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DEVELOPMENT AND PROOF SERVICES

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ABSTRACT

This report describes the tests of five AR15 rifles which incorporated the following modifications: the charging handle grip enlarged, the bolt closure-device plunger-head area increased, and three firing pins with inertia retarding devices. The weapons with modified parts were subjected to adverse conditions and endurance tests. Data recorded during testing indicate the charging handle and bolt closure device functioned satisfactorily; however, minor design and fabrication changes are recommended to increase the serviceability of the parts. A firing pin inertia retarding device appears to be unnecessary.

REPORT ON USATECOM PROJECT NO. 8-3-0030-08-F,

PRODUCT IMPROVEMENT TEST OF

MODIFIED AR15 RIFLES

REPORT NO. DPS-1276

Test Director: Franklin H. Miller
Infantry and Aircraft Weapons Division
Development and Proof Services
Aberdeen Proving Ground, Maryland
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REPORT ON USATECOM PROJECT NO. 8-3-0030-08-F,

PRODUCT IMPROVEMENT TEST OF

MODIFIED AR15 RIFLES

12 NOVEMBER TO 5 DECEMBER 1963

PART I - GENERAL

1.1 Authority

1.1.1 Directive. This test was authorized by USATECOM letter, 24 October 1963.

1.1.2 Purpose of Test. This test was conducted to evaluate the following modifications of the AR15 rifle:

a. Bolt closure device (two modifications).

b. Charging handle.

c. Firing pin (three modifications).

1.2 Description of Materiel

Modifications to the AR15 rifle (Figure 1) were as follows:

a. The size of the plunger cap of the bolt closure device was increased. Figures 2 and 3 show the first and second designs of this device. The second design incorporated a stronger plunger spring and the pawl tip was straight instead of beveled. The pawl hardness was increased from Rockwell C 43 to C 51 at the tip.

b. Modification of the charging handle (Figure 4) was made by enlarging the grip area so manual retraction of the bolt and carrier assemblies is easier.

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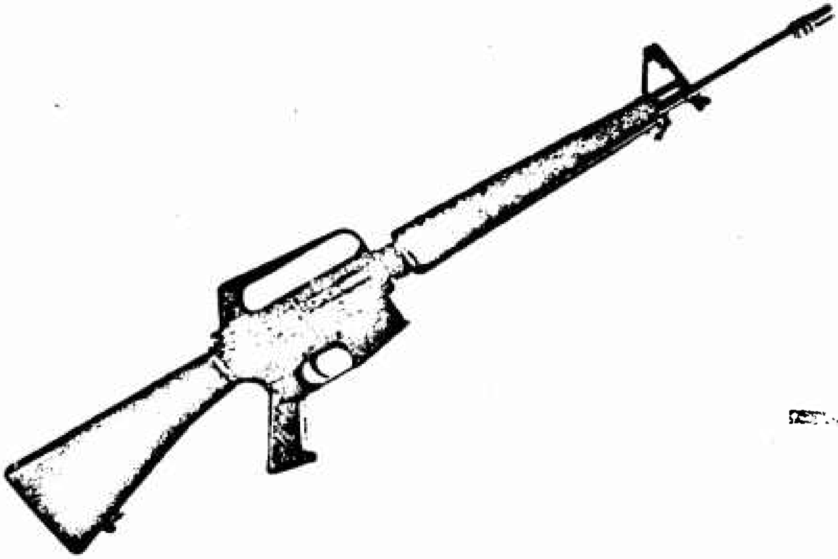

Figure 1: Modified AR15 Rifle.

Figure 2: Modified Charging Handle and Bolt Closing Devices for the AR15 Rifle.

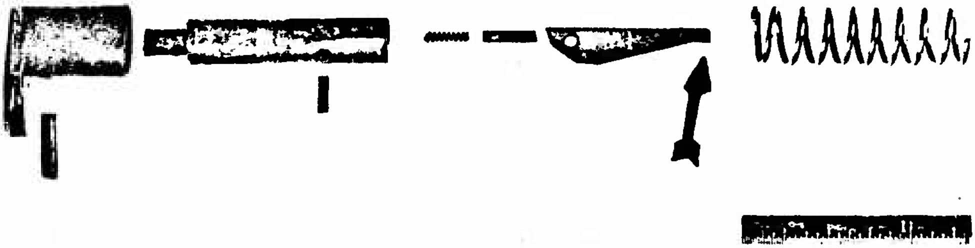

Figure 3: Second Design of Bolt Closure Pawl Assembly. The Pawl Tip and Plunger Spring Have Been Redesigned.

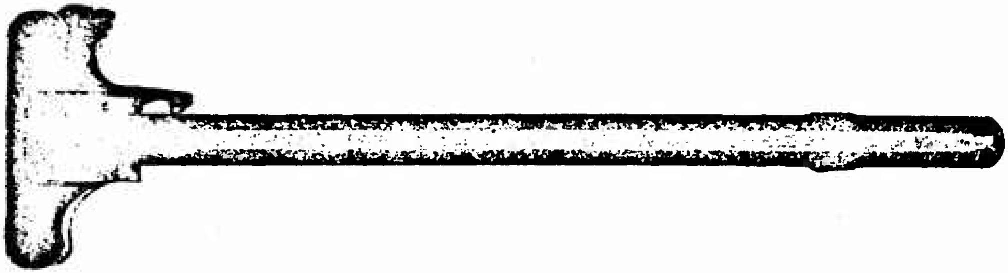

Figure 4: Charging Handle.

c. Firing pin modifications consisted of a firing pin with a lineally mounted helical compression spring, a bolt cam pin machined to accept a spring and plunger which protruded into the firing pin hole and exerted force on the 26° included angle of the firing body, and a bolt cam pin constructed similarly to the first design, but with the lower part of the firing pin hole modified by an eccentric relief cut, machined to a depth of 0.115 inch from both sides, leaving a narrow land midway of the hole, opposite the plunger. The retaining shoulder of the firing pin was reduced in thickness. Figures 5 through 7 compare the various retarding devices tested.

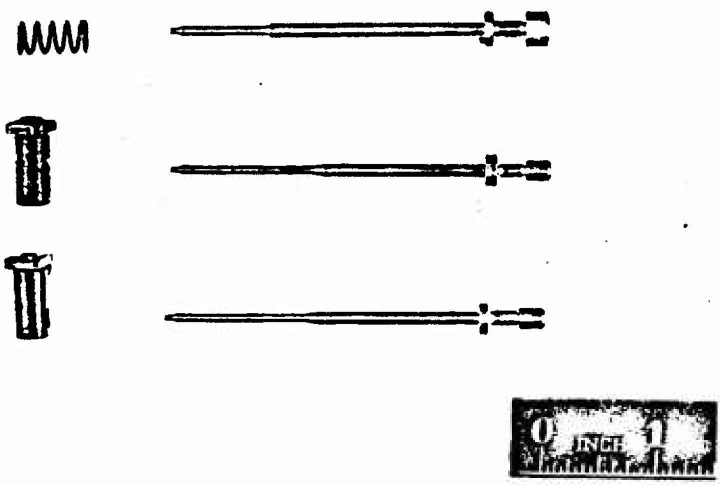

Figure 5: Three Modified Firing Pins for AR15 Rifle. TOP: Lineal Spring and Firing Pin. CENTER: First Friction Cam Pin and Firing Pin. BOTTOM: Second Friction Cam Pin and Firing Pin.

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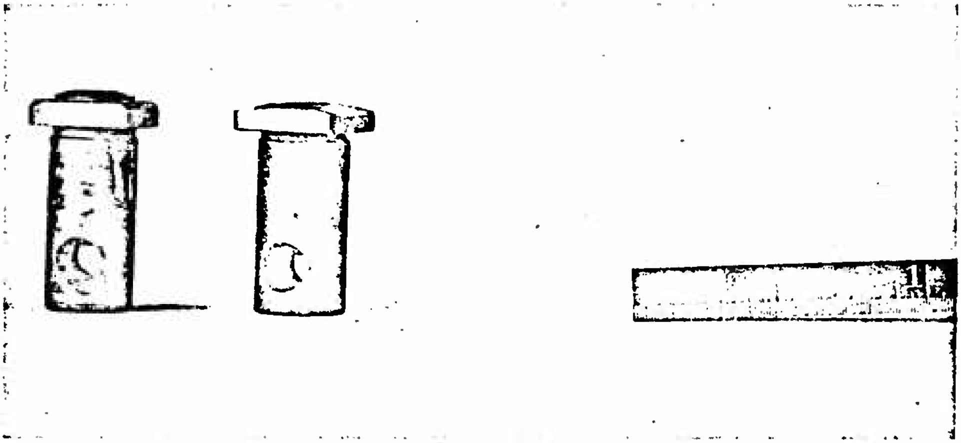

Figure 6: Two Modifications of Friction Cam Pins Showing Firing Pin Hole Differences.

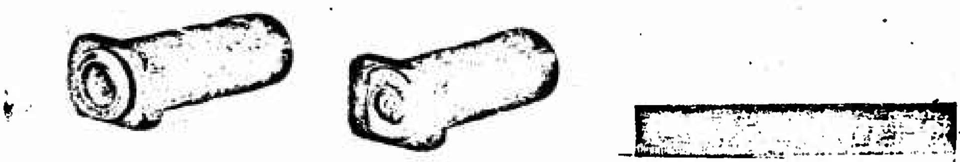

Figure 7: Two Different Modifications of Friction Cam Pins, Top View.

Ammunition used in testing was lot RA-5022.

The number of parts changes and parts increase in comparison with that of an unmodified AR15 rifle, so that it conforms to the modified configuration, are as follows:

a. Bolt closure device, parts changes, ten; parts increase, nine.

b. Charging handle, parts changes, three; parts increase, none.

c. Firing pin inertia retarding devices:

Parts changes, Type L, three; F1, four; F2, five.
Parts increase, Type L, one; F1, two; F2, three.

Firing pin modifications are designated as follows:

a. L - Firing pin and helical compression spring.

b. F1 - First design bolt cam pin and firing pin.

c. F2 - Second design bolt cam pin and firing pin.

1.3 Background

During previous testing of the AR15 rifle, the charging handle did not provide sufficient gripping area for manual bolt retraction under all conditions. Also, since chambering of a round is dependent solely upon the energy delivered by the action spring to the bolt, incorporation of a manually assisted bolt closing device was desirable to enable the shooter to chamber slightly deformed or dirty rounds and aid in locking if the rifle failed to function properly.

Tests conducted by the Air Force indicated the need of a device to control the free movement of the floating-type firing pin, thereby eliminating the possibility of unintentional firing due to firing pin contact with the cartridge primer during loading of the weapon.

Five AR15 rifles incorporating the modifications described in paragraph 1.2 were subjected to test.

1.4 Summary of Findings

Weakness of the bolt closure plunger spring permitted the bolt closure pawl to interfere with rearward travel of the bolt carrier during firing. This resulted in damage to the pawl and pawl retaining pin in each weapon. Failure of the pawl and the retaining pin occurred after firing an average of 1993 rounds in each weapon. A second design incorporating a stronger bolt closure plunger spring and a redesigned bolt closure pawl corrected the problem of short parts life. Figure 8 compares pawl tip deformation after completion of all firing. The bolt closure device successfully assisted the chambering of all rounds which failed to completely strip from the magazine during chambering, except rounds which were improperly positioned by the magazine so the bullet tips stubbed the front of the magazine. Release of the bolt to chamber these rounds resulted in a failure to chamber. Application of the bolt closure device forced the bullets into the case mouth, causing a short-round condition. This should not be considered a failure of the bolt closure device to function properly.

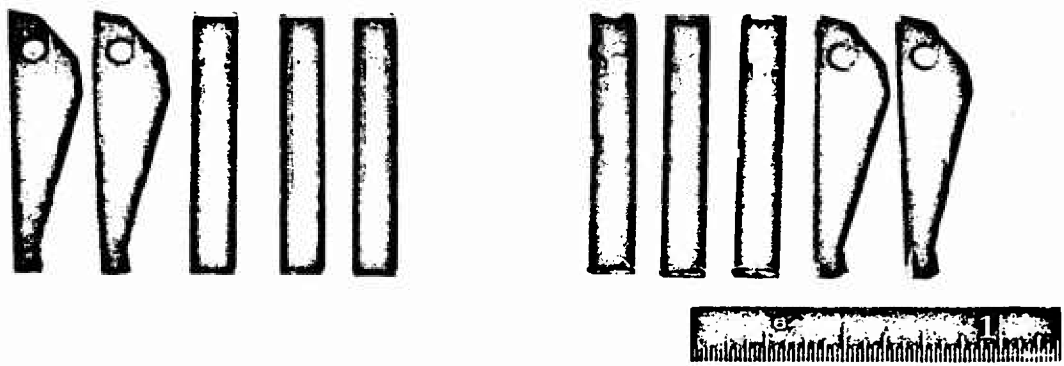

Figure 8: Bolt Closure Pawl Tip Deformation. Right, First Design. Left, Second Design.

The charging handle provides adequate gripping area to facilitate retraction of the bolt and bolt carrier assemblies; however, the 2-piece fabrication of this charging handle is unsatisfactory because of separation of the tang from the handle at the weld (Figure 9).

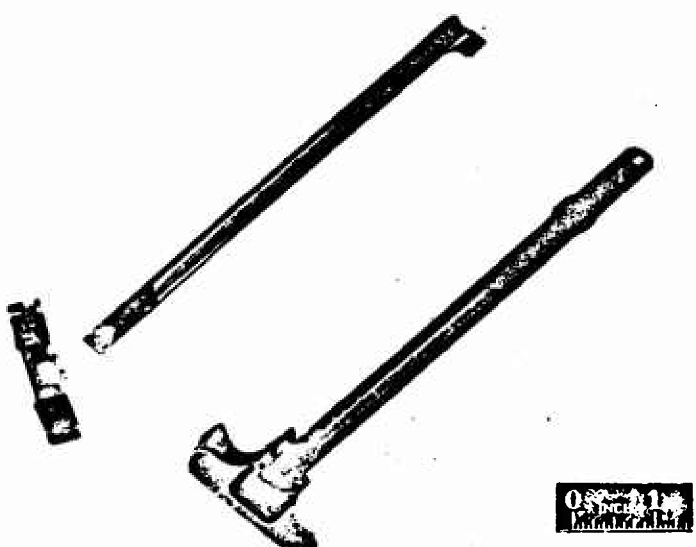

Figure 9: Broken Charging Handles Showing Separation of Tang from Handle at Weld.

Although the firing pin with the helical compression spring performed satisfactorily, energy develcped by this pin, when struck by the hammer, was reduced to a level below the present primer-sensitivity limit. The second bolt cam pin design permits greater impact energy when the firing pin is struck by the hammer and adequately controls inertial firing pin energy during chambering. Misalignment of the firing pin with the hole in the bolt face, caused by pressure of the bolt cam pin plunger on the firing pin, resulted in a damaged firing pin tip which caused pierced primers.

Three failures to fire occurred; however, they were not attributable to insufficient firing pin energy. Incomplete locking of the bolt group caused two failures; the other failure to fire was attributed to the ammunition. Firing pin indentation of the primer was normal and upon disassembly of the round it was noted that the inside of the case was blackened by partially burned powder.

No unintentional firing was experienced.

The majority of malfunctions encountered were attributed to failure of parts other than those submitted for test evaluation. The following standard parts caused malfunctions:

a. Magazines supplied with the test weapons failed to properly position the top five rounds of a fully-loaded magazine. The lips of the magazines became worn and deformed during firing, which caused feeding malfunctions.

b. The bolt catch spring was weak and allowed the bolt catch to function prior to being actuated by the magazine follower. During testing, 170 malfunctions of this type were observed.

c. The action spring failed to provide sufficient energy to the bolt carrier to accomplish first-round chambering on 156 occasions; however, these occurrences may be related to first-round bullet stubbing.

d. Three extractor springs broke after firing an average of 5443 rounds each.

1.5 Conclusions

It is concluded that:

a. The frequency of feeding and chambering malfunctions indicates the necessity of a positive method of manually assisting the forward movement of the bolt and bolt carrier assemblies. The bolt clesure device with 1.30-inch-long plunger spring and pawl with straight tip, hardened to Rockwell C 53, was adequate in performing its intended function (ref Figures 3 and 8 and Tables IV, V, and XV).

b. The modified charging handle design provides adequate means for retracting the bolt and bolt carrier assemblies; however, fabrication should be changed to avoid separation of the tang from the handle at the weld. No other malfunctions of the charging handle were observed (ref Figure 9 and Table XVII).

c. Test data do not indicate the need for a firing pin inertia retarding device. If it is determined that such a device is desirable, the firing pin with the helical compression spring appears more promising since damage to the firing pin tip is avoided. Additional development will be required to increase the striking energy of this type of firing pin when struck by the hammer (ref Figures 5, 6, and 7, Tables III, XIV, and XV, and Appendix C).

d. Life of the extractor spring was less than that of other spring components of the AR15 rifle. A minimum life expectancy of 6000 rounds is desirable (ref Table XVII).

e. The magazines supplied with the test weapons caused failures to feed and to chamber. Improper stacking characteristics of the top five rounds of a fully-loaded magazine and feed-lip wear and deformation caused feeding and chambering malfunctions (ref Table XVI).

f. Weakness of the bolt catch spring allowed functioning of the bolt catch before the last round was fired. A stronger spring is needed (ref Table XVI).

g. The energy delivered by the action spring to the bolt carrier during the loading cycle of the weapon appeared to be marginal (ref Table XVI).

1.6 Recommendations

It is recommended that:

a. The 1.30-inch-long bolt closure plunger spring and plunger pawl with straight tip, hardened to Rockwell C 53, be considered for adoption.

b. The configuration of the charging handle be considered satisfactory and that fabrication of this part be improved to exclude any possibility of separation of the handle from the tang.

c. A firing pin inertia retarding device not be considered necessary.

d. Extractor spring life be improved.

e. Strength of the bolt catch spring be increased.

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f. Magazine design be improved to eliminate improper cartridge stacking characteristics and the susceptibility of magazines to deformation of the feed lip.

g. The adequacy of the action spring to accomplish first-round chambering be investigated.

SUBMITTED:

FRANKLIN H. MILLER
Sp4, US Army
Test Director

REVIEWED:

S. A. DOILNEY
Chief, Small Arms and
Aircraft Weapons Branch

CLAUDE E. BROWN
Chief, Infantry and
Aircraft Weapons Division

APPROVED FOR THE DIRECTOR,
DEVELOPMENT AND PROOF SERVICES:

J. A. TOLEN
Assistant Deputy Director for
Engineering Testing

PART II - DETAILS OF TEST

2.1 Examination

2.1.1 Procedure. All weapons were disassembled and component parts were visually inspected for manufacturing defects. Firing-pin protrusion was measured with all firing pins in all rifles. The weights of the three different types of firing pins were compared. Using copper cylinders and the head space-gage type of cylinder-holding fixture supplied by the US Army Munitions Command, 50 firing pin indentation samples were taken with each weapon in two phases. Samples were taken with the weapon hand held vertically with muzzle down. A copper cylinder and its holder were inserted into the chamber and, in phase I, the bolt was released from the bolt latch. For phase II, the bolt was lowered slowly by the charging handle and was locked by actuating the bolt closing device. The hammer was released and struck the firing pin. Indent depth, measured in 0.0001 inch, was converted to inch-ounces of striking energy in accordance with an accepted conversion chart furnished by the US Army Munitions Command.

Bolt closure pawl hardness was taken. The free length of firing pin and bolt closure plunger springs was recorded.

2.1.2 Results. All weapons were in operating order. Tables I through V contain the measurements discussed in the procedure. Figure 10 shows the various parts of the AR15 rifle which were damaged by firing. General characteristics of the modified AR15 rifle are given in Figure 11.

Table I. Firing Pin Protrusion

Gun No.	Protrusion, in. Firing Pin Type			No. Rds Fired	Protrusion, in. Firing Pin Type		No. Rds Fired
	L	F1	F2		L	F2	
023209	0.030	0.032	0.032	0	0.031	-	6720
023239	.029	.033	.031	0	.030	-	6719
023205	.030	.031	.032	0	-	0.032	5219
023216	.033	.032	.032	0	-	.032	6100
023217	.030	.032	.031	0	-	.032	6084

Table II. Firing Pin Weight

Pin Type	Weight,[a] lb
L	0.2
F1	.2
F2	.2
Standard	.3

[a]Average weight for five pins.

Table III. Firing Pin Energy (Inspection Phase, 50 Samples)

	Gun No. 023209		023239		023205		023216		023217	
	Energy, inch-ounce									
	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike
Pin Type: Standard.										
Maximum	7.0	69.0	5.0	75.0	5.0	72.0	6.5	73.5	5.5	73.5
Minimum	3.0	52.5	3.5	56.5	3.5	60.5	3.5	59.0	3.5	57.5
Average	4.6	61.5	4.2	68.0	4.2	67.0	4.5	67.5	4.5	66.5
Standard deviation of indent[a]	0.0005	0.0006	0.0004	0.0006	0.0004	0.0004	0.0004	0.0005	0.0004	0.0005
Pin Type: L.										
Maximum	0	52.5	0	56.0	0	52.0	0	51.5	0	49.0
Minimum	0	41.0	0	42.0	0	38.5	0	34.0	0	37.0
Average	0	47.0	0	48.0	0	44.5	0	39.5	0	42.0
Standard deviation of indent[a]	0	0.0006	0	0.0005	0	0.0006	0	0.0006	0	0.0005
Pin Type: F1.										
Maximum	2.5	79.5	3.0	80.5	3.0	76.5	0	82.0	3.0	77.0
Minimum	0	59.0	0.1	59.0	0.1	56.0	0	59.0	0	55.5
Average	0.5	70.0	0.2	70.0	1.2	69.5	0	70.0	1.3	67.5
Standard deviation of indent[a]	0.0005	0.0008	0.0005	0.0009	0.0004	0.0007	0	0.0009	0.0007	0.0006
Pin Type: F2.										
Maximum	0	62.5	0	63.5	0	61.5	0	56.5	0	63.5
Minimum	0	44.5	0	44.0	0	49.0	0	42.5	0	44.5
Average	0	51.5	0	53.0	0	55.5	0	50.5	0	52.5
Standard deviation of indent[a]	0	0.0006	0	0.0006	0	0.0005	0	0.0005	0	0.0007

[a]Measured in 0.0001 inch.

Note: Some values given in inertia columns have been extrapolated. The conversion chart furnished by the Munitions Command did not give values below 4 inch-ounces of energy. Standard deviation of samples refers to depth of indent of the copper cylinders and is given in inches since the energy level is too small to extrapolate from the conversion chart. All energy values above 4 inch-ounces have been given to the nearest 0.5-inch-ounce, in accordance with the chart furnished.

Table IV. Bolt Closure Pawl Tip Hardness
(Rockwell C Scale)

Gun No.	First Design	Second Design
023209	46.0	53.0
023239	42.0	50.0
023205	42.0	51.0
023216	43.0	48.5
023217	42.0	51.0
Average	43.0	51.0

Table V. Free Length of Springs Measurements, in.

Gun No.	Bolt Closure Plunger Spring First	Bolt Closure Plunger Spring Second	Firing Pin Spring Pin, Type L Before Firing	Firing Pin Spring Pin, Type L After Firing
023209	0.90	1.30	0.604	0.595
023239	.90	1.30	.605	.600
023205	.90	1.30	.605	-
023216	.90	1.30	.604	-
023217	.90	1.30	.605	-

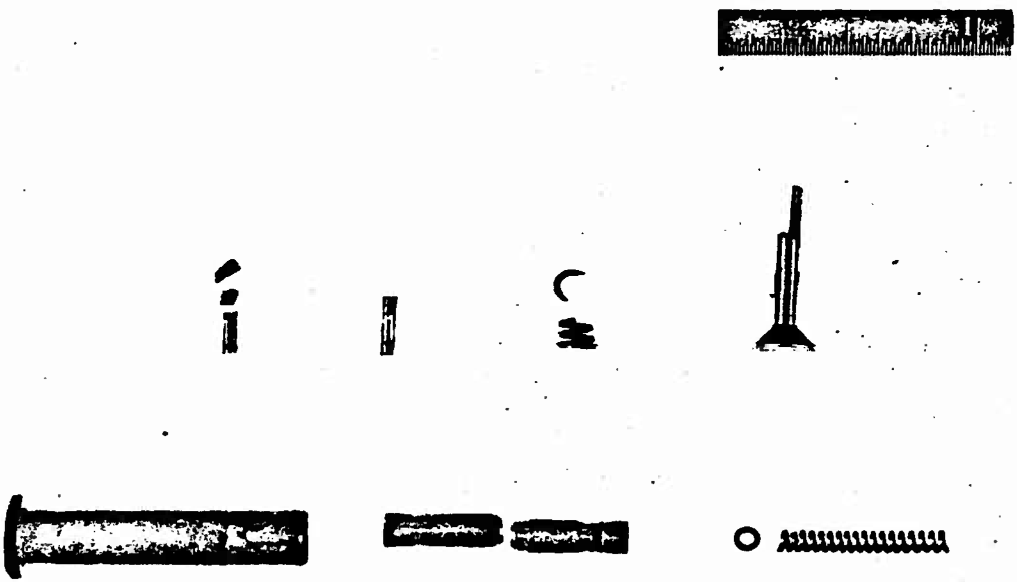

Figure 10: Broken Parts Encountered during Testing. TOP: Broken Bolt Closure Pawl Pin, Deformed Pawl Pin, Extractor Spring, and Firing Pin Retaining Pin. BOTTOM: Receiver Pivot Pin, Hammer Pin, and Ejector Spring.

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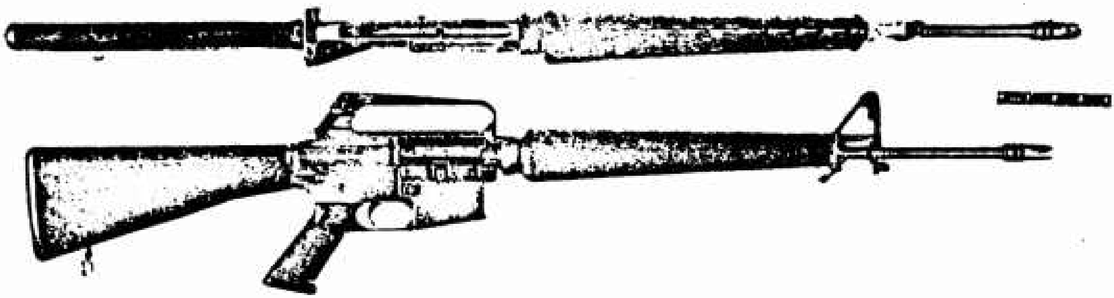

CHARACTERISTICS OF RIFLE, CALIBER .223, AR15

Overall length	38.8 in.
Overall length with bayonet	44.5 in.
Length of barrel	20.5 in.
Sight radius	19.8 in.
Rifling	one turn in 14 in.
Weight of rifle without magazine or accessories	6.4 lbs
Operating principle:	gas operated
Cycle rate of automatic fire	700 rds/min.
Magazine capacity	20 rds.
Weight of accessories:	
Magazine	0.2 lb.
Bipod	0.6 lb.
Sling	0.3 lb.
Bayonet	0.6 lb.
*Grenade Launcher	0.1 lb.
Cleaning kit	0.2 lb.

Stock and handguard material:
Stock, pistol grip and handguards are of black plastic

Type of sights:
Adjustable aperture rear sight and adjustable post front sight

*The flash suppressor also serves as the grenade launcher.

CHARACTERISTICS OF CARTRIDGE, BALL, CALIBER .223

Length of round	2.25 in.
Weight of round	170 grs.
Weight of projectile	55 grs.
Weight of propellant	25 grs.
Primer type	Percussion, Boxer type
Muzzle velocity of projectile	3200 fps

Figure 11: Characteristics of Modified AR15 Rifle.

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2.2 Extreme Cold Test (-65°F)

2.2.1 Procedure. Prior to testing, all weapons were disassembled, cleaned, inspected, and lubricated with MIL-L-14107 (PD 500) oil. Weapons and ammunition were conditioned at -65°F for 12 hours prior to firing 20 rounds semiautomatically and for 2 hours at -65° before firing one 20-round burst automatically.

2.2.2 Results. Malfunctions encountered in this test are recorded in Table VI.

Table VI. Extreme Cold Test (-65°F)

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
023209	L	40		0
	F1	40		0
	F2	40		0
023239	L	40	Bolt overrode base of case.	2
	F1	40		0
	F2	40		0
023205	L	40	Failure to fire. Primer indent normal. Propellant failed to ignite.	1
	F1	40		0
023216	L	40	Failure to lock.	[a]1
	F1	40	Bolt overrode base of case.	1
	F2	40		0
023217	L	40	Failure to chamber first round.	[a]2
	F1	40	Failure to chamber.	[a]1
	F2	40		0

[a]Malfunctions corrected by use of bolt closure de ice.

2.3 Extreme Heat Test (+125°F)

2.3.1 Procedure. Prior to testing, all weapons were disassembled, cleaned, inspected, and lubricated with MIL-L-644B oil. Weapons and ammunition were conditioned at +125°F for 6 hours prior to firing 20 rounds semiautomatically and for two hours at +125°F before firing one 20-round burst automatically.

2.3.2 Results. Table VII lists the malfunctions encountered during the extreme heat test.

Table VII. Extreme Heat Test (+125°F)

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
023209	L	40		0
	F1	40	Small primer leak.	1
	F2	40		0
023239	L	40	Bolt overrode base of case.	1
	F1	40		0
	F2	40		0
023205	L	40		0
	F1	40	Small primer leak.	1
023216	L	40		0
	F1	40		0
	F2	40	Pierced primer.	1
023217	L	40	Failure to chamber first round.	[a]1
	F1	40		0
	F2	40	Bullet tip stubbed front of magazine.	[b]1

[a]Malfunction corrected by use of bolt closure device.
[b]Bullet seated into case by operation of bolt closure device.

2.4 Rain Test

2.4.1 Procedure. Prior to testing, all weapons were disassembled, cleaned, inspected, and lubricated with lubriplate grease. Rainfall, water, and air temperature were recorded prior to firing each weapon. The weapon was suspended horizontally 3 feet below the rain source for a 5-minute period, unloaded and with the bolt retracted. The selector was placed in the safe position and a fully-loaded magazine was inserted. A round was chambered and conditioning was continued for 5 minutes more. Before firing, the muzzle of the weapon was depressed and the bolt was retracted slightly to insure that all water was drained from the bore. One hundred rounds were fired semiautomatically. The conditioning procedure was repeated with the muzzle up and with the muzzle down. These three procedures were repeated and each weapon was fired 100 rounds automatically. A total of 600 rounds was fired in each weapon.

2.4.2 Results. Table VIII gives rainfall, water, and air temperature data. Table IX tabulates malfunctions encountered during the rain test.

Table VIII. Rainfall

Gun No.	Rate of Fall, in. per hour	Water Temperature, °F	Air Temperature, °F
023209	60	50	56
023239	60	52	58
023205	58	54	62
023216	57	53	60
023217	60	50	59

Table IX. Rain Test

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
023209	L	600	Failure to chamber first round.	2
023239	L	600		0
023205	F1	600	Failure of bolt to remain to rear after firing last round.	6
			Bolt lacked sufficient energy to strip round from magazine.	[a] 6
023216	F1	600	Bolt lacked sufficient energy to strip round from magazine.	[a] 1
			Bolt catch functioned prior to firing last round.	21
			Failure of the bolt to remain to rear after firing last round.	4
023217	F1	600		0

[a]Malfunction was corrected by use of bolt closure device.

Note: Malfunctions were not attributable to rain conditions.

2.5 Dust Test

2.5.1 Procedure. Prior to testing, all weapons were disassembled, cleaned, inspected, and lubricated with MIL-L-644B oil.

The barrel muzzle was taped to prevent dust from entering the bore. The selector was positioned on safe and the weapon was loaded. After closing the dust cover, all weapons were placed in an upright horizontal position in a specially constructed dust box. In one minute 5 pounds of dust, consisting of 9 parts grade 0 Albany sand and one part clean silica core sand, was uniformly poured into a pour hole in the top of the dust box.

The dust was circulated by a forge-type air blower operating at a handle speed of 60 rpm. The weapons were inverted and dust conditioning was repeated. The test items were removed from the dust chamber, all tape was stripped off the muzzle, and an attempt to fire 20 rounds semiautomatically was made.

2.5.2 Results. No malfunctions were encountered during this phase of testing.

2.6 Mud Test

2.6.1 Procedure. Prior to firing, the weapons were disassembled, cleaned, inspected, and lubricated with MIL-L-644B oil.

The barrel muzzle was taped to prevent mud from entering the bore. The selector was placed on safe and the weapon was loaded. After closing the dust cover, each weapon was immersed for 15 seconds in a mixture of mud consisting of a ratio of 10 pounds of red clay, 2 pounds of clean river sand, and 8 quarts of water. The weapon was withdrawn from the mud and wiped off by hand. The tape at the muzzle was removed and an attempt was made to fire 20 rounds semiautomatically.

2.6.2 Results. Table X gives malfunction data on this phase of testing.

Table X. Mud Test

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
023209	L	20	Bolt overrode base of case.	2
			Failure to eject.	20
			Failure to chamber.	[a]19
	F2		Failure to chamber	[a] 4
023239	L	19	Bolt overrode base of case.	6
			Failure to eject.	19
			Failure to chamber.	[a]19
	F2	20	Bolt overrode base of case.	3
			Double feed.	1
			Failure of bolt to remain to rear after firing last round.	1
023205	F1	2	Failure to chamber.	[b] 2
			Failure to eject	1
	F2	20	Failure to chamber	1

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Table X (Cont'd)

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
023216	F1	19	Bolt overrode base of case.	3
			Failure to eject.	19
			Failure to chamber.	[a]18
	F2	20	Bolt overrode base of case.	2
			Failure to feed.	1
			Failure to chamber.	3
023217	F1	10	Bolt overrode base of case.	1
			Failure to eject.	9
			Failure to chamber.	[b]10
	F2	4	Failure to eject.	2
			Failure to chamber.	2
			Blown primer, primer pocket enlarged.	1

[a]Malfunction corrected by use of bolt closure device.
[b]Bolt closure device failed to operate after being successful the number of times indicated. Failure was caused by mud fouling in the housing of the bolt closure device.

2.7 Endurance

2.7.1 Procedure. Prior to testing, all weapons were disassembled, cleaned, inspected, and lubricated with MIL-L644B oil. Using the same method described in paragraph 2.1.1, firing pin indent samples were taken as follows:

a. During firing, ten samples with each weapon at 600-round intervals.

b. After firing, 50 samples with each weapon.

Semiautomatic and automatic fire were alternated every 100 rounds. Cyclic rate of automatic fire was recorded and the weapons were disassembled, cleaned, inspected, and lubricated at 600-round intervals.

2.7.2 Results. Malfunction data for this phase of testing are contained in Table XI. Cyclic rates of automatic fire are given in Table XII. Firing pin energy taken during and after this phase of testing are given in Tables XIII and XIV. Table XV is a compilation of weapon malfunction data taken during the firing of 33,673 rounds. The breaking point of parts is recorded in Table XVI.

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Table XI. Endurance Test

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
023209	L	6000	Failure to feed.	1
			Double feed.	8
			Bullet nose stubbed front of magazine in chambering.	[a] 4
			Failure to chamber first round.	[b] 31
			Failure to chamber - other than first round.	[b] 2
			Bolt catch stopped forward travel of bolt during firing.	7
			Bolt lacked energy to strip round from magazine.	[b] 6
			Failure of bolt to remain to rear after firing last round.	3
023239	L	6000	Failure to feed.	2
			Double feed.	2
			Bullet nose stubbed front of magazine in chambering.	[a] 8
			Failure to chamber first round.	[b] 41
			Bolt catch stopped forward travel of bolt during firing.	[b] 5
			Bolt lacked energy to strip round from magazine.	[a] 4
			Bolt overrode base of case in chambering.	1
			Failure of bolt to remain to rear after firing last round.	9
023205	F2	5119	Failure to feed.	10
			Double feed.	2
			Bullet nose stubbed front of magazine.	[a] 13
			Failure to chamber first round.	[b] 30
			Failure to chamber - other than first round.	[b] 8
			Bolt catch stopped forward travel of bolt during firing.	73
			Bolt lacked energy to strip round from magazine.	[b] 124
			Bolt overrode base of case.	2
			Failure to lock	1

[a]Magazine caused bullet tip of the first five rounds to stub front of magazine. Bullet was forced into the case when the bolt closure device was used with a stubbed round.
[b]Bolt closure device was used to correct malfunction.

Table XI (Cont'd)

Gun No.	Firing Pin Type	Rds Fired	Type of Malfunctions	No. Malfunctions
			Failure to extract	6
			Failure to eject	1
			Failure of bolt to remain to rear after firing last round.	14
			Pierced primer.	2
023216	F2	6000	Failure to feed.	10
			Double feed.	4
			Bullet nose stubbed front of magazine.	[a] 9
			Failure to chamber first round.	[b]16
			Bolt catch stopped forward travel of bolt during firing.	27
			Bolt lacked energy to strip round from magazine.	[b] 2
			Bolt overrode base of case.	2
			Failure to eject.	4
			Failure of bolt to remain to rear after firing last round.	6
			Pierced primer.	4
023217	F2	6000	Failure to feed.	8
			Failure to chamber first round.	[b]36
			Failure to chamber other than first round.	[b] 8
			Bolt catch stopped forward travel of bolt during firing	37
			Bolt lacked energy to strip round from magazine.	[b]11
			Bolt overrode base of case in chambering.	8
			Failure to lock.	1
			Failure of bolt to remain to rear after firing last round.	3
			Pierced primer.	17

[a]Magazine caused bullet tip of the first five rounds to stub front of magazine. Bullet was forced into the case when the bolt closure device was used with a stubbed round.
[b]Bolt closure device was used to correct malfunction.

Table XII. Cyclic Rate of Fire, rd/min

Round No.	Gun No. 023209	023239	023205	023216	023217
600	689	701	760	663	692
1200	697	708	728	658	645
1800	709	735	628	751	709
2400	691	699	562	722	675
3000	707	706	606	739	669
3600	726	737	589	759	636
4200	703	677	616	706	647
4800	796	778	648	713	629
5400	702	819	-	752	654
6000	685	674	-	692	654
Average	710	723	642	716	661

Table XIII. Firing Pin Energy
(Endurance Phase, Ten Samples)

		Energy, inch-ounce									
		Pin Type L				Pin Type F2					
		Gun No. 023209		Gun No. 023239		Gun No. 023205		Gun No. 023216		Gun No. 023217	
	Round No.	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike
Maximum	0	0	48.5	0	52.0	0	61.5	0	56.5	0	63.5
Minimum		0	36.0	0	41.0	0	49.0	0	42.5	0	44.5
Average		0	42.5	0	45.0	0	55.5	0	50.5	0	52.5
Maximum	600	0	49.0	0	52.5	0	65.0	0	59.0	0	59.5
Minimum		0	35.5	0	39.0	0	47.0	0	43.5	0	51.5
Average		0	42.0	0	45.0	0	56.5	0	50.0	0	55.0
Maximum	1200	0	43.5	0.9	53.0	0	60.5	0	59.0	0	57.5
Minimum		0	36.0	0	38.0	0	45.0	0	50.5	0	45.0
Average		0	40.0	0.2	45.0	0	55.0	0	55.0	0	50.5
Maximum	1800	0	52.0	0.8	50.0	0	63.5	0	52.0	0	56.0
Minimum		0	36.0	0	36.5	0	52.0	0	40.0	0	42.0
Average		0	41.5	0.1	44.0	0	56.0	0	45.0	0	49.0
Maximum	2400	0	52.0	0.6	45.5	0	58.0	0	58.0	0.7	56.5
Minimum		0	33.5	0	40.0	0	43.5	0	38.5	0.0	43.0
Average		0	40.5	0.1	42.0	0	49.5	0	49.5	0.1	50.0
Maximum	3000	0	46.5	1.0	46.5	0	66.0	0	55.0	0	52.5
Minimum		0	34.0	0	36.0	0	46.5	0	42.5	0	38.0
Average		0	41.0	0.5	40.0	0	54.0	0	48.5	0	44.5
Maximum	3600	0	42.5	1.0	41.5	0	56.5	0	48.0	0	52.5
Minimum		0	35.0	0	36.5	0	44.5	0	36.0	0	36.5
Average		0	40.5	0.6	38.0	0	52.0	0	42.0	0	44.5
Maximum	4200	0	41.0	0.6	46.5	0	58.0	0	52.0	0.4	52.5
Minimum		0	33.5	0	35.0	0	39.5	0	39.5	0.0	43.0
Average		0	37.5	0.2	39.0	0	49.0	0	47.0	0.1	48.5
Maximum	4800	0	43.0	1.0	41.5	0	56.5	0	55.5	0	55.5
Minimum		0	38.0	0	37.0	0	46.5	0	44.0	0	45.5
Average		0	40.0	0.5	39.0	0	51.5	0	50.0	0	52.0
Maximum	5400	0	45.0	1.0	48.0	-	-	0	52.5	0.6	52.5
Minimum		0	32.0	0	31.0	-	-	0	41.0	0	45.5
Average		0	37.5	0.2	40.0	-	-	0	45.5	0.1	49.5
Maximum	6000	0	45.5	0.8	41.0	-	-	0	56.0	1.2	57.5
Minimum		0	36.5	0	36.0	-	-	0	41.0	0	46.5
Average		0	40.0	0.1	38.0	-	-	0	45.0	0.4	52.0

Note: Some values given in inertia columns have been extrapolated. The conversion chart furnished by the US Army Munitions Command did not give values below four inch-ounces of energy. All energy values above four inch-ounces have been given to the nearest 0.5-inch-ounce value, in accordance with the chart furnished.

Table XIV. Firing Pin Energy
(After-Firing Phase, 50 Samples)

	Energy, inch-ounce									
	Pin Type L				Pin Type F2					
	Gun No. 023209		Gun No. 023239		Gun No. 023205		Gun No. 023216		Gun No. 023217	
	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike	Inertia	Hammer Strike
Maximum	0	48.0	0	46.5	0	59.0	0	60.0	0	66.0
Minimum	0	36.5	0	35.0	0	43.0	0	38.0	0	45.0
Average	0	42.0	0	39.0	0	50.5	0	49.0	0	55.0
Standard deviation of indent[a]	0	0.0007	0	0.0005	0	0.0006	0	0.0008	0	0.0008

[a]Measured in 0.0001 inch.

Table XV. No. of Malfunctions

A total of 33,673 rounds were fired by Aberdeen Proving Ground.

	Test Phase						
	-65°F	+125°F	Rain	Dust	Mud	Endurance	Totals
Failure to Feed							
Cartridge not in path of bolt for chambering					1	31	32
Bullet stubbed front of magazine		1				34	[a] 35
Double feed					1	16	17
Failure to chamber							
First round	1	1				154	[b]156
Other than first round	1				11	18	30
Bolt lacked energy to force round from magazine			7			147	[c]154
Bolt overrode base of round in feeding from magazine	3	1			17	13	34
Failure of bolt to lock completely						2	2
Failure to fire	1						1
Failure to extract						6	6
Failure to eject					70	5	75
Failure of bolt to remain to rear after last round was fired			10		1	35	46
Bolt catch prevented bolt from starting to chamber round			21			149	[d]170
Primer joint leak		2					2
Pierced primer		1				23	[e] 24
Blown primer					1		[e] 1
Totals	6	6	38	0	102	633	785

[a]Cartridges did not stack properly in magazine; 33 occurred in first round feeding.
[b]Action spring energy apparently marginal or condition related to round stubbing.
[c]A total of 124 occurred in one rifle; weapon had low cyclic rate; was withdrawn from test.
[d]Weak spring, replacement from earlier model rifle corrected the condition in the one rifle (023216) in which it was installed.
[e]Tip of firing pin was deformed in three rifles using the friction bolt cam pin device. The damage was observed after 1200 rounds in each of two rifles and after 1800 in the third rifle, during the 6000-round endurance test.

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Table XVI. Parts Breakage and Replacement

	Broken Extractor Spring	Broken Ejector Spring	Broken Hammer Pin	Broken Charging Handle	Broken Firing Pin Retaining Pin	Weak Bolt Catch Spring	Broken or Deformed Bolt Closure Pawl Pin	Worn Bolt Closure Pawl	Weak Bolt Closure Plunger Spring	Receiver Pivot Pin Ball Detent Loose
Gun No. 023209										
Quantity	1		1			1	1	1	1	
Rounds No.	5640		6840			[a]4420	4420	[b]4420	[a]4420	
Gun No. 023239										
Quantity	1					1	1	1	1	
Rounds No.	5639					[a]4420	4420	[b]1419	[a]4414	
Gun No. 023205										
Quantity	1	1		1		1	1	1	1	
Rounds No.	5020	5920		5920		[a]4420	4420	[b]1201	[a]4400	
Gun No. 023216										
Quantity		1		1	1	1	1	1	1	
Rounds No.		6838		6918	6238	[c]2019	4420	[b]1319	[a]4418	
Gun No. 023217										
Quantity				2		1	1	1	1	1
Rounds No.				3270, 2244		[a]4420	210	[b]1610	[a]3270	3210

[a]Insufficient strength to function properly at the beginning of the test. The round number given was the point at which replacement of parts was made.

[b]Part replaced at same time as bolt closure plunger spring.

[c]Replacement was from a previous test weapon; the spring appeared to be stronger. The other replacement springs appeared to be identical to the original springs installed in the rifles furnished.

PART III - APPENDICES

APPENDIX A

References

1. Moore, L. F. "A Test of Rifle, Caliber .223, AR15." Aberdeen Proving Ground. Report No. DPS-96, October 1960.

2. Wilson, A. J. "Product Improvement Test of Bolt Assist Devices for Rifle, Caliber .223, AR15." Aberdeen Proving Ground. Report No. DPS-1120, October 1963.

3. Ordnance Proof Manual, OPM 20-20, Hand and Shoulder Weapons, 9 June 1958.

4. Air Force Technical Manual No. T. O. 11W3-5-5-1, 31 August 1963.

APPENDIX B
Correspondence

HEADQUARTERS

COPY/1h U.S. ARMY TEST AND EVALUATION COMMAND

ABERDEEN PROVING GROUND MARYLAND 21005

24 Oct 1963

AMSTE-BC

SUBJECT: Product Improvement Test of Modified AR-15 Rifles

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

1. Reference:

a. Message Unclas TT 8077 AMSWE-RD, 162130Z Oct 63.

b. Message Unclas TT 8446 AMSWE-RD, 211410Z Oct 63.

2. A product improvement test of modifications to the AR-15 Rifle is directed. USATECOM Project Number 8-3-0030-08F is assigned.

3. Five Ar-15 Rifles incorporating a bolt closure device (Colt ratchet type), modified charging handle and two types of modified firing pins will be furnished for test by the US Army Weapons Command. Weapons are scheduled for delivery to your agency on 8 Nov 63.

4. A plan of test will be submitted this headquarters in fifteen copies. Plan will reflect type of tests to be conducted, costs and materiel requirements as previously descussed with Mr. Moore, Development and Proof Services and Colonel Rafferty, this Command, on 18 Oct 63.

5. Report of test will be forwarded this headquarters in fifteen copies by 3 Dec 63. A letter report is acceptable followed by a formal report.

FOR THE COMMANDER

/s/ Roger W. Kemp Lt Col
/t/ JOHN W. RODGERS
Colonel, GS
C, Admin Ofc

NNNNEUA130CMB195

LAND

10-992
DATE: 17 Oct 63
ACTION: INFANTRY
INFO: SGS

RR RUEPAP

DE RUCMRK 8077C 17/1455Z

ZNR

R 162130Z

FM CG USAWECOM ROCK ISLAND ILL

TO CG USATECOM APG MD

BT

UNCLAS TT 8077 FOR AMSTE FROM AMSWE-RD SCHUMACHER.

1. IT WILL BE NECESSARY TO ET/ST RECENT MODIFICATIONS TO AR-15 RIFLE AS: (A) SPRING CUSHIONED FIRING PIN MODIFICATION (B) BOLT CLOSURE DEVICE-COLT RATCHET TYPE (C) NEW CONFIGURATION OF CHARGING HANDLE.

2. TEST SCOPE SHOULD COVER (A) 6000 ROUND ENDURANCE (B) ENVIRONMENTAL PLUS 125 DEGREES TO MINUS 65 DEGREES (C) MUD, DUST, RAIN (D) INDENT TEST; GAGES FOR IDENT TEST ARE AVAILABLE FROM PREVIOSS TESTING AT FRANKFORD ARSENAL (E) SUITABLE ET/ST PLAN TO EVALUATE COLT RATCHET TYPE BOLT CLOSURE DEVICE.

3. REQUEST THAT COST ESTIMATE AND MATERIEL REQUIREMENTS WITH COORDINATED TEST PLAN TO ACCOMPLISH ABOVE SCOPE OF WORK BE SUBMITTED THIS HEADQUARTERS ATTN: AMSWE-RDS NOT LATER THAN 4 NOVEMBER.

4. PRESENT INFORMATION INDICATES 10 - 15 RIFLES WILL BE AVAILABLE BY 8 NOV FOR INITIATING ET/ST. PRESENT SCHEDULE DICTATES ET/ST MUST BE COMPLETED WITH SUBMISSION OF FINAL REPORT NOT LATER THAN 10 DECEMBER

BT

NNNN

29

10-1207
DATE: 22 Oct 63
ACTION: IMF
INFO: SOS

NNNNEUA12 CMD195

RR RUEPAP

DE RUCMRK 844CM 22/1654Z

ZNR

R 211410Z

FM CG USAWECOM ROCK ISLAND ILL

TO CG USATECOM APG MD

BT

UNCLAS TT 8446 REF (A) OUR 8277 2130Z OCT 63 (B) VERBAL CONVERSATION 17 OCT, AT COLT PLANT, BETWEEN COL YOUNT AND COL RAFFERTY. FOR AMSTE FROM AMSWE-RD SCHUMACHER.

1. PURSUANT TO CONVERSATION, AS REFERENCE B, IT WILL BE NECESSARY TO INCLUDE THE FRICTION TYPE FIRING PIN FOR EVALUATION IN ET/ST OF AR-15 MODIFICATIONS.

2. REQUEST THAT COST ESTIMATE AND MATERIAL REQUIREMENTS SCHEDULE, PER REFERENCED TT, REFLECT ET/ST PROVISION FOR THE FRICTION TYPE FIRING PIN

BT

COPY/1h

APPENDIX C

Frankford Arsenal Report on Primer Sensitivity

FRANKFORD ARSENAL

SEVENTH MEMO REPORT ON AR-15 RIFLE/AMMUNITION SYSTEM

PRIMER SENSITIVITY TESTS OF SELECTED LOTS OF 5.56MM BALL CARTRIDGES

I. INTRODUCTION:

At the August 1963 meeting of the Joint Services Technical Committee on the AR-15 System it was agreed that primer sensitivity run-down tests would be conducted on several lots of commercial .223 ammunition, some of which had reportedly given accidental firing on bolt closure in field use. The USAF at Lackland AFB forwarded four samples of 600 rounds each to FA for these tests. Originally it had been planned that a sample from lot WCC 61UD22 would be included in these tests. This lot reportedly gave a high incidence of accidental firings, the frequency being estimated at one per 90 rounds. Subsequent to the August meeting, however, Lackland AFB advised this installation that this lot had been nearly expended and no sample could be provided (Ref Incl 6). In its place, a sample from Remington lot RA-223-B11 (which was available at Frankford Arsenal) was substituted. Remington personnel had advised that the primer cups used in this lot had been manufactured from thicker strip in an effort to "harden" and de-sensitize the primer.

II. PROCEDURES AND RESULTS:

1. Primer sensitivity tests are conducted by dropping steel balls of known weights through various measured heights upon a device containing a firing pin and primed case assembly, and varying the heights of drop by fixed increments between the point where all of the primers fire and the point where all of the primers fail to fire. The primer drop sensitivity machine consists basically of a case holder of "chamber", a "breech-block" containing the firing pin, and a vertical column to which a movable electromagnet is attached. In use, a steel ball of known weight is suspended from the magnet core. The machine is adjusted so that a prolongation of the vertical axis through the center of the magnet core coincides with the vertical axis through the center of the firing pin. When the circuit through the magnet-coil is interrupted, the ball drops through a known height onto the firing pin. For this test, a firing pin made with the point configuration of the AR-15 Rifle firing pin and with other dimensions suitable for use in the drop sensitivity machine was used.

2. Since only loaded cartridges were available, it was necessary first to extract the bullets and empty the propellant from each cartridge case. Care was taken to insure that the bullets were extracted by an axial pull so as not to distort the cases and thereby interfere with their proper seating in the case holder of the drop-testing machine.

3. Care was also taken to insure the proper "headspacing" of the equipment. A "minimum" head space gage was placed in the case holder and the holder was adjusted by means of a collar and thread until the head of the gage just touched under side of the breech block when closed and locked in its normal position.

4. The procedure used in conducting the primer sensitivity run-down test is described in detail in Appendix II of Specification MIL-C-9963C for the 5.56mm M193 ball cartridge and will not be repeated here.

5. The detailed test results will be found in inclosure 1 through 5. These results may be summarized as follows:

Lot No.	$\bar{H}$ (Inches)	σ (Inches)	$\bar{E}$ (Inch-Ounces)	σ (Inch-Ounces)
RA 5003	5.74	0.51	22.96	2.04
RA 5006	5.86	0.97	23.44	3.88
RA 5016	5.56	0.84	22.24	3.36
RA 5022	5.20	0.81	20.80	3.24
RA 223-B11	8.42	1.26	33.68	5.04

6. For convenience in comparing the results of these tests with current or proposed primer sensitivity limits, these data may be presented in the following manner:

Lot No.	$\bar{E}$	$\bar{E}-4\sigma$	$\bar{E}-3\sigma$	$\bar{E}-2\sigma$	$\bar{E}+2\sigma$	$\bar{E}+3\sigma$	$\bar{E}+4\sigma$	$\bar{E}+5\sigma$
RA 5003	[illegible].96	14.80	16.84	18.88	27.04	29.08	31.12	33.16
RA 5006	23.44	7.92	11.80	15.68	31.20	35.08	38.96	42.84
RA 5016	22.24	8.80	12.16	15.52	28.96	32.32	35.68	39.04
RA 5022	20.80	7.84	11.08	14.32	27.28	30.52	33.76	37.00
RA 223-B11	33.68	13.52	18.56	23.60	43.76	48.80	53.84	58.88

III. OBSERVATIONS:

1. It will be noted that of the four lots representing previous Remington production, two would have failed to meet the current specification requirement for primer sensitivity ($\bar{E}-3\sigma$ not less than 12 inch-ounces and $\bar{E}+3\sigma$ not greater than 48 inch-ounces), and one lot would have passed only marginally. The more recent special lot of Remington cartridges would also have failed against the current criteria, but by virtue of having exceeded the upper limit rather than the lower limit. This stems from the fact that while the mean sensitivity level increased, the standard deviation also increased considerable. This graphically illustrates the difficulty encountered in attempting to "de-sensitize" the primer.

2. At the August 1963 meeting of the Technical Committee, a presentation was made of the predicted accidental firing rate based on data relating to actual firing-pin energy acquired from the Lackland AFB tests and an <u>assumed</u> "worst" lot of ammunition which would be acceptable

under the $\bar{E} \pm 3\sigma$ limits of 12 and 48 inch-ounces. For those calculations, an assumed primer sensitivity distribution having an $\bar{E}$ equal to 30 inch-ounces and a standard deviation equal to 6 inch ounces was used, because that distribution is the "worst" condition of an accep[illegible] l[illegible]. The predicted accidental-fire rate was given as one in sev[illegible] [illegible] (1 in 6400 by calculation). It would now appear, from th[illegible] described herein, that a "typical" lot of previous Remington pr[illegible] would have an $\bar{E}$ of about 23 inch-ounces and a standard devi[illegible] [illegible]out 3.6 inch-ounces (i.e., a distribution having a mean energ[illegible] [illegible] of about 23 inch-ounces and a standard deviation such that [illegible] d be about 12 inch-ounces). On this basis, the predicted accident[illegible] rate, calculated in the same manner, for a "typical" lot [illegible]om pr[illegible] Remington production, would be one in 43,000 rounds. The [illegible]obabil[illegible] of an accidental firing with a "typical" lot is thus understandably less than with the "worst" lot which might be accepted under the current criteria. While the "typical" primers are more sensitive as indicated by the lower $\bar{E}$, the standard deviation or variability among the "typical" primers is also smaller and the net result is a lower probability of accidental firing. Although these calculations are mathematically quite precise, probability functions such as these should be used only as orders of magnitude for predicting such rare occurrences. Probabilities such as one in 6400 and one in 43,000 should be interpreted as "one in several thousand" or "one in several tens-of-thousands."

3. In supplying the samples for these tests, Lackland AFB reported (see incl 6) that the actual accidental firing rates for each of the lots, based on their own tests, were as follows:

Lot No.	Actual Accidental Fire Rate
RA 5003	1 per 3600
RA 5006	1 per 1000
RA 5016	1 per 6000
RA 5022	1 per 740

Thus it will be observed that the actual accidental fire rate for these lots in Lackland AFB tests has been on the order of "one in several thousand", and this is reasonable consistent with the predicted accidental-fire rate. The rates actually observed in these lots of ammunition were actually somewhat higher than those predicted by statistical procedures, but were not surprisingly so.

IV. CONCLUSIONS:

1. Although not manufactured to the present criteria, the primers used in previous Remington production would appear to meet, or nearly meet, the primer sensitivity limits established by the Technical Committee at the August 1963 meeting. To the extent that these four lots are representative of previous production, it would appear that the producer could in fact meet the current primer sensitivity requirement with adjustment to the process.

COPY/lh

2. Insofar as these four lots are concerned, it appears that the predicted accidental-fire rate based on a statistical model is fairly consistent with the actual rate as reported by Lackland AFB.

/s/ Charles J. Rhoades
/t/ CHARLES J. RHOADES
Deputy Project Director

6 Incl
1 thru 5 Data Sheets
6. Ltr dtd 19 Aug 63
from Lackland AFB

RA-223

FINAL REPORT

SENSITIVITY TEST OF PRIMERS, CALIBER ____ TYPE NO. ____ Lot No. B11

ACCEPTANCE TEST OR SPECIAL TEST (cross out one)

Authority for Test ____ W.O. ____

Primer Composition ____ Batch No. ____ Primers in Lot ____

Primer Cups ____ Lot No. ____ Anvils ____ Lot No. ____

Date Manufactured ____ Date Sample Taken ____ Primers in Sample ____

Date of Inspection of Sample ____ Results ____

Date Sample Inserted in Cases ____ Primer Inserting Machine No. ____

Average Depth of Seating ____ inch. Hangfire Test sent ____

Drop Test Machine No. ____ Weight of Ball 4 ounces. Date of Test 9/19/63

	Height of Drop	No. Tested	Number Firing	Number Missed	Squibs	Fraction Missed p	Variance Factor k	pk	Moment Factor s	ps
1	7		5	45		.90	1	.90	1	
2	8		21	29		.58	3	1.74	7	
3	9		38	12		.24	5	1.20	19	
4	10		41	9		.18	7	1.26	37	
5	11		49	1		.02	9	.18	61	
6							11		91	
7							13		127	
8							15		169	
9							17		217	
10							19		271	
11							21		331	
12							23		397	
13							25		469	
14							27		547	

Find $\bar{H}$ and σ for each test. Find a_s only when directed.

	Record	Limits
$\bar{H} + 3\sigma$	12.20	12
$\bar{H} - 3\sigma$	4.64	3

Ht. all Fired	12
Ht. all Missed	6

Σp 1.92

$H_1 - .5$ 6.56

$\bar{H}$ 8.42

$(\Sigma p)^2$

$(\Sigma p)^3$

Σpk 5.28

$(\Sigma p)^2$ 3.69

σ^2 1.59

σ 1.26

$(\Sigma p)(\Sigma pk)$

Σps

$2(\Sigma p)^3$

$3(\Sigma p)(\Sigma pk)$

a_s

Lot No. RA-223-B11

FORM NO. ORDBA - 737
30 JUNE '43

ARMY-FRANKFORD ARSENAL PA

INCL 1

C-5

35

SENSITIVITY TEST OF PRIMERS, [illegible] TYPE NO.________ Lot No. RA5003
ACCEPTANCE TEST OR SPECIAL TEST (check one)

Authority for Test ______________________________ W.O. ____________

Primer Composition ________ Batch No. ________ Primers in Lot ____________

Primer Type ____________ Lot No. ________ Anvils ____________ Lot No. ____________

Date [illegible] Loaded ________ Date Sample Taken ________ Primers in Sample ______

Date of Inspection of Sample ______________ Results ____________________

Date Sample Inserted in Cases ____________ Primer Inserting Machine No. ______

Average Depth of Seating ____________ inch. Hangfire Test sent to ____________

Drop Test Machine No. ____ Weight of Ball 4 ounces. Date of Test 9/19/63

	Height of Drop	Number Tested	Number Firing	Number Missed	Squares	Fraction Missed p	Variance Factor k	kp	Known Factor s	sp
1	5		1	49		.98	1	.98	1	
2	6		38	12		.24	3	.72	7	
3	7		49	1		.02	5	.10	19	
4							7		37	
5							9		61	
6							11		91	
7							13		[illegible]27	
8							15		[illegible]69	
9							17		[illegible]17	
10							19		[illegible]71	
11							21		[illegible]31	
12							23		[illegible]97	
13							25		[illegible]59	
14							27		[illegible]47	

Find H and σ for each test.
Find σ_s only when directed.

	Record	Limits
$\bar{H} + \frac{30}{64}$	7.27	12
$\bar{H} - \frac{30}{64}$	4.21	3

Σp 1.24

$H_1 - .5$ 4.50

$\bar{H}$ 5.74

$(\Sigma p)^2$

$(\Sigma p)^3$

Σpk 1.80

$(\Sigma p)^2$ 1.54

σ^2 .26

σ .51

Σps

$(\Sigma p)^3$ ______

$(\Sigma p)(\Sigma pk)$ ______

σ_s

$(\Sigma p)(\Sigma pk)$

No. of Fired	8
No. of Missed	4

Lot No. RA5003

FORM NO. ORDBA - 737
30 JUNE '43

ARMY-FRANKFORD ARSENAL, PA

No T[illegible] 2

[illegible]

SENSITIVITY TEST OF PRIMERS, CALIBER ______ TYPE NO. ________ Lot No. *RA 5006*
ACCEPTANCE TEST OR SPECIAL TEST (cross out one)

Authority for Test ______________________________ W.O. ____________

Primer Composition ________ Batch No. ________ Primers in Lot ____________

Primer Cups __________ Lot No. ________ Anvils __________ Lot No. __________

Date Manufactured ________ Date Sample Taken ________ Primers in Sample ____

Date of Inspection of Sample ____________ Results ____________________

Date Sample Inserted in Cases ____________ Primer Inserting Machine No. ____

Average Depth of Seating __________ inch. Hangfire Test sent to ___, ______

Drop Test Machine No. ____ Weight of Ball *4* ounces. Date of Test *9/19*

	Height of Drop H	Number Tested	Number Firing	Number Missed	Squibs	Fraction Missed p	Variance Factor k	pk	Skewness Factor s	ps
1	*5*		*18*	*32*		*.64*	1	*.64*	1	
2	*6*		*14*	*36*		*.72*	3	*2.16*	7	
3							5		19	
4							7		37	
5							9		61	
6							11		91	
7							13		127	
8							15		169	
9							17		217	
10							19		271	
11							21		331	
12							23		397	
13							25		469	
14							27		547	

Find $\bar{H}$ and σ for each test.
Find σ_3 only when directed.

	Record	Limits
$\bar{H}$ + ~~5σ~~ *3σ*	*8.77*	*12*
$\bar{H}$ − ~~2σ~~ *3σ*	*2.95*	*3*
Ht. All Fired		*7*
Ht. All Missed		*4*

Σp *1.36*
$H_1 - .5$ *4.50*
$\bar{H}$ *5.86*

$(\Sigma p)^2$
$(\Sigma p)^3$

Σpk *2.80*
$(\Sigma p)^2$ *1.85*
σ^2 *.95*
σ *.97*

$(\Sigma p)(\Sigma pk)$

Σps ______
$2(\Sigma p)^3$ ______
$3(\Sigma p)(\Sigma pk)$ ______
σ_3

Lot No. *RA 5006*

FORM NO. ORDBA - 737
30 JUNE '43

ARMY-FRANKFORD ARSENAL, PA

INCL 3

[illegible]

SENSITIVITY [illegible] TYPE NO. ________ Lot No. RA5016

ACCEPTANCE TEST OR [illegible] (cross out one)

Authority for Test ______________________ W.O. ________

Primer Composition ________ Batch No. ________ Primers in Lot ________

Primer [illegible] ________ Lot No. ________ Anvils ________ Lot No. ________

Date [illegible]factured ________ Date Sample Taken ________ Primers in Sample ________

Date of Inspection of Sample ________ Results ________

Date Sample Inserted in Cases ________ Primer Inserting Machine No. ________

Average Depth of Seating ________ inch. Hangfire Test [illegible] ________

Drop Test Machine No. ____ Weight of Ball 4 ounces. Date of Test 9/19/63

	Height of Drop H	Number Tested	Number Firing	Number Missed	Squibs	Fraction Missed p	Variance Factor k	pk	[illegible] Factor	pk²
1	5		15	35		.70	1	.70	1	
2	6		33	17		.34	3	1.02	7	
3	7		49	1		.02	5	.10	19	
4							7		37	
5							9		61	
6							11		91	
7							13		[illegible]	
8							15		[illegible]	
9							17		[illegible]	
10							19		[illegible]	
11							21		[illegible]	
12							23		[illegible]	
13							25		[illegible]	
14							27		[illegible]	

Find $\bar{H}$ and σ for each test. Find σ_s only when directed.

	Record	Limits
$\bar{H} + 3\sigma$	8.08	12
$\bar{H} - 3\sigma$	3.04	3
Ht. all Fired		8
Ht. all Missed		4

Σp	1.06
$H_1 - .5$	4.50
$\bar{H}$	5.56
$(\Sigma p)^2$	
$(\Sigma p)^2$	

Σpk	1.82
$(\Sigma p)^2$	1.12
σ^2	.70
σ	.84
$(\Sigma p)(\Sigma pk)$	

Σpk^2 ________

$\Sigma(\Sigma p)$ ________

$\Sigma(\Sigma p)(\Sigma pk)$ ________

σ_s ________

Lot No. RA5016

FORM NO. ORDBA - 737
30 JUNE '43

ARMY-FRANKFORD ARSENAL PA

38 Incl 4

SENSITIVITY TEST OF PRIMERS, CALIBER ______ TYPE NO.________ Lot No. RA5022
ACCEPTANCE TEST OR SPECIAL TEST (cross out one)

Authority for Test ______________________________ O.O. __________

Primer Composition ________ Batch No. ________ Primers in Lot __________

Primer Cups__________ Lot No.________ Anvils__________ Lot No.__________

Date Manufactured ________ Date Sample Taken ________ Primers in Sample _____

Date of Inspection of Sample ____________ Results ____________________

Date Sample Inserted in Cases ____________ Primer Inserting Machine No. _____

Average Depth of Seating__________inch. Hangfire Test sent to ___, ________

Drop Test Machine No. ____ Weight of Ball 4 ounces. Date of Test 9/19/63

	Height of Drop H	Number Tested	Number Firing	Number Missed	Squibs	Fraction Missed p	Variance Factor k	pk	Sum Factor s	ps
1	4		4	46		.92	1	.92	1	
2	5		17	33		.66	3	1.98	7	
3	6		45	5		.10	5	.50	19	
4	7		49	1		.02	7	.14	37	
5							9		61	
6							11		91	
7							13		127	
8							15		169	
9							17		217	
10							19		271	
11							21		331	
12							23		397	
13							25		469	
14							27		547	

Find $\bar{H}$ and σ for each test.
Find a_3 only when directed.

	Record	Limits
$\bar{H}$ + ~~5σ~~ 3σ	7.63	12
$\bar{H}$ − ~~2σ~~ 3σ	2.77	3

Ht. all Fired	8
Ht. all Missed	3

Σp 1.70
$H_1 - .5$ 3.50
$\bar{H}$ 5.20

$(\Sigma p)^2$
$(\Sigma p)^3$

Σpk 3.54
$(\Sigma p)^2$ 2.89
σ^2 .65
σ .81

$(\Sigma p)(\Sigma pk)$

Σps ______
$2(\Sigma p)^3$
$3(\Sigma p)(\Sigma pk)$______
a_3

Lot No. RA5022

FORM NO. ORDBA - 737
30 JUNE '43

ARMY-FRANKFORD ARSENAL PA

INCL 5

C-9

HEADQUARTERS
USAF MARKSMANSHIP SCHOOL
LACKLAND MILITARY TRAINING CENTER (ATC)
LACKLAND AIR FORCE BASE, TEXAS

REPLY TO ATTN OF: MMS-M-E

19 AUG 1963

SUBJECT: Primer Sensitivity Tests

TO: Frankford Arsenal
Philadelphia, Pa
Attn: Mr W C Davis

1. In accordance with agreement at the Inter-Service Conference on the AR-15, 13-14 Aug 63 at Frankford Arsenal, the following 5.56 mm (.223) ammunition has been shipped for tests to determine primer sensitivity:

LOT	AMOUNT
Remington 5022	600 rounds
Remington 5003	600 rounds
Remington 5016	600 rounds
Remington 5006	600 rounds

2. The Western lot with an overly sensitive primer has been expended.

3. In limited tests, this organization has recorded the following accidental firing rates with above lots:

Remington 5022	1 in 740 rounds
Remington 5003	1 in 3600 rounds
Remington 5016	1 in 6000 rounds
Remington 5006	1 in 1000 rounds

4. Also as agreed at the above conference, the following 5.56 mm (.223) ammunition has been shipped for tests to determine the mean radius for individual lots listed below:

Remington 5000
Remington 5002
Remington 5005
Remington 5006
Remington 5011
Remington 5013
Remington 5014
Remington 5020
Remington 5021
Remington 5023

Incl. 6

5. Lots 5016, 5003, and 5022 were previously shipped for M.R. determination.

FOR THE COMMANDER

RICARDO DAVILA
Captain, USAF
Administrative Officer

Info Cy To:
OOAMA (OOYEC)
Hill AFB Utah
Attn: Mr D H Jensen

AD ____________ Accession No. ______________
D&PS, Aberdeen Proving Ground, Maryland
USATECOM PROJECT NO. 8-3-0030-08-F, PRODUCT
IMPROVEMENT TEST OF MODIFIED AR15 RIFLES
Franklin H. Miller

Report No. DPS-1276, April 1964
AMCMS Code No.: 4420.25.0132.2.08
Unclassified Report

This report describes the tests of five AR15 rifles which incorporated the following modifications: the charging handle grip enlarged, the bolt closure-devise plunger-head area increased, and three firing pins with inertia retarding devises. Data recorded during testing indicate the charging handle and bolt closure devise functioned satisfactorily; however, minor design and fabrication changes are recommended to increase the serviceability of the parts. A firing pin inertia retarding device appears to be unnecessary.

AD ____________ Accession No. ______________
D&PS, Aberdeen Proving Ground, Maryland
USATECOM PROJECT NO. 8-3-0030-08-F, PRODUCT
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AD ____________ Accession No. ____________
D&PS, Aberdeen Proving Ground, Maryland
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