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INFANTRY AND AIRCRAFT WEAPONS DIVISION

REPORT ON

EVALUATION TEST OF THE RATE OF RIFLING TWIST IN RIFLE, CALIBER .223, AR15

by

G. E. HENDRICKS

Report No. DPS-880

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(D. A. Project No. 5020-804-601)

APRIL 1963

Aberdeen Proving Ground
Maryland

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AUTHORITY: AMSTE-BC Letter dated
14 December 1962

GEHendricks/tsp

EVALUATION TEST OF THE RATE OF RIFLING TWIST IN RIFLE, CALIBER .223, AR15

Report No. DPS-880

Dates of Test: 10 to 29 January 1963

ABSTRACT

Four AR15 rifles, two having a rate of rifling twist of one turn in 14 inches and two with a rate of one turn in 12 inches, were subjected to accuracy, velocity, bullet stability, and endurance tests. One rifle, U. S., 7.62-mm, M14, was used as a control. Long range accuracy and bullet stability of the AR15 rifle with a rate of twist of 1 turn in 12 inches were superior to those of the rifle with 1 turn in 14 inches.

CONTENTS

1. INTRODUCTION

Four rifles, AR15, caliber .223, two having a rate of rifling twist of one turn in 14 inches and two having a rate of one turn in 12 inches, were tested to determine the effect of rate of twist on accuracy, velocity, bullet stability, and endurance. One 7.62-mm, M14, U. S. rifle was used as a control. The standard AR15 has one turn in 14 inches.

2. DESCRIPTION OF MATERIEL

2.1 Rifle, Caliber .223, AR15

The four rifles submitted for testing were similar to those previously tested at this station except two had a different rate of rifling twist. A detailed description of the AR15 rifle is contained in Reference 3.

2.2 Rifle, U. S., 7.62-mm, M14

The rifle used for control was manufactured by Harrington and Richardson Arms Company. A detailed description is contained in Reference 4.

2.3 Ammunition

Weights for the complete rounds and components are given in Table I.

Table I. Ammunition Weight, grains

Five rounds of each model were weighed.

Round No.	Projectile	Propellant	Primed Case	Complete Round
Cartridge, ball, caliber .223, lot RA-5024 (Z01M).				
1	54.3	25.2	95.1	175
2	54.1	25.1	94.8	174
3	55.1	25.3	93.9	174
4	54.8	25.4	94.2	174
5	54.8	25.0	93.8	174
Average	54.6	25.2	94.4	174

Table I. (Cont'd)

Round No.	Projectile	Propellant	Primed Case	Complete Round
Cartridge, ball, caliber 7.62-mm, NATO, M80, lot FC-1907[a].				
1	147.6	46.6	184.6	379
2	147.7	46.6	184.1	378
3	147.4	46.6	187.2	381
4	147.2	46.7	183.2	377
5	147.5	46.6	184.2	378
Average	147.5	46.6	184.7	379

[a]This information was extracted from Report No. DPS-799, "Comparative Evaluation on AR15 and M14 Rifles."

2.4 Lubricant

PL-Special Lubricating Oil General Purpose Preservative, MIL-L-644B, was used in all phases of the test.

3. DETAILS OF TEST

3.1 Velocity Test

Lumiline screens were positioned 53 feet and 103 feet, respectively, from the muzzle and one counter chronograph was used to measure the time of flight of the bullets. The velocity of bullets fired from each test and control rifle were calculated before and after the endurance test. Results are given in Table II.

Table II. Velocity

The average instrumental velocity at 78 feet for 20 rounds.

Rifle	Rate of Twist of Rifle (Length for 1 Turn in Inches)	Velocity, fps				
		Avg	Max	Min	Variation Extreme	Variation Mean
Before Endurance Test						
AR15 No. 8825	14	3057	3102	3010	92	22.7
AR15 No. 8833	14	3070	3109	3000	109	19.9
AR15 No. 11285	12	3072	3127	3028	99	25.4
AR15 No. 11705	12	3085	3163	3000	163	25.1
M14 No. 894613	12	2803	2841	2759	82	16.9

Table II. (Cont'd)

Rifle	Rate of Twist of Rifle (Length for 1 Turn in Inches)	Velocity, fps			Variation	
		Avg	Max	Min	Extreme	Mean
		After Endurance Test				
AR15 No. 8825	14	2877	2948	2834	114	29.2
AR15 No. 8833	14	2889	3047	2830	217	34.7
AR15 No. 11285	12	2910	2973	2841	132	21.5
AR15 No. 11705	12	2933	3019	2874	145	27.5
M14 No. 894613	12	2805	2856	2770	86	11.2

3.2 Machine-Rest Accuracy Test

Ten 10-round groups were fired from each test and control rifle.

A paper screen was used at 100 yards and a 12- by 12-foot plywood target covered with Kraft paper was used at 500 yards to collect groups at the two ranges simultaneously. The firing was conducted using a universal accuracy cradle (heavy model) mounted on a V-block assembled in a Frankford Arsenal machine rest. Results are given in Table III.

Legend

MR	-	Mean radius
MVD	-	Mean vertical deviation.
MHD	-	Mean horizontal deviation.
EVD	-	Extreme vertical deviation.
EHD	-	Extreme horizontal deviation.
ES	-	Extreme spread.

Table III. Machine-Rest Accuracy

The averages for ten 10-shot groups are given in inches.

Rifle	Rate of Twist of Rifling (Length for 1 Turn in Inches)	MR	MVD	MHD	EVD	EHD	ES
		100 yards (before endurance)					
AR15 No. 8825	14	1.56	1.11	0.82	5.5	3.7	6.4
AR15 No. 8833	14	0.92	0.65	0.51	2.9	2.2	3.2
AR15 No. 11285	12	0.96	0.67	0.55	2.6	2.2	3.2
AR15 No. 11705	12	0.93	0.62	0.57	2.4	2.5	3.0
M14 No. 894613	12	1.02	0.74	0.56	3.0	2.2	3.1

Table III. (Cont'd)

Rifle	Rate of Twist of Rifling (Length for 1 Turn in Inches)	MR	MVD	MHD	EVD	EHD	ES
	500 yards (before endurance)						
AR15 No. 8825[a]	14	8.13	5.52	4.76	26.5	22.0	32.1
AR15 No. 8833	14	5.63	4.13	3.02	17.5	13.1	19.3
AR15 No. 11285	12	5.00	3.51	2.80	13.6	11.6	16.0
AR15 No. 11705	12	4.79	3.28	2.86	13.9	12.2	15.8
M14 No. 894613	12	4.53	3.08	2.84	12.4	10.7	14.3
	100 yards (after endurance)						
AR15 No. 8825	14	1.18	0.74	0.76	3.0	3.6	4.2
AR15 No. 8833	14	1.14	0.84	0.60	3.6	2.4	4.0
AR15 No. 11285	12	1.25	0.84	0.76	3.3	3.2	4.1
AR15 No. 11705	12	1.05	0.63	0.70	2.6	2.9	3.4
M14 No. 894613	12	1.63	1.26	0.78	5.2	3.4	5.7
	500 yards (after endurance)						
AR15 No. 8825	14	8.93	6.27	4.96	27.1	24.1	34.3
AR15 No. 8833	14	7.65	6.01	3.74	28.5	14.6	29.9
AR15 No. 11285	12	6.37	4.30	3.74	17.9	15.4	20.6
AR15 No. 11705	12	6.13	4.27	3.55	16.6	14.0	20.0
M14 No. 894613	12	7.61	5.72	3.91	23.6	17.0	27.0

[a]One shot missed the 12- by 12-foot target; thus the averages in this line are based on nine 10-shot groups rather than ten.

The difference in accuracy before and after endurance on the AR15 rifles was not significant. Table IV gives the relationship between the 500- and the 100-yard accuracy.

Table IV. Relationship Between the 500- and 100-Yard Accuracy

Rifle	Rate of Twist of Rifling (Length for 1 Turn in Inches)	Before or After Endurance Test	$\frac{500\ MR}{100\ MR}$
AR15 No. 8825	14	Before	5.58[b]
	14	After	7.57
AR15 No. 8833	14	Before	6.12
	14	After	6.71
		Average	6.50

[b]Based on average of nine shot groups both at 100 and 500 yards.

Table IV. (Cont'd)

Rifle	Rate of Twist of Rifling (Length for 1 Turn in Inches)	Before or After Endurance Test	500 MR / 100 MR
AR15 No. 11285	12	Before	5.21
	12	After	5.10
AR15 No. 11705	12	Before	5.15
	12	After	5.84
		Average	5.32
M14 No. 894613	12	Before	4.44
	12	After	4.67
		Average	4.56

The difference in relationship between the 500- and 100-yard accuracy in the AR15 rifles having a rate of rifling twist of one turn in 12 inches is significantly smaller when compared with that of rifles having a rate of twist of one turn in 14 inches.

3.3 Combat Accuracy Test

A test was conducted to investigate the accuracy that can be obtained when the rifle is fired under conditions similar to those encountered in combat. Two expert riflemen were used in this test. Each rifleman fired an AR15 rifle having the rate of rifling twist of one turn in 12 inches, one AR15 rifle having the rate of twist of one turn in 14 inches and the M14 control rifle. Each rifle was fired over the following course at 100 yards:

With sights properly adjusted and with a fouled bore, one 10-round target was fired from a bench rest.

The rifle was disassembled (field stripped), cleaned, oiled, and reassembled.

Starting with a cold and oiled bore, one 10-round target was fired from a bench rest.

One 10-round target was fired from the prone position using a sling.

One hundred rounds were fired as rapidly as possible (automatic fire).

Immediately after firing the 100 rounds, one 10-round target was fired from a bench rest.

Another 10-round target was fired immediately from the prone position using a sling.

Results are given in Table V.

Table V. Combat Accuracy

The averages for five 10-shot groups are given in inches.

Rifle	Rate of Twist of Rifling (Length for 1 Turn in Inches)	MR	MVD	MHD	EVD	EHD	ES	Measurements from Center of Group 1	
								Mean	ES
AR15 No. 8825	14	1.71	1.20	0.89	5.8	4.2	6.4	4.80	8.1
AR15 No. 8833	14	1.19	0.84	0.61	3.8	2.3	4.1	2.72	4.7
AR15 No. 11285	12	1.11	0.81	0.63	2.9	2.6	3.6	4.59	6.2
AR15 No. 11705	12	1.23	0.79	0.75	3.4	3.1	3.8	3.19	4.4
M14 No. 894613	12	2.31	1.67	1.32	7.0	5.5	8.2	3.30	6.0
M14 No. 894613	12	2.35	1.56	1.45	6.3	6.9	8.4	3.48	5.9

3.4 Bullet Stability and Jacket Separation

Ten bullets were fired from each test rifle through an A target (used as a paper screen) at each of four ranges. The ranges were 4, 5, 10, and 25 meters from the muzzle. Results are given in Table VI. Figures 1 through 5 show the bullet holes in the paper screen at 4 meters.

Table VI. Results of Keyholing

Rifle	Rate of Twist of Rifling (Length for 1 Turn in Inches)	Number of Bullet Holes Showing Yaw Range (Distance from Muzzle)			
		4 meters	5 meters	10 meters	25 meters
AR15 No. 8825	14	7	5	3	0
AR15 No. 8833	14	7	5	0	1
AR15 No. 11285	12	0	2	0	0
AR15 No. 11705	12	1	4	0	0
AR15 No. 894613	12	7	6	0	3

Figure 1: Bullet Holes Obtained by Firing 10 Rounds from Rifle, Caliber .223, AR15 No. 8825 through a Paper Screen Positioned 4 Meters from the Muzzle.

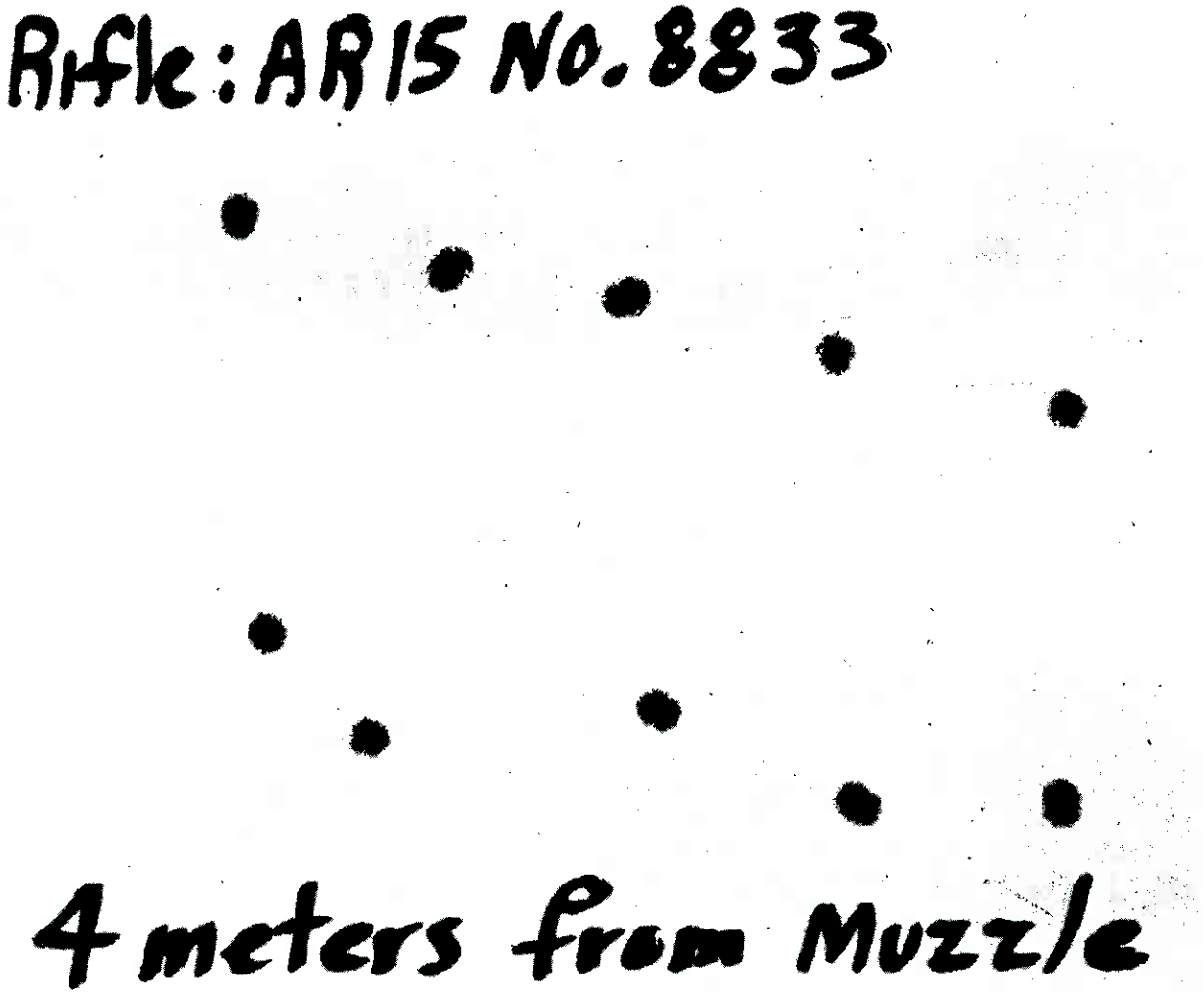


Figure 2: Bullet Holes Obtained by Firing 10 Rounds from Rifle, Caliber .223, AR15 No. 8833 through a Paper Screen Positioned 4 Meters from the Muzzle.

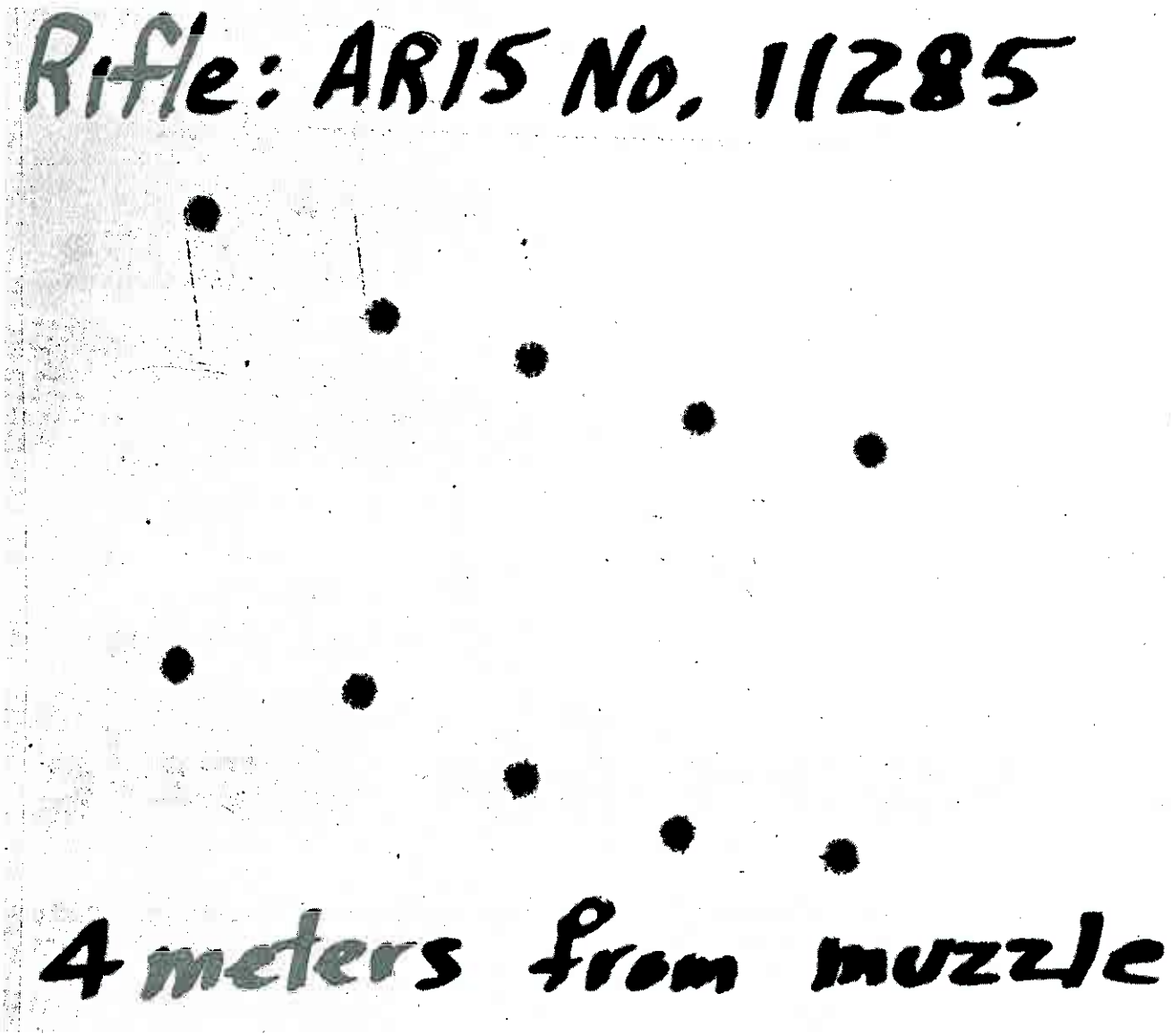


Figure 3: Bullet Holes Obtained by Firing 10 Rounds from Rifle, Caliber .223, AR15 No. 11285 through a Paper Screen Positioned 4 Meters from the Muzzle.

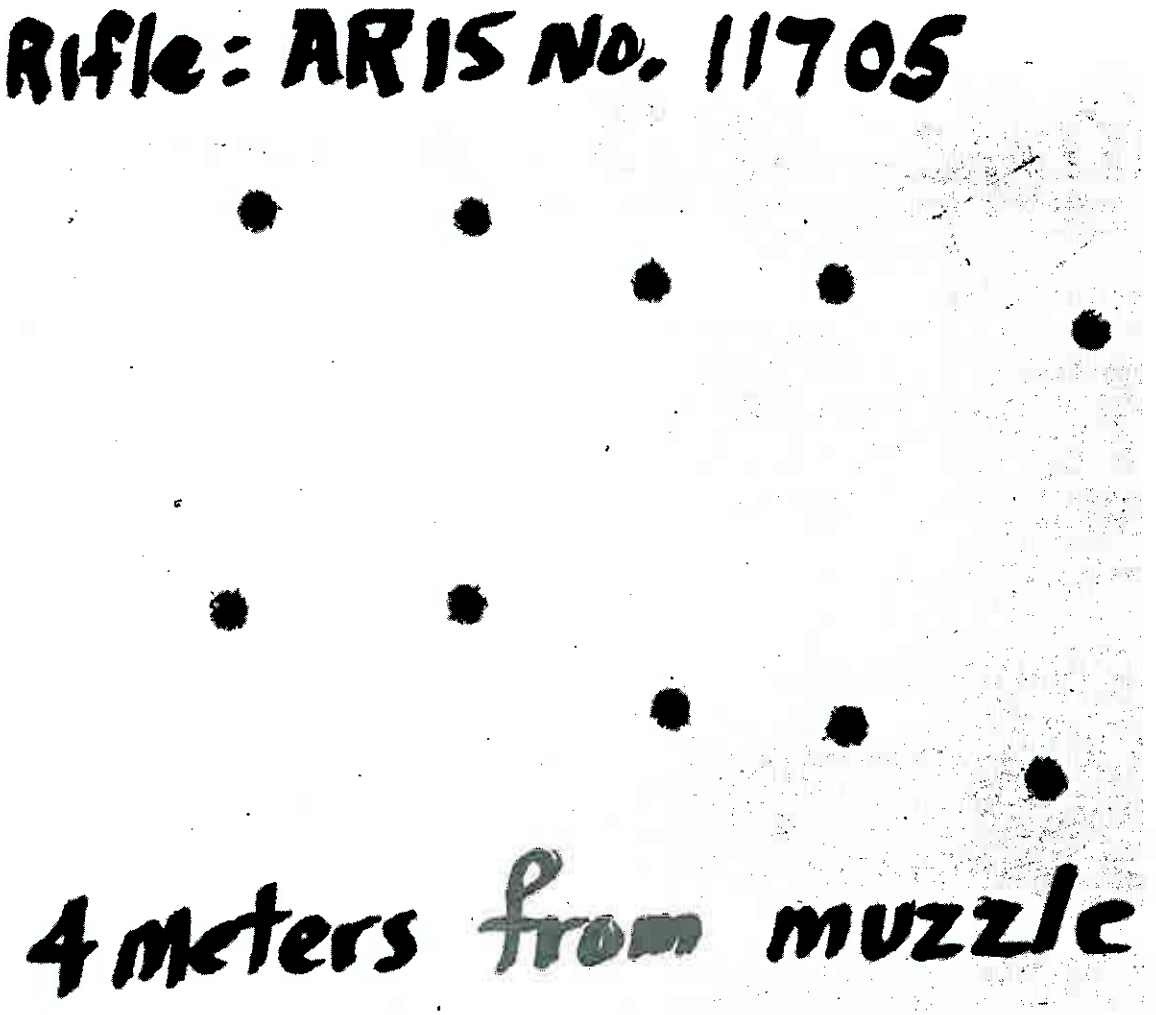


Figure 4: Bullet Holes Obtained by Firing 10 Rounds from Rifle, Cáliber .223, AR15 No. 11705 through a Paper Screen Positioned 4 Meters from the Muzzle.

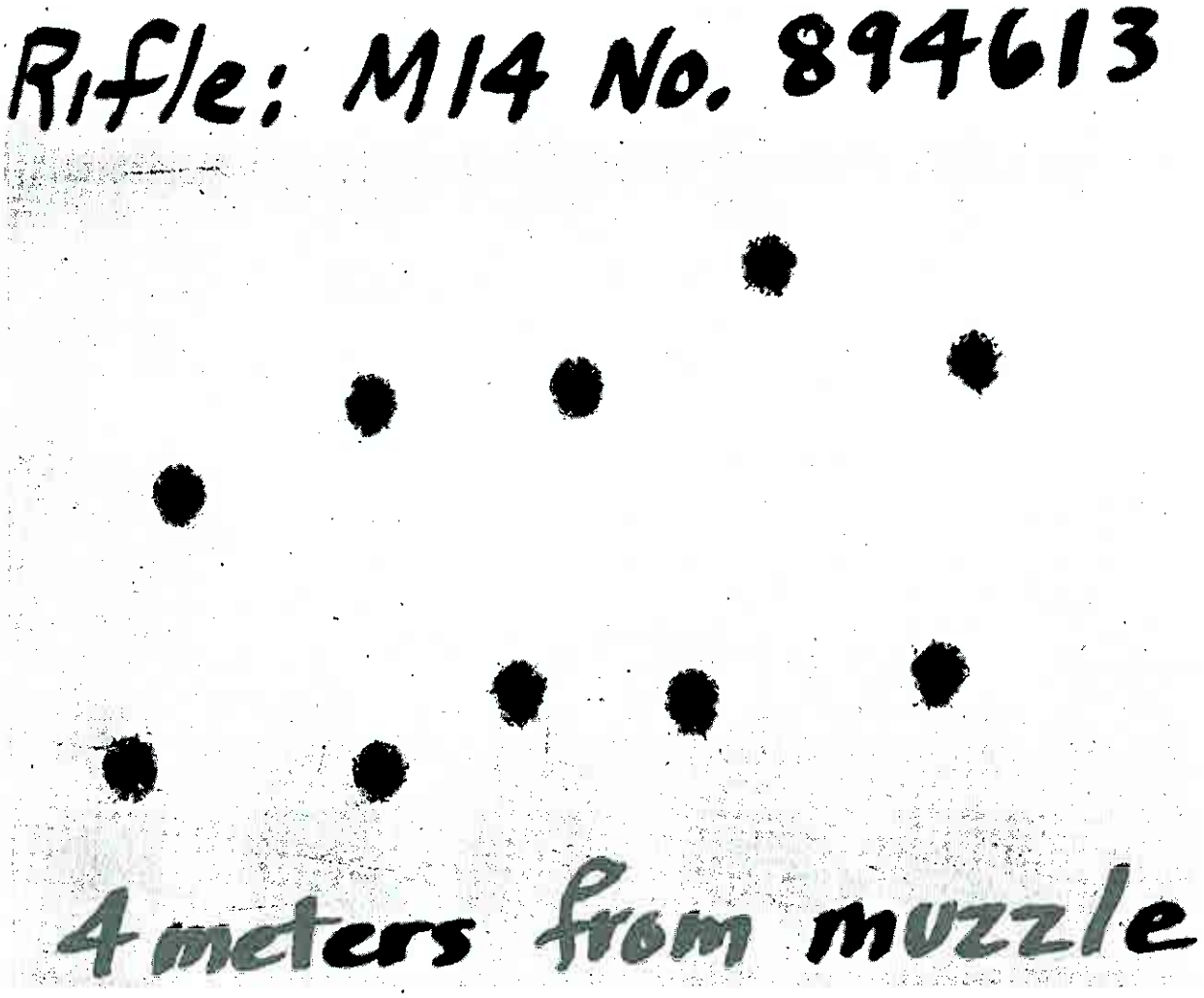


Figure 5: Bullet Holes Obtained by Firing 10 Rounds from Rifle, U. S. Caliber 7.62-mm, M14 No. 894613 through a Paper Screen Positioned 4 Meters from the Muzzle.

Five bullets were fired from each test rifle into polyurethane foam for recovery. Bullets fired from the AR15 rifles indicated no slippage but those fired from the M14 rifle indicated minor slippage. Figures 6 through 10 show the recovered bullets.

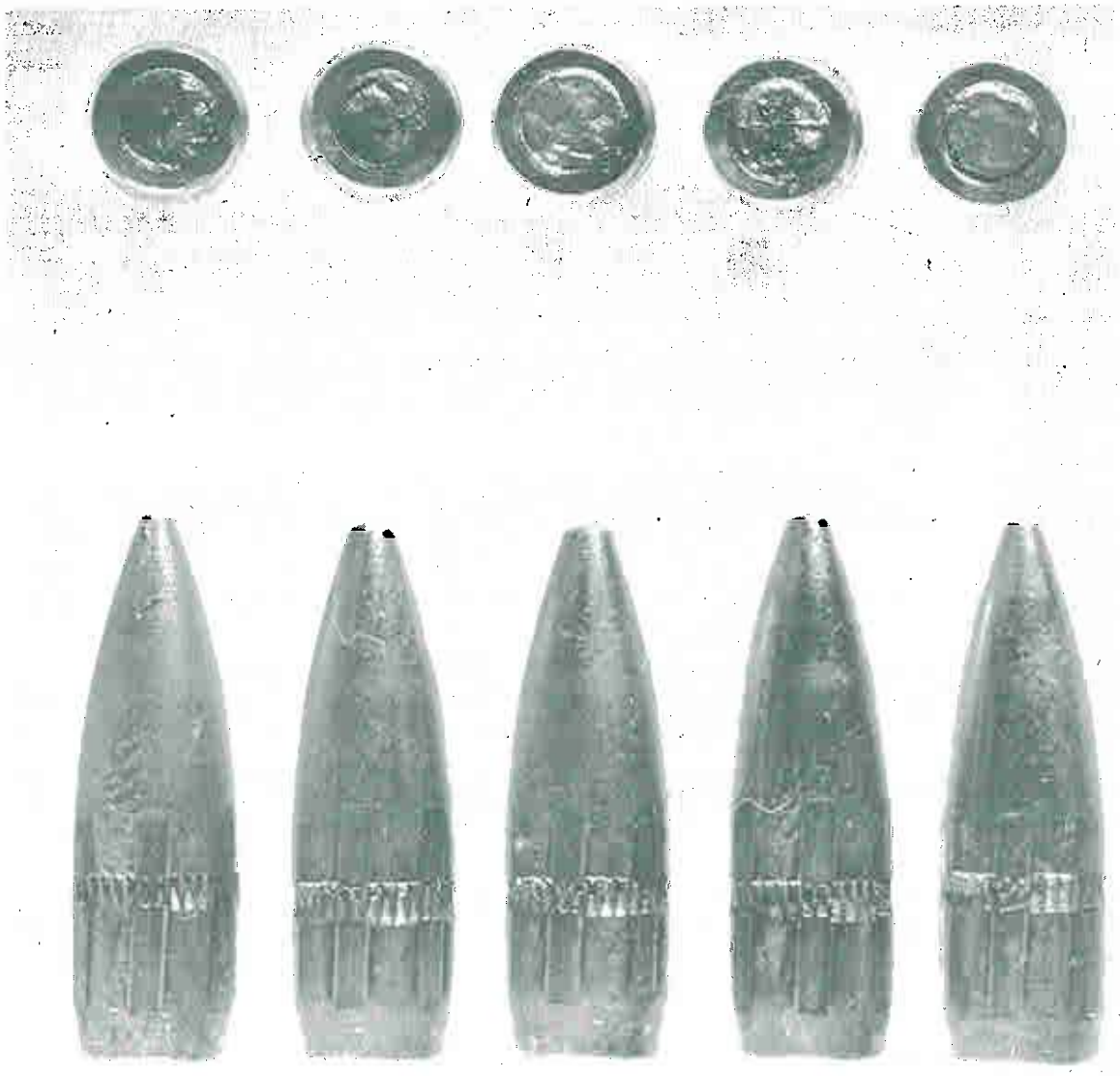


Figure 6: Bullets Fired from Rifle, Caliber .223, AR15 No. 8825.

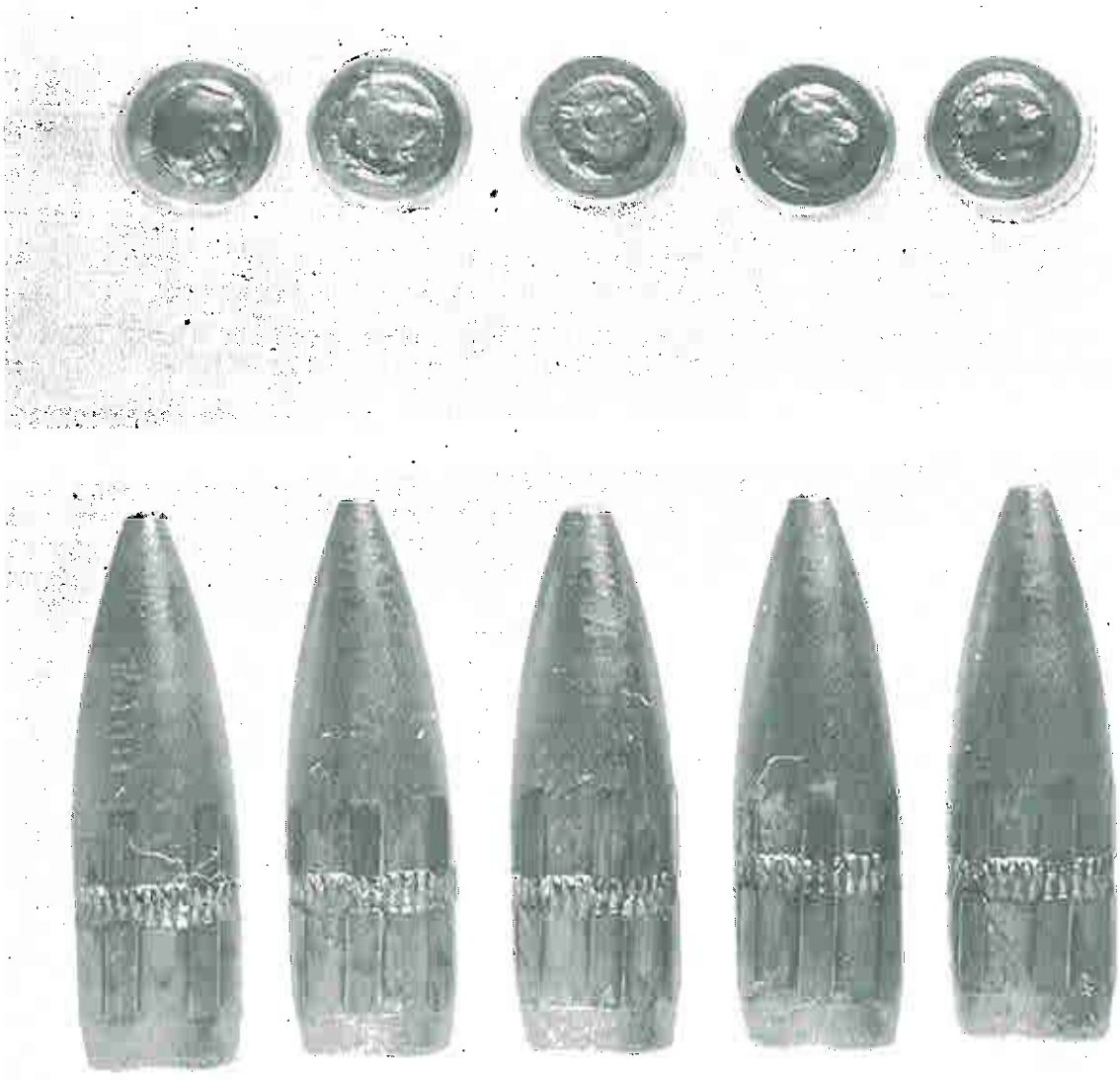


Figure 7: Bullets Fired from Rifle, Caliber .223, AR15 No. 88833.

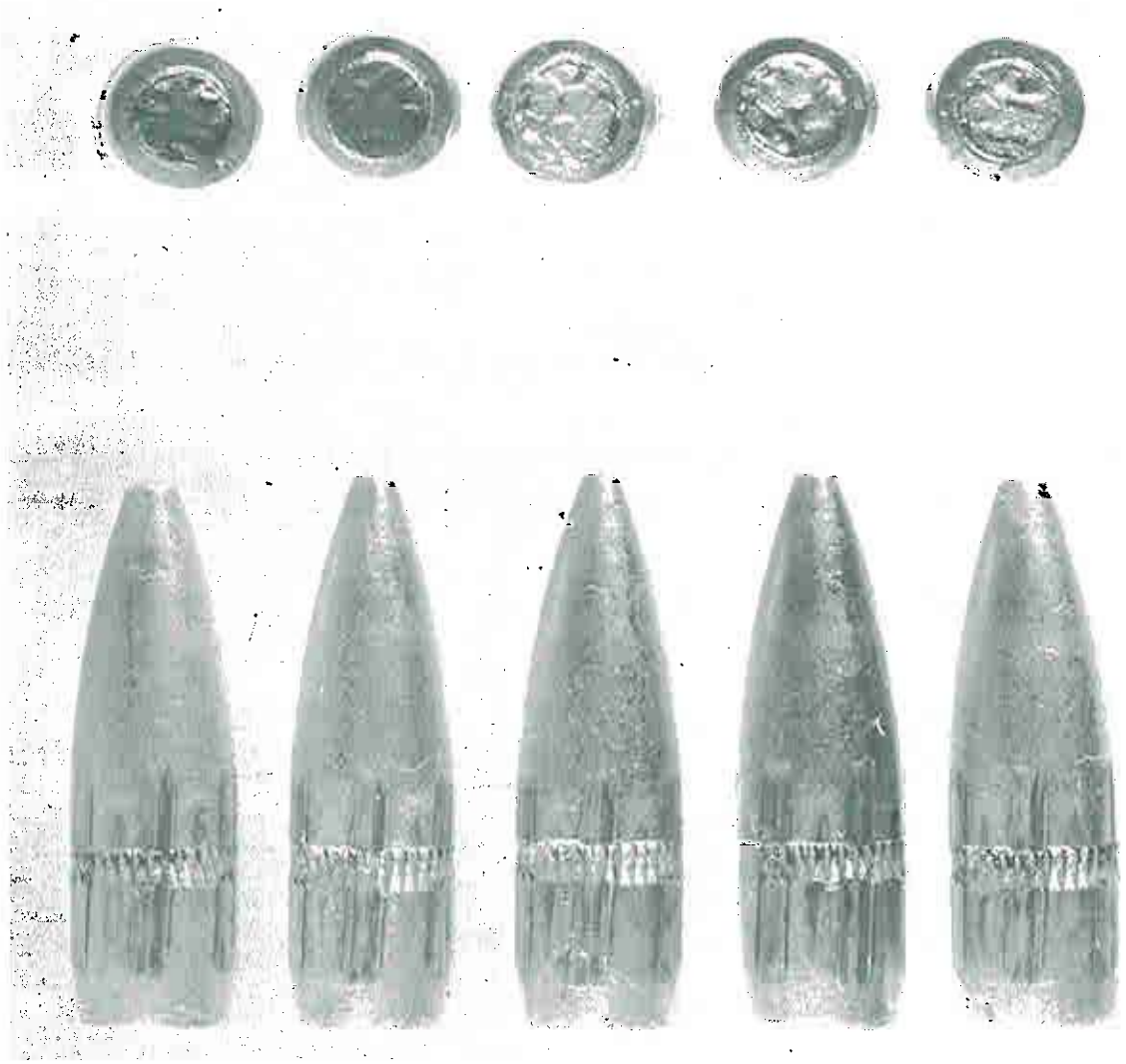


Figure 8: Bullets Fired from Rifle, Caliber .223, AR15 No. 11285

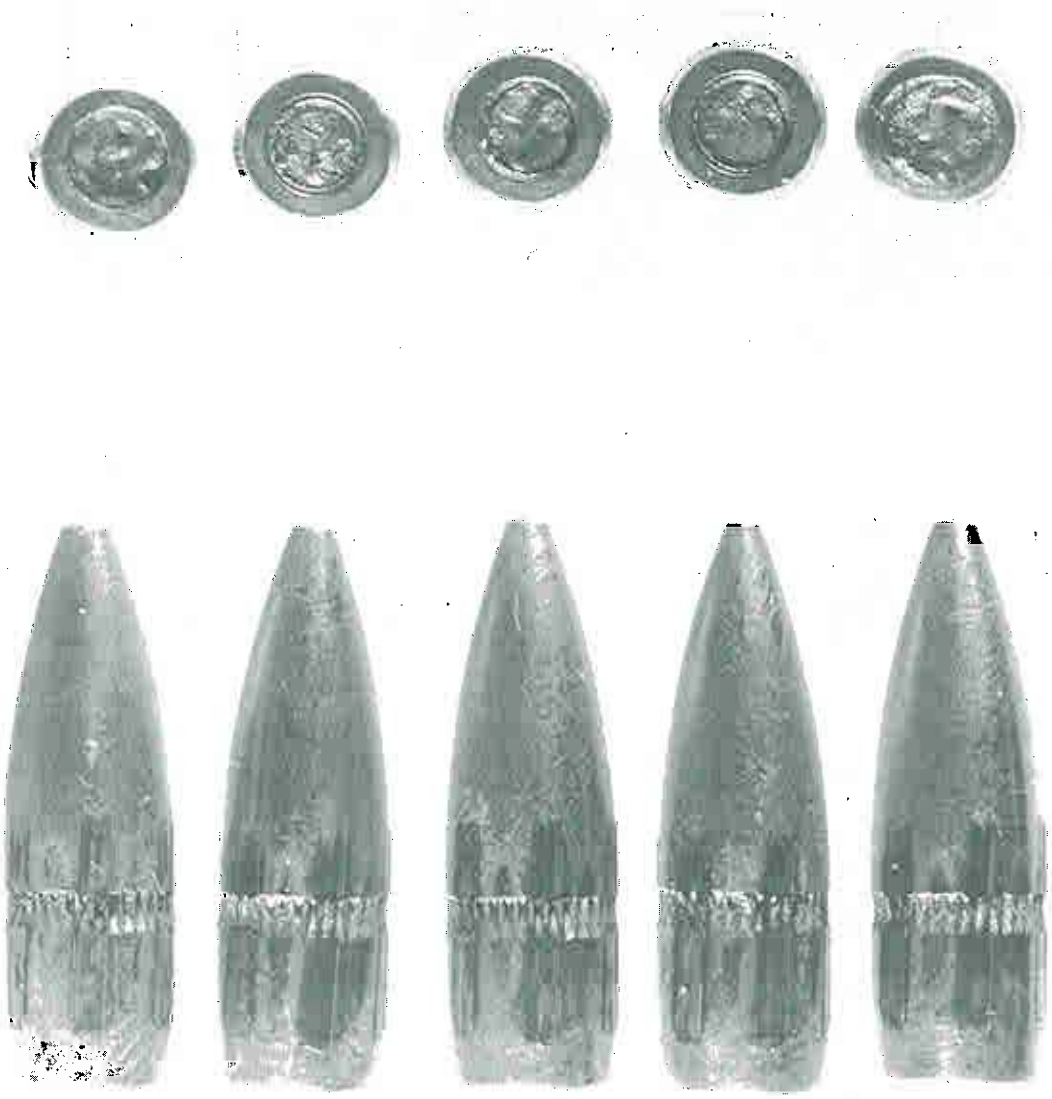


Figure 9: Bullets Fired from Rifle, Caliber .223, AR15, No. 11705.

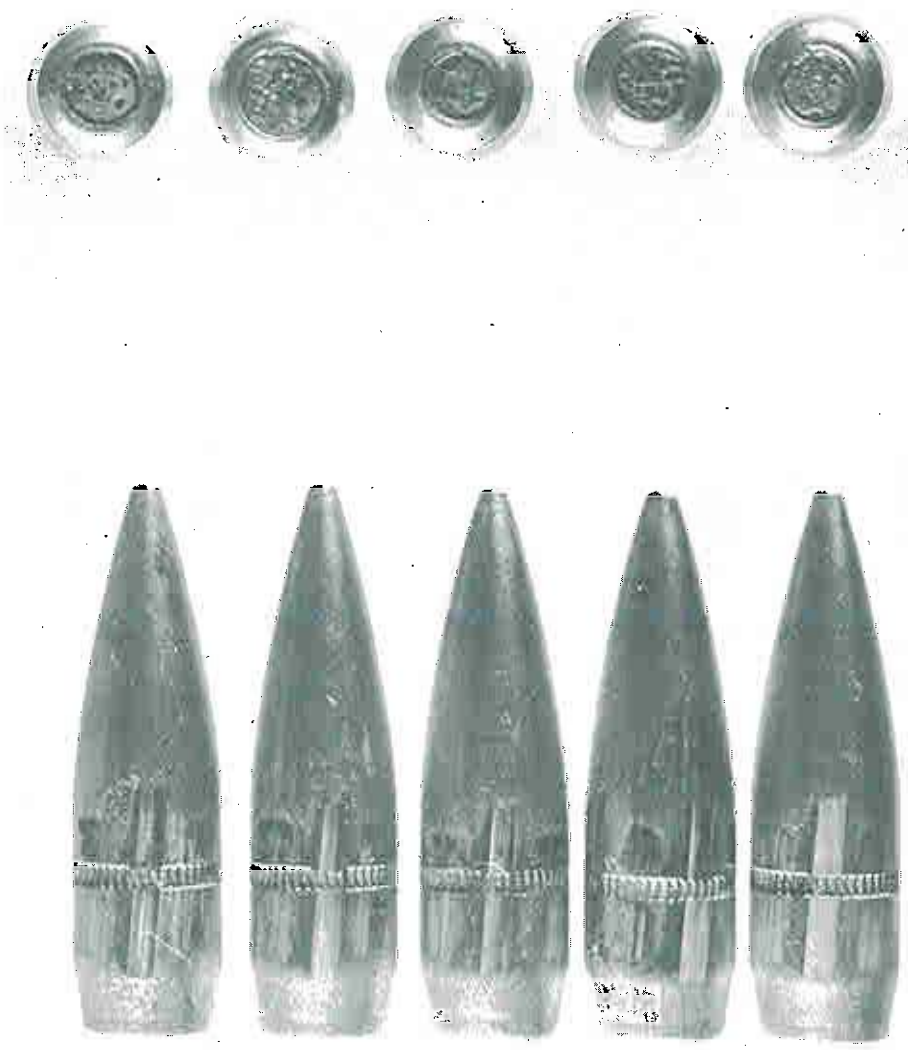


Figure 10: Bullets Fired from Rifle, U. S., Caliber 7.62-mm, M14 No. 894613.

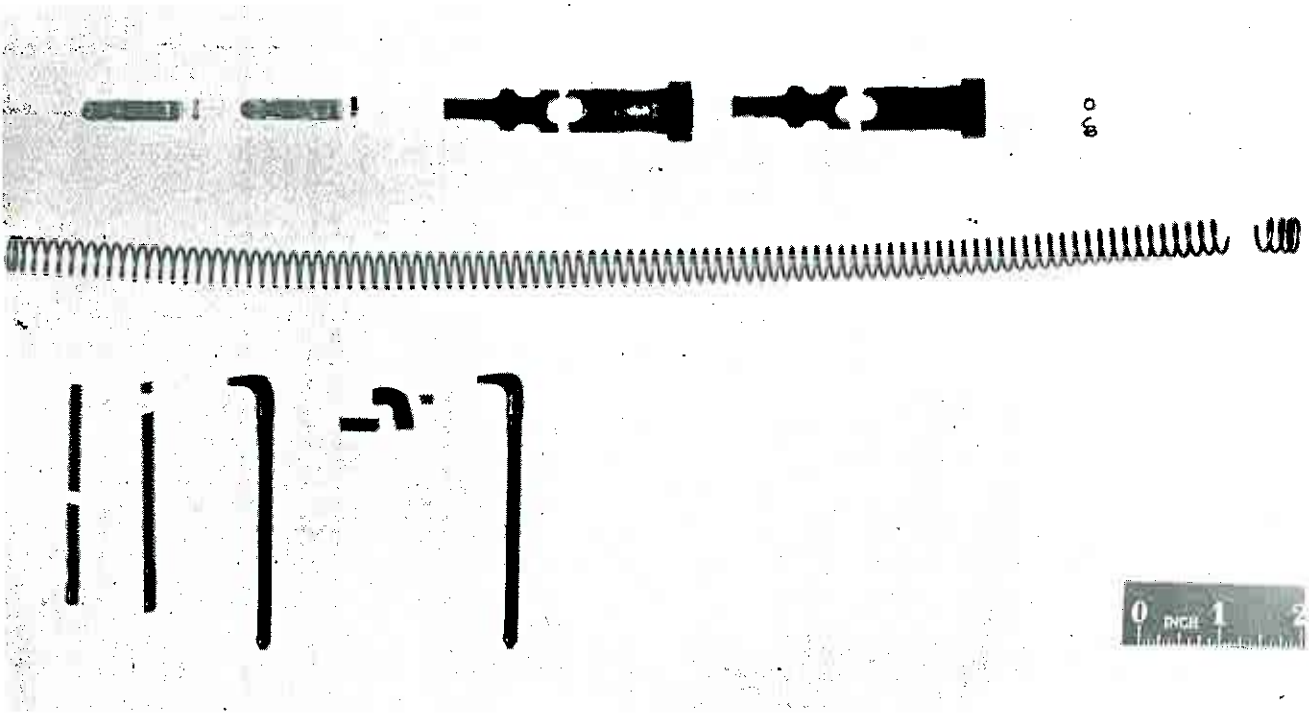
3.5 Endurance Test

Each rifle was subjected to a 6000-round endurance test. The rifle was disassembled, cleaned, inspected, and lubricated after every 1000 rounds. The rifle was cooled after each 100 rounds. Firing was alternated between semi-automatic and automatic fire after each 100 rounds. Results are given in Table VII. Figure 11 shows the broken parts.

No difference in fouling was observed in the AR15 rifles during the endurance test.

Table VII. Summary of Malfunctions and Broken Parts which Occurred in the Endurance Test

Rifle	Malfunctions No.	Malfunctions Type	Detailed Description	Broken Parts
AR15 - 8825	49	Failures to feed.	All failures occurred on loading the first round from the magazine. On numerous occasions, the failure to feed was corrected by the gunner applying pressure, by hand, on the magazine toward the muzzle, causing the bolt to strip the first round from the magazine.	
	98		Failures of the bolt to remain at rear after the last round.	
	2		Failures were caused by bolt overriding the base of round in feeding from magazine.	
	1		Failure to extract, caused by a broken extractor.	One extractor.
AR15 - 8833	6	Failures to feed.	All failures occurred on loading the first round from the magazines.	
	86		Failures of the bolt to remain at rear after last round.	
	1		Failure to eject, caused by a broken extractor.	One extractor.
AR15 - 11285	17	Failures to feed.	On 15 occasions, the bolt failed to strip the first round from the magazines. On 2 occasions, the bolt failed to engage the base of the round.	
	2		Failures of the bolt to remain at rear after last round.	
	1		Failure to fire, caused by a broken bolt.	
	1		Failure to extract, caused by a broken bolt.	One bolt.
AR15 - 11705	130	Failures to feed.	Ninety-three failures occurred on loading the first round from the magazine. Thirty-three failures occurred when the nose of the bullet stubbed on the barrel extension. One failure occurred when the bolt failed to engage the base of the round. Two failures occurred when the last round of the magazine failed to remain in position in the magazine and the bolt partially closed with the base of the round protruding from the ejection port. One failure occurred when the last round of the magazine failed to remain in the magazine, causing the bolt to remain at the rear with the round laying on top of the magazine.	One bolt.
	30		Failures of the bolt to remain at rear after last round.	
	1		Failure to eject, caused by a broken extractor spring.	One extractor spring.
	1		Failure to extract, caused by a broken bolt.	
M14 - 894613	8	Failures to feed.	Seven failures occurred when the nose of the bullet stubbed on the magazine. One failure occurred when the bolt failed to engage the base of the round..	Two firing pins. Two ejector springs.
	1		Failure to fire, caused by a broken firing pin.	One extractor.
	1		Failure to eject, caused by a broken extractor and extractor spring.	One extractor spring.
	1		Failure was caused by bolt overriding the base of round in feeding from magazine.	One operating rod spring.



Parts from Rifle, Caliber .223, AR15

Extractor from rifle No. 8825.
Extractor from rifle No. 8833.
Bolt from rifle No. 11285.
Bolt from rifle No. 11705.
Extractor spring from rifle No. 11705.

Parts from Rifle, U. S. 7.62-mm, M14, No. 894613.

Operating spring.
Ejector spring.
Ejector spring.
Firing pin.
Extractor.
Extractor spring.
Firing pin.

Figure 11: Parts Broken during Endurance Test.

3.6 Observations

The AR15 rifles cooled more rapidly than the M14 rifle after being fired 100 rounds at a high rate.

Sight picture distortion caused by dissipation of heat from the barrel was not as severe when firing the AR15 rifle as when firing the M14 rifle.

Recovered bullets fired from some AR15 rifles showed longitudinal scratches which resulted from a burr on the edge of the gas port hole in the bore.

4. CONCLUSION

Long range accuracy and bullet stability of the AR15 rifle with a rate of twist of 1 turn in 12 inches were superior to those of the rifle with 1 turn in 14 inches.

SUBMITTED:

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Deputy Director
for Engineering Testing
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REFERENCES

1. Hendricks, G. E. "Comparative Evaluation of AR15 and M14 Rifles," Aberdeen Proving Ground. Report No. DPS-799, December 1962.

2. Moore, L. F. "A Test of Rifle, Caliber .22, AR15; Rifle, Lightweight Military, Caliber .224; and Pertinent Ammunition." Aberdeen Proving Ground, Project No. TS2-2015/57, January 1959.

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

4. Department of the Army Technical Manual TM9-1005-223-34, "Field Maintenance 7.62-mm, Rifle, M14."

APPENDICES

APPENDIX A

Correspondence

AMSTE-BC (18 Jan 63) 1st Ind
SUBJECT: Evaluation of Bullet Stability in AR15 Rifle

Headquarters, United States Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 15 FEB 1963

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

Your agency is authorized to conduct tests as outlined in the inclosure to the basic letter.

FOR THE COMMANDER:

1 Incl
wd

JOHN W. RODGERS
Colonel GS
C, Admin Div

U. S. ARMY
DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

MrLMoore/ps/31246

IN REPLY REFER TO

18 JAN 1963

STEAP-DS-TI

SUBJECT: Evaluation of Bullet Stability in AR15 Rifle

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

1. Reference 2nd Indorsement to subject letter, dated 9 January 1963.

2. In accordance with paragraph 3 of the referenced indorsement, a detailed plan for the subject test is inclosed.

FOR THE DIRECTOR:

ROBERT W. SAMUEL
Lt Colonel, OrdC
Deputy Director for
Engineering Testing

1 Incl
1. a/s

TEST PLAN

1. PROJECT IDENTIFICATION

1.1 Subject: Evaluation of Bullet Stability in the AR15 Rifle

1.2 Project No.: DA-5020004601

1.3 Type of Test: Evaluation of Performance

1.4 Cognizant Agency: U.S. Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland

1.5 Authority: AMCMS 5561.12.466A0.06 and Letter, AMSTE-EC dated 14 December 1962

1.6 DA Priority: 1A

1.7 Classification: Unclassified

1.8 Project Assignment: George E. Hendricks, Small Arms and Aircraft Weapons Branch

1.9 Date: 11 January 1963

2. PROJECT DESCRIPTION

2.1 Introduction

Four caliber .223 AR15 rifles, two having 1 in 12 inch rate of twist and two having 1 in 14 rate of twist, manufactured by Colt will be tested. One 7.62-mm M14 manufactured by Harrington and Richardson Arms Company will be subjected to all the tests.

2.2 Objective

To determine differences in stability and accuracy of the AR15 rifle with 1 in 12 and 1 in 14 rate of twist rifling.

2.3 Background

Related reports, DPG-96, DPG-799 and "A Test of Rifle, Caliber .22, AR15; Rifle, Lightweight Military, Caliber .224 and Pertinent Ammunition", Project No. T32-2015/57, January 1959.

2.4 Description of Material

Two AR15 rifles with 1 in 12 rate of twist, two AR15 rifles with 1 in 14 rate of twist and one M14 rifle will be utilized in the test.

3. TEST PROCEDURE

3.1 Test I - Velocity and Accuracy (OPM 20-20 Par. 3.9)

3.1.1 Purpose

To determine instrumental velocity of the caliber .223 bullet at 78 feet, and determine accuracy at 100 and 500 yards.

3.1.2 Method

Lumiline screens and counter chronographs will be used for velocity measurement. Paper screens will be used for accuracy, to collect 10-round groups at 100 and 500 yards simultaneously. Accuracy firing will be conducted using a universal accuracy cradle.

3.2 Combat Accuracy Test (OPM 20-20 Appendix II, Test No. IV - Accuracy, para 3.)

The test will be in accordance with the referenced OPM, except that two riflemen will each fire a 1 in 12, a 1 in 14 twist AR15 and the M14 rifles.

3.2.1 Purpose

To investigate the accuracy which can be obtained when the rifle is fired under various conditions similar to those encountered by a combat rifleman.

3.2.2 Method

As stated in OPM 20-20, Appendix II, Test No. IV - Accuracy, para 3.

3.3 Test 2 - Bullet Stability and Jacket Separation

3.3.1 Purpose

To determine keyholing at various ranges and jacket separation.

3.3.2 Method

Firings will be conducted through paper screens at various ranges for evidence of bullet keyholing. Firings into approximately 30 cubic feet of Urethane foam will be accomplished for bullet recovery and check for jacket separation.

3.4 Test 3 - Endurance

Reference will be made to OPM 20-20, paragraph 3.9

3.4.1 Purpose

To determine primarily, erosion differences between the different rate of twist rifles. Functioning is secondary.

3.4.2 Method

Elevations, depressions, and holdings positions will be omitted. Each rifle will be subjected to a 6000-round endurance test, the rifle will be disassembled, cleaned, inspected and lubricated after every 1000 rounds. The rifle will be cooled after each 100 rounds. Firing will be alternated between semiautomatic and automatic fire after each 100 rounds. Velocity and accuracy tests will be conducted after this test to determine bore erosion characteristics. Observations will be made on fouling during each inspection. All firing will be conducted from a bench rest at 0 to 3^{0} elevation.

4. REPORTS

4.1 Formal, upon completion of test.

5. SCHEDULE

Bore measurements - 10 January 1963
Preparations set ups - 10 thru 14 January 1963
Velocity - 12 January 1963
Accuracy - 14 thru 17 January 1963
Combat Accuracy - 14 thru 17 January 1963
Bullet Stability and Jacket Separation - 14 thru 17 January 1963
Endurance - 17 thru 22 January 1963
Accuracy - 23 thru 25 January 1963
Velocity - 26 January 1963
Report writing and target reading - 26 January thru 4 February 1963

6. REFERENCES

6.1 Related reports

DPG-96, "A Test of Rifle, Caliber .22, AR15; Rifle,Lightweight Military Caliber .224 and Pertinent Ammunition", Project TS2-2015/57, January 1959 and DPG-799

7. AUTHENTICATION

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8. DISTRIBUTION

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APPENDIX B

Function Reports

Legend:

SAT	-	Satisfactory.
SS	-	Single shot.
S	-	Semiautomatic.
A	-	Automatic
FF	-	Failure to feed.
FX	-	Failure to extract.
FJ	-	Failure to eject.
FFR	-	Failure to fire.
FBR	-	Failure of bolt to remain at rear after last round.
BOB	-	Bolt overrode base of round in feeding from magazine.

No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks

Rifle, caliber .223, AR15, No. 8825.

11 January 1963

The rifle was disassembled and inspected. There were heavy circumferential tool marks in the body and neck of the chamber, and light circumferential tool marks on the lands throughout the bore. Light metal deposits were present throughout the bore.

Rifling: One turn in 14 inches.
Width of lands: 0.038 inch.
Width of grooves: 0.074 inch.
Firing pin protrusion: 0.034 inch.
Trigger pull (average of five trials): 8.9 pounds.
Diameter of front sight at top of post: 0.066 inch.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
12 January 1963					
Cartridge, ball, caliber .223, lot RA-5024 (Z01M).					
		Velocity Test			
1039 to 1103	23	23	S	1 - FF	The bolt failed to strip the first round from the magazine.
		Bullet Recovery Test			
Polyurethane foam was positioned approximately 87 yards from the muzzle to recover fired bullets.					
1450	1	24	SS	SAT	Sighting shot.
1452 to 1617	5	29	SS	SAT	The bullets penetrated from 16 feet 10 inches to 17 feet 6 inches.
14 January 1963					
		Machine-Rest Accuracy Test			
1430 to 1450	8	37	SS	SAT	Sighting shots.
1715	3	40	SS	SAT	Sighting shots.
1742 to 1832	100	140	SS	SAT	Fired by G. Hendricks.
17 January 1963					
		Combat Accuracy Test (100 yards)			
An A target with a 12-inch bull's-eye was used as an aiming point.					
Fired by L. Staley (except 100-rounds automatic).					
1005 to 1008	5	145	S	SAT	Sighting shots.
1025 to 1027	10	155	S	SAT	Fired from a bench rest.

The rifle was disassembled (field stripped), cleaned, lubricated (including the bore), and reassembled.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
1041 to 1043	10	165	S	SAT	Fired from a bench rest.
1047 to 1048	10	175	S	SAT	Fired from the prone position using a sling and shooting glove.
1109	100	275	A	SAT	Fired by E. Kelly.
1110 to 1111	10	285	S	SAT	Fired from a bench rest.
1112 to 1113	10	295	S	SAT	Fired from the prone position using a sling and shooting glove.

18 January 1963

Bullet Stability Test

Ten rounds were fired through an A target used as a paper screen at each of four ranges; 4, 5, 10, and 25 meters.

1322 to 1437	40	335	S	SAT	

19 January 1963

Endurance Test

The rifle was subjected to a 6000-round endurance test. The rifle was disassembled, cleaned, inspected, and lubricated after every 1000 rounds. The rifle was cooled after each 100 rounds. Firing was alternated between semi-automatic and automatic fire after each 100 rounds. Five new magazines furnished by Mr. Morrow, Test and Evaluation Command, APG, Maryland, were used in the endurance test. The magazines were numbered 1 through 5, inclusive.

Fired by R. Daigle

0919 to 1326	1000	1335	-	12 - FF	On 12 occasions the bolt failed to strip the first round from magazines No. 3 and 5.
				15 - FBR	Malfunctions occurred using magazines No. 2, 3, 4, and 5.

The rifle was disassembled, cleaned, inspected, and lubricated. All magazines were slightly bent on the lips. They were straightened with a plastic hammer.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
1419 to 1551	500	1835	-	5 - FF	On five occasions the bolt failed to strip the first round from magazines No. 3 and 4.
				5 - FBR	Malfunctions occurred using magazines No. 3, 4, and 5.

21 January 1963

Fired by J. Hughes

0925 to 1037	500	2335	-	2 - FF	On two occasions the bolt failed to strip the first round from magazine No. 3.
			-	3 - FBR	Malfunctions occurred using magazines No. 3, 4, and 5.

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

Cartridge, ball, caliber .223, lot RA-5024 (Z311).

1245 to 1517	1000	3335	-	7 - FF	On seven occasions the bolt failed to strip the first round from magazine No. 3.
				17 - FBR	Malfunctions occurred using magazines No. 1, 3, 4, and 5.

22 January 1963

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

Fired by P. Jones.

0917 to 0940	200	3535	-	2 - FBR	Malfunctions occurred using magazines No. 3 and 5.

Cartridge, ball, caliber .223, lot RA-5024 (Z15M)

0952 to 1300	800	4335	-	2 - BOB	Malfunctions occurred using magazine No. 5.
			-	8 - FF	On eight occasions the bolt failed to strip the first round from magazines No. 1, 3, 4, and 5.

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

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
1425 to 1535	500	4835	-	5 - FF	On five occasions the bolt failed to strip the first round from magazines No. 2, 3, and 4
				14 - FBR	Malfunctions occurred using all magazines.

23 January 1963

Cartridge, ball, caliber .223, lot RA-5024 (Z01M).

0957 to 1011	500	5335	-	2 - FF	On two occasions the bolt failed to strip the first round from magazine No. 3.
				15 - FBR	Malfunctions occurred using all magazines.

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

1107 to 1506	1000	6335	-	8 - FF	On eight occasions the bolt failed to strip the first round from magazines No. 2, 3, and 5.
				27 - FBR	Malfunctions occurred using all magazines.
				1 - FX	The extractor broke after firing 5835 rounds. An extractor from rifle No. 7227 was installed.

Velocity Test

1802 to 1817	20	6355	S	SAT	

24 January 1963

Machine-Rest Accuracy Test

1955 to 2009	10	6365	SS	SAT	Sighting shots.
2020 to 2119	100	6465	SS	SAT	Fired by G. Hendricks.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks

5 February 1963

The rifle was disassembled and inspected. There was moderate erosion in the first 2 inches of the bore near the chamber. There was very slight chipping on the leading edge of the lands near the breech. Some metal fouling was present throughout the bore. The gas porthole was slightly eroded.

Rifle, caliber .223, AR15, No. 8833.

11 January 1963

The rifle was disassembled and inspected. There were heavy circumferential tool marks in the body and neck of the chamber, and light circumferential tool marks on the lands throughout the bore. Light metal deposits were present throughout the bore.

Rifling: One turn in 14 inches.
Width of lands: 0.039 inch.
Width of grooves: 0.073 inch.
Firing pin protrusion: 0.033 inch.
Trigger pull (average of five trials): 9.2 pounds.
Diameter of front sight at top of post: 0.063 inch.

12 January 1963

Cartridge, ball, caliber .223, lot RA-5024 (Z01M).

Velocity Test

1045 to 1106	21	21	S	1 - FF	The bolt failed to strip the first round from the magazine.
				1 - FJ	The fired cartridge case stubbed on the barrel extension.

14 January 1963

Machine-Rest Accuracy Test

1902 to 1913	10	31	SS	SAT	Sighting shots.
1930 to 2025	100	131	SS	SAT	Fired by G. Hendricks.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
16 January 1963					
		Bullet Recovery Test			
		Polyurethane foam was positioned approximately 87 yards from the muzzle to recover fired bullets.			
1025 to 1057	5	136	SS	SAT	The bullets penetrated from 16 feet 7 inches to 17 feet 9 inches.
17 January 1963					
		Combat Accuracy Test (100 yards)			
		An A target with a 12-inch bull's-eye was used as an aiming point.			
		Fired by G. Hendricks (except 100-rounds automatic).			
1413 to 1415	9	145	S	SAT	Sighting shots.
1416 to 1418	10	155	S	SAT	Fired from a bench rest.
		The rifle was disassembled (field stripped), cleaned, lubricated (including the bore), and reassembled.			
1427 to 1429	10	165	S	SAT	Fired from a bench rest.
1431 to 1433	10	175	S	SAT	Fired from the prone position using a sling and shooting glove.
1442	100	275	A	SAT	Fired by E. Kelly
1443 to 1444	10	285	S	SAT	Fired from a bench rest.
1445 to 1446	10	295	S	SAT	Fired from the prone position using a sling and shooting glove.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks

18 January 1963

Bullet Stability Test

Ten rounds were fired through an A target used as a paper screen at each of four ranges, 4, 5, 10, and 25 meters.

1324 to 1441	40	335	SS	SAT	

19 January 1963

Endurance Test

The rifle was subjected to a 6000-round endurance test. The rifle was disassembled, cleaned, inspected, and lubricated after every 1000 rounds. The rifle was cooled after each 100 rounds. Firing was alternated between semiautomatic and automatic fire after each 100 rounds. Five new magazines, furnished by Mr. Morrow, Test and Evaluation Command APG, Maryland, were used in the endurance test. The magazines were numbered 1 through 5, inclusive.

Fired by E. Kelly.

0924 to 1328	1000	1335	-	4 - FBR	Malfunctions occurred using magazines No. 3 and 5.

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

1424 to 1555	500	1835	-	2 - FBR	Malfunctions occurred using magazines No. 2 and 3.

21 January 1963

0930 to 1038	500	2335	-	SAT	

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

Cartridge, ball, caliber .223, lot RA-5024 (Z311).

1249 to 1520	1000	3335	-	11 - FBR	Malfunctions occurred using all magazines.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
22 January 1963					
The rifle was disassembled, cleaned, inspected, and lubricated.					
0921 to 0943	200	3535	-	3 - FBR	Malfunctions occurred using magazines No. 3, 4, and 5.
Cartridge, ball, caliber .223, lot RA-5024 (Z15M).					
0956 to 1303	800	4335	-	2 - FF	On two occasions the bolt failed to strip the first round from magazines No. 3 and 5.
				18 - FBR	Malfunctions occurred using all magazines.
The rifle was disassembled, cleaned, inspected, and lubricated.					
1248 to 1539	500	4835	-	9 - FBR	Malfunctions occurred using magazines No. 1, 2, 3, and 4.
23 January 1963					
Cartridge, ball, caliber .223, lot RA-5024 (Z01M).					
0900 to 1013	500	5335	-	3 - FF	On three occasions the bolt failed to strip the first round from magazines No. 1 and 3.
				10 - FBR	Malfunctions occurred using all magazines.
				1 - FJ	The extractor broke after firing 4955 rounds. The cartridge case extracted but did not eject. A new extractor was installed.
The rifle was disassembled, cleaned, inspected, and lubricated.					
1112 to 1509	1000	6335	-	1 - FF	On one occasion the bolt failed to strip the first round from magazine No. 1
				29 - FBR	Malfunctions occurred using all magazines.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
		Velocity Test			
1804 to 1818	20	6355	S	SAT	

25 January 1963

		Machine-Rest Accuracy Test			
1915 to 1924	10	6365	SS	SAT	Sighting shots.
1731 to 1817	100	6465	SS	SAT	Fired by G. Hendricks

5 February 1963

The rifle was disassembled and inspected. There was heavy erosion on the first 1/2 inch of the bore near the chamber and moderate erosion for the next 2 to 3 inches. The leading edge of the lands for the first 3 inches from the chamber was heavily chipped. Some metal fouling was present throughout the bore. The gas porthole was slightly eroded.

Rifle, caliber .223, AR15, No. 11285.

11 January 1963

The rifle was disassembled and inspected. There were moderately heavy circumferential tool marks in the neck of the chamber, and very light circumferential tool marks on the lands throughout the bore. Light metal deposits were present throughout the bore.

Rifling: One turn in 12 inches.
Width of lands: 0.036 inch.
Width of grooves: 0.079 inch.
Firing pin protrusion: 0.031 inch.
Trigger pull (average of five trials): 9.4 pounds.
Diameter of front sight at top of post: 0.064 inch.

12 January 1963

Cartridge, ball, caliber .223, lot RA-5024 (Z01M).

		Velocity Test			
1053 to 1109	20	20	S	SAT	

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
			Bullet Recovery Test		
Polyurethane foam was positioned approximately 87 yards from the muzzle to recover fired bullets.					
1523	1	21	SS	SAT	Sighting shot.
1527 to 1542	5	26	SS	SAT	The bullets penetrated from 17 feet 4 inches to 19 feet.
16 January 1963					
			Machine-Rest Accuracy Test		
1640 to 1658	10	36	SS	SAT	Sighting shot.
1706 to 1755	100	136	SS	SAT	Fired by G. Hendricks.
17 January 1963					
			Combat Accuracy Test (100 yards)		
An A target with a 12-inch bull's-eye was used as an aiming point.					
Fired by L. Staley (except 100 rounds automatic).					
1009 to 1012	4	140	S	SAT	Sighting shot.
1242 to 1244	10	150	S	SAT	Fired from a bench rest.
The rifle was disassembled (field stripped), cleaned, lubricated (including the bore), and reassembled.					
1253 to 1255	10	160	S	1 - BOB	Fired from a bench rest.
1257 to 1259	10	170	S	SAT	Fired from the prone position using a sling and shooting glove.
1308	100	270	A	SAT	Fired by E. Kelly.
1309 to 1310	10	280	S	SAT	Fired from a bench rest.
1311 to 1313	10	290	S	SAT	Fired from the prone position using a sling and shooting glove.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
18 January 1963					
		Bullet Stability Test			
		Ten rounds were fired through an A target used as a paper screen at each of four ranges, 4, 5, 10, and 25 meters.			
1333 to 1444	40	330	S	SAT	
19 January 1963					
		Endurance Test			
		The rifle was subjected to a 6000-round endurance test. The rifle was disassembled, cleaned, inspected, and lubricated after every 1000 rounds. The rifle was cooled after each 100 rounds. Firing was alternated between semiautomatic and automatic fire after each 100 rounds. Five new magazines, furnished by Mr. Morrow, Test and Evaluation Command, APG, Maryland, were used in the endurance test. The magazines were numbered 1 through 5, inclusive.			
		Fired by L. Staley.			
0930 to 1330	1000	1330	-	7 - FF	On two occasions the bolt failed to engage the base of the 17th round using magazines No. 1 and 2. On five occasions the bolt failed to strip the first round from magazine No. 2. Magazine No. 2 was bent on the lip. It was straightened with a plastic hammer.
		The rifle was disassembled, cleaned, inspected, and lubricated.			
1430 to 1559	500	1830	-	2 - FF	On two occasions the bolt failed to engage the base of the round.
				1 - FBR	Malfunction occurred using magazine No. 5.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
21 January 1963					
	Fired by J. Oliver				
0934 to 1040	500	2330	-	SAT	
	The rifle was disassembled, cleaned, inspected, and lubricated. the firing pin retaining pin was broken in disassembly. A new one was assembled.				
	Cartridge, ball, caliber .223, lot RA-5024 (Z311).				
1253 to 1521	1000	3330	-	1 - FF	On one occasion the bolt failed to strip the first round from magazine No. 2.
22 January 1963					
	The rifle was disassembled, cleaned, inspected, and lubricated.				
0920 to 0946	200	3530	-	SAT	
	Cartridge, ball, caliber .223, lot RA-5024 (Z15M).				
1001 to 1305	800	4330	-	1 - FBR	Malfunction occurred using magazine No. 3.
	The rifle was disassembled, cleaned, inspected, and lubricated.				
1432 to 1522	345	4675	-	2 - FF	On two occasions the bolt failed to strip the first round from magazines No. 3 and 5.
				1 - FFR	There was a light indent in the primer. The round was reloaded and it fired on second trial
				1 - FX	but it failed to extract. The bolt broke after firing 4675 rounds. It was necessary to push the front portion of the bolt out of the barrel extension with a cleaning rod.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
23 January 1963					
A bolt assembly and carrier from rifle No. 7036 was installed.					
Cartridge, ball, caliber .223, lot RA-5024 (Z01M).					
0835 to 0836	55	4730	-	SAT	
0850 to 1015	600	5330	-	2 - FF	On two occasions the bolt failed to strip the first round from magazines No. 3 and 5.
The rifle was disassembled, cleaned, inspected, and lubricated.					
1121 to 1516	1000	6330	-	3 - FF	On three occasions the bolt failed to strip the first round from magazines No. 1, 3, and 5.
		Velocity Test			
1806 to 1820	20	6350	S	SAT	
25 January 1963					
		Machine-Rest Accuracy Test			
2016 to 2030	10	6360	SS	SAT	Sighting shots.
2036 to 2121	100	6460	SS	SAT	Fired by G. Hendricks.

5 February 1963

The rifle was disassembled and inspected. There was moderate erosion on the first inch of the bore near the chamber. Some metal fouling was present throughout the bore. The gas porthole was slightly eroded.

Rifle, caliber .223, AR15, No. 11705.

11 January 1963

The rifle was disassembled and inspected. There were heavy circumferential tool marks in the body and neck of the chamber, and very light circumferential

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks

tool marks on the lands throughout the bore. Light metal deposits were present throughout the bore.

Rifling: One turn in 12 inches.
Width of lands: 0.036 inch.
Width of grooves: 0.076 inch.
Firing pin protrusion: 0.034 inch.
Trigger pull (average of five trials): 8.7 pounds.
Diameter of front sight at top of post: 0.064 inch.

12 January 1963

Cartridge, ball, caliber .223, lot RA-5024 (Z01M).

Velocity Test

1055 to 1111	20	20	S	SAT	

14 January 1963

Machine-Rest Accuracy Test

2042 to 2050	10	30	SS	SAT	Sighting shots.
2103 to 2140	100	130	SS	SAT	Fired by G. Hendricks.

16 January 1963

Bullet Recovery Test

Polyurethane foam was positioned approximately 87 yards from the muzzle to recover fired bullets.

1105 to 1129	5	135	SS	SAT	The bullets penetrated from 17 feet 6 inches to 18 feet 10 inches.

17 January 1963

Combat Accuracy Test (100 yards)

An A target with a 12-inch bull's-eye was used as an aiming point.

Fired by G. Hendricks (except 100-rounds automatic).

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
1452 to 1453	5	140	S	SAT	Sighting shots.
1454 to 1456	10	150	S	SAT	Fired from a bench rest.

The rifle was disassembled (field stripped), cleaned, lubricated (including the bore), and reassembled.

1505 to 1506	10	160	S	SAT	Fired from a bench rest.
1507 to 1508	10	170	S	SAT	Fired from the prone position using a sling and shooting glove.
1519	100	270	A	SAT	Fired by E. Kelly.
1520 to 1521	10	280	S	SAT	Fired from a bench rest.
1521 to 1522	10	290	S	SAT	Fired from the prone position using a sling and shooting glove.

18 January 1963

Bullet Stability Test

Ten rounds were fired through an A target used as a paper screen at each of four ranges, 4, 5, 10, and 25 meters.

1336 to 1446	40	330	S	SAT

19 January 1963

Endurance Test

The rifle was subjected to a 6000-round endurance test. The rifle was disassembled, cleaned, inspected, and lubricated after every 1000 rounds. The rifle was cooled after each 100 rounds. Firing was alternated between semiautomatic and automatic fire after each 100 rounds. Five new magazines, furnished by Mr. Morrow, Test and Evaluation Command, APG, Maryland, were used in the endurance test. The magazines were numbered 1 through 5, inclusive.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
Fired by K. Powers.					
0934 to 1333	1000	1330	-	12 - FF	On 12 occasions the bolt failed to strip the first round from the magazine.
				10 - FBR	Malfunctions occurred using magazines No. 3, 4, and 5. Magazine No. 4 was bent on the lip. It was straightened with a plastic hammer.
The rifle was disassembled, cleaned, inspected, and lubricated.					
1434 to 1604	500	1830	-	6 - FF	On four occasions the bolt failed to strip the first round from magazines No. 1, 3, and 5.
					On two occasions the nose of the bullet stubbed on the barrel extension.
				4 - FBR	Malfunctions occurred using magazines No. 3, 4, and 5. Magazine No. 5 was bent on the lip. It was straightened with a plastic hammer.
21 January 1963					
0937 to 1042	500	2330	-	8 - FF	On six occasions the bolt failed to strip the first round from magazines No. 1, 3, and 5.
					On two occasions the nose of a bullet stubbed on the barrel extension.
The rifle was disassembled, cleaned, inspected, and lubricated.					
Cartridge, ball, caliber .223, lot RA-5024 (Z311).					
1257 to 1523	1000	3330	-	19 - FF	On 13 occasions the bolt failed to strip the first round from the magazine.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
					On six occasions the nose of the bullet stubbed on the barrel extension.
				4 - FBR	Malfunctions occurred using magazines No. 3, 4, and 5.

22 January 1963

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

Fired by E. Martin.

0930 to 0949	200	3530	-	6 - FF	On four occasions the bolt failed to strip the first round from magazines No. 1, 3, and 4. On two occasions the nose of the bullet stubbed on the barrel extension.

Cartridge, ball, caliber .223, lot RA-5024 (Z15M).

1007 to 1318	800	4330	-	28 - FF	On 21 occasions the bolt failed to strip the first round from the magazine. On seven occasions the nose of the bullet stubbed on the barrel extension.
				3 - FBR	Malfunctions occurred using magazines No. 1 and 4.
				1 - FX	The extractor spring broke after firing 4235 rounds. It was necessary to use a cleaning rod to extract the cartridge case. A new extractor spring was installed. One small leak in primer joint.

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

1436 to 1543	500	4830	-	10 - FF	On nine occasions the bolt failed to strip the first round from the magazine.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
					On one occasion the nose of the bullet stubbed on the barrel extension
				5 - FBR	Malfunctions occurred using magazines No. 1, 2, 3, and 5.

23 January 1963

Cartridge, ball, caliber .223, lot RA-5024 (Z01M).

0907 to 1017	500	5330	-	11 - FF	On six occasions the bolt failed to strip the first round from magazines No. 1, 3, 4, and 5.
					On five occasions the nose of the bullet stubbed on the barrel extension.
				4 - FBR	Malfunctions occurred using magazines 2, 3, 4, and 5.

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

1124 to 1519	1000	6330	-	30 - FF	On 18 occasions the bolt failed to strip the first round from the magazine.
					On one occasion the bolt failed to engage the base of the round and it closed on an empty chamber.
					On two occasions the last round in the magazine failed to remain in position and the bolt partially closed with the base of the round protruding out of the ejection port. On both occasions the round was damaged and would not permit chambering. The damaged rounds were replaced.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
					On one occasion the last round of the magazine failed to remain in position and the bolt remained at the rear leaving the round lying on top of the magazine.
					On eight occasions the nose of the bullet stubbed on the barrel extension.
				1 - BOB 1 - FJ	The bolt broke after firing 5738 rounds. A bolt assembly and carrier from rifle No. 8275 was installed.
					Magazines No. 1 and 5 were bent on the right rear lips. They were straightened with a plastic hammer.
			Velocity Test		
1802 to 1817	20	6350	S	SAT	
25 January 1963					
			Machine-Rest Accuracy Test		
1848 to 1900	10	6360	SS	SAT	Sighting shots.
1904 to 1955	100	6460	SS	SAT	Fired by G. Hendricks.
5 February 1963					

The rifle was disassembled and inspected. There was moderate erosion on the first inch of the bore near the chamber. Some metal fouling was present throughout the bore. The gas porthole was slightly eroded.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks

Rifle, U. S., 7.62-mm, M14, No. 894613 manufactured by Harrington and Richardson Arms Company.

11 January 1963

The rifle was disassembled and inspected. There were heavy circumferential tool marks in the body and neck of the chamber. Light metal deposits were present throughout the bore.

Rifling: One turn in 12 inches.
Firing pin protrusion: 0.051 inch.
Trigger pull (average of five trials): 6.3 pounds.

12 January 1963

Cartridge, ball, 7.62-mm, NATO, M80, lot FC-1907.

Velocity Test

1050 to 1108	20	20	S	SAT	

16 January 1963

Bullet Recovery Test

Polyurethane foam was positioned approximately 87 yards from the muzzle to recover fired bullets.

0850 to 0948	5	25	SS	SAT	The bullets penetrated from 22 feet 3 inches to 24 feet 6 inches.

Machine-Rest Accuracy Test

1900 to 1915	10	35	SS	SAT	Sighting shots.
1919 to 2020	100	135	SS	SAT	Fired by G. Hendricks. The gas cylinder plug came loose. It was tightened.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
17 January 1963					
		Combat Accuracy Test (100 yards)			
		An A target with a 12-inch bull's-eye was used as an aiming point.			
		Fired by L. Staley (except 100 rounds automatic).			
1013 to 1018	5	140	S	SAT	Sighting shots.
1324 to 1326	10	150	S	SAT	Fired from a bench rest.
		The rifle was disassembled (field stripped), cleaned, lubricated (including the bore), and reassembled.			
1332 to 1334	10	160	S	SAT	Fired from a bench-rest.
1335 to 1337	10	170	S	SAT	Fired from the prone position using a sling and shooting glove.
1357	100	270	A	SAT	Fired by E. Kelly.
1358 to 1359	10	280	S	SAT	Fired from a bench rest.
1400 to 1401	10	290	S	SAT	Fired from the prone position using a sling and shooting glove.
		Fired by G. Hendricks (except 100 rounds automatic).			
1528	2	292	S	SAT	Sighting shots.
		The same sight settings were maintained as used by the previous shooter.			
1529 to 1530	10	302	S	SAT	Fired from a bench-rest.
		The rifle was disassembled (field stripped), cleaned, lubricated (including the bore), and reassembled.			
1538 to 1540	10	312	S	SAT	Fired from a bench-rest.
1543 to 1545	10	322	S	SAT	Fired from the prone position using a sling and shooting glove.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
1552	100	432	A	SAT	Fired By E. Kelly.
1553 to 1554	10	442	S	SAT	Fired from a bench rest.
1555 to 1556	10	452	S	SAT	Fired from the prone position using a sling and shooting glove.

18 January 1963

Bullet Stability Test

Ten rounds were fired through an A target used as a paper screen at each of four ranges, 4, 5, 10, and 25 meters.

1345 to 1448	40	492	S	SAT	

19 January 1963

Endurance Test

The rifle was subjected to a 6000-round endurance test. The rifle was disassembled, cleaned, inspected, and lubricated after every 1000 rounds. The rifle was cooled after each 100 rounds. Firing was alternated between semiautomatic and automatic fire after each 100 rounds.

Fired by E. Martin.

0938 to 1346	1000	1492	-	SAT	

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

1438 to 1612	500	1992	-	SAT	

21 January 1963

0941 to 1049	500	2492	-	2-FF	On two occasions the nose of the bullet stubbed on the magazine. The elevating knob screw backed out. It was tightened.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
					One small leak in primer joint.

The rifle was disassembled, cleaned, inspected, and lubricated. When the firing pin was disassembled, a piece from the forward end of the firing pin, approximately 0.060-inch long, remained in the firing pinhole in the face of the bolt. It was necessary to bump the bolt on a wooden work bench to remove the broken piece. The ejector spring was broken. The ejector spring was replaced with one from rifle No. 894302. The firing pin was replaced with a new one.

1301 to 1528	1000	3492	-	1 - FF	The bolt failed to engage the base of the round and it closed on an empty chamber.
				1 - BOB	

22 January 1963

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

The operating rod spring was broken. It was replaced with one from rifle No. 894302.

0934 to 1321	1000	4492	-	SAT	On one occasion the nose of a bullet stubbed on the magazine for two or three seconds, but it chambered without assistance from the gunner. This occurred during automatic fire.

The rifle was disassembled, cleaned, inspected, and lubricated. The ejector spring was broken. It was replaced with a new one.

1439 to 1550	500	4992	-	1 - FF	The nose of the bullet stubbed on the magazine.

23 January 1963

0908 to 1026	500	5492	-	1 - FF	The nose of the bullet stubbed on the magazine.

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
The rifle was disassembled, cleaned, inspected, and lubricated.					
1129 to 1520	1000	6492	-	3 - FF	On three occasions the nose of the bullet stubbed on the magazine.
				1 - FJ	The extractor and extractor spring broke after firing 6049 rounds. The cartridge case extracted but failed to eject. The broken parts were replaced with parts from rifle No. 894302.
				1 - FFR	The firing pin broke after firing 6068 rounds. It was replaced with one from rifle No. 894302.
Velocity Test					
1813 to 1824	20	6512	S	SAT	
24 January 1963					
Machine-Rest Accuracy Test					
1802 to 1807	10	6522	SS	SAT	Sighting shots.
1813 to 1858	100	6622	SS	SAT	Fired by Hendricks.
5 February 1963					

The rifle was disassembled and inspected. The chrome plating was chipped on the edges of the lands on the first inch of the bore near the chamber. There was light pitting on the first 6 inches of the bore near the chamber. Some metal fouling was present throughout the bore. The gas porthole was slightly eroded.

APPENDIX C

Accuracy, Velocity, and Bore Measurements

Machine-Rest Accuracy Test

Date: 14 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 8825.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 26 to 30°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (before endurance)			
1	2.41	2.24	0.61	13.6	2.1	13.6
2	0.97	0.44	0.69	2.2	3.0	3.0
3	1.53	1.34	0.49	8.5	2.4	8.7
4	1.26	0.98	0.59	3.9	2.2	4.0
5	1.11	0.58	0.77	2.2	3.7	4.0
6	2.08	1.20	1.51	5.4	7.4	8.6
7	1.87	1.31	1.11	5.3	5.9	6.7
8	1.14	0.66	0.73	2.7	3.3	3.4
9	1.33	1.08	0.62	4.0	2.8	4.4
10	1.86	1.26	1.11	7.0	4.2	7.8
Average	1.56	1.11	0.82	5.5	3.7	6.4
			500 Yards (before endurance)			
1	[a]					
2	4.71	2.21	3.37	12.4	14.6	14.7
3	8.57	7.94	2.09	45.9	12.0	47.0
4	8.29	6.51	3.79	24.2	14.6	24.2
5	6.24	3.35	4.35	15.3	21.1	22.1
6	11.72	7.23	8.64	33.1	42.7	51.2
7	11.66	8.11	6.60	37.7	35.5	43.7
8	5.98	2.51	4.65	12.0	17.9	18.3
9	5.97	4.36	3.35	19.4	12.7	21.8
10	10.08	7.43	6.01	38.6	27.1	45.8
Average[b]	8.13	5.52	4.76	26.5	22.0	32.1

[a] One shot missed the 12-by 12-foot target.
[b] Based upon average of nine targets.

Date: 14 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 8833.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 25 to 29°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (before endurance)			
1	0.94	0.60	0.61	3.0	2.2	3.1
2	0.90	0.82	0.34	3.7	1.5	3.6
3	0.72	0.43	0.49	1.8	1.8	2.3
4	1.10	0.74	0.67	4.1	3.7	4.1
5	0.86	0.65	0.42	4.0	2.0	4.1
6	1.19	0.66	0.87	2.7	3.9	3.9
7	0.65	0.46	0.32	1.9	1.4	1.9
8	1.19	1.04	0.37	4.3	1.5	4.4
9	0.75	0.49	0.50	1.5	2.2	2.3
10	0.89	0.65	0.52	2.2	2.1	2.6
Average	0.92	0.65	0.51	2.9	2.2	3.2
			500 Yards (before endurance)			
1	5.93	4.26	3.38	21.2	10.7	22.0
2	7.29	6.47	2.41	29.1	9.7	29.6
3	4.13	2.72	2.56	13.2	10.0	13.2
4	7.46	5.27	3.91	20.3	22.9	23.5
5	5.02	3.26	3.07	17.8	13.3	18.9
6	7.19	4.45	5.15	17.1	24.4	26.2
7	3.29	2.37	1.90	10.6	6.7	10.6
8	6.01	5.07	2.40	18.6	10.2	19.0
9	4.77	3.10	2.99	12.5	12.2	14.1
10	5.24	4.35	2.42	14.7	10.8	16.0
Average	5.63	4.13	3.02	17.5	13.1	19.3

Date: 16 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 11285.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 27 to 30°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (before endurance)			
1	0.84	0.48	0.62	2.1	2.4	2.4
2	0.69	0.58	0.17	3.4	1.2	3.4
3	0.71	0.44	0.50	1.6	2.0	2.4
4	1.14	1.00	0.42	3.6	1.6	3.6
5	1.06	0.70	0.63	3.1	2.0	3.3
6	1.27	0.93	0.73	3.6	2.4	3.6
7	0.58	0.38	0.37	1.8	1.5	1.9
8	1.11	0.76	0.66	2.3	3.5	4.2
9	1.17	0.84	0.66	2.8	2.5	3.7
10	1.01	0.55	0.70	2.0	3.4	3.8
Average	0.96	0.67	0.55	2.6	2.2	3.2
			500 Yards (before endurance)			
1	5.25	3.65	3.10	14.2	12.4	15.3
2	3.78	3.14	1.01	16.8	6.9	16.9
3	3.90	2.45	2.64	10.1	10.7	11.5
4	5.75	5.27	1.98	18.3	7.5	19.1
5	5.66	3.67	3.35	14.9	10.9	16.0
6	5.93	3.94	3.74	15.1	12.2	16.0
7	2.88	1.94	1.92	8.5	7.2	11.1
8	5.82	3.92	3.38	12.2	17.3	19.5
9	6.09	4.38	3.30	16.0	12.8	16.1
10	4.98	2.75	3.56	10.3	17.7	18.6
Average	5.00	3.51	2.80	13.6	11.6	16.0

Date: 14 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 11705.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 26 to 30°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (before endurance)			
1	0.77	0.57	0.39	2.0	1.8	2.3
2	0.74	0.49	0.44	2.1	2.0	2.6
3	0.99	0.64	0.62	2.2	3.0	3.4
4	0.97	0.45	0.75	2.1	2.7	2.7
5	0.88	0.71	0.45	2.8	1.9	2.9
6	1.09	0.79	0.61	3.5	3.3	3.8
7	1.09	0.73	0.66	2.6	2.3	3.1
8	0.87	0.42	0.71	2.1	3.6	4.2
9	0.81	0.60	0.44	2.2	1.7	2.3
10	1.09	0.80	0.62	2.6	2.8	3.0
Average	0.93	0.62	0.57	2.4	2.5	3.0
			500 Yards (before endurance)			
1	4.02	3.04	2.14	10.9	7.9	11.5
2	3.65	2.18	2.39	11.9	10.7	12.6
3	5.07	3.65	3.01	14.2	14.4	18.3
4	5.51	3.21	3.64	15.2	12.7	15.5
5	4.04	2.67	2.31	16.6	8.9	17.5
6	5.22	3.74	2.92	17.6	15.5	18.2
7	5.28	3.55	3.15	11.1	10.4	13.1
8	4.95	3.00	3.57	13.8	18.5	21.4
9	4.05	2.86	2.45	11.9	8.9	12.4
10	6.09	4.95	3.04	15.9	13.7	17.9
Average	4.79	3.28	2.86	13.9	12.2	15.8

Date: 16 January 1963.
Direction of Fire: SW.
Rifle: U. S., 7.62-mm, M14, No. 894613.
Cartridge: Ball, caliber, 7.62-mm, NATO, M80, lot FC-1907.
Fired from: Machine-rest.
Wind: 0 Temperature: 26 to 27°F.

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (before endurance)			
1	1.16	0.83	0.60	3.0	2.9	3.0
2	1.03	0.70	0.64	2.4	2.0	2.6
3	1.19	0.80	0.80	3.3	2.5	3.4
4	0.92	0.72	0.45	3.0	1.8	3.0
5	0.96	0.66	0.56	3.1	1.8	3.6
6	1.14	0.80	0.64	3.3	2.3	3.4
7	0.98	0.72	0.51	3.3	2.0	3.5
8	1.09	0.80	0.64	3.1	2.4	3.3
9	0.74	0.65	0.30	2.2	1.1	2.3
10	0.96	0.76	0.48	3.0	2.7	3.0
Average	1.02	0.74	0.56	3.0	2.2	3.1
			500 Yards (before endurance)			
1	5.15	3.30	3.15	11.9	15.1	15.2
2	4.57	2.93	3.12	9.7	10.3	13.1
3	5.33	2.88	4.14	12.9	12.5	15.2
4	3.78	2.69	2.15	11.1	8.7	11.1
5	4.56	3.29	2.85	15.1	8.7	17.4
6	5.08	3.48	3.25	13.2	11.1	15.4
7	4.50	3.48	2.41	13.0	9.5	16.2
8	4.81	3.39	3.12	14.8	12.0	15.4
9	3.27	2.30	1.81	9.8	5.8	10.2
10	4.22	3.04	2.39	12.1	13.7	14.1
Average	4.53	3.08	2.84	12.4	10.7	14.3

Date: 24 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 8825.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 8°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (after endurance)			
1	0.97	0.69	0.55	2.3	2.6	2.8
2	0.92	0.63	0.63	2.0	2.3	2.5
3	1.20	0.74	0.83	3.5	3.8	4.9
4	1.18	0.78	0.58	3.6	3.6	3.9
5	2.08	1.10	1.45	5.2	9.6	10.1
6	0.75	0.47	0.53	1.7	2.2	2.3
7	0.85	0.50	0.57	1.7	2.7	2.7
8	1.29	0.89	0.80	3.0	3.0	3.6
9	1.34	1.02	0.64	5.3	2.7	5.6
10	1.17	0.55	0.97	2.0	3.5	3.6
Average	1.18	0.74	0.76	3.0	3.6	4.2
			500 Yards (after endurance)			
1	6.90	5.18	3.88	19.0	20.3	27.8
2	7.33	5.82	3.59	22.6	13.8	23.5
3	10.85	8.75	5.47	37.6	27.2	44.1
4	10.36	7.54	4.70	32.1	27.5	33.7
5	14.94	8.72	9.94	36.0	62.8	67.1
6	4.05	2.27	3.07	8.2	12.7	13.2
7	5.40	2.61	4.03	10.4	20.2	21.1
8	9.15	6.63	5.40	22.7	18.8	25.8
9	10.52	9.19	2.78	57.7	13.2	57.9
10	9.80	5.96	6.74	25.1	24.7	29.1
Average	8.93	6.27	4.96	27.1	24.1	34.3

Date: 25 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 8833.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 18°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (after endurance)			
1	1.39	0.66	1.07	2.2	4.1	4.4
2	1.13	0.85	0.62	2.8	2.0	3.2
3	1.03	0.94	0.31	4.4	1.2	4.4
4	1.14	0.75	0.67	3.1	2.5	3.3
5	1.04	0.79	0.52	2.9	2.2	3.2
6	0.82	0.51	0.58	2.8	2.9	3.7
7	1.23	0.90	0.62	4.3	2.2	4.8
8	1.58	1.38	0.57	6.0	2.8	6.4
9	1.02	0.67	0.58	2.9	2.1	3.0
10	1.07	0.90	0.44	4.4	2.2	3.2
Average	1.14	0.84	0.60	3.6	2.4	4.0
			500 Yards (after endurance)			
1	8.11	5.14	5.20	25.2	18.8	25.3
2	7.58	5.81	3.68	26.8	13.7	27.4
3	5.82	4.73	2.69	19.5	9.6	20.7
4	8.87	6.24	4.98	34.5	18.5	36.7
5	6.96	5.17	3.94	25.7	17.9	28.2
6	9.03	7.72	4.10	28.1	17.7	30.6
7	6.82	5.84	2.98	26.2	11.9	27.5
8	10.14	9.37	2.99	48.8	15.6	50.5
9	7.98	6.26	4.01	30.5	12.2	31.4
10	5.23	3.86	2.84	19.4	10.4	20.5
Average	7.65	6.01	3.74	28.5	14.6	29.9

Date: 25 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 11285.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temepature: 14°F.

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (after endurance)			
1	1.68	0.78	1.37	2.8	4.7	4.9
2	1.24	0.87	0.72	4.2	2.7	4.3
3	1.13	0.84	0.66	2.8	2.7	3.8
4	1.33	1.12	0.39	4.4	2.5	4.4
5	1.34	0.97	0.66	3.8	3.4	4.2
6	1.38	0.97	0.85	3.8	3.5	5.2
7	1.16	0.76	0.64	2.6	3.4	3.4
8	0.97	0.56	0.73	2.9	3.2	3.5
9	1.36	0.86	0.93	3.4	3.5	4.4
10	0.94	0.63	0.65	2.2	2.3	2.8
Average	1.25	0.84	0.76	3.3	3.2	4.1
			500 Yards (after endurance)			
1	8.21	4.08	6.02	14.3	20.0	21.4
2	6.09	3.94	3.81	17.2	14.6	18.2
3	4.46	2.54	3.45	12.6	11.8	16.3
4	7.29	6.38	1.93	24.8	13.1	25.4
5	7.39	5.86	3.23	20.1	16.0	20.9
6	7.02	4.96	4.24	25.0	17.4	30.5
7	5.88	4.14	3.14	15.1	15.7	16.0
8	5.90	3.97	3.48	16.9	14.9	17.5
9	6.68	4.28	4.56	19.3	18.2	24.5
10	4.81	2.80	3.54	14.1	11.9	14.8
Average	6.37	4.30	3.74	17.9	15.4	20.6

Date: 25 January 1963.
Direction of Fire: SW.
Rifle: Caliber .223, AR15, No. 11705.
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Fired from: Machine-rest.
Wind: 0 Temperature: 16 to 17°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (after endurance)			
1	0.79	0.63	0.39	2.6	2.1	2.8
2	1.18	0.75	0.74	2.6	3.1	3.2
3	1.12	0.76	0.72	3.3	3.0	3.7
4	1.16	0.91	0.62	3.7	2.5	3.7
5	0.73	0.31	0.59	1.2	2.3	2.5
6	1.04	0.70	0.70	2.1	2.5	2.8
7	0.96	0.37	0.77	1.7	2.9	2.9
8	0.98	0.71	0.51	3.4	2.0	3.6
9	1.44	0.66	1.10	3.3	3.9	4.2
10	1.10	0.52	0.86	2.5	4.3	4.5
Average	1.05	0.63	0.70	2.6	2.9	3.4
			500 Yards (after endurance)			
1	5.21	4.38	2.05	22.6	9.0	22.9
2	8.39	6.99	3.92	19.5	15.2	22.6
3	5.53	3.76	3.53	12.6	14.7	16.5
4	6.11	4.79	3.08	18.2	12.5	18.4
5	5.26	3.40	3.00	15.1	11.3	16.4
6	5.56	3.83	3.42	12.6	11.2	16.5
7	4.73	2.05	3.87	9.8	13.3	13.6
8	6.60	5.73	2.18	24.5	10.4	24.8
9	7.97	4.50	6.10	17.3	20.4	25.3
10	5.96	3.25	4.38	13.9	21.6	23.0
Average	6.13	4.27	3.55	16.6	14.0	20.0

Date: 24 January 1963.
Direction of Fire: SW.
Rifle: U. S., 7.62-mm, M14, No. 894613.
Cartridge: Ball, caliber 7.62-mm, NATO, M80, lot FC-1907.
Fired from: Machine-rest
Wind: 0 Temperature: 8 to 10°F

Target measurements are given in inches.

Target No.	MR	MVD	MHD	EVD	EHD	ES
			100 Yards (after endurance)			
1	1.13	0.60	0.78	2.8	3.3	3.3
2	1.50	0.97	0.97	3.2	3.8	4.4
3	1.98	1.42	1.04	6.7	4.6	6.7
4	2.06	1.98	0.47	6.7	2.1	6.7
5	1.11	0.99	0.37	4.6	1.4	4.8
6	1.48	1.25	0.57	4.3	2.7	4.4
7	1.33	1.01	0.78	4.2	3.0	5.2
8	2.45	1.96	0.95	8.5	3.8	8.6
9	1.72	1.24	1.06	6.6	4.3	6.8
10	1.55	1.19	0.77	4.0	4.7	5.9
Average	1.63	1.26	0.78	5.2	3.4	5.7
			500 Yards (after endurance)			
1	5.20	2.61	4.27	10.5	17.0	17.9
2	6.93	4.19	4.73	15.9	19.0	21.3
3	9.06	5.94	5.13	30.4	22.2	30.9
4	9.35	8.90	2.31	31.1	10.0	31.1
5	5.20	4.58	1.98	20.6	7.7	22.0
6	6.58	5.44	2.70	19.6	13.6	20.1
7	6.45	4.71	4.00	19.6	15.2	24.8
8	11.73	9.36	4.81	38.1	19.2	38.3
9	8.06	5.71	5.20	30.2	22.5	33.5
10	7.58	5.80	3.95	19.8	23.9	30.6
Average	7.61	5.72	3.91	23.6	17.0	27.0

Combat-Accuracy Test

All target data are given in inches.
Target number 1 = Normal bench-rest group.
Target number 2 = Bench-rest group starting with a cold and oiled bore.
Target number 3 = Normal prone group.
Target number 4 = Bench-rest group with a hot barrel.
Target number 5 = Prone group with a hot barrel.

Date: 17 January 1963.
Range: 100 yards.
Direction of Fire: ESE.

Wind: NNE to SSE, 0 to 4, mph.
Sky Condition: Scattered clouds to clear.
Temperature: 32 to 46°F.

Target No.	MR	MVD	MHD	EVD	EHD	ES	Center of Impact from Target Center Vert	Center of Impact from Target Center Hor	Measurements from Center of Group No. 1 Group Center Vert	Measurements from Center of Group No. 1 Group Center Hor	Mean	ES

Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).
Target: A, with 12-inch bull's-eye.
Rate of Twist of Rifling (length for one turn in inches): 14.

Rifleman: G. Hendricks Rifle: Caliber .223, AR15, No. 8833.

1	0.81	0.22	0.74	1.4	2.6	2.7	-1.2	+0.8	-	-	0.81	2.5
2	1.67	1.17	0.83	5.2	3.3	5.3	+1.4	-1.2	+0.6	0.0	1.71	3.6
3	0.84	0.65	0.41	3.3	1.6	3.3	-1.4	-2.7	-2.2	-1.5	2.78	4.4
4	1.39	1.10	0.61	4.8	2.0	4.9	+0.1	-1.6	-0.6	-0.5	1.44	3.5
5	1.24	1.07	0.48	4.5	2.0	4.5	-5.9	-2.9	-6.6	-1.7	6.86	9.3
Avg	1.19	0.84	0.61	3.8	2.3	4.1	-1.4	-1.5	-1.8	-0.7	2.72	4.7

Rifleman: L. Staley Rifle: Caliber .223, AR15, No. 8825.

1	1.19	0.56	0.89	3.4	4.2	4.2	+0.5	-0.9	-	-	1.19	2.6
2	2.26	1.88	0.79	8.7	4.1	8.8	-0.7	-0.5	-1.2	+0.4	2.20	6.6
3	2.40	1.87	1.09	7.7	4.9	8.0	-4.5	-0.6	-5.0	+0.3	5.26	10.3
4	1.27	0.89	0.68	5.9	4.2	6.7	-3.0	+0.4	-3.5	+1.4	3.87	8.5
5	1.41	0.80	1.01	3.2	3.8	4.2	-10.7	+1.4	-11.2	+2.4	11.49	12.4
Avg	1.71	1.20	0.89	5.8	4.2	6.4	-3.7	0.0	-4.2	+0.9	4.80	8.1

Target No.	MR	MVD	MHD	EVD	EHD	ES	Center of Impact from Target Center Vert	Center of Impact from Target Center Hor	Measurements from Center of Group No. 1 Group Center Vert	Measurements from Center of Group No. 1 Group Center Hor	Mean	ES
Cartridge: Ball, caliber .223, lot RA-5024 (Z01M).												
Target: A, with 12-inch bull's-eye.												
Rate of Twist of Rifling (length for one turn in inches): 12.												
Rifleman: L. Staley							Rifle: Caliber .223, AR15, No. 11285.					
1	1.09	0.79	0.62	3.0	2.3	3.4	-0.7	+0.6	-	-	1.09	2.5
2	0.91	0.66	0.50	3.1	2.1	3.2	-1.5	+1.0	-0.8	+0.3	1.20	2.7
3	1.17	0.99	0.52	3.3	2.2	4.7	-5.1	+0.6	-4.5	0.0	4.49	6.9
4	1.27	0.85	0.83	2.5	3.4	3.5	-5.3	+2.0	-4.6	+1.4	4.91	6.0
5	1.11	0.76	0.66	2.5	3.1	3.2	-11.8	+2.3	-11.1	+1.6	11.25	12.7
Avg	1.11	0.81	0.63	2.9	2.6	3.6	-4.9	+1.3	-4.2	+0.7	4.59	6.2
Rifleman: G. Hendricks							Rifle: Caliber .223, AR15, No. 11705.					
1	1.19	0.65	0.77	2.8	3.2	3.3	-1.0	+1.4	-	-	1.19	1.8
2	1.21	0.78	0.70	4.0	4.0	4.7	-1.2	+1.4	-0.2	0.0	1.23	3.2
3	0.92	0.56	0.53	3.0	2.3	3.0	-5.3	-1.1	-4.3	-2.6	5.04	6.7
4	1.59	1.18	0.94	3.7	3.1	4.4	-1.5	+0.5	-0.5	-0.9	1.98	2.6
5	1.22	0.79	0.79	3.6	3.0	3.8	-7.0	-0.8	-6.0	-2.2	6.52	7.6
Avg	1.23	0.79	0.75	3.4	3.1	3.8	-3.2	+0.3	-2.2	-1.1	3.19	4.4
Rifle: U. S., caliber 7.62-mm, M14, No. 894613.												
Cartridge: Ball, caliber 7.62-mm, NATO, M80, lot FC-1907.												
Target: A, with 12-inch bull's-eye.												
Rifleman: G. Hendricks												
1	1.37	1.01	0.83	5.0	3.7	5.7	-1.2	-1.9	-	-	1.37	3.0
2	1.12	0.65	0.73	3.0	3.7	3.9	-2.1	-2.2	-0.9	-0.3	1.54	2.4
3	1.93	1.65	0.87	5.8	3.4	6.0	-3.1	-1.2	-1.9	+0.6	2.54	4.7
4	4.80	2.84	3.19	10.2	18.2	18.3	-5.8	-4.8	-4.6	-2.9	7.52	12.1
5	2.55	1.64	1.63	7.4	5.3	8.0	-5.0	-1.2	-3.7	+0.7	4.41	7.3
Avg	2.35	1.56	1.45	6.3	6.9	8.4	-3.4	-2.3	-2.2	-0.4	3.48	5.9
Rifleman: L. Staley												
1	1.40	0.87	0.94	3.2	3.4	4.6	+0.1	-0.9	-	-	1.40	2.6
2	1.30	0.93	0.58	4.0	2.7	4.3	-1.4	-0.6	-1.5	+0.3	1.84	3.4
3	1.72	1.16	0.90	6.5	3.5	6.5	-1.6	-0.9	-1.8	0.0	2.50	4.6
4	3.09	2.20	1.85	7.8	7.3	8.3	-4.1	-2.4	-4.2	-1.5	5.19	8.1
5	4.06	3.19	2.35	13.7	10.6	17.3	-3.5	-2.1	-3.6	-1.2	5.57	11.4
Avg	2.31	1.67	1.32	7.0	5.5	8.2	-2.1	-1.4	-2.2	-0.5	3.30	6.0

Velocity Test

Test Ammunition: Cartridge, ball, caliber .223, lot RA-5024 (Z01M).
Chronograph Type: Counter. Initiator Type: Lumiline screens.
Ammunition Temperature: 70°F.

Before Endurance Test	After Endurance Test
Time started: 1039	Time started: 1802
Time completed: 1103	Time completed: 1817
Date: 12 January 1963	Date: 23 January 1963
Range temperature: 58°F	Range temperature: 57°F

Instrumental velocities are in fps at 78 feet.

Round No.	Velocity	Round No.	Velocity
Rifle: Caliber .223, AR15, No. 8825			
1	3052	1	2948
2	3045	2	2869
3	3094	3	2915
4	3102	4	2934
5	3016	5	2852
6	3062	6	2849
7	3090	7	2889
8	3060	8	2897
9	3081	9	2880
10	3030	10	2841
11	3010	11	2924
12	3040	12	2885
13	3062	13	2843
14	3071	14	2847
15	3016	15	2841
16	3045	16	2877
17	3036	17	2834
18	3060	18	2860
19	3083	19	2841
20	3094	20	2912
Average	3057		2877
Maximum	3102		2948
Minimum	3010		2834
Extreme variation	92		114
Mean variation	22.7		29.2

Before Endurance Test	After Endurance Test
Time started: 1045	Time started: 1804
Time completed: 1106	Time completed: 1818
Date: 12 January 1963	Date: 23 January 1963
Range temperature: 58°F	Range temperature: 57°F

Instrumental velocities are in fps at 78 feet.

Round No.	Velocity	Round No.	Velocity
Rifle: Caliber .223, AR15, No. 8833.			
1	3000	1	2941
2	3075	2	2884
3	3081	3	2867
4	3066	4	2854
5	3062	5	2860
6	3083	6	2879
7	3073	7	2885
8	3054	8	2836
9	3062	9	2830
10	3040	10	2846
11	3081	11	2973
12	3108	12	3047
13	3109	13	2870
14	3081	14	2910
15	3090	15	2887
16	3106	16	2915
17	3088	17	2880
18	3067	18	2897
19	3034	19	2852
20	3051	20	2875
Average	3070		2889
Maximum	3109		3047
Minimum	3000		2830
Extreme variation	109		217
Mean variation	19.9		34.7

Before Endurance Test		After Endurance Test	
Time started: 1053		Time started: 1806	
Time completed: 1109		Time completed: 1820	
Date: 12 January 1963		Date: 23 January 1963	
Range temperature: 58°F		Range temperature: 57°F	
Instrumental velocities are in fps at 78 feet.			
Round No.	Velocity	Round No.	Velocity
Rifle: caliber .223, AR15, No. 11285.			
1	3038	1	2926
2	3125	2	2865
3	3066	3	2915
4	3115	4	2900
5	3069	5	2922
6	3073	6	2892
7	3043	7	2909
8	3069	8	2910
9	3079	9	2880
10	3036	10	2912
11	3127	11	2841
12	3028	12	2897
13	3062	13	2973
14	3054	14	2922
15	3058	15	2905
16	3098	16	2943
17	3062	17	2919
18	3030	18	2900
19	3113	19	2892
20	3104	20	2969
Average	3072		2910
Maximum	3127		2973
Minimum	3028		2841
Extreme variation	99		132
Mean variation	25.4		21.5

Before Endurance Test	After Endurance Test
Time started: 1055	Time started: 1809
Time completed 1111	Time completed: 1822
Date: 12 January 1963	Date: 23 January 1963
Range temperature: 58°F	Range temperature: 57°F

Instrumental velocities are in fps at 78 feet.

Round No.	Velocity	Round No.	Velocity
Rifle: Caliber .223, AR15, No. 11705.			
1	3051	1	2892
2	3092	2	2914
3	3000	3	2945
4	3094	4	2943
5	3088	5	2959
6	3077	6	2909
7	3123	7	2987
8	3115	8	2890
9	3081	9	2959
10	3066	10	2938
11	3163	11	2957
12	3108	12	3019
13	3131	13	2874
14	3088	14	2948
15	3081	15	2914
16	3083	16	2907
17	3000	17	2929
18	3096	18	2917
19	3088	19	2909
20	3075	20	2950
Average	3085		2933
Maximum	3163		3019
Minimum	3000		2874
Extreme variation	163		145
Mean variation	25.1		27.5

Before Endurance Test	After Endurance Test
Time started: 1050	Time started: 1813
Time completed: 1108	Time completed: 1824
Date: 12 January 1963	Date: 23 January 1963
Range temperature: 58°F	Range temperature: 57°F

Instrumental velocities are in fps at 78 feet.

Round No.	Velocity	Round No.	Velocity
Test Ammunition: Cartridge, ball, caliber 7.62-mm, NATO, M80, lot FC-1907. Rifle: U. S., 7.62-mm, M14, No. 894613.			
1	2782	1	2792
2	2759	2	2823
3	2793	3	2792
4	2811	4	2812
5	2811	5	2804
6	2836	6	2823
7	2772	7	2809
8	2781	8	2795
9	2825	9	2804
10	2804	10	2803
11	2812	11	2801
12	2814	12	2787
13	2812	13	2803
14	2826	14	2856
15	2786	15	2804
16	2792	16	2817
17	2790	17	2800
18	2803	18	2795
19	2812	19	2803
20	2841	20	2770
Average	2803		2805
Maximum	2841		2856
Minimum	2759		2770
Extreme variation	82		86
Mean variation	16.9		11.2

Bore Measurements

The bore measurements were made by the Physical Test Laboratory, APG.

Measurements are given in inches

Rifle: Caliber .223, AR15, No. 8825

Distance from End of Flash Suppressor	Date: 10 January 1963 — Lands			Date: 29 January 1963 — Lands		
	1 and 4	2 and 5	3 and 6	1 and 4	2 and 5	3 and 6
	Before Endurance			After Endurance		
1.35	0.2185	0.2205	0.2200	0.2190	0.2190	0.2180
2.00	.2200	.2205	.2205	.2200	.2200	.2195
3.00	.2205	.2205	.2210	.2210	.2205	.2210
4.00	.2205	.2205	.2210	.2200	.2210	.2205
5.00	.2205	.2210	.2210	.2205	.2200	.2200
6.00	.2210	.2210	.2210	.2200	.2200	.2195
7.00	.2210	.2210	.2210	.2195	.2205	.2195
8.00	.2210	.2210	.2210	.2195	.2205	.2195
9.00	.2210	.2210	.2210	.2200	.2205	.2195
10.00	.2210	.2210	.2210	.2200	.2205	.2205
11.00	.2210	.2210	.2210	.2210	.2210	.2205
12.00	.2210	.2210	.2210	.2210	.2210	.2210
13.00	.2210	.2210	.2210	.2215	.2215	.2215
14.00	.2210	.2210	.2210	.2220	.2220	.2220
15.00	.2210	.2210	.2210	.2220	.2220	.2225
16.00	.2210	.2210	.2210	.2230	.2230	.2225
17.00	.2210	.2210	.2210	.2230	.2230	.2230
18.00	.2210	.2210	.2210	.2225	.2225	.2230
18.35	.2210	.2210	.2210	.2220	.2220	.2220
18.85	.2210	.2210	.2210	.2220	.2220	.2220
19.10	.2210	.2210	.2210	.2220	.2230	.2220
19.25	.2210	.2210	.2210	.2230	.2230	.2230

Instruments were not available for measuring the groove diameter.

Measurements are given in inches.

Distance from End of Flash Suppressor	Lands			Lands		
	1 and 4	2 and 5	3 and 6	1 and 4	2 and 5	3 and 6
Rifle: Caliber .223, AR15, No. 8833						
	Before Endurance			After Endurance		
1.35	0.2180	0.2190	0.2180	0.2175	0.2175	0.2175
2.00	.2195	.2195	.2190	.2195	.2200	.2195
3.00	.2195	.2200	.2200	.2200	.2190	.2200
4.00	.2200	.2200	.2200	.2195	.2190	.2200
5.00	.2200	.2200	.2200	.2200	.2190	.2200
6.00	.2200	.2200	.2200	.2195	.2190	.2195
7.00	.2200	.2200	.2200	.2195	.2190	.2195
8.00	.2200	.2200	.2200	.2195	.2190	.2190
9.00	.2200	.2200	.2200	.2190	.2190	.2195
10.00	.2200	.2200	.2200	.2195	.2195	.2200
11.00	.2200	.2200	.2200	.2200	.2200	.2205
12.00	.2200	.2200	.2200	.2205	.2200	.2205
13.00	.2200	.2200	.2200	.2210	.2205	.2210
14.00	.2200	.2200	.2200	.2210	.2210	.2210
15.00	.2200	.2200	.2200	.2210	.2210	.2210
16.00	.2200	.2200	.2200	.2210	.2215	.2210
17.00	.2200	.2200	.2200	.2215	.2215	.2220
18.00	.2200	.2200	.2200	.2215	.2215	.2215
18.35	.2200	.2200	.2200	.2215	.2210	.2215
18.85	.2200	.2200	.2200	.2220	.2220	.2215
19.10	.2200	.2200	.2200	.2225	.2220	.2225
19.25	.2200	.2200	.2200	.2230	.2230	.2230

Instruments were not available for measuring the groove diameter.

Measurements are given in inches.

Distance from End of Flash Suppressor	Lands			Lands		
	1 and 4	2 and 5	3 and 6	1 and 4	2 and 5	3 and 6
Rifle: Caliber .223, AR15, No. 11285.						
	Before Endurance			After Endurance		
1.35	0.2180	0.2180	0.2195	0.2180	0.2175	0.2175
2.00	.2190	.2200	.2200	.2190	.2195	.2195
3.00	.2200	.2200	.2200	.2200	.2200	.2200
4.00	.2200	.2200	.2200	.2200	.2200	.2200
5.00	.2200	.2200	.2200	.2200	.2195	.2200
6.00	.2200	.2200	.2200	.2200	.2190	.2195
7.00	.2200	.2200	.2200	.2200	.2190	.2200
8.00	.2200	.2200	.2200	.2200	.2190	.2195
9.00	.2200	.2200	.2200	.2195	.2190	.2200
10.00	.2200	.2200	.2200	.2205	.2200	.2200
11.00	.2200	.2200	.2200	.2205	.2200	.2205
12.00	.2200	.2200	.2200	.2205	.2205	.2210
13.00	.2200	.2200	.2200	.2205	.2205	.2210
14.00	.2200	.2200	.2200	.2215	.2210	.2215
15.00	.2200	.2200	.2200	.2215	.2220	.2220
16.00	.2200	.2200	.2200	.2215	.2220	.2220
17.00	.2200	.2200	.2200	.2200	.2220	.2220
18.00	.2200	.2200	.2200	.2220	.2220	.2220
18.35	.2200	.2200	.2200	.2215	.2220	.2215
18.35	.2200	.2200	.2200	.2215	.2215	.2210
19.10	.2200	.2200	.2200	.2220	.2225	.2225
19.25	.2200	.2200	.2200	.2230	.2230	.2230

Instruments were not available for measuring the groove diameter.

Measurements are given in inches.

Distance from End of Flash Suppressor	Lands 1 and 4	Lands 2 and 5	Lands 3 and 6	Lands 1 and 4	Lands 2 and 5	Lands 3 and 6
Rifle: Caliber .223, AR15, No. 11705	Before Endurance			After Endurance		
1.35	0.2200	0.2200	0.2200	0.2180	0.2180	0.2195
2.00	.2200	.2200	.2200	.2195	.2195	.2200
3.00	.2200	.2200	.2200	.2200	.2200	.2200
4.00	.2200	.2200	.2200	.2190	.2190	.2195
5.00	.2200	.2200	.2200	.2205	.2190	.2190
6.00	.2200	.2200	.2200	.2195	.2190	.2190
7.00	.2200	.2200	.2200	.2200	.2190	.2190
8.00	.2200	.2200	.2200	.2200	.2190	.2195
9.00	.2200	.2200	.2200	.2205	.2195	.2200
10.00	.2200	.2200	.2200	.2205	.2200	.2200
11.00	.2200	.2200	.2200	.2210	.2205	.2205
12.00	.2200	.2200	.2200	.2210	.2205	.2210
13.00	.2200	.2200	.2200	.2210	.2205	.2210
14.00	.2200	.2200	.2200	.2210	.2210	.2215
15.00	.2200	.2200	.2200	.2215	.2215	.2215
16.00	.2200	.2200	.2200	.2220	.2220	.2220
17.00	.2200	.2200	.2200	.2220	.2220	.2220
18.00	.2200	.2200	.2200	.2220	.2220	.2215
18.35	.2200	.2200	.2200	.2210	.2210	.2215
18.85	.2200	.2200	.2200	.2210	.2215	.2215
19.10	.2200	.2200	.2200	.2230	.2230	.2230
19.25	.2200	.2200	.2200	.2230	.2230	.2230

Instruments were not available for measuring the groove diameter.

Measurements are given in inches.

Rifle: U..S., 7.62-mm, M14, No. 894613.

Distance from End of Flash Suppressor	Before Endurance				After Endurance			
	Lands		Grooves		Lands		Grooves	
	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical	Horizontal
3.2	0.3002	0.3002	0.3078	0.3077	0.3008	0.3008	0.3078	0.3078
3.3	.3002	.3002	.3077	.3077	.3008	.3008	.3078	.3078
4.0	.3004	.3003	.3078	.3078	.3008	.3007	.3078	.3079
5.0	.3006	.3005	.3080	.3079	.3010	.3007	.3080	.3080
6.0	.3007	.3007	.3081	.3080	.3011	.3007	.3081	.3081
7.0	.3007	.3007	.3081	.3082	.3011	.3008	.3082	.3082
8.0	.3008	.3008	.3082	.3082	.3011	.3009	.3082	.3082
9.0	.3008	.3008	.3082	.3082	.3010	.3010	.3082	.3082
10.0	.3008	.3009	.3082	.3082	.3010	.3010	.3083	.3083
11.1	.3008	.3008	.3083	.3082	.3009	.3008	.3083	.3082
12.0	.3007	.3008	.3083	.3081	.3008	.3007	.3083	.3081
13.0	.3007	.3008	.3082	.3081	.3008	.3007	.3083	.3081
14.0	.3007	.3008	.3082	.3082	.3007	.3007	.3082	.3082
15.0	.3007	.3008	.3082	.3082	.3007	.3006	.3082	.3082
16.0	.3007	.3008	.3082	.3082	.3006	.3005	.3082	.3082
17.0	.3007	.3007	.3082	.3082	.3006	.3006	.3082	.3082
18.0	.3007	.3007	.3082	.3082	.3006	.3006	.3081	.3082
19.0	.3007	.3008	.3082	.3082	.3005	.3007	.3081	.3082
20.0	.3006	.3008	.3082	.3082	.3005	.3007	.3081	.3081
21.0	.3006	.3007	.3082	.3082	.3005	.3006	.3081	.3081
21.2	.3006	.3007	.3082	.3082	.3004	.3006	.3081	.3081
22.2	.3006	.3007	.3082	.3081	.3000	.3002	.3081	.3080
22.3	.3006	.3007	.3082	.3081	.2999	.3001	.3081	.3080
22.5	.3006	.3007	.3082	.3081	.2998	.2998	.3081	.3079

APPENDIX D

Distribution

NAME AND ADDRESS	NO. OF COPIES
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D&PS, Aberdeen Proving Ground, Maryland
EVALUATION TEST OF THE RATE OF RIFLING TWIST IN RIFLE, CALIBER .223, AR15
G. E. Hendricks

Report No. DPS-880, April 1963
AMCMS Code No. 5561.12.466.A0.06
D. A. Project No. 5020-804-601
Unclassified Report

Four AR15 rifles, two having a rate of rifling twist of one turn in 14 inches and two with a rate of one turn in 12 inches, were subjected to accuracy, velocity, bullet stability, and endurance tests. One rifle, U. S., 7.62-mm, M14, was used as a control. Long range accuracy and bullet stability of the AR15 rifle with a rate of twist of 1 turn in 12 inches were superior to those of the rifle with 1 turn in 14 inches.

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