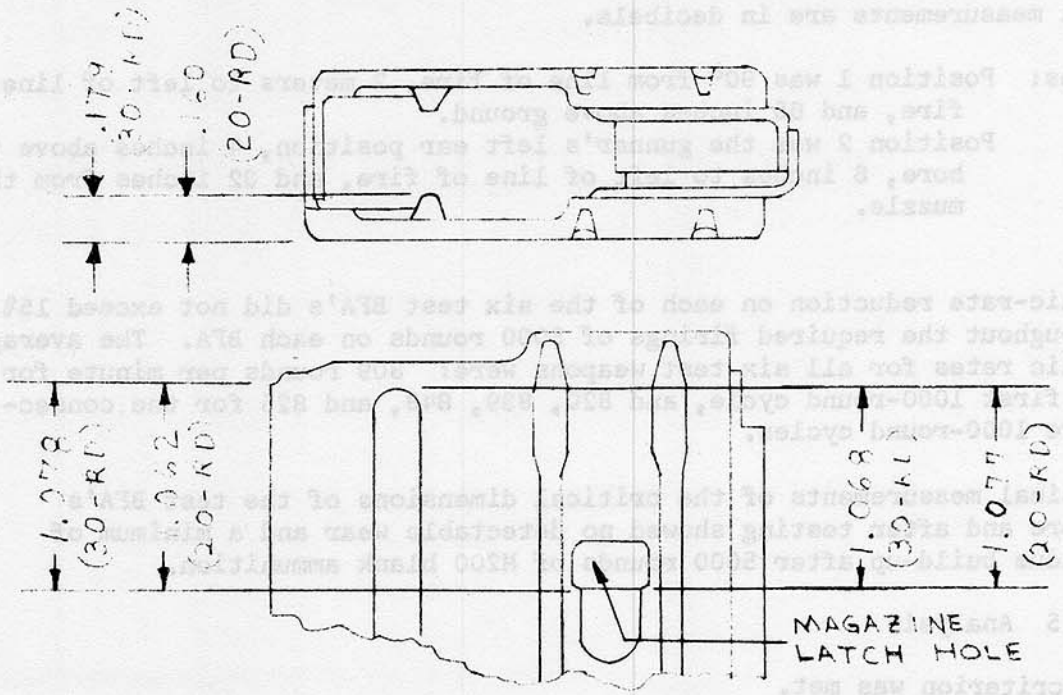


Figure 2.4-5: Applicatory Dimensional Differences between 20- and 30-Round Magazines.

The X rays of the test rifles taken at 1000-round intervals showed no significant residue build-up in the gas tubes throughout the 5000-round test.

At the 95% confidence level no significant difference in the M193 ball round dispersion resulted after the firing of 5000 blank rounds. Target data are included in Appendix I.

Sound - pressure level measurements are presented in Table 2.4-III.

Table 2.4-III. Summary of Sound - Pressure Data during the Endurance Phase, M200 Blanks, Lot TW 11-46[a]

Gun	Initial		After 1000 Rds		After 2000 Rds		After 3000 Rds		After 5000 Rds	
No.	Pos 1	Pos 2	Pos 1	Pos 2	Pos 1	Pos 2	Pos 1	Pos 2	Pos 1	Pos 2
1	137.6	142.2	139.4	143.2	139.7	145.4	136.3	144.2	133.0	143.6
3	138.0	144.0	135.4	141.5	136.3	144.0	135.9	142.8	137.6	144.0
4	138.0	144.7	135.4	142.6	137.6	144.5	140.0	144.7	137.2	144.0
5	139.0	141.9	136.8	143.6	138.4	143.0	133.7	144.0	135.9	144.0
6	131.6	144.2	137.6	144.6	135.4	144.2	140.0	144.5	133.7	143.4

[a]All measurements are in decibels.

Notes: Position 1 was 90° from line of fire, 2 meters to left of line of fire, and 65 inches above ground.
Position 2 was the gunner's left ear position, 4 inches above the bore, 6 inches to left of line of fire, and 32 inches from the muzzle.

Cyclic-rate reduction on each of the six test BFA's did not exceed 15% throughout the required firings of 5000 rounds on each BFA. The average cyclic rates for all six test weapons were: 809 rounds per minute for the first 1000-round cycle, and 820, 839, 848, and 825 for the consecutive 1000-round cycles.

Physical measurements of the critical dimensions of the test BFA's before and after testing showed no detectable wear and a minimum of residue build-up after 5000 rounds of M200 blank ammunition.

2.4.5 Analysis

The criterion was met.

2.5 FLASH TEST

2.5.1 Objective

The objective was to determine the muzzle-flash characteristics produced by firing the M200 blank cartridge in the M16A1 rifle equipped with the BFA.

2.5.2 Criterion

The criterion is that the flash produced at the muzzle of the weapon shall be visible at a 100-yard distance, when observed under conditions of darkness.

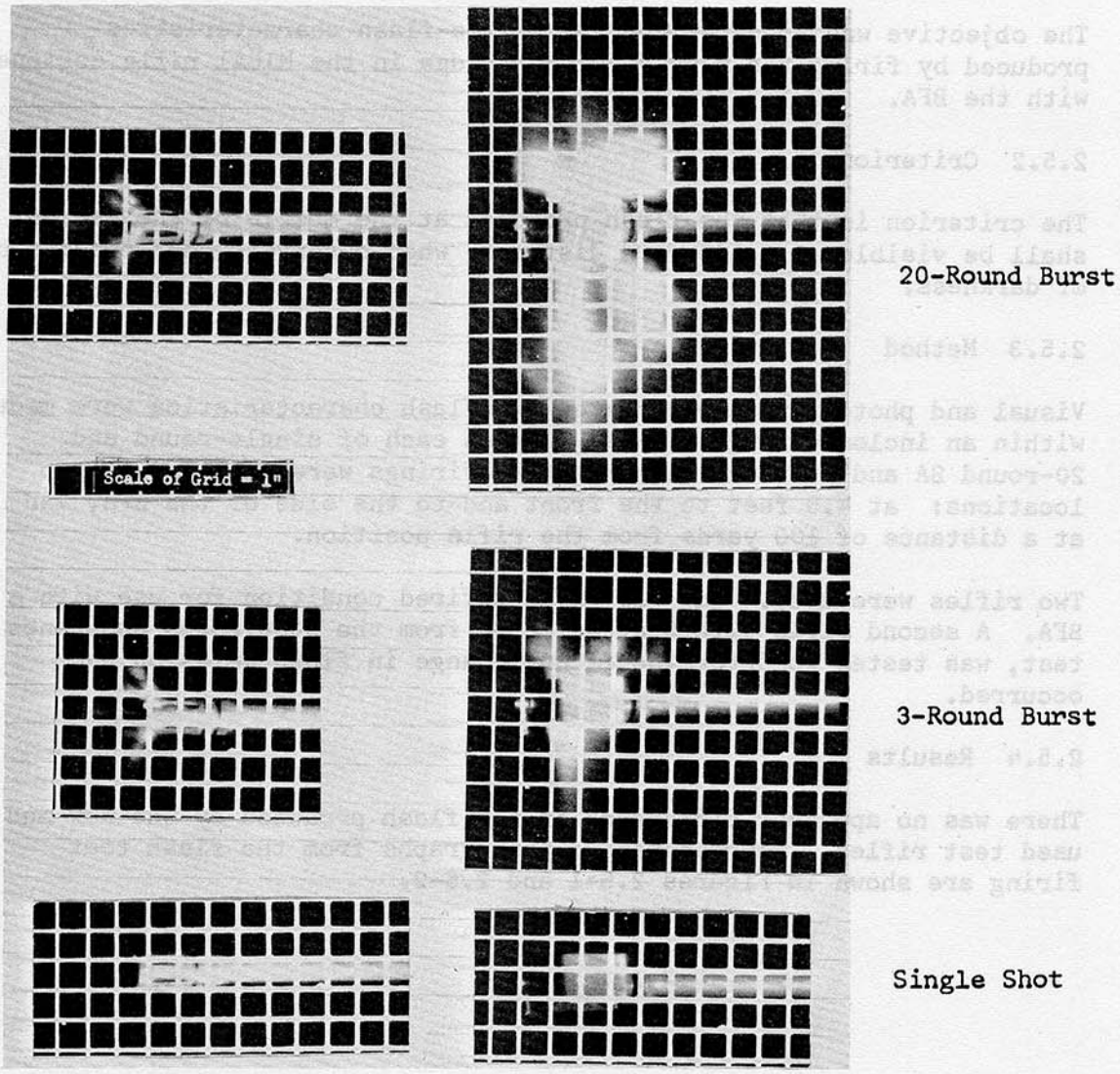
2.5.3 Method

Visual and photographic records of the flash characteristics were made within an inclosed range. Three samples each of single-round and 20-round SA and 20-round FA cumulative firings were obtained at two locations: at 4.5 feet to the front and to the side of the BFA, and at a distance of 100 yards from the rifle position.

Two rifles were used. One was in an unfired condition for use with a new BFA. A second rifle with BFA, selected from the 5000-round endurance test, was tested to determine if any change in flash emission had occurred.

2.5.4 Results

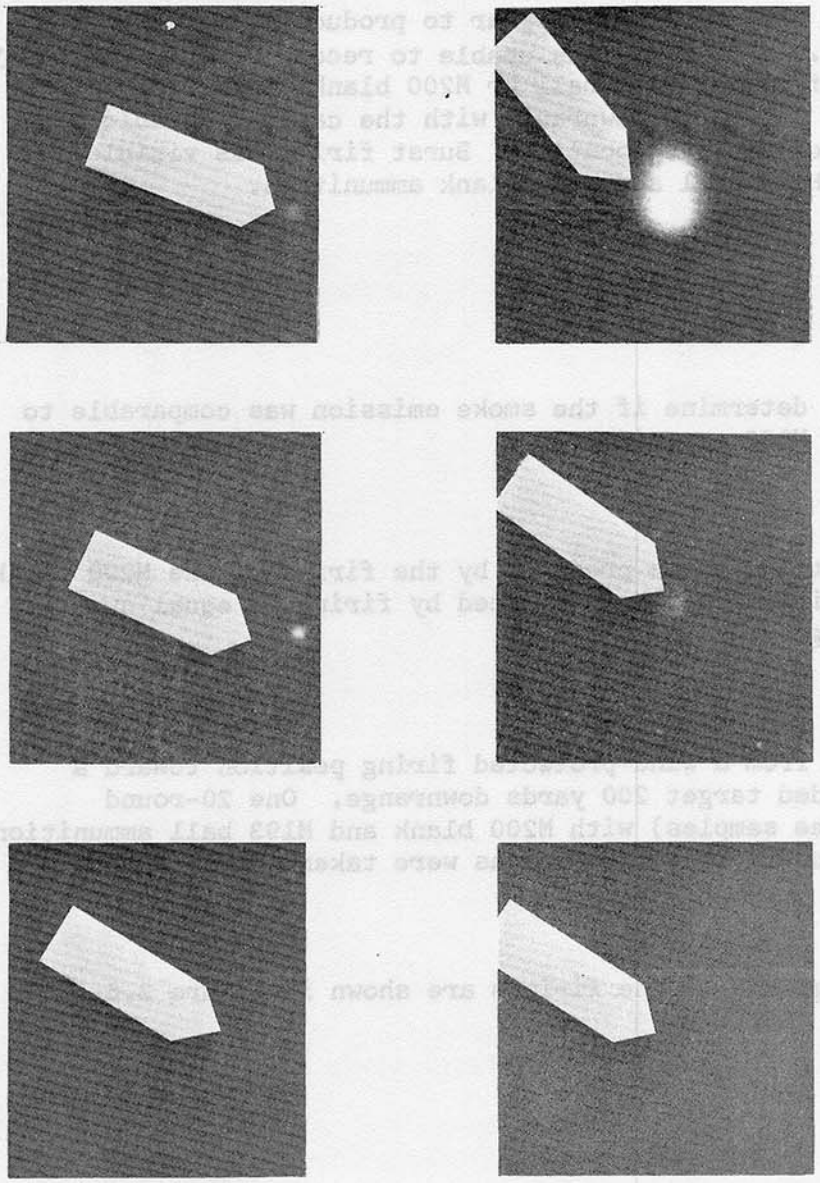
There was no apparent difference in the flash produced by the new and used test rifles. Representative photographs from the flash test firing are shown in Figures 2.5-1 and 2.5-2.



M16A1 Firing M193 Ball Ammunition

M16A1 Firing M200 Blank Ammunition with Attached XM15E1 BFA (Orifice Down)

Figure 2.5-1: Flash Characteristics of M16A1 Rifle Viewed from the Side.



M16A1 Firing M193 Ball Ammunition

M16A1 Firing M200 Blank Ammunition with Attached XM15E1 BFA

Figure 2.5-2: Flash Characteristics at 100 Yards from the Rifle Position Downrange.

2.5.5 Analysis

The M200 blanks with the XM15E1 BFA appear to produce more flash than M193 ball ammunition. The camera was unable to record flash produced by single-shot firing of either M193 ball or M200 blank ammunition. However, an observer 100 yards downrange with the camera was able to see the flash when he knew its location. Burst firing was visible at 100 yards with both M193 ball and M200 blank ammunition.

2.6 SMOKE TEST

2.6.1 Objective

The objective was to determine if the smoke emission was comparable to that of the bulleted M193 cartridge.

2.6.2 Criterion

The criterion is that the smoke produced by the firing of the M200 blank cartridge shall be similar to that produced by firing an equal quantity of M193 ball cartridges.

2.6.3 Method

Firing was conducted from a wind-protected firing position toward a black-and-white gridded target 200 yards downrange. One 20-round burst was fired (three samples) with M200 blank and M193 ball ammunition. Immediately after each firing, photographs were taken of the board.

2.6.4 Results

Representative photographs of the firings are shown in Figure 2.6-1.

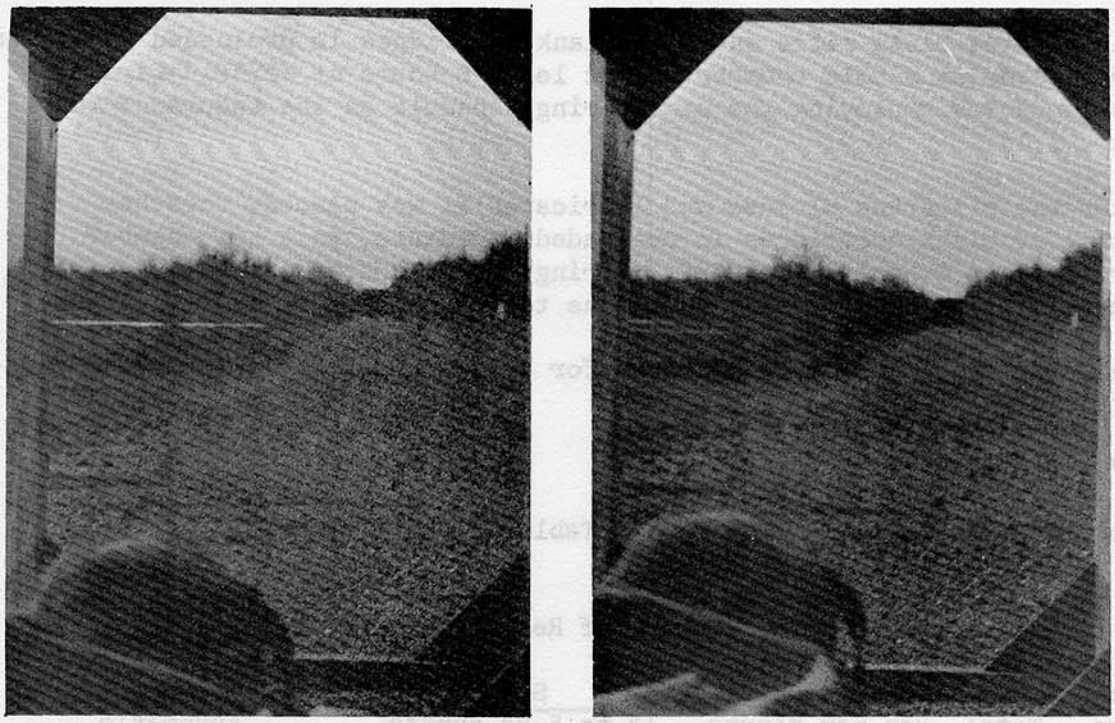


Figure 2.6-1: Smoke Test, 20-Round Burst Fired with M193 Ball Ammunition (LEFT) and with M200 Blank Ammunition with the XM15E1 BFA (RIGHT).

2.6.5 Analysis

The amount of smoke produced by the firing of the M200 blank cartridge with the XM15E1 BFA is similar to that produced by firing an equal quantity of M193 ball cartridges.

2.7 CLIMATIC TEST

2.7.1 Objective

The objective was to determine if any operational limits are imposed by the conditions of extreme temperature.

2.7.2 Criterion

The criterion is that the blank cartridge and BFA shall, as a minimum, operate the M16A1 rifle satisfactorily over the temperature range limits of -25 to +125°F.

2.7.3 Method

A lubricated M16A1 rifle and 1000 blank cartridges in preloaded magazines were placed in a cold chamber for at least 6 hours at -25°F. Firing was conducted employing the same firing schedule as the endurance test (par. 2.4).

After the rifle was cleaned and lubricated it was placed, together with 1000 blank cartridges in preloaded magazines, in a hot chamber for at least 6 hours at +125°F. Firing was conducted employing the same firing schedule as the endurance test (par. 2.4).

Cyclic rates of fire were recorded for all full-automatic (uninterrupted-burst) fire.

2.7.4 Results

The test results are summarized in Table 2.7-I.

Table 2.7-I. Summary of Results of Climatic Tests

Ammo Temp, °F	Total Rds	Cyclic Rate, Rds per Minute			Stoppages Per 1000 Rounds					
					3 to 5-Rd Bursts			Automatic		
		Max	Min	Avg	STUB[a]	FBR[b]	BOB[c]	STUB[a]	FBR[b]	BOB[c]
+125	1000	996	879	945	10	10	1	22	10	3
- 25	1000	750	672	704	40	0	0	81	0	0

[a]Failure to feed, nose of cartridge stubbed barrel.
[b]Bolt failed to remain to rear after last round in magazine was fired.
[c]Bolt overrode base of cartridge.

2.7.5 Analysis

The XM15E1 BFA with the M200 blank cartridge operated the M16A1 rifle over a range of -25 to +125°F at least as well as at ambient temperatures.

2.8 PLUGGED-BFA FIRING TEST

2.8.1 Objective

The objective was to determine the damage to the rifle and those safety hazards which might exist if a blank cartridge is fired while the BFA orifice is completely closed.

2.8.2 Criterion

The criterion is that the firing of a blank cartridge with the orifice of the BFA restricted shall not cause damage to the rifle. (Safety hazards will be determined.)

2.8.3 Method

Firing of the M16A1 rifle was conducted from a fixed mount, by remote control, with the BFA orifice welded completely closed. The test rifle with plugged BFA was placed in close proximity to Kraft paper. Three single shots and one 20-round automatic burst were fired.

2.8.4 Results

The plugged BFA did not cause damage to the rifle and did not cause perforation of the Kraft paper.

2.8.5 Analysis

A blank cartridge fired while the BFA orifice was completely closed caused no damage to the rifle or any apparent safety hazard.

2.9 BULLET DESTRUCTION TEST

2.9.1 Objective

The objective was to determine if user personnel would be endangered if a ball round (M193) were inadvertently fired with the BFA attached to the rifle.

2.9.2 Criterion

The criterion is that no fragments shall be expelled in the area of the rifleman.

2.9.3 Method

Three 10-round accuracy targets were fired at a 100-yard range before and after firing the bullet-destruction test. The rifle with test BFA attached was placed in a fixed rest and in close proximity to Kraft paper. A single M193 ball round was remotely fired through the attached BFA.

2.9.4 Results

The BFA was blown apart and propelled 20 yards downrange. The damaged BFA is shown in Figure 2.9-1. The Kraft paper was perforated by the BFA fragments in the area of the rifle flash-hider and forward of it. There was no apparent damage to the rifle.

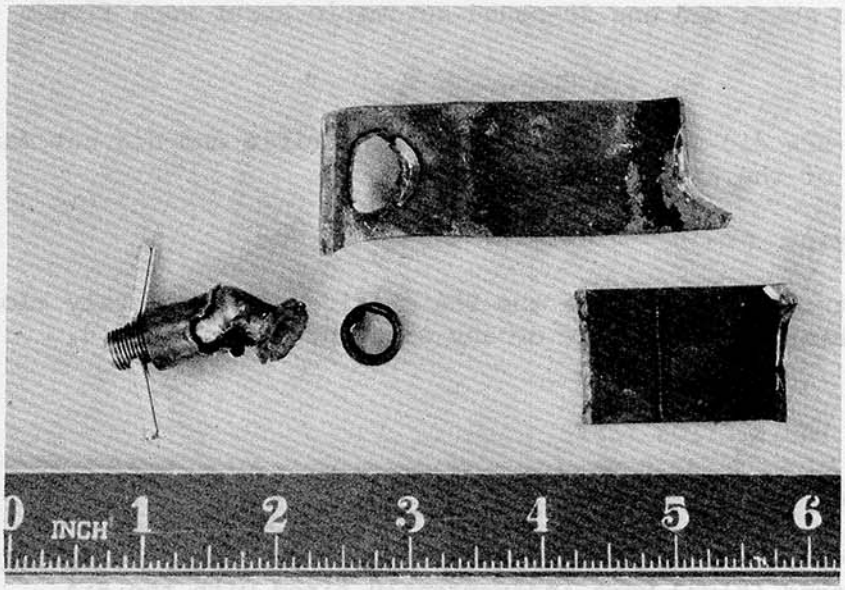


Figure 2.9-1: The XM15E1 BFA After the Bullet-Destruction Test.

2.9.5 Analysis

Firing an M193 ball round through a rifle with an attached BFA presents no apparent safety hazard to the rifleman. However, the area immediately around the flash-hider would be a potential danger area to nearby personnel. The area in front of the muzzle, out to at least 20 yards, would be a hazard area. There was no significant difference in the accuracy targets fired before and after the firing of the ball round through the attached XM15E1 BFA, at the 95% confidence level.

SECTION 3. APPENDICES

APPENDIX I - TEST DATA

100 Yard Accuracy Targets - Endurance Phase[a]

Sequence	EVD[b]	MVD[c]	VSD[d]	EHD[e]	MHD[f]	HSD[g]	ES[h]	MR[i]	CI[j] H[k]	CI[j] V[l]
1 Before	8.5	1.9	2.6	5.5	1.5	1.8	9.0	2.7	2.6	5.7
1 After	4.4	1.0	1.3	3.4	0.9	1.1	5.0	1.5	1.0	3.0
2 Before	5.7	1.1	1.6	3.8	1.0	1.2	6.3	1.6	-7.2	- 1.0
2 After	3.6	0.9	1.2	3.6	0.9	1.1	4.2	1.4	-3.8	5.1
3 Before	4.3	1.2	1.4	4.9	1.2	1.5	5.7	1.8	-3.5	8.9
3 After	4.6	1.1	1.4	4.0	0.9	1.2	5.3	1.6	-3.4	7.7
4 Before	4.4	1.1	1.4	3.7	0.9	1.2	5.2	1.6	-1.6	2.6
4 After	4.0	1.1	1.4	3.4	0.8	1.0	5.1	1.5	-1.7	0.9
5 Before	4.2	1.1	1.4	4.0	0.9	1.1	5.5	1.5	1.2	8.7
5 After	4.0	1.1	1.3	4.1	0.9	1.2	5.0	1.6	1.5	13.4
6 Before	5.3	1.3	1.6	3.4	0.7	1.0	5.4	1.6	-0.3	- 1.3
6 After	4.0	1.1	1.3	2.4	0.6	0.8	4.2	1.3	-2.1	- 0.9

[a]All measurements are in inches.
[b]Extreme vertical dispersion.
[c]Mean vertical dispersion.
[d]Vertical standard deviation.
[e]Extreme horizontal dispersion.
[f]Mean horizontal deviation.
[g]Horizontal standard deviation.
[h]Extreme spread.
[i]Mean radius.
[j]Center of impact from aiming point.
[k]Horizontal mean.
[l]Vertical mean.

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APPENDIX II - TEST FINDINGS

The source for all test requirements is the test plan for the check test of the BFA for the M16A1 rifle, January 1971.

Item	Requirements	Applicable Subtest	Remarks
1	The BFA shall be interchangeable with all M16A1 rifles.	2.2	Met.
2	A blank cartridge, when fired through the BFA, shall not cause perforation of a paper screen (0.0025 inch in thickness) placed 15 feet from the gun muzzle.	2.3	Met.
3	The fouling produced by the firing of 1000 blank cartridges shall not cause a build-up of residue in the rifle bore to such an extent that a ball round (M193) cannot be fired, with the BFA removed, without evidence of excessive pressure or stripping of the bullet jacket.	2.3	Met.
4	The peak sound - pressure level produced by the M200 blank cartridge, when fired in the M16A1 rifle with the XM15E1 BFA attached, shall not exceed the level produced by M193 ball cartridges when tested under identical conditions.	2.3	Met.
5	The BFA shall satisfactorily operate the M16A1 rifle for a minimum of 5000 firings of M200 blank cartridge. Determination of serviceability will be based on examination for erosion and evidence of gas loss which will cause a cyclic-rate reduction in excess of 15%.	2.4	Met.
6	The flash produced at the muzzle of the weapon shall be visible at a 100-yard distance, when observed under conditions of darkness.	2.5	Met.

Item	Requirements	Applicable Subtest	Remarks
7	The smoke produced by the firing of the M200 blank cartridge shall be similar to that produced by firing an equal quantity of M193 ball cartridges.	2.6	Met.
8	The blank cartridge, M200 and the BFA shall, as a minimum, operate the M16A1 rifle satisfactorily over the temperature range limits of -25 to +125°F.	2.7	Met.
9	The firing of a blank cartridge with the orifice of the BFA restricted shall not cause damage to the rifle. (Safety hazards will be determined.)	2.8	Met.
10	No fragments shall be expelled in the area of the rifleman.	2.9	Met.

APPENDIX III - DEFICIENCIES AND SHORTCOMINGS

1. Deficiencies

None.

2. Shortcomings

Shortcoming	Suggested Corrective Action	Remarks
2.1 Firing M200 blanks with 20-round magazines resulted in stubbing rates up to 22%. During feeding from standard 20-round magazines, the blank cartridge would jam on the upper receiver (FSN 1005-017-9542) adjacent to the feed-ramp area of the barrel extension. It appears that this is caused by the M200 blank cartridge being shorter than standard 5.56-mm ball ammunition.	The M200 blank cartridge should be lengthened to equal the standard 5.56-mm cartridge (similar to the M82 blank cartridge for the 7.62-mm M14 rifle) to reduce stubbing.	None.

3. Corrected Deficiencies and Shortcomings

None.

4. Previous Deficiencies

None.

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DEPARTMENT OF THE ARMY Mr Crider/sr/234-3350-3608
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC

27 OCT 1970

SUBJECT: Test Directive for Check Test of Blank Firing Attachment (BFA) for M16A1 Rifle, USATECOM Project Nos. 8-WE-620-015-001/002

Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-MT-D
President, US Army Infantry Board, ATTN: STEBC-MO

1. References.

a. APG Plan of Engineering Test of Blank Ammunition and Blank Firing Attachment, for XM16E1 Rifle, USATECOM Project No. 8-4-0250-01, March 1965.

b. USAIB Plan of Service Test of Blank Ammunition and Blank Firing Attachment, for XM16E1 Rifle, USATECOM Project No. 8-4-0250-02, April 1965.

c. Letter, HQ USATECOM, AMSTE-BC, 4 Dec 68, subject: Final Engineer and Service Test Reports for Blank Firing Attachment, XM15, and Cartridge, 5.56mm, Blank, XM200, for M16A1 Rifle, USATECOM Project Nos. 8-4-0250-01/02.

d. AMCTC Committee Meeting 3B-68, 16 April 1968, Item No. 5492, Type Classification Standard A of Cartridge, 5.56mm, Blank, M200.

e. Message, USAIB, AJIIS-P, 12-707, 141400Z Dec 63, Draft Characteristics (essential) of BFA for M16E1 Rifle, Inclosure 1.

2. Background.

a. Reference 1c concluded that XM15, BFA, with Blank Cartridge, XM200, was unsuitable for US Army use due to fouling of the rifle gas tube. Subsequently, only the cartridge was type classified Standard A as a separate item, reference 1d. Tests by Frankford Arsenal (FA) indicate that the fouling problem has been corrected.

b. By direction of Product Manager, Rifles (PM-RS), competitive tests are now being conducted by USA Weapons Command (USAWECOM) with an objective of selecting a single design for TECOM tests.

c. Background details are available in the references.

3. Description of Materiel.

The inclosed photograph represents the WECOM design. Other designs are very similar with minor differences in metallurgical characteristics. The current design uses low carbon steel for the body and a free machining stainless steel for the restrictor tube. The BFA attaches to the flash hider. The restrictor tube screws up flush with the muzzle face so as to secure the BFA to the rifle. A hole in the center of the restrictor tube provides the controlled pressure that enables weapon functioning.

4. Test Objectives.

a. Determine physical and technical characteristics at ambient, intermediate, cold and hot dry temperature conditions as defined in AR 70-38.

b. Determine if deficiencies and shortcomings previously reported have been adequately corrected.

c. Determine if the XM15E1 BFA with M200 Blank Cartridge is suitable for US Army use.

5. Responsibilities.

a. CO, APG is responsible for preparation of test plan, execution of test and publication of final report on engineering type tests.

b. President, USAIB is responsible for preparation of plan, execution of test and publication of final report on service type tests at ambient temperatures.

6. Special Instructions.

a. The XM15E1 BFA is a new design compared to the XM15 previously tested. In view of this, a comprehensive test is required. Testing is not restricted to assessment of problem areas previously encountered.

b. The subtests in references 1a and b are considered adequate when updated in accordance with present procedures and regulations.

c. Estimated delivery of test items is 7 Dec 70. Early completion of tests is urgent; the test program will not exceed 3 months from test initiation to receipt of report at this headquarters.

d. Early planning estimates were provided to PM-RS as follows:

(1) For APG:

(a) Weapons - 10 M16A1 Rifles w/BFA

(b) Ammunition - 50,000 rounds M200 Blank

(c) Cost -

(2) For USAIB:

(a) Weapons - 10 M16A1 Rifles w/BFA

(b) Ammunition - 30,750 rounds M200 Blank

e. Confirmation of the above is required within 20 work days after receipt of this directive per TECR 70-8.

f. By design, no specific maintenance is required. As a result of firing with the BFA assembled to the rifle, any difference noted between firing the blank as opposed to firing ball ammunition will be reported under the maintenance subtest.

g. Reference 1e contains currently available criteria and will be used as a basis for determining suitability.

h. This task is a suitability test. USATECOM priority 3 and project numbers are assigned as follows:

(1) APG - 8-WE-620-015-001

(2) USAIB - 8-WE-620-015-002

7. Safety.

Several thousand rounds of cartridge, blank, M200 has been fired using the BFA as depicted by Inclosure 2. It is anticipated that a safety release for shoulder fire will be issued directly to USAIB from this headquarters upon receipt of test results from WECOM. Safety tests such as, noise level, screen perforation, fouling and firing of bulleted round with BFA assembled are required.

8. Test Plan and Reports.

Formal test plans and reports are required in accordance with the established schedule. Test plan receipt by COB 7 Dec 70 is required.

AMSTE-BC 27 OCT 1970

SUBJECT: Test Directive for Check Test of Blank Firing Attachment (BFA) for M16A1 Rifles, USATECOM Project Nos. 8-WE-620-015-001/002

9. Coordination.

Due to the urgency expressed by PM-RS, there is no formal coordination required by the test agencies. This command will coordinate the plans as required.

10. Security.

Test plans and reports will be unclassified.

FOR THE COMMANDER:

V. Kovalevsky

V. KOVALEVSKY
Colonel, GS
Dir, Inf Mat Test Dir

4 Incls w/d
1. Draft Reg
2. Photograph
3. TRMS
4. Dist List

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AMSTE-BC

FOR STEBC-TE-SA, STEAP-MT-TI (MAILED): INFO AMCPM-RS

SMUFA-J9100

SUBJ: Check Test of BFA for M16A1 Rifle

1. Malfunction rates at APG particularly with 20 round magazine substantially exceeds that reported by USAIB. Probable cause requires investigation of interface weapon to magazines but does not appear relatable to the BFA as such. Details have been provided AMCPM-RS verbally.

2. Following actions are directed:

a. For USAIB - Ship weapons, magazines, and associated BFA's to APG, ATTN: STEAP-MT-TI Mr Doilney. Tag each element with historical record of rounds fired, rates of

CHARLES L. CRIDER, PO, AMSTE-BC 2175

V. KOVALEVSKY, COL, GS, Dir, Inf 4476

UNCLASSIFIED

fire, and cycles for each magazine.

b. For APG -

(1) Investigate relationship between twenty-round and thirty-round magazines as contributing to interface feeding problems of blank ammunition.

(2) Investigate differences between systems tested at USAIB and your systems that could contribute to unacceptable stubbing malfunction rate.

(3) The results are to be included in the final report.

V. KOVALEVSKY, COL, GS, Dir, Inf 4476

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APPENDIX V - REFERENCES

1. Test Directive, USATECOM, AMSTE-BC, Check Test of Blank Firing Attachment (BFA) for M16A1 Rifle, USATECOM Project Nos. 8-WE-620-015-001/-002.

2. Equipment Performance Report No. (K-2)-1, 22 February 1971.

3. Orzech, P., Test Plan on Check Test of Blank-Firing Attachment for M16A1 Rifle. USATECOM Project No. 8-WE-620-015-001. Aberdeen Proving Ground. January 1971.

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APPENDIX VI - ABBREVIATIONS

AMCTC	= Army Materiel Command Technical Committee
APG	= Aberdeen Proving Ground
BFA	= blank-firing attachment
FA	= full automatic
GM	= General Motors Hydramatic Division
H&R	= Harrington & Richardson
pos	= position
SA	= semiautomatic
std dev	= standard deviation
TECR	= Test and Evaluation Regulation
USAIB	= US Army Infantry Board
USATECOM	= US Army Test and Evaluation Command
USAWECOM	= US Army Weapons Command

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APPENDIX VII - DISTRIBUTION LIST

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Aberdeen Proving Ground, Maryland 21005

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11. SUPPLEMENTARY NOTES
None

12. SPONSORING MILITARY ACTIVITY
USAWECOM

13. ABSTRACT

The check test of the blank-firing attachment for the M16A1 rifle was conducted by the Materiel Testing Directorate of Aberdeen Proving Ground from 21 December 1970 to 9 April 1971. The purpose of the test was to determine if the XM15E1 attachment with the M200 blank cartridge is suitable for US Army use. The testing covered physical characteristics, safety, durability, climatic operation, and effectiveness of the attachment in simulating firing of standard ammunition. The XM15E1 attachment, with 20-round magazines had stubbing rates up to 22.6%, and 2.9% with 30-round magazines. The XM15E1 attachment met the criteria for physical characteristics, safety, durability, climatic operation, and the simulation of firing standard ammunition. It was determined that the stubbing was due to the short length (when compared to standard M193 ball ammunition) of the M200 blank using standard 20-round magazines. It was concluded that the XM15E1 attachment met the required criteria.

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

Unclassified
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Blank-firing attachment (XM15E1) M16A1 rifle 5.56-mm ammunition M200 blank ammunition M193 ammunition						

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

AMSTE-BC

14 MAY 1971

SUBJECT: Suitability for Use of Blank Firing Attachment, XM15E1, for M16A1 Rifle, USATECOM Project No. 8-WE-620-015-001/002

Project Manager, Rifles
US Army Weapons Command
Rock Island, Illinois 61201

1. References:

a. AMCTC Committee Meeting 3B-68, 16 April 1968, Item No. 5492, Type Classification Standard A of Cartridge, 5.56mm, Blank, M200.

b. Letter, HQ USATECOM, AMSTE-BC, 4 Dec 68, subject: Final Engineer and Service Test Reports for Blank Firing Attachment, XM15, and Cartridge, 5.56mm, Blank, M200 for M16A1 Rifle, USATECOM Project No. 8-4-0250-01/02.

c. Message, USAIS, AJIIS-P, 12-707, 141400Z Dec 63, Draft Characteristics (essential) of BPA for M16E1 Rifle.

d. Letter, HQ USATECOM, AMSTE-BC, 19 Feb 71, subject: Check Test of Blank Firing Attachment (BFA) for M16A1 Rifle, USATECOM Project No. 8-WE-620-015-002.

e. Message, DA, OACSFOR-SD-FS, 201757Z Apr 71, subject: Blank Firing Attachment (BFA) for M16A1 Rifle.

f. Frankford Arsenal Report, R-1946, Feb 70, subject: Elimination of Gas Tube Fouling in the M16A1 Rifle When Using the M200 Blank Cartridge.

2. Approval Statement. The check test reports are approved.

3. Background.

a. The Blank Firing Attachment (BFA), XM15E1, for the M16A1 Rifle consists of a low carbon steel box-shaped body with a stainless steel restrictor tube. It weighs 2.6 ounces. The BFA attaches to the flash hider. The restricter tube screws up flush with the muzzle face so as

to secure the BFA to the rifle. A hole in the center of the restrictor tube provides the controlled pressure that enables weapon functioning.

b. In April 1968, the M200 Blank Cartridge was type classified as Standard A, but was necessarily restricted to a single-shot, manually operated mode of fire because the BFA was not available, ref 1a. In Dec 1968, engineering and service test of the BFA, XM15, were conducted using the standard M200 Blank Cartridge. After firing about 3,000 rounds, it was reported that the weapon became inoperative due to gas tube fouling. It was concluded that the system (BFA with M200 Cartridge) was unsuitable for Army use, ref 1b. Frankford Arsenal (FA) determined that the cartridge waterproofing scalant caused the fouling problem, imposed a product improvement, and verified its effectiveness, ref 1f. To simplify assembly and disassembly of the BFA to the rifle, USAWECOM redesigned the BFA and submitted it for this check test as an XM15E1. The product improved M200 Blank Cartridge was utilized throughout.

c. Check tests were conducted at Aberdeen Proving Ground (APG) during the period 21 Dec 1970 to 9 April 1971 and utilized ten BFA's for a total expenditure of 35,000 rounds. Tests by USA Infantry Board (USAIB) were conducted during the period 1 Dec 1970 to 4 Jan 1971 and utilized nine BFA's for a total expenditure of 31,000 rounds. Reference 1d forwarded the USAIB report for information only.

d. These tests were conducted in accordance with the approved test plans. The USAIB plan was approved by the USA Combat Developments Command.

e. By AR 71-6, low density, expendable items are exempt from normal type classification action. Department of the Army now considers that the BFA, XM15E1, falls within this category, ref 1e. USAWECOM has been designated as the releasing agency, and the first production run has been initiated.

4. Test Results:

a. All twelve requirements of reference 1c were met. No deficiencies and no shortcomings were reported.

b. Safety. The BFA is safe to use with the M16A1 Rifle, provided that adjacent personnel are no closer than 36 inches from the muzzle. When closer than 36 inches, propelled residue can cause skin or eye damage.

c. Maintainability. The BFA was easily maintained. Maintenance of rifles fitted with the BFA and firing the blank cartridge was the same as for rifles firing the standard ball cartridge.

d. Reliability/Durability. All eight BFA's successfully completed the 5,000 round endurance test.

5. Comments.

a. Although not associated with the BFA, differences in malfunction rates using 20 round magazines were reported between USAIB and APG. Excluding one weapon as possibly being non-representative, the USAIB malfunction rate of 2.6 percent was within the acceptable level of 3 percent (see page 2-8, ref 1d) as compared to 10.5 percent at APG (see page 11). Feeding failures (stubbing) accounted for 10 percent of malfunctions at APG and 0.8 percent at USAIB and were attributed to the blank cartridge's being shorter than the standard cartridge. To further isolate the cause of the feeding malfunction, two additional weapons were fired in the endurance phase, Table 2.4-II, page 11. A discussion of dimensional differences in weapon feed ramp lips which explains the difference in blank cartridge malfunction rates between USAIB and APG is contained in the APG report (pages 11-15).

b. In addition to twenty round magazines, APG used thirty round magazines. The overall malfunction rate with this magazine was 2.3 percent. The feeding failures (stubbing) malfunction rate was 1.8 percent. A discussion of the differences between 20 and 30 round magazines which can explain the lower malfunction rate is contained in the APG report (pages 11-15); the 30-round magazine presents the blank round to the feed ramp higher and more firmly, as the bolt strips the blank cartridge out of the magazine.

c. This command has been informed that the production BFA will have a case hardened body to improve the structural integrity of the BFA when fired at rates beyond the established requirement. Product improvement tests both destructive and nondestructive, at the USA Weapons Command, have revealed no differences in functioning or safety.

6. Conclusion. The Blank Firing Attachment, XM15E1, is suitable for US Army use.

7. Recommendation. The M200 blank cartridge be lengthened to equal

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SUBJECT: Suitability for Use of Blank Firing Attachment, XM15E1, for M16A1 Rifle, USATECOM Project No. 8-WE-620-015-001/002

the standard ball cartridge to reduce the frequency of stubbing. (The US Army Munitions Command has initiated correction action.)

FOR THE COMMANDER:

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1 Incl
APG Report, USATECOM
Proj No. 8-WE-620-015-001

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