



DEPARTMENT OF THE ARMY
ABERDEEN PROVING GROUND Mr. Brundiek/gab/870-2711
ABERDEEN PROVING GROUND, MARYLAND 21005

26 JUN 1972

STEAP-MT-I

SUBJECT: Final Letter Report of Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001, Report No. APG-MT-4089

Commanding Officer
US Army Small Arms Systems Agency
ATTN: AMXAA-WS
Aberdeen Proving Ground, Maryland 21005

1. REFERENCES:

a. Letter, TECOM, AMSTE-BC, Customer Test Directive: Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001/002, 19 January 1972.

b. Letter, USASASA, AMXAA-WS, Subcaliber Training Device (.22 LR) for the M16A1 Rifle, 11 November 1971.

c. Letter, MTD, STEAP-MT-I, Test Plan Outline for Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001/002, 8 February 1972.

d. Code A, Operator's Manual.

e. Code B, Operation and Maintenance Manual (Temporary).

2. BACKGROUND:

The subcaliber training device allows the firing of caliber .22, long rifle, rimfire ammunition in the M16A1 rifle. Basic training in weapon

This document is marked for OFFICIAL USE ONLY solely because of the inclosure of a Code Sheet. When the Code Sheet is removed, protective marking will be cancelled.

MANUFACTURERS' CODE SHEET, CONTAINED WITHIN THIS REPORT, WILL BE REMOVED PRIOR TO DISTRIBUTION OUTSIDE THE DEPARTMENT OF DEFENSE.

~~FOR OFFICIAL USE ONLY~~

Digitized by:

STEAP-MT-I

SUBJECT: Final Letter Report of Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001, Report No. APG-MT-4089

b. Accuracy. Sight-adjustment, accuracy, and velocity data are summarized in Table 4-I.

Table 4-I. Summary of Accuracy (50-Meter Range) and Velocity Firings^a

Mfr	Sight Adjustment ^b		ES	CI		Velocity ^c		
	Horiz	Vert		H	V	Min	Max	Mean
Code A	0	10	5.0	-0.1	2.1	822	1136	995
Code B	-1	9	4.5	.6	2.4	919	1143	1035

^aThe data summarized in the table are for three 10-shot groups from each of six devices per contractor.

^bSight adjustment is in clicks from mechanical zero.

^cVelocities are instrumental, at a point 15 feet from the muzzle, in feet per second.

c. Functioning Performance. Three each Code A and Code B devices were fired 1000 rounds each. After 250 rounds the devices were inspected and lightly oiled. Inspection showed much propellant residue; this had no adverse effect on the free movement of the bolt, the firing pin, or the extractors but did cause binding of the recoil-spring guide in its well (in the Code B devices).

After 500 rounds the devices, the magazines, and the rifles were inspected. The propellant residue was heavier, but the devices were still operational. Cleaning of the devices with bore cleaner, brushes, and patches was accomplished satisfactorily except for the recoil-spring guide hole of the Code B device; it was necessary to use a sharp tool or reamer to remove the propellant residue which had been deposited. The next 500 rounds of firing produced similar results. Table 4-II is a summary of malfunctions.

STEAP-MT-I

SUBJECT: Final Letter Report of Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001, Report No. APG-MT-4089

Table 4-II. Summary of Malfunctions during Functioning and Performance

<u>Type of Malfunction</u>	<u>Code A</u>	<u>Code B</u>
FF	14	11
FFR	6	5
FJ	3	6
F2R	13	6
FBF	-	3
FRA	1	1
Total	37	32

The firing of two rounds on one trigger pull is a malfunction which is associated with short recoil and the basic design of the M16A1 trigger. This point needs further investigation, however. Failure of the bolt to go forward (FBF) occurred with each Code B device. The diameter of the recoil-spring guide hole in the bolt was decreased by deposits of combustion residue, which caused binding of the guide. The right extractor failed to remain in assembly in the same Code A device as during hand-cycling.

In the Code B device the failure of the part to remain in assembly (FRA) malfunction is attributable to the right barrel assembly pin of the device.

d. Various Orientations. In the various orientations subtest, cleaned devices were compared with devices fired 500 rounds in the functioning performance subtest without cleaning. Table 4-III is a summary of malfunction data.

STEAP-MT-I

SUBJECT: Final Letter Report of Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001, Report No. APG-MT-4089

Table 4-III. Summary of Malfunction Data Obtained during Various Orientations Test

Type	Elevation, degrees					
	0		60		-60	
	<u>C</u>	<u>U</u>	<u>C</u>	<u>U</u>	<u>C</u>	<u>U</u>
Code A Devices						
FF	-	-	2	1	1	2
FFR	-	1	1	1	1	3
F2R	2	-	3	3	6	6
Code B Devices						
FF	2	1	-	2	1	-
FFR	1	2	-	5	1	-
FJ	1	4	-	2	1	1
F2R	2	-	-	-	-	1
FX	-	-	-	-	-	1

The "cleaned" devices (C) were fired 300 rounds each in this test and the "uncleaned" devices (U) were fired 300 rounds in addition to the 500 previous rounds, with a light oiling after the first 500 rounds. Both the Code A and Code B devices were still operational.

The design of the Code B devices indicated a likelihood of deformation of the firing-pin guide by rifle-hammer impacts in dry firings; this may result in restriction or jamming of the firing pin. One device which had been previously fired a total of 1340 rounds was therefore subjected to a dry-firing test; however, 500 dry firings had no adverse effect on the free movement of the firing pin.

4. CONCLUSIONS:

It is concluded that:

a. Both device models are considered to be safe to fire; however, a potentially unsafe condition is associated with the Code A device, which necessitates the use of an ejector-equipped magazine to discard a round withdrawn from the chamber (para 4.a and 2.3).

STEAP-MT-I

SUBJECT: Final Letter Report of Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001, Report No. APG-MT-4089

b. The malfunction rates of the two models of devices exceed the allowable rate of 9 in 6000 rounds, specified for the basic M16A1 rifle in Military Specification MIL-R-44587 (Table 4-II).

5. RECOMMENDATIONS:

It is recommended that:

a. The Code A device in its present design not be used unless the potential safety hazard is corrected.

b. The Code B device be considered favorably for further evaluation, as a training device.

FOR THE COMMANDER:



R. P. WITT
Associate Director
Materiel Testing Directorate

2 Incl

1. Details of Test
2. List of Abbreviations

Copies furnished:

CG, TECOM, APG, Md. 21005, ATTN: AMSTE-BC (10 cys)

CO, APG, APG, Md. 21005, ATTN: STEAP-TL (1 cy)

STEAP-MT-X (1 cy)

STEAP-MT-I (5 cy)

Cmdr, DDC, Alexandria, Va. 22314, ATTN: Docu Svc Ctr (2 cys)

Secondary distribution is controlled by US Army Small Arms Systems Agency, ATTN: AMXAA-WS.

DETAILS OF TEST

1. INTRODUCTION

Six each devices manufactured by Code A and Code B were tested and fired in accordance with the test plan outline. The final inspections of the Code B devices indicated a possibility of firing-pin binding from dry firing; therefore, in addition to the firing directed by the test plan outline, one of the Code B devices was dry-fired 500 times. The Code A devices were fired a total of 5092 rounds; the Code B devices were fired a total of 5132 rounds.

The ammunition used in all firings was cartridge, caliber .22, ball, long rifle, lot RA 5668.

2. INITIAL INSPECTION AND SAFETY EVALUATION

2.1 Objective

The objective was to determine the completeness, the physical characteristics, and the functioning of the test items.

2.2 Method

a. The subcaliber training devices were cleaned and visually inspected, with particular attention being directed towards determining whether any safety hazards existed or could be unknowingly created.

b. Measurements and photographs, as required, were obtained. As a minimum, the firing-pin protrusion, the headspace, and the lengths of the springs were measured.

c. The devices were magnetic-particle inspected for cracks.

d. The devices were assembled to the rifles and a full magazine of ammunition was hand-cycled. The extracted cartridges were inspected for deformation and shaving of lead from the bullets.

e. One magazine complement was hand-cycled through each weapon with the weapon in 90° depression, for a determination of firing-pin inertia effects.

f. The following tests were conducted after the various orientations subtest (para 5.) with one device from each supplier:

1) With a live round chambered, a second round was fed from the magazine and into the base of the chambered round. This was repeated 10 times.

2) With a bullet lodged in the bore, the rifle was loaded with one cartridge and fired remotely.

2.3 Results

The visual inspection of the Code A devices showed the over-all appearance of the components to be highly satisfactory; however, the ejector is an integral part of the magazine of this device. Unloading requires hand-cycling with the magazine in the rifle. This is highly unusual and is considered to be potentially hazardous. If the magazine is removed and the bolt is pulled back to clear the weapon in the usual manner, a cartridge will be pulled out of the chamber (and held by the two extractors) but will not be ejected. If this is not observed and the bolt is released, the cartridge will be chambered again.

The Code B devices showed tool marks and a rough surface in the chamber and bore of the barrels. The barrels were also leaded and fouled from previous firings. Photographs were taken of the complete devices (with the magazines), of the field-stripped devices and the magazines, and of the devices completely disassembled (Figures 2.3-1 through 2.3-6).

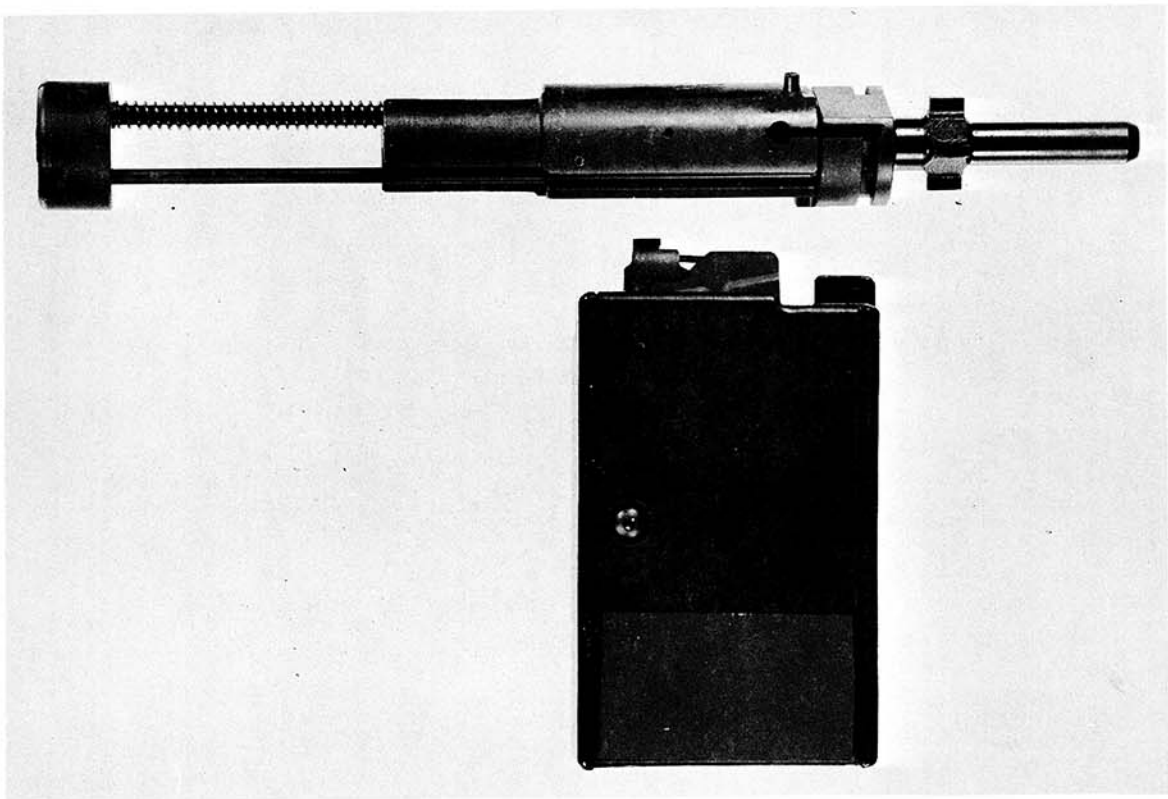


Figure 2.3-1: Code A Device with Magazine.

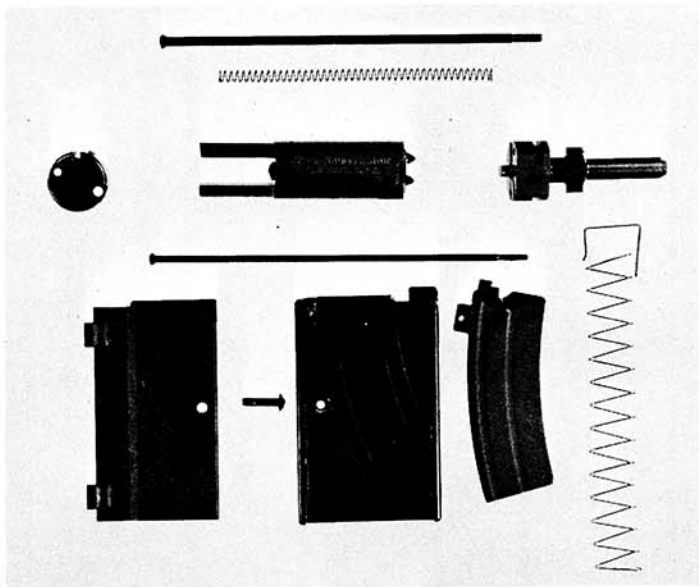


Figure 2.3-2: Code A Device and Magazine Field-Stripped.

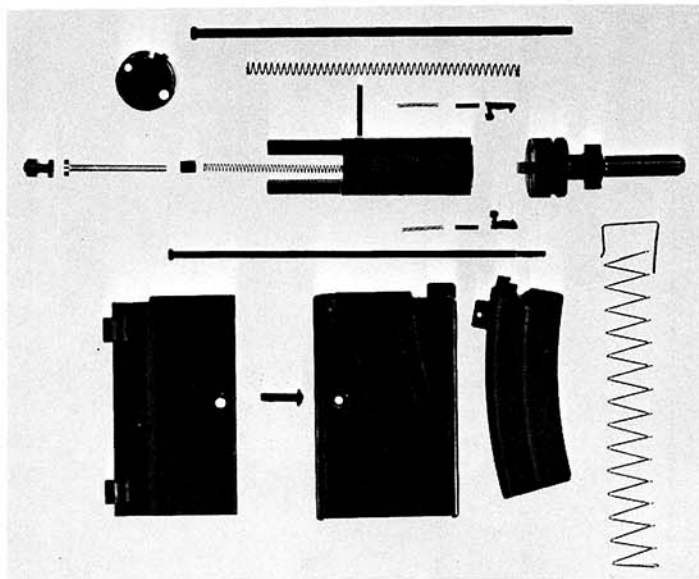


Figure 2.3-3: Code A Device and Magazine Completely Disassembled.

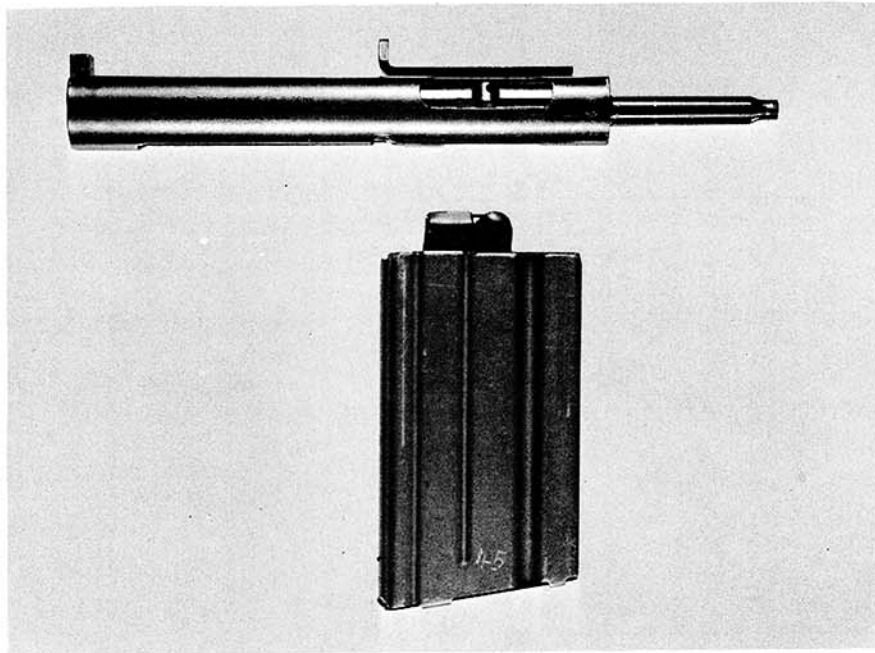


Figure 2.3-4: Code B Device with Magazine.

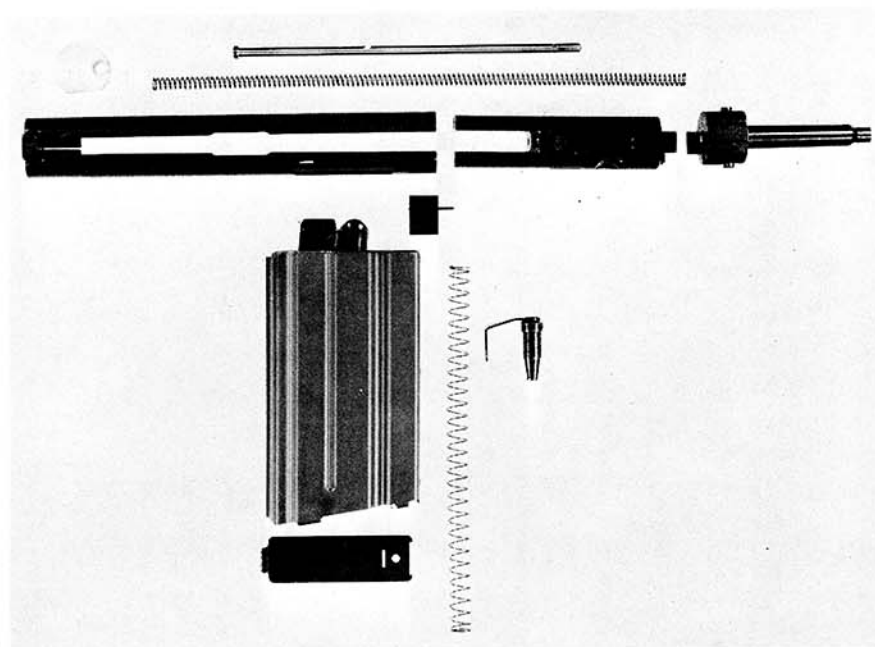


Figure 2.3-5: Code B Device and Magazine Field-Stripped.

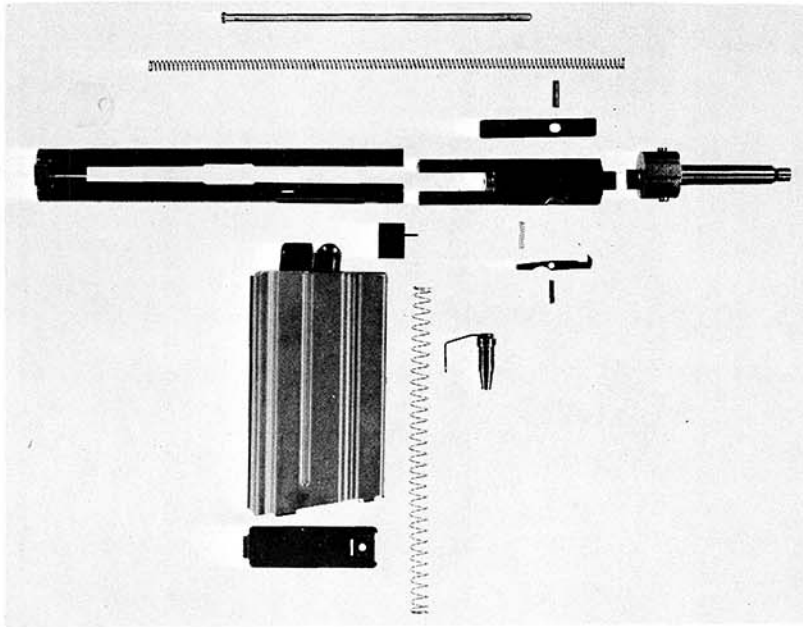


Figure 2.3-6: Code B Device and Magazine Completely Disassembled.

The weights are presented in Table 2.3-I.

Table 2.3-I. Weights^a

Code	Device ^b	Magazine	
		Empty	Loaded
A	10.5	5.75	6.9 (10 rounds)
B	13.0	4.6	6.5 (16 rounds)

^aAll measurements are in ounces.

^bThe replaced M16A1 bolt-carrier group weighs 11.5 ounces.

Measurements are given in Table 2.3-II. This table includes the measurements taken after completion of the firings.

The magnetic-particle inspection of the bolts and barrels showed no cracks.

The ammunition hand-cycled through each weapon was still in good condition and showed very light shaving of lead from the bullets.

Table 2.3-II. Measurements of Devices and Magazines^a

Device	Depth to the Recessed Bolt Face	Firing-Pin Protrusion	Action/Recoil Spring		RH Extr		Extr Spring		LH Extr		Firing-Pin Spring		Magazine Spring	
			Length	Number of Coils	Length	Number of Coils	Length	Number of Coils	Length	Number of Coils	Length	Number of Coils	Length	Number of Coils
A6	0.050	0.030	4.53	45.5	0.695	29.5	0.700	29.5	0.700	29.5	2.35	20.5	5.01	14.5
A12	.050	.030	4.47	45.5	.695	29.5	.695	29.5	.695	29.5	2.35	20.5	4.78	14.5
A13	.050	.030	4.43	45.5	.700	29.5	.700	29.5	.700	29.5	2.06	20.5	5.03	14.5
A16	.050	.030	4.50	45.5	.695	29.5	.695	29.5	.695	29.5	2.34	20.5	4.73	14.5
A23	.050	.030	4.48	45.5	.690	29.5	.700	29.5	.695	29.5	2.11	20.5	4.68	14.5
A25	.050	.030	4.42	45.5	.690	29.5	.700	29.5	.700	29.5	2.05	20.5	5.06	14.5
B31	.050	.050	8.75	109.3	.51	11.5	.51	11.5	.51	11.5	2.34	20.5	5.87	14.5
B34	.050	.050	8.70	109.8	.50	11.5	.50	11.5	.50	11.5	-	20.5	4.95	14.5
B36	.050	.050	8.73	109.7	.50	11.5	.50	11.5	.50	11.5	2.34	20.5	4.74	14.5
B45	.049	.049	8.70	109.7	.51	11.5	.51	11.5	.51	11.5	2.34	20.5	6.25	32.5
B57	.050	.050	8.68	109.8	.50	11.5	.50	11.5	.50	11.5	2.34	20.5	6.25	32.5
B58	.050	.050	8.73	109.7	.51	11.5	.51	11.5	.51	11.5	2.05	20.5	6.05	32.5
			8.75	109.8	.51	11.5	.51	11.5	.51	11.5	2.34	20.5	6.00	32.5
			8.68	109.5	.50	11.5	.50	11.5	.50	11.5	2.34	20.5	5.97	32.5
			8.75	109.5	.50	11.5	.50	11.5	.50	11.5	2.34	20.5	5.96	32.5
			-	-	-	-	-	-	-	-	-	-	6.03	32.5
			-	-	-	-	-	-	-	-	-	-	5.98	32.5
			-	-	-	-	-	-	-	-	-	-	5.95	32.5
			-	-	-	-	-	-	-	-	-	-	5.92	32.5
			-	-	-	-	-	-	-	-	-	-	5.93	32.5
			-	-	-	-	-	-	-	-	-	-	5.91	32.5

^aAll measurements are in inches, except for the numbers of coils.

^bMeasurement before test firings.

^cMeasurement after test firings.

Table 2.3-III contains data on malfunctions.

Table 2.3-III. Malfunction Data Obtained during Hand-Cycling

Device	Malfunction		Attributable To	Remarks
	Type	Number		
Weapon in 0° Elevation				
A6	-			
A12	-			
A13	-			
A16	FJ	2	Device	Extractors failed to hold cartridge
A23	FJ	1	Device	Extractors failed to hold cartridge
A25	-			
B31	FX	1	Device	Extracted on second try
B34	-			
B36	FX	1	Device	Extracted on second try
	FF	1	Magazine	Cartridge jumped out of magazine
B45	-			
B57	-			
B58	-			
Weapon in 90° Depression				
A6	FF	1	Magazine	Magazine follower binding
A12	FF	3	Magazine	Magazine opened and reloaded
A16	-			
A23	FRA	1	RH extractor	Ejected parts reinstalled
A25	-			
B31	FX	3	Device	Each cartridge was extracted on second try
B34	FX	2	Device	Each cartridge was extracted on second try
B36	-			
B45	FF	5	Magazine - 4 Repetitive	Magazine lip contours corrected
	FX	3	Device	Each cartridge was extracted on second try
B57	FX	2	Device	Each cartridge was extracted on second try
B58	-			

Feeding a second round from the magazine into the base of a chambered round results in little or no deformation of the base of the chambered round. It is unlikely that a cartridge may be fired by this action.

Firing a cartridge with a second bullet lodged in the bore in front of the chambered cartridge was accomplished without any damaging or hazardous effects in both a Code A and a Code B device. An examination of the cases fired under these conditions showed little evidence of the higher pressures which are assumed to have occurred during these firings.

2.4 Analysis

None.

3. ACCURACY

3.1 Objective

The objective was to determine the extreme spread of groups fired from the rifles with the device assembled.

3.2 Method

a. From a benchrest position at 50 meters one rifleman adjusted the sights on all rifles and directed fire to the target point of aim (6 o'clock position of a 6-inch bull's-eye). The final sight setting was recorded relative to the mechanical zero of the rifle, which was defined as:

- 1) Rear sight, centrally located on windage adjustment.
- 2) Front sight, positioned so the flange was flush.

b. Three 10-round groups were fired from each rifle. Velocity measurements were made concurrently with these firings.

3.3 Results

The results of adjusting the rifle sights, accuracy shooting, and velocity measurements are shown in Table 3.3-I.

Table 3.3-I. Adjustment Data, Center of Impact, Extreme Spread, and Instrumental Velocity

Device	Target	Sight Adjustment, clicks ^a		Center of Impact, in.		Spread, in.			Instrumental Velocity, at 15 Feet, fps		
		Horiz	Vert	H	V	ES	EHD	EVD	Min	Average	Max
A6	1	-2	+12	-0.8	0.6	3.8	2.7	3.6	924	978.3	1037
	2			-0.5	1.7	3.0	2.2	3.0	972	1046.6	1098
	3			-0.5	1.8	7.3	4.7	5.9	894	1030.2	1136
	Mean			-0.6	1.4	4.7	3.2	4.2	-	1018.4	-
A12	1	0	+ 6	-0.2	1.8	6.0	3.4	5.5	892	997.3	1090
	2			-0.3	1.9	7.9	2.3	7.8	822	999.5	1062
	3			+0.2	2.6	4.0	1.9	3.8	891	989.3	1076
	Mean			-0.1	2.1	6.0	2.5	5.7	-	995.4	-
A13	1	0	+10	+0.2	2.8	5.7	2.4	5.4	900	1004.5	1097
	2			+0.0	2.0	5.1	3.3	4.1	892	7030.4	1125
	3			+0.3	2.2	3.6	2.5	3.4	895	986.3	1115
	Mean			+0.2	2.3	4.8	2.7	4.3	-	1007.1	-
A16	1	-2	+ 2	+1.0	2.1	5.5	2.3	5.5	877	1002.3	1091
	2			+0.8	2.8	2.8	1.9	2.6	840	1023.1	1128
	3			+0.6	2.5	4.2	2.5	4.1	876	977.3	1056
	Mean			+0.8	2.5	4.2	2.2	4.1	-	1000.9	-
A23	1	0	+16	+0.0	1.8	4.7	4.5	2.9	911	1028.3	1112
	2			-0.2	0.1	5.9	1.4	5.8	858	976.2	1076
	3			-0.3	0.7	6.8	2.5	6.4	832	971.1	1076
	Mean			-0.1	0.9	5.8	2.8	5.0	-	991.9	-
A25	1	+3	+11	+0.1	2.6	4.5	3.1	4.4	829	923.2	1037
	2			-0.5	3.2	5.5	1.0	5.4	825	981.8	1094
	3			-1.2	4.0	4.1	1.1	3.9	894	988.5	1107
	Mean			-0.5	3.2	4.7	1.7	4.6	-	964.5	-
Average		0	+10	-0.1	2.1	5.0	2.5	4.6	-	995.4	-
B31	1	0	+ 2	+1.7	0.9	9.6	4.4	9.5	937	1039.0	1097
	2			+1.2	2.4	3.3	2.6	2.8	1043	1071.0	1085
	3			+0.9	2.9	5.9	3.1	5.8	962	1031.7	1143
	Mean			+1.3	2.1	6.3	3.4	6.0	-	1047.3	-
B34	1	-2	+ 6	+0.9	0.7	2.7	2.5	2.0	956	1006.6	1062
	2			+1.4	0.7	1.8	1.5	1.8	938	1009.0	1097
	3			+1.5	1.5	2.4	1.6	2.0	933	1018.1	1091
	Mean			+1.3	1.0	2.3	1.9	1.9	-	1011.2	-
B36	1	-3	+10	-0.2	3.9	6.7	3.2	6.5	968	1042.4	1100
	2			+0.1	2.2	6.5	4.4	6.5	919	1024.6	1090
	3			+1.2	2.9	5.8	3.5	5.4	970	1044.2	1114
	4			+0.4	3.0	6.3	3.7	6.1	-	1037.1	-

See footnote on following page.

Table 3.3-I (Cont'd)

Device	Target	Sight Adjustment, clicks ^a		Center of Impact, in.		Spread, in.			Instrumental Velocity, at 15 Feet, fps		
		Horiz	Vert	H	V	ES	EHD	EVD	Min	Average	Max
B45	1	+2	+22	+0.0	2.2	3.7	3.3	2.7	929	1012.3	1103
	2			+0.6	2.8	2.5	2.5	2.2	961	1055.7	1088
	3			-0.3	2.3	2.6	2.1	2.3	973	1020.5	1077
	Mean			+0.1	2.4	2.9	2.6	2.4	-	1029.5	-
B57	1	-5	+ 8	+0.1	3.9	6.9	6.1	4.9	996	1051.5	1134
	2			+0.8	3.4	5.5	5.5	4.3	975	1041.7	1083
	3			+0.7	3.3	3.5	1.9	3.5	944	1050.6	1098
	Mean			+0.5	3.5	5.3	4.5	4.2	-	1047.9	-
B58	1	+3	+ 7	+0.2	1.9	4.2	3.0	3.2	922	1015.1	1085
	2			+0.2	2.3	4.1	1.9	4.0	971	1044.8	1104
	3			+0.3	2.2	3.0	1.8	2.6	952	1044.0	1109
	Mean			+0.2	2.1	3.8	2.2	3.3	-	1034.6	-
Average		-1	+ 9	+0.6	2.4	4.5	3.0	4.0	-	1034.5	-

^aA plus (+) in front of the adjustment figures indicates that the point of impact had to be moved up or to the right. A minus (-) indicates the opposite direction.

3.4 Analysis

None.

4. FUNCTIONING PERFORMANCE

4.1 Objective

The objective was to determine the functioning performance of the devices when subjected to 1000 rounds of firing.

4.2 Method

Devices A12, A16, A23, B31, B36, and B57 were shoulder-fired (normally held) a total of 1000 rounds each. The devices were visually inspected after each 250 rounds, with cleaning and oiling being done as required. After the test the rifles with the devices were not cleaned, but were retained for use in the various orientations subtest (para 5.). In this test all six magazines were used in sequence with each device.

4.3 Results

At least 500 rounds can be fired with the Code A and Code B devices without cleaning. With the Code A devices the receiver of the M16A1 rifles shows more propellant residue, specially in the trigger housing and on the buffer plate. The Code B device largely retains the propellant residue deposits inside the device itself. Table 4.3-I contains data on malfunctions.

Table 4.3-I. Malfunction Data Obtained during Rounds 1 to 500 of Functioning Performance Test

Device	Malfunction		Attributable To	Remarks
	Type	No.		
A12	FF	2	Magazine	Follower binding
	FFR	2	Device	Light firing-pin indent on rounds
	F2R	3	System	Short recoil
A16	FF	6	Magazine	Follower binding
	FFR	1	Device	Light firing-pin indent on round
	F2R	1	System	Short recoil
A23	FRA	1	RH extractor	Disassembled extractor reinstalled
	FF	6	Magazine	Follower binding
	FJ	1	Device	Magazine failed to remain in position (ejector could not reach case)
FJ	1	Magazine		
B31	F2R	5	System	Short recoil
	FF	1	Magazine	Bullet stub on barrel (point too high)
	FJ	1	Device	In one case no firing-pin indent on round
	FFR	2	Device	
	F2R	1	System	Short recoil
FBF	1	Device	Combustion residue build-up in recoil-spring guide hole	
B36	FF	1	Magazine	Bullet stub on barrel
	FFR	1	Device	Light firing-pin indent on round
	F2R	1	System	Short recoil
B57	FF	4	Magazine and device	In one instance, short recoil
	FJ	5	Device	Short recoil
	F2R	1	System	
	FBF	4	Device (build-up in guide hole)	One and three repetitive
	FRA	1	RH barrel assembly pin	Device difficult to remove

After 500 rounds the devices and magazines were cleaned, inspected, and oiled. No special efforts were required in cleaning the devices with bore cleaner, brushes, and patches except for the recoil-spring guide hole of the Code B device. A special reamer should be supplied for the removal of combustion residue from the recoil-spring guide. This build-up cannot be removed with brushes. The residue build-up caused the reported FBF malfunctions.

The follower in the Code A magazines binds; this is probably caused by the sharp edge of the follower short guide. In most instances disassembly of the magazines is required for correction of the malfunction. In both devices the reported failures to fire (FFR's) are attributed to an incompletely closed bolt. Table 4.3-II contains malfunction data.

Table 4.3-II. Malfunction Data Obtained during Rounds 501 to 1000 of the Functioning Performance Test

Device	Malfunction		Attributable To	Remarks
	Type	No.		
A12	FJ	1	Device	
	FFR	2	Device	One light, one medium firing-pin indent
	F2R	1	System	Short recoil
A16	FFR	1	Device	Medium firing-pin indent
	F2R	1	System	Short recoil
A23	F2R	2	System	Short recoil
B31	FF	1	Magazine	Bullet stub on barrel
	FFR	1	Device	Light firing-pin indent
	F2R	1	System	Short recoil
B36	FJ	1	Device	Last round of magazine
	F2R	1	System	Short recoil
B57	FF	4	Magazine	Bullet stub on barrel
	FJ	3	Device	
	FFR	1	Device	No firing-pin indent
	F2R	1	System	Short recoil

After firing 500 rounds the devices were not cleaned but were visually inspected and lightly oiled. The devices and magazines were heavily fouled with propellant residue, but all parts moved freely.

During the functioning performance test the observed (fired two rounds on one trigger pull F2R) malfunctions with both Code A and Code B devices seem to be connected with short recoil and the basic design of the trigger mechanism in the M16A1 rifle; however, a kinematic study is required to definitely establish the cause of this malfunction.

4.4 Analysis

The allowable malfunction rate for the M16A1 rifle specified in Military Specification MIL-R-45587 is 9 in 6000 rounds (1.5 per 1000). The malfunction rate for the Code A and Code B devices, as shown in Tables 4.3-II and 4.3-III, were 37 and 32 per 1000 rounds respectively; thus, the malfunction rate of each of the devices far exceeds the allowable rate for the rifle.

The title of this subtest was changed from functioning reliability to functioning performance, since no reliability considerations were intended, in accordance with paragraph 5a(1) of the TECOM directive.

5. VARIOUS ORIENTATIONS

5.1 Objective

The objective was to evaluate functioning of the devices in various orientations. In this subtest three clean devices and three uncleaned devices from subtest 4, were fired for functioning.

5.2 Method

This was in three sections:

a. With the rifle held loosely (buttstock under the upper arm) at 0° elevation, each rifle was fired 100 rounds.

b. Each rifle was shoulder-fired 100 rounds at +60° elevation, with the rifles held normally.

c. Each rifle was shoulder-fired 100 rounds at -60° elevation, with the rifles held normally.

Methods b. and c. were alternated with the firing of each magazine.

5.3 Results

Tables 5.3-I and 5.3-II contain data on malfunctions.

Table 5.3-I. Malfunction Data Obtained during the Various Orientations Test

Device	Malfunction		Attributable To	Remarks
	Type	Number		
0° Elevation (100 Rounds Each)				
A6	F2R	1	System	Short recoil
^a A25	FFR	1	Device	Light firing-pin indent
A25	F2R	1	System	Short recoil
^a B31	FFR	1	Device	Light firing-pin indent
B34	FF	1	Magazine	Bullet stub on barrel
	FJ	1	Device	
	F2R	2	System	Short recoil
^a B36	FJ	1	Device	
B45	FF	1	Magazine	Bullet stub on barrel
^a B57	FF	1	Magazine	Bullet stub on barrel
	FJ	3	Device	
+60° Elevation (100 Rounds Each)				
A6	FFR	1	Device	Light firing-pin indent
	F2R	1	System	Short recoil
^a A12	FF	1	Personnel	Insufficient pullback of bolt
A13	FF	2	Magazine	Follower binding
	F2R	2	System	Short recoil
^a A16	F2R	3	System	Short recoil
^a A23	FFR	1	Device	Light firing-pin indent
^a B31	FF	1	Magazine	Bullet stub on barrel
	FJ	1	Device	
	FFR	4	Device	Very light firing-pin indent
B34	FF	1	Magazine	Bullet stub on barrel
^a B36	FFR	1	Ammunition	Heavy firing-pin indent
^a B57	FF	1	Magazine	Bullet stub on barrel
	FJ	1	Device	

Table 5.3-I (Cont'd)

<u>Device</u>	<u>Malfunction</u>		<u>Attributable To</u>	<u>Remarks</u>
	<u>Type</u>	<u>Number</u>		
-60° Elevation (100 Rounds Each)				
A6	FFR	1	Device	Light firing-pin indent
	F2R	3	System	Short recoil
^a A12	FF	1	Magazine	Follower binding
	F2R	2	System	Short recoil
A13	FF	1	Magazine	Follower binding
	F2R	1	System	Short recoil
^a A16	FFR	1	Device	Light firing-pin indent
A23	FF	1	Magazine	Follower binding
	FFR	2	Device	Very light firing-pin indent
	F2R	4	System	Short recoil
A25	F2R	2	System	Short recoil
^a B31	FX	1	Unknown	
	F2R	1	System	Short recoil
B34	FJ	1	Device	
^a B57	FJ	1	Device	
B58	FF	1	Magazine	Bullet stub on barrel
	FFR	1	Device	Medium firing-pin indent

^aIndicates uncleaned devices from functioning performance subtest.

Table 5.3-II. Malfunction Data Obtained during the
Various Orientations Test; Total of 300
Rounds of Each of Three Devices

Type of Malfunction	Number of Malfunctions			
	Code A		Code B	
	C	U	C	U
FF	3	3	4	3
FFR	2	5	2	7
FJ	-	-	2	7
F2R	11	9	2	1
FX	-	-	-	1
Total	16	17	10	19

After the devices had been cleaned, final inspection was performed and measurements were taken. The results of the measurements are in Table 2.3-I. The Code A devices were in good condition with very little signs of wear.

The Code B devices were in good condition too, but had a little more wear on the bolt. One point of wear was the part of the bolt which cocks the hammer during recoil. Another point was the area at both sides of the firing-pin slot, which is struck by the hammer during dry firing. The material is displaced into the firing-pin guide slot and it appeared likely that the firing pin may bind after many dry firings. One Code B device was therefore dry-fired 500 times; however, there were no adverse effects on the firing pin itself or its free movement in the guide slot.

The failures to feed in the Code B devices are attributable mostly to the magazines. The material appears to be too soft. The lips of the magazine do not stay in their original shape; this allows the bullet of the cartridge to feed too high, out of alignment with the chamber. A harder material for the magazine would improve the performance (and the military potential) of the Code B device.

It was found during the test firings of both devices that safety glasses should be worn, specially by a left-handed shooter, for protection from propellant particles.

LIST OF ABBREVIATIONS

C = cleaned devices
CI = center of impact (in inches) relative to the aiming point
EHD = extreme horizontal dispersion
ES = extreme spread, inches
EVD = extreme vertical dispersion
extr = extractor
FBF = failure of bolt to go forward
FF = failure to feed
FFR = failure to fire
FJ = failure to eject
FRA = failure of part to remain in assembly
FX = failure to extract
F2R = fired two rounds on one trigger pull
H = horizontal distance of center of impact to the aiming point
horiz = horizontal
LH = left-hand
mfr = manufacturer
RH = right-hand
U = uncleaned devices
V = vertical distance of center of impact to the aiming point
vert = vertical

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

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

1. ORIGINATING ACTIVITY (Corporate author) Materiel Testing Directorate Aberdeen Proving Ground, Maryland 21005		2a. REPORT SECURITY CLASSIFICATION Unclassified (FOUO w/Code Sheet)	
2b. GROUP			
3. REPORT TITLE MILITARY POTENTIAL TEST OF SUBCALIBER TRAINING DEVICE FOR M16A1 RIFLE			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final Letter Report 25 April to 19 May 1972			
5. AUTHOR(S) (First name, middle initial, last name) Hans H. Brundiek			
6. REPORT DATE June 1972		7a. TOTAL NO. OF PAGES 26	7b. NO. OF REFS 5
8a. CONTRACT OR GRANT NO. Not applicable.		9a. ORIGINATOR'S REPORT NUMBER(S) APG-MT-4089	
b. PROJECT NO. TECOM Project No. 8-WE-623-016-001		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
c.			
d.			
10. DISTRIBUTION STATEMENT Distribution limited to U. S. Government Agencies only; Test and Evaluation; June 1972. Other requests for this document must be referred to Commanding Officer, US Army Small Arms Systems Agency, ATTN: AMXAA-WS.			
11. SUPPLEMENTARY NOTES None		12. SPONSORING MILITARY ACTIVITY USASASA	

13. ABSTRACT
The military potential test of the subcaliber training devices (Code A and Code B) for the M16A1 rifle was conducted by the Materiel Testing Directorate from 25 April to 19 May 1972 at Aberdeen Proving Ground. The purpose of the test was to give the US Army Test and Evaluation Command a basis for safety release and to evaluate the military potential of the devices. Testing of six devices consisted of initial inspection and safety evaluation, accuracy, functioning performance, and various orientations. The Code A devices were fired 5095 rounds with 73 malfunctions. The Code B devices were fired 5132 rounds with 62 malfunctions. The malfunction rate recorded with both devices is considered to be excessive when compared with a service weapon and is therefore unsatisfactory. The basic design of the Code A devices with the ejector as a part of the magazine is considered to be potentially hazardous and undesirable in a military training device. The material of the Code B device and the hardness of the bolt, receiver, and magazine well should be improved.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Training device, subcaliber (.22) Conversion kit/device, M16A1 rifle Rifle, 5.56-mm, M16A1 Subcaliber .22 device						

TECOM PROJECT NO. 8-WE-623-016-001
FINAL LETTER REPORT ON MILITARY POTENTIAL TEST OF
SUBCALIBER TRAINING DEVICE FOR M16A1 RIFLE

Report No. APG-MT-4089

CODE SHEET

Code A - Colt Industries

Code B - Military Armament Corporation

(This code sheet is to be removed from this report when loaned or otherwise distributed outside the Department of Defense.)

FOR OFFICIAL USE ONLY

STEAP-MT-I

SUBJECT: Final Letter Report of Military Potential Test of Subcaliber Training Device for M16A1 Rifle, TECOM Project No. 8-WE-623-016-001, Report No. APG-MT-4089

familiarization and marksmanship can be accomplished with substantial savings in the cost of ammunition. Two different designs, Code A and Code B, were provided for the tests. Both devices work on the blowback principle and use a smoothbored adapter or barrel piece so the bullets move more than 2 inches and attain a considerable velocity before they reach the rifling of the M16A1 barrel. In all firearms such conditions are considered to be detrimental to both velocity and accuracy. The caliber .22 rimfire cartridge itself has some drawbacks when used in semiautomatic weapons. The soft lead bullet may be easily deformed or misaligned in the case. The shape of the cartridge, with a cylindrical body and a rim, makes it difficult to handle in box-type magazines.

3. OBJECTIVE:

The test objective was to provide a basis for issue of a safety release and an evaluation of operational performance.

4. SUMMARY OF RESULTS:

The test procedures employed were in accordance with the test plan outline, Reference 1.c. In addition, one Code B device was dry-fired 500 times. The detailed results of the test are in Inclosure 1.

The findings are summarized as follows:

a. Initial Inspection and Safety Evaluation. The Code A and Code B devices were complete, uniform in the dimensions checked by measurement, and free of cracks and visible defects.

The construction of Code A devices with the ejector as a part of the magazine involves an unusual procedure for unloading the rifle. Hand-cycling with the magazine in the rifle is mandatory in order to eject a live round which has been extracted from the chamber. Hand-cycling tests showed no adverse effects on the ammunition. During hand-cycling, the right extractor of one Code A device failed to remain in assembly.

In ten trials with one device from each of the two suppliers, a round was fed from the magazine and into the base of a live chambered round; no incidents of firing occurred.

Firing a cartridge with a second bullet lodged in the bore in front of the chambered cartridge was accomplished without any damaging or hazardous effects in the Code A and Code B devices.