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TECOM PROJECT NO. 2-WE-600-016-027
REPORT NO. USACSTA-6148

FINAL REPORT

INITIAL PRODUCTION TEST

(SAFETY PHASE)

OF

M16A2 RIFLE SYSTEM

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INDIVIDUAL EQUIPMENT DIRECTORATE

US ARMY COMBAT SYSTEMS TEST ACTIVITY
ABERDEEN PROVING GROUND, MD 21005-5059

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3-round burst control
Semiautomatic

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This test was conducted at US Army Combat Systems Test Activity (USACSTA), formerly the Materiel Testing Directorate, from 16 March to 31 December 1984. The M16A2 Rifle System was subjected to inspections, function performance, extreme temperature, drop, sand and dust, mud, dispersion, endurance, and salt fog testing. Ball M193-type ammunition was used in this test and therefore, no criteria for rifle functioning or dispersion were addressed. The M16A2 Rifle System was considered safe for personnel utilizing the M193 ball ammunition.

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DEPARTMENT OF THE ARMY
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Ms Glover/sg/283-3711

REPLY TO ATTENTION OF
STECS-SA-S

27 February 1985

SUBJECT: Final Report on Initial Production (Safety Phase) of M16A2 Rifle System, TECOM Project No. 2-WE-600-016-027, Report No. USACSTA-6148

Commander
US Army Armament, Munitions and
Chemical Command
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1. REFERENCES

a. Letter, DRSTE-CM-F, TECOM, 25 October 1983, subject; Test Execution Directive for First Article/Initial Production Test of Rifle System, 5.56-MM, M16A2, TECOM Project No. 2-WE-600-016-027.

b. Letter, DRSMC-QAG-S, AMCCOM, 23 August 1983, subject: Initial Production Test for M16A2 Rifle.

c. Additional references are contained in Enclosure 2.

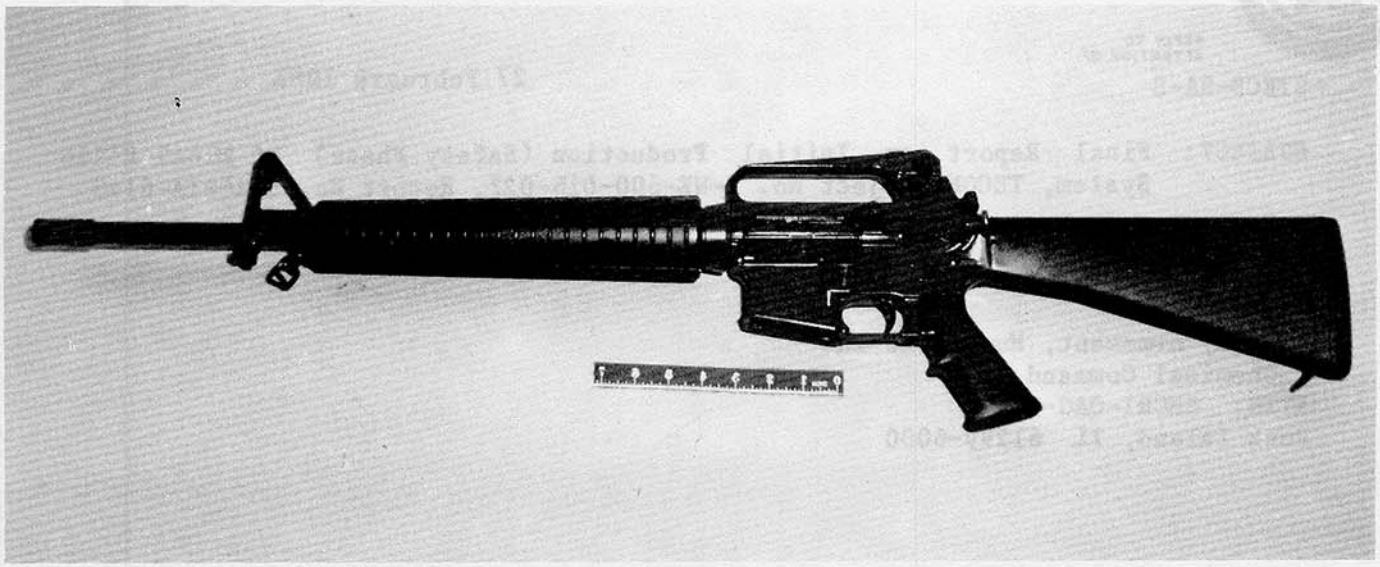
2. BACKGROUND

a. Conduct of test. This test was directed by Reference 1a and conducted in accordance with the US Army Combat Systems Test Activity (USACSTA) test plan outline (encl 2, ref 4).

b. History. The US Army and US Marine Corps are jointly developing an improved version of the M16A1 rifle, designated the M16A2 (see figure). The Marines anticipate fielding the M16A2 to their units before the Army. Although the M16A2 is intended to use M855 ball and M856 tracer ammunition the unavailability of this ammunition dictated using M193 ball ammunition for this test. As a result, criteria were not addressed during each of the subtests performed because the use of M193 ball ammunition may change the function and dispersion characteristics of the M16A2 rifle.

c. It should be noted that a complete IPT was not conducted at this time. A safety phase was conducted to obtain information only for a conditional release for the Marine Corps using ball M193 ammunition. The IPT is to be conducted at a later date when M855 and M856 ammunition become available.

2 (Cont'd)



M16A2 RIFLE

PHYSICAL DATA:
  Length:
    Rifle with compensator ---------- 100.6 cm (39.63 in.)
  Weight:
    With 30-round magazine ---------- 3.99 kg (8.79 lb)

RIFLING: 1 turn in 7 in.

d. Description of materiel. The M16A2 rifle is a gas operated, air-cooled, magazine fed, semiautomatic or 3-round burst shoulder fired weapon. It differs from the M16A1 rifle in the following salient features: The automatic fire option is replaced by a 3-round burst control. The barrel is thicker from under the front sight to the muzzle and the flash suppressor has been modified to compensate for muzzle climb. The twist of the barrel rifling has been increased to one in seven (from one in twelve) in order to impart a faster spin required for heavier bullets, which are designed to be used with this weapon. Both front and rear sights have been modified. Viewing the M16A2 rifle from the top, the front sight post presents a square cross section where previously the front sight had presented a round one. It is beleived that the square cross section will give better post edge definition to the shooter's eye, under a variety of lighting conditions, than the round cross section. The rear sight currently incorporates manipulative knobs for both windage and elevation adjustments. A spent cartridge case deflector has been added to the upper receiver. New, more durable plastics have been developed for the buttstock and handguard. The handguard now has a cylindrical configuration with a rough gripping surface. Its two identical halves separate on a horizontal plane. This decreases the previous logistic burden of right and left components of the M16A1 triangular-shaped handguard. The butt plate has been changed to a more durable nylon.

3. TEST OBJECTIVE

The objective of this test was to obtain information necessary for TECOM to provide a conditional release of the M16A2 rifle to the Marine Corps using ball M193 ammunition.

4. SCOPE

a. An Initial Production Test (safety phase) of the M16A2 rifle was performed by US Army Combat Systems Test Activity (USACSTA), formerly US Army Materiel Testing Directorate (MTD), from 16 March 1984 to 31 December 1984.

b. The safety phase of the Initial Production Test consisted of conducting an initial inspection test, function performance test, extreme temperature test, drop test, mud test, sand and dust test, dispersion test, endurance test, salt/fog test, and final inspection test on the M16A2 rifle with M193 ball ammunition. Thirteen M16A2 rifles were used in the test. Four of these rifles were previously used in the First Article Test at the manufacturer's facilities. The sample size was adequate for the intended scope of testing.

c. There was no environmental impact as a result of this test.

5. SUMMARY OF RESULTS

a. During initial inspection, no defects were discovered with any of the thirteen M16A2 rifles that were received for testing at USACSTA.

b. All M16A2 rifles functioned satisfactorily during the initial function subtest.

c. Two malfunctions occurred while firing 1200 rounds on three M16A2 rifles during extreme temperature test at 68.3° C (155° F) and 256 malfunctions occurred while firing 3600 rounds on three other M16A2 rifles during extreme temperature at -45.6° C (-50° F). The majority of the 256 malfunctions were failure-to-feed (FF) malfunctions (236 FF's). The suspected cause of the FF malfunctions was firing residue buildup inside the magazines which may have hindered the smooth transition of the rounds to the bolt face.

d. The M16A2 rifle functioned satisfactorily after being dropped from a height of 1.5 meters (5 ft) onto a cinder block in a 68.3° C and -45.6° C temperature environment.

e. The M16A2 rifle functioned satisfactorily after being subjected to mud, dynamic sand and dust, 12,000 rounds of endurance firing (in addition to these rounds fired at APG, 6000 rounds had previously been fired on each of the four weapons used in the endurance test at the manufacturer's facility), and salt fog tests.

f. No defects (other than a cracked extractor, swivel retainer, and bolt catch) were discovered during the final inspection test.

g. There were seven incidents during the endurance test where the weapons failed-to-fire 3-round bursts which contributed to a degradation in weapon performance. These incidents occurred after approximately 12,000 to 16,000 rounds were fired. During those incidents, 1- and 2-rounds were fired instead of the desired 3-round bursts. It should be noted that on all the incidents, the weapons did not fire uncontrollably when their respective triggers were released. Although the incidents mentioned above did occur, the M16A2 rifle utilizing M193 ball ammunition, is considered safe for personnel use.

6. CONCLUSION

It is concluded that the M16A2 rifle is safe for personnel use with M193 ball ammunition.

FOR THE COMMANDER:

JAMES C. WHITE
Director, Small Arms and Automatic Weapons and Individual Equipment Directorate

6 Encl
1. Details of Test
2. References
3. Chamber and Bore Measurements During Initial Inspection
4. Chamber and Bore Measurements During Endurance Test
5. Malfunctions of M16A2 Rifle During Extreme Temperature Test at -45.6° C
6. Distribution List

(Page 6 Blank)

DETAILS OF TEST

INTRODUCTION

a. The M16A2 rifles were maintained during all testing in accordance with TM 05538C-10/1, Rifle, 5.56-MM, M16A2 with Enclosures, dated June 1983.

b. The ammunition used for all testing was 5.56-mm, ball, M193, lot No. RA 2-24.

c. All test weapons were fired from the shoulder during testing except for the dispersion and velocity portions which were conducted from a test mount.

d. Since the M16A2 rifle was not designed for M193 ball-type ammunition, no criteria for rifle functioning or dispersion were addressed.

e. The M16A2 rifles were identified in this test by using the last three digits of the serial number.

(Page 2 blank)

1. INITIAL INSPECTION TEST

1.1 Objective

To ensure that the M16A2 Rifle System is complete and in a satisfactory condition to be used in subsequent testing.

1.2 Criterion

None.

1.3 Data Acquisition Procedure

a. This test was conducted in accordance with TECOM TOP 3-2-045 (encl 2, ref 7), thirteen M16A2 rifles that were received for testing at USACSTA, Aberdeen Proving Ground (APG) and were inspected.

b. The following measurements were recorded.

(1) Trigger pull.

(2) Headspace.

(3) Firing pin indent.

(4) Firing pin protrusion.

(5) Bore erosion gaging.

c. A magnetic particle inspection (MPI) of the following components was conducted.

(1) Barrel.

(2) Bolt carrier.

(3) Sear.

(4) Bolt.

(5) Trigger.

(6) Bolt cam pin.

(7) Hammer.

(8) Selector lever.

(9) Extractor.

(10) Firing pin.

(11) Bolt catch.

(12) Magazine catch.

(13) Ejector.

(14) Burst selector sear.

(15) Disconnector.

d. The following components were inspected by the liquid penetrant method.

(1) Upper receiver.

(2) Lower receiver.

(3) Charging handle.

e. Barrel chamber and bore measurements were recorded.

1.4 Results

a. Table 1-1 indicates the rifle measurements that were collected during this test.

b. The magnetic particle and liquid penetrant inspections revealed no cracks or defects in the thirteen M16A2 rifles.

c. Table 1 of Enclosure 3 contains the chamber measurements of all the barrels taken during the initial inspection. Enclosure 3 also contains the bore meaurements, of all the barrels, taken during the initial inspection. Although the majority of the chamber measurements of all the weapons exceeded the maximum specifications, subsequent firings in the subtests performed showed that there was no serious degradation of weapon performance.

d. An inspection of all the rifles revealed no defects that would contribute to a degradation to safety.

TABLE 1-1. M16A2 RIFLE MEASUREMENTS DURING INITIAL INSPECTION TEST

Rifle No.	Head Space (in.)	Firing Pin Protrusion (in.)	Firing Pin Indent (in.) Trial 1	Trial 2	Trial 3	Avg	Trigger Pull[d], lb Trial 1	Trial 2	Trial 3	Avg	Barrel Erosion Gage (mm)
901	1.4666	0.031	0.021	0.022	0.022	0.022	9.5	9.5	9.0	9.3	5.6
902	1.4676	.033	.022	.022	.020	.021	9.0	8.5	9.0	8.8	1.6
903	1.4656	.031	.020	.021	.021	.021	10.5	10.0	10.0	10.2	6.4
904	1.4666	.032	.021	.021	.021	.021	8.5	8.0	8.5	8.3	5.6
905	1.4676	.032	.022	.021	.020	.020	10.0	10.5	10.0	10.2	2.4
906	1.4676	.033	.022	.022	.021	.022	10.5	10.5	10.0	10.3	5.6
907	1.4676	.033	.022	.020	.021	.020	9.0	10.0	10.0	9.7	5.6
908	1.4666	.031	.021	.020	.021	.021	8.5	8.5	9.0	8.7	1.6
910	1.4656	.032	.021	.022	.021	.021	10.5	10.0	9.5	10.0	5.6
911	1.4656	.033	.023	.022	.022	.022	8.0	9.5	9.0	8.8	5.6
912	1.4656	.032	.021	.021	.021	.021	9.5	8.0	9.5	9.0	0.8
913	1.4646	.033	.021	.022	.022	.022	9.0	9.0	8.5	8.8	5.6
915	1.4666	.031	.022	.020	.020	.021	9.5	9.5	10.0	9.7	5.6
Requirement per MIL-R-45587A:											
	[a]1.4646	[a]0.028			[c]0.020				[a]5.5		
	[b]1.4706	[b]0.036							[b]8.5		

[a]Minimum.
[b]Maximum.
[c]Not less than.
[d]It should be noted that only weapon No. 904 is within the requirement for trigger pull. All the other weapons exceeded the maximum trigger pull requirement. Trigger pull is considered a nonessential (desirable) characteristic of the weapon.

1.5 Analysis

The thirteen M16A2 rifles were considered complete and in satisfactory condition for use in the initial production (safety phase) test.

1.6 Conclusion

It was concluded that the thirteen M16A2 Rifle Sytems that were received at APG for testing were complete and suitable for subsequent testing.

2. FUNCTION PERFORMANCE TEST

2.1 Objective

To evaluate specific M16A2 rifle characteristics and to affirm that the M16A2 rifle functions satisfactorily.

2.2 Criterion

None.

2.3 Data Acquisition Procedure

This test was conducted in accordance with TECOM TOP 3-2-045 (encl 2, ref 7). The following subtests were conducted on thirteen M16A2 rifles.

a. Safety check. The selector lever of each rifle was set on the SAFE position prior to firing. The M16A2 rifles were then checked to assure that they could not be fired.

b. Semiautomatic firing. The selector lever of each rifle was set on SEMI for semiautomatic firing. Ten rounds were fired from each M16A2 rifle that was fixed in a test mount to collect dispersion data on a target set at a range of 91.4 meters (100 yd). Three 10-round targets were fired from each M16A2 rifle and the velocity of each round at 15 meters (49.2 ft), was recorded. During semiautomatic firing any multiple shots which occurred during any one trigger pull would be recorded as a malfunction.

c. Burst firing. The selector lever of each rifle was set on BURST. Thirty rounds were fired from each rifle using the 3-round burst control. The trigger was pulled until firing stopped, then released and pulled again. This was repeated until the magazine of each rifle was empty. Failure to fire three rounds during any but the first and last burst in the magazine would be recorded as a malfunction.

d. Cyclic rate of fire. Not more than 3 minutes after completion of burst firing, an additional 30 rounds were fired using the 3-round burst control. The cyclic rates of the third, and last 3-round bursts were recorded.

2.4 Results

The results of the three subtests conducted are as follows:

a. Safety check. None of the M16A2 rifles fired with the selector lever set on the SAFE position.

b. Semiautomatic firing.

(1) Table 2-1 indicates the high, low, and average instrumental velocity recorded during the firing of the three 10-round targets for each M16A2 rifle.

2.4 (Cont'd)

TABLE 2-1. M16A2 RIFLE INSTRUMENTAL VELOCITY DATA AT 15 METERS (49.2 FT) OF FUNCTION PERFORMANCE TEST

Rifle No.	Instrumental Velocity (fps)								
	Target No. 1			Target No. 2			Target No. 3		
	High	Low	Mean	High	Low	Mean	High	Low	Mean
901	3112	3026	3081	3119	3029	3099	3117	3057	3093
902	3150	3063	3089	3130	3032	3075	3156	3033	3041
903	3150	3044	3111	3168	3069	3124	3226	3042	3124
904	3137	3033	3076	3149	3071	3105	3135	3072	3099
905	3127	3063	3102	3109	3035	3091	3144	3050	3091
906	3111	3063	3085	3172	3079	3120	3137	3066	3096
907	3172	3060	3098	3153	3050	3105	3156	3092	3130
908	3125	3070	3098	3172	3058	3123	3139	3054	3099
910	3125	3069	3097	3156	3065	3097	3139	3054	3113
911	3125	3067	3085	3184	3044	3095	3157	3033	3099
912	3144	3054	3097	3130	3062	3096	3132	3021	3096
913	3124	3084	3101	3188	3015	3083	3167	3042	3104
915	3152	3028	3084	3144	3060	3090	3145	3039	3089

(2) The average dispersion data are contained in Table 2-2.

TABLE 2-2. M16A2 RIFLE MEAN DISPERSION DATA OF FUNCTION PERFORMANCE TEST

Rifle No.	Mean Target Measurements (cm)				
	HSD	VSD	EHS	EVS	ES
901	2.6	3.5	8.4	11.0	12.1
902	3.3	3.6	9.8	11.4	14.2
903	3.2	2.7	8.9	9.0	10.7
904	3.8	2.2	13.7	7.0	14.1
905	3.8	2.7	12.2	8.2	13.0
906	2.7	3.9	8.8	13.4	15.0
907	3.0	2.2	10.0	7.3	11.2
908	2.2	3.0	6.6	10.0	10.3
910	2.4	3.0	7.2	8.8	9.6
911	2.7	3.2	8.6	10.7	12.8
[a]912	4.3	5.1	14.7	16.6	20.7
913	3.4	3.1	10.8	9.4	12.9
915	2.9	3.8	10.0	11.4	13.1

[a]Although these figures are consistently larger, they are not statistically significant (0.05 level) when compared with the mean of the other 12 test weapons.

HSD = Horizontal standard deviation.
VSD = Vertical standard deviation.
EHS = Extreme horizontal spread.
EVS = Extreme vertical spread.
ES = Extreme spread.

(3) No malfunctions occurred during semiautomatic firing of any of the M16A2 rifles.

c. Burst firing. No failure to obtain 3-round bursts during any but the first and last bursts in the 30-round magazines occurred during the burst firing subtest.

d. Cyclic rate of fire. The cyclic rate of fire of the third, sixth, and the last 3-round burst for each M16A2 rifle is shown in Table 2-3.

TABLE 2-3. M16A2 CYCLIC RATE OF FIRE DURING FUNCTION PERFORMANCE TEST

Rifle No.	Cyclic Rate of Fire (spm) Three-round Burst			
	Third	Sixth	Last	Avg
901	767	801	825	798
902	773	786	817	792
903	757	789	792	779
904	793	814	853	820
905	808	821	856	828
906	794	813	842	816
907	777	780	802	786
908	783	784	786	784
910	783	800	812	798
911	770	794	815	793
912	774	790	814	793
913	762	795	814	790
915	800	816	835	817

spm = Shots per minute.

2.5 Analysis

a. Velocity data were obtained for 13 weapons, three targets each. Comparisons were made among weapons and among targets within weapons with respect to average velocity. A 2-way nested analysis of variance model was used. The two main effects were weapons (13 levels) and targets with weapons (3 levels) with 10 replications. Significance testing was at the 0.05 level. It is assumed that velocity is a normally distributed random variable. A significant difference was detected among weapons with respect to average velocity. However, no significant difference was detected among targets within weapons with respect to average velocity.

b. Cyclic rate and dispersion data were obtained for 13 weapons, three targets each. Comparisons were made among weapons with respect to cyclic rate, horizontal standard deviation, vertical standard deviation, extreme horizontal

spread, extreme vertical spread, and extreme spread. A 1-way analysis of variance model was used. The main effect was weapons (13 levels) with three replications. Significance testing was at the 0.05 level. It is assumed that the above stated variables are random and normally distributed. No significant difference was detected among weapons with respect to mean cyclic rate or any of the mean dispersion parameters.

2.6 Conclusions

It is concluded that all M16A2 rifles initially functioned properly.

3. EXTREME TEMPERATURE TEST

3.1 Objective

To determine the functioning performance of the M16A2 rifle under conditions of extreme temperature.

3.2 Criterion

None.

3.3 Data Acquisition Procedure

a. This test was conducted in accordance with TECOM TOP 3-2-045 (encl 2, ref 7). Ten 120-round firing cycles were performed on three M16A2 rifles conditioned at 68.3° C (155° F) and thirty 120-round firing cycles were performed on three other M16A2 rifles that were conditioned at -45.6° C (-50° F). Table 3-1 indicates the 120-round firing cycle procedure.

TABLE 3-1. 120-ROUND FIRING CYCLE FOR EXTREME TEMPERATURES

No. Rd Fired	Firing Mode	Firing Rate (spm)
60	Burst	[a] -
30	Semiautomatic	60
30	Semiautomatic	30

[a]A rate of fire was not established in the test plan while using the burst control unit; however, a rate of 85 spm was used.

b. Four 30-round magazines per rifle (12 total) were used in the firing sequence. The magazines were marked by using the last digit of the rifle No. with A, B, C, or D and were rotated after the completion of each cycle in accordance with the sequence shown in Table 3-2.

TABLE 3-2. MAGAZINE ROTATION OF M16A2 RIFLE SYSTEM DURING EXTREME TEMPERATURE TESTS

Cycle No.	Magazine No.			
1	A	B	C	D
2	B	C	D	A
3	C	D	A	B
4	D	A	B	C

c. The rotation of the magazines was continued by using the sequence shown in Table 3-2 until completion of the extreme temperature test. The M16A2 rifles were conditioned for a minimum of 6 hours in an environmental chamber before initial firing. Each M16A2 rifle was cleaned, inspected, and lubricated every 1200 rounds inside the environmental chamber.

d. The following operations were performed because several buffer malfunctions occurred during extreme temperature test at -45.6° C. Buffer assemblies were replaced with parts from M16A2 rifles which were used in the extreme temperature test at 68.3° C since no replacement parts were provided to APG. Each replacement buffer was reconditioned for 2 hours before firing continued. Testing was temporarily stopped after all buffer assemblies from the M16A2 rifles used in the extreme temperature test at 68.3° C malfunctioned. Testing was started again after the manufacturer supplied additional buffers.

e. The following operations were performed in order to determine the cause of several failure-to-feed stoppages that occurred on the M16A2 Rifle System during the extreme temperature test at -45.6° C: (1) the magazines used with M16A2 rifles that had numerous failure-to-feed malfunctions during a firing cycle were replaced with new magazines; (2) during cycle No. 13, a study was conducted that involved replacing the magazines from rifle No. 910 with the magazines from rifle No. 906. (Rifle No. 910 was selected because a small amount of failure-to-feed malfunction had occurred during the previous cycle, while a numerous amount of failure-to-feed malfunctions occurred while using rifle No. 906 during the previous cycle.)

3.4 Results

3.4.1 Temperature conditioned at 68.3° C (155°F).

a. Two malfunctions occurred on the M16A2 Rifle System during extreme temperature testing at 68.3° C. Table 3-3 summarizes these malfunctions.

TABLE 3-3. MALFUNCTIONS OF THE M16A2 RIFLE DURING EXTREME TEMPERATURE TEST AT 68.3° C (155° F)

Rifle No.	Type of Malfunction	Firing Mode	Life Period	Magazine Rd No.	Subtest Rd	Magazine No.	Cycle No.
901	0	-	-	-	-	-	-
903	0	-	-	-	-	-	-
904	FFR[a]	SA	1033	4	933	4C	8
	FFR[a]	SA	1043	14	943	4C	8

[a]A light strike on the primer because of inability of the bolt to lock properly caused these malfunctions.

FFR = Failure-to-fire.
SA = Semiautomatic.

b. No incidents occurred that contributed to a degradation in safety.

3.4.2 Temperature Conditioned at -45.6° C (-50° F)

a. Table 3-4 is a summary of the malfunctions that occurred on the M16A2 rifles during extreme temperature testing at -45.6° C. Table 1 of Enclosure 5 contains more detailed data regarding the malfunctions listed in Table 3-4 below.

TABLE 3-4. TOTAL MALFUNCTIONS OF THE M16A2 RIFLES DURING EXTREME TEMPERATURE TEST AT -45.6° C (-50° F)

120-Round Cycle No.	Type of Malfunction					Maintenance Action
	Total	FF	FFR	BD	BOB	
1	3	0	0	3	0	
2	0	-	-	-	-	
3	8	4	0	3	1	
4	15	14	0	1	0	
5	16	13	2	1	0	
6	8	8	0	0	0	
7	13	13	0	0	0	
8	7	7	0	0	0	
9	26	26	0	0	0	
10	34	33	0	0	1	CIL[a]
11	10	10	0	0	0	
12	41	40	0	0	1	
13	27	27	0	0	0	
14	2	1	0	0	1	
15	2	2	0	0	0	
16	3	0	0	0	3	
17	7	5	0	0	2	
18	11	11	0	0	0	
19	14	14	0	0	0	
20	1	1	0	0	0	CIL[a]
21	0	-	-	-	-	
22	1	0	1	0	0	
23	0	-	-	-	-	
24	0	-	-	-	-	
25	0	-	-	-	-	
26	0	-	-	-	-	
27	0	-	-	-	-	
28	4	4	0	0	0	
29	2	2	0	0	0	
30	1	1	0	0	0	CIL[a]
Total	256	236	3	8	9	

[a]Cleaning, inspection, and lubrication occurred at the completion of each ten 120-round cycles.

FF = Failure-to-feed.
FFR = Failure-to-fire.
BD = Buffer disconnection.
BOB = Bolt-over-base.
CIL = Clean, inspect, and lubricate.

3.4.2 (Cont'd)

b. During cycles No. 1, and 3 through 5, eight stoppages occurred where the M16A2 rifle bolt remained at the rear. The M16A2 rifle was therefore disassembled after each of the eight stoppages. The examination revealed that the plastic end plug of the buffer assembly had disconnected from the metal housing. The individual internal buffer components were discovered scattered throughout the lower receiver extension. Table 3-5 summarizes these stoppages.

TABLE 3-5. BUFFER MALFUNCTIONS OF THE M16A2 RIFLE SYSTEM DURING EXTREME TEMPERATURE TEST AT -45.6° C

120-Rd Cycle No.	Rifle No.	Buffer Malfunction Firing Mode	Life Period	Rd No.	Subtest Rd	Buffer Replaced With Part From M16A2 Rifle No.
1	907	SA	182	3	92	904
1	907	SA	189	10	99	901
1	907	SA	198	19	108	a -
3	906	B	214	5	129	903
3	906	B	222	13	132	a -
3	906	B	224	15	134	a -
4	910	B	472	23	382	a -
5	910	SA	686	27	596	a -

[a]Manufacturer-supplied.

B = Burst.
SA = Semiautomatic.

c. Table 3-4 indicates that 236 failure-to-feed stoppages occurred on the M16A2 Rifle System during the extreme temperature test at -45.6° C. Since residue build-up inside the magazine may have been the cause of these failure-to-feed stoppages, during cycle No. 10 an original magazine used with rifle No. 910 was replaced with a new magazine. During cycle No. 13 the magazines that were used with M16A2 rifle No. 910 were switched with the magazines that were used with rifle No. 906. (One stoppage occurred on rifle No. 910 during cycle No. 12 and 40 stoppages occurred on rifle No. 906 during cycle No. 12.) Table 3-6 shows the results of this investigation.

3.4.2 (Cont'd)

TABLE 3-6. MALFUNCTIONS OF THE M16A2 RIFLE DURING EXTREME TEMPERATURE TEST AT -45.6° C

Rifle No.	Type of Malfunction	Firing Mode	Life Period	Magazine Rd No.	Subtest Rd	Magazine No.	120-Rd Cycle No.
910	FF	B	1562	3	1472	6B	13
	FF	B	1564	5	1474	6B	13
	FF	B	1566	7	1476	6B	13
	FF	B	1568	9	1478	6B	13
	FF	B	1570	11	1480	6B	13
	FF	B	1572	13	1482	6B	13
	FF	B	1574	15	1484	6B	13
	FF	B	1576	17	1486	6B	13
	FF	B	1578	19	1488	6B	13
	FF	B	1580	21	1490	6B	13
	FF	B	1582	23	1492	6B	13
	FF	B	1584	25	1494	6B	13
	FF	B	1586	27	1496	6B	13
	FF	B	1588	29	1498	6B	13
	FF	B	1592	3	1502	6C	13
	FF	B	1594	5	1504	6C	13
	FF	B	1596	7	1506	6C	13
	FF	B	1598	9	1508	6C	13
	FF	B	1600	11	1510	6C	13
	FF	B	1602	13	1512	6C	13
	FF	B	1604	15	1514	6C	13
	FF	B	1606	17	1516	6C	13
	FF	B	1608	19	1518	6C	13
	FF	B	1610	21	1520	6C	13
	FF	B	1612	23	1522	6C	13
	FF	B	1614	25	1524	6C	13
	FF	B	1616	27	1526	6C	13
	FF	B	1618	29	1528	6C	13
906	0	-	-	-	-	-	13

FF = Failure-to-feed.
B = Burst.

d. After the fourth 120-round firing cycle of M16A2 rifle No. 910 had been completed and during the replacement of a buffer, the pistol grips on all of the M16A2 rifles were tightened. The buffer malfunctions caused firing to stop on some M16A2 rifles because the replacement parts from the M16A2 rifles used in testing at 68.3° C had also malfunctioned. Firing was continued using the M16A2 rifles that were functioning. The pistol grips were tightened after M16A2 rifles No. 906 and 907 had completed cycle No. 5.

e. After the completion of 120-round cycle No. 25 both portions of the handguard were discovered radially cracked on rifle No. 910 (fig 3-1).

f. No incidents occurred contributing to a degradation in safety.

3.4.2 (Cont'd)

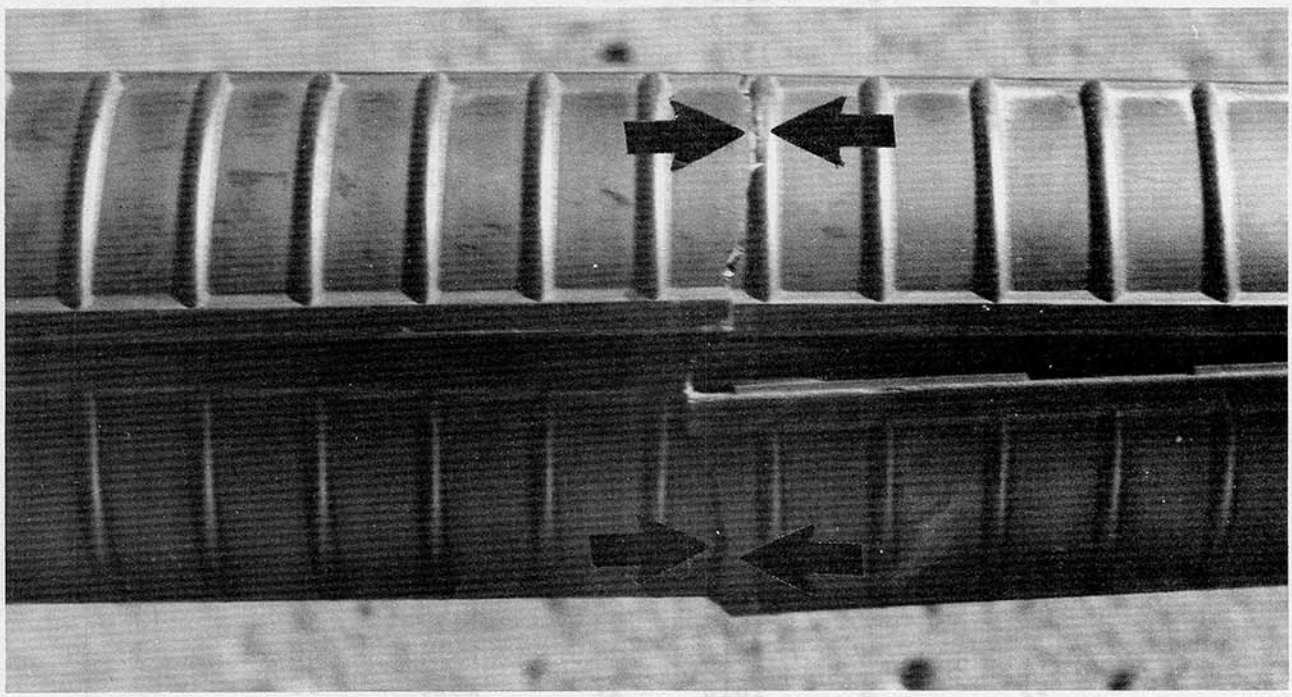


Figure 3-1. M16A2 rifle No. 910 handguard. The arrows show where the handguard cracked radially around both portions.

3.5 Analysis

3.5.1 Temperature Conditioned at 68.3° C (155° F)

Table 3-7 indicates a point estimate of the mean rounds between stoppages (MRBS) for the M16A2 Rifle System during extreme temperature test at 68.3° C (155° F).

TABLE 3-7. M16A2 RIFLE SYSTEM[a] MRBS OF THE EXTREME TEMPERATURE TEST AT 68.3° C

Total No. of Rd Fired per Firing Mode	No. of Malfunctions		MRBS Point Estimate	
	SA	Burst	SA	Burst
1800	0	2	[b]-	900

[a]The M16A2 Rifle System includes all components needed to fire 1200 rounds on three M16A2 rifles used in this phase of the extreme temperature test.
[b]A point estimate for the MRBS could not be calculated because no malfunctions occurred during the semiautomatic firing mode.

SA = Semiautomatic.
MRBS = Mean rounds between stoppage.

3.5.2 Temperature Conditioned at -45.6° C (-50° F)

a. The apparent cause of the numerous failure-to-feed (FF) stoppages was the dirty magazines used with the weapons. It was later determined that this dirt in the magazines was firing residue. Firing residue in the magazine probably mixed with the lubricant and because of the low temperature environment, the firing residue-lubricant mixture may have partially solidified or "caked." This solidified firing residue-lubricant mixture probably caused the internal components of the magazine (the spring and the follower) to work sluggishly or not move at all under certain instances. Since the spring and follower move sluggishly, the cartridges would not be quickly positioned in the bolt face when the bolt moves forward hence the FF stoppages. The use of new magazines did alleviate the FF occurrence but as soon as dirt (firing residue) accumulated in the magazines, FF stoppages occurred again. From the test data, it was determined that from three to ten cycles may be fired with new magazines prior to the occurrence of an FF stoppage.

b. Table 3-8 shows a point estimate of the MRBS for the M16A2 Rifle System during extreme temperature test at -45.6° C (-50° F).

3.5.2 (Cont'd)

TABLE 3-8. M16A2 RIFLE SYSTEM[a] MRBS OF THE EXTREME TEMPERATURE TEST AT -45.6° C (-50° F)

Total No. of Rd Fired per Firing Mode	No. of Malfunctions		MRBS Point Estimate	
	SA	Burst	SA	Burst
5400	148	108	36	50

[a]The M16A2 Rifle System includes all components needed to fire 1200 rounds on three M16A2 rifles used in this phase of the extreme temperature test.

SA = Semiautomatic.
MRBS = Mean rounds between stoppage.

c. Table 3-9 indicates a point estimate and a 95% confidence limit of the number of malfunctions that occurred on the M16A2 Rifle System during firing of every ten 120-round cycles in the extreme temperature test at -45.6° C. (An analysis of these results was performed in order to determine if cleaning, inspection, and lubrication had any affect upon the malfunction rate of the M16A2 rifle.)

TABLE 3-9. CONFIDENCE LIMIT AND POINT ESTIMATE, M16A2 RIFLE SYSTEM MALFUNCTION DATA[a] FOR EVERY TEN 120-ROUND CYCLES OF THE EXTREME TEMPTERATURE TEST AT -45.6° C (-50° F)

120-Rd Cycle No.	No. of Rd Fired On System	Semiautomatic and Burst		
		Total Malf	Point Estimate (malf/1000 rd)	Upper 95% Confidence Limit (malf/1000 rd)
1 to 10	3600	130	36.1	41.7
11 to 20	3600	119	33.1	38.5
21 to 30	3600	7	1.9	3.7

[a]The above M16A2 Rifle System malfunction data summarizes the number of malfunctions occurring on three M16A2 rifles.

Malf = Malfunction.

d. Table 3-10 indicates if any significant difference at the 0.05 level was noted between the malfunction rate of each group of ten 120-round cycles on the three M16A2 rifles and also on the M16A2 rifle and also on the M16A2 Rifle System.

TABLE 3-10. M16A2 RIFLE MALFUNCTION RATE COMPARISON BETWEEN THREE - TEN 120-ROUND CYCLE GROUPS OF THE EXTREME TEMPERATURE TEST AT -45.6° C (-50° F)

M16A2 Rifle No.	120-Round Cycles 1-10 Versus 11-20		120-Round Cycles 11-20 Versus 21-30		120-Round Cycles 1-10 Versus 21-30	
	SA	Burst	SA[c]	Burst	SA[d]	Burst
906	S [b]	NS	S	S [c]	S	S [d]
907	S [a]	S [a]	S	NS	S	S[d]
910	NS	S [b]	S	S [c]	S	NS
M16A2 Rifle System	NS	NS	S	S [c]	S	S [d]

[a]Cycles 11 to 20 had a significantly lower malfunction rate than cycles 1 to 10.
[b]Cycles 11 to 20 had a significantly higher malfunction rate than cycles 1 to 10.
[c]Cycles 21 to 30 had a significantly lower malfunction rate than cycles 11 to 20.
[d]Cycles 21 to 30 had a significantly lower malfunction rate than cycles 1 to 10.

SA = Semiautomatic.
S = Significant difference.
NS = No significant difference.

e. No significant difference was detected with respect to the malfunction rate of the M16A2 Rifle System between 120-round cycles 1 to 10 and 11 to 20 for the total malfunctions (combined malfunctions from the semiautomatic mode and the burst firing mode). However, the malfunction rate of the M16A2 Rifle System was significantly lower for 120-round cycles 21 to 30 than for 120-round cycles 1 to 10 and 11 to 20 for the total malfunctions (combined malfunctions from the semiautomatic mode and the burst firing mode).

3.6 Conclusions

It is concluded that:

a. The M16A2 Rifle System does perform satisfactorily under an extreme temperature condition of 68.3° C.

b. The M16A2 Rifle System does perform satisfactorily under an extreme temperature condition of -45.6° C provided the magazines used are free of any firing residue.

c. Cleaning, inspection, and lubrication may aid the decrease of the malfunction rate.

d. Safety of the M16A2 rifle is not degraded by firing M193 ball ammunition at temperatures of -45.6° C and 68.3° C.

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4. DROP TEST

4.1 Objective

To determine the M16A2 Rifle System susceptibility to damage from dropping.

4.2 Criterion

None.

4.3 Data Acquisition Procedure

a. This test was conducted in accordance with the customer's test plan (encl 2, ref 4). Three M16A2 rifles were dropped from a height of 1.5 meters (5 ft) in an environmental chamber after completing ten 120-round firing cycles during extreme temperature testing at 68.3° C (155° F). Three other M16A2 rifles were also dropped from a height of 1.5 meters (5 ft) in an environmental chamber after completing thirty 120-round firing cycles during extreme temperature testing at -45.6° C (-50° F).

b. The drop orientation was held at the start of the drop not at impact. The M16A2 rifle was dropped from a height of 1.5 meters (5 ft) above a flat concrete floor in the following attitudes (rear sight set at 200 meters):

(1) Top side edge of rear sight impacting (rifle 135° from normal) the cinder block edge.

(2) The top edge of the stock impacting on cinder block edge.

(3) The side of the stock impacting on cinder block edge.

(4) The side of the handguard impacting on cinder block edge.

(5) The bottom of the handguard impacting on cinder block edge.

(6) The top of the carrying handle impacting on cinder block edge.

(7) The side of the carrying handle impacting on cinder block edge (rifle 135° from normal).

c. Dispersion data were collected from each M16A2 rifle by firing three 10-round targets at 91.4 meters (100 yd) after the drop test was completed.

4.4 Results

4.4.1 Drop Test at 68.3° C (155° F)

a. No damage occurred to the rear sight, stock, and carrying handle as a result of dropping from a 1.5 meter (5 ft) height in an environmental chamber.

b. The handguard was damaged on all the M16A2 rifles as a result of the drop test. Figures 4-1 through 4-4 show the condition of the M16A2 rifles after dropping from a 1.5 meter (5 ft) height.

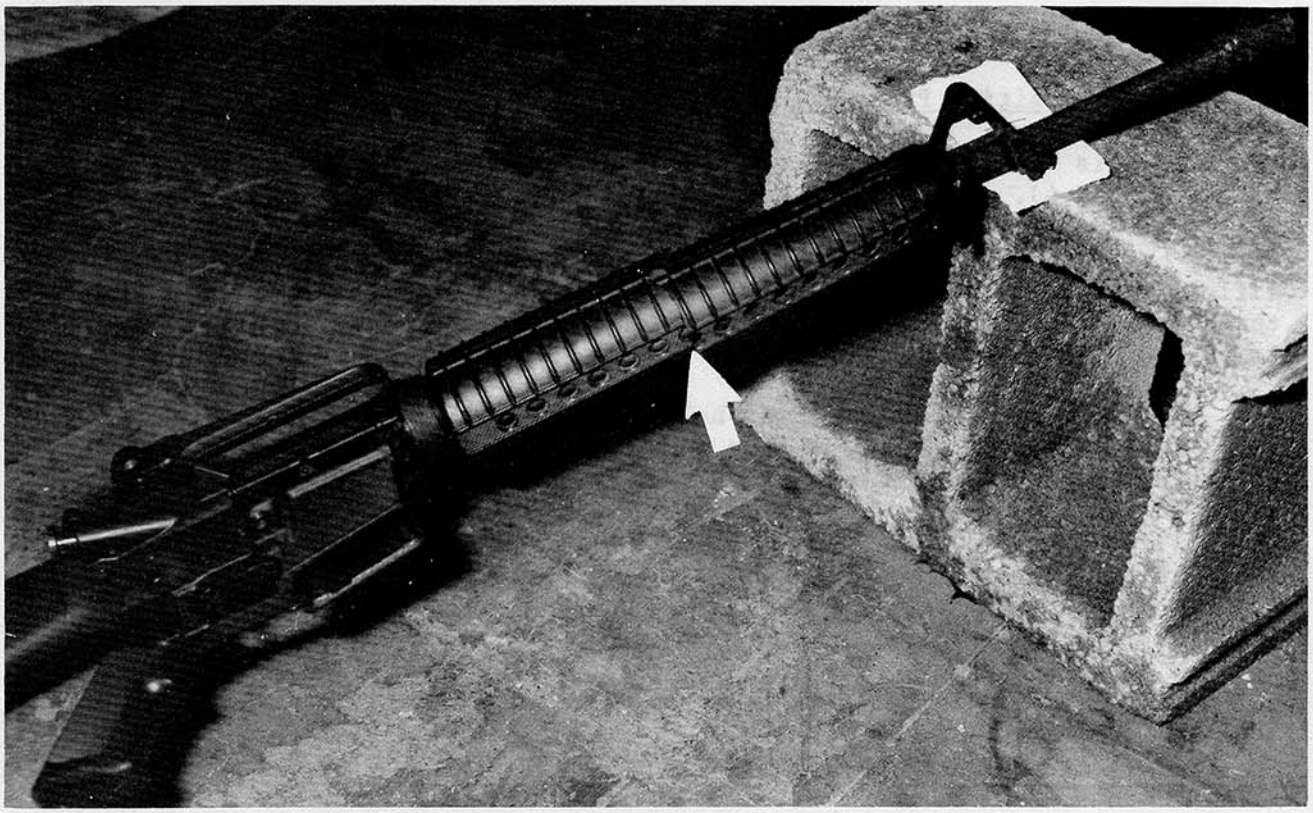

Figure 4-1. M16A2 rifle No. 901 handguard.

The handguard was damaged after the side of the rifle was dropped on the cinder block edge after completion of extreme temperature testing at 68.3° C (155° F). The arrow shows the location of the cracked handguard.

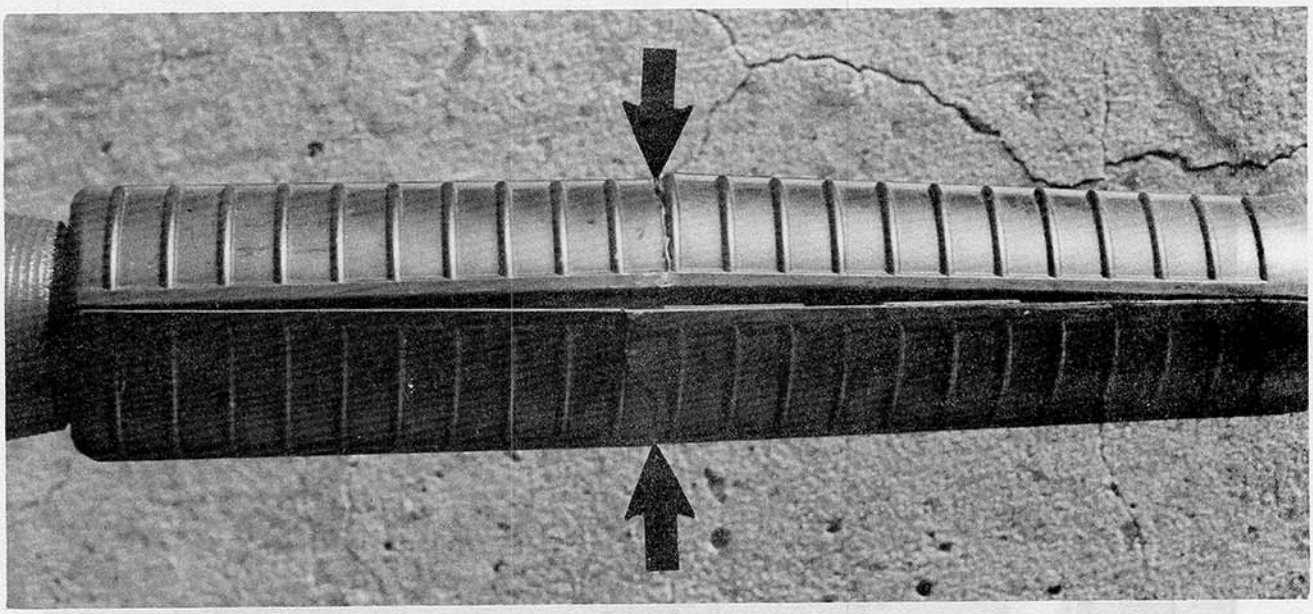

Figure 4-2. M16A2 rifle No. 903 handguard.

The handguard was damaged after the side of the rifle was dropped on the cinder block edge after completion of extreme temperature testing at 68.3° C (155° F). The arrows indicate where the handguard cracked.

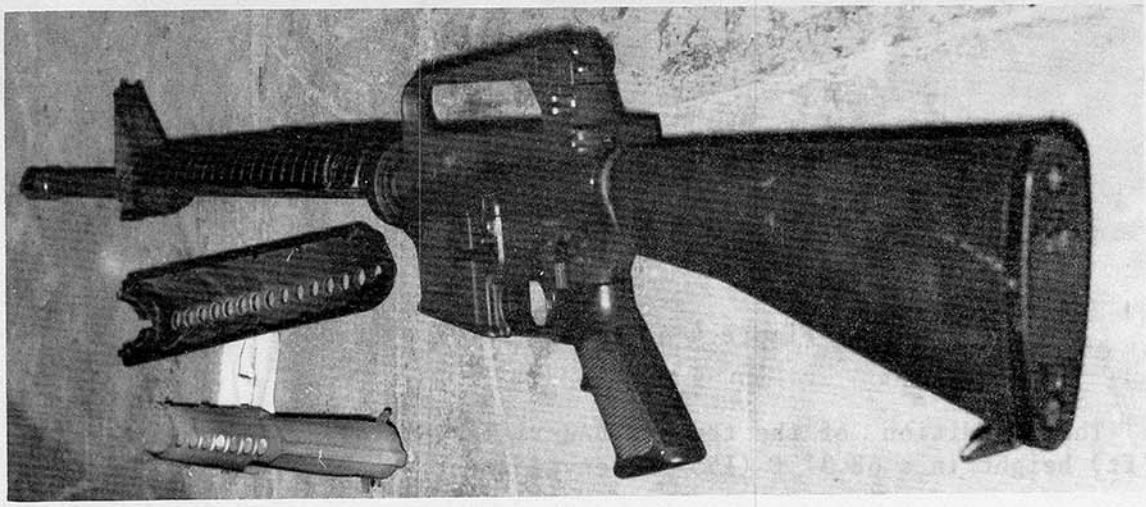

Figure 4-3. M16A2 rifle No. 904 handguard.

The condition of the handguard after the side of the rifle was dropped on a cinder block edge after completion of extreme temperature testing at 68.3° C (155° F).

Figure 4-4. M16A2 Rifle Systems.

The condition of the three M16A2 rifles after dropping from a 1.5 meter (5 ft) height in a 68.3° C (155° F) environment.

4.4.1 (Cont'd)

c. No malfunctions occurred while firing all of the M16A2 rifles after the drop test.

d. Dispersion data taken after the drop test are contained in Table 4-1.

TABLE 4-1. M16A2 RIFLE DISPERSION DATA AFTER DROP TEST AT EXTREME TEMPERATURE OF 68.3° C (155° F)

Rifle No.	Target No.	Target Statistics (cm) HSD	VSD	EHS	EVS	ES	N
901	1	4.7	4.3	13.4	13.7	17.1	10
	2	3.1	3.5	10.3	12.1	14.6	10
	3	2.4	4.0	7.3	13.3	13.8	10
903	1	4.1	2.7	13.2	7.9	14.4	10
	2	11.2	2.3	34.0	8.5	35.1	10
	3	2.3	3.8	7.7	11.2	11.3	10
904	1	4.1	2.0	14.2	6.1	14.2	10
	2	6.1	3.1	17.5	10.1	18.1	10
	3	2.5	2.1	7.1	6.6	9.0	10

HSD = Horizontal standard deviation (azimuth)
VSD = Vertical standard deviation (elevation)
EHS = Extreme horizontal spread
EVS = Extreme vertical spread
ES = Extreme spread
N = No. of rounds fired

e. Table 4-2 indicates average dispersion data for each weapon prior to and after the drop test. The dispersion data collected prior to the drop test were obtained during the function performance semiautomatic firing subtest.

f. No incidents occurred contributing to a degradation in safety.

TABLE 4-2. M16A2 RIFLE AVERAGE DISPERSION DATA BEFORE AND AFTER DROP TEST AT 68.3° C (155° F)

	Average Target Measurements (cm)									
	HSD		VSD		EHS		EVS		ES	
Rifle No.	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop
901	2.6	3.4	3.5	4.0	8.4	10.4	11.0	13.0	12.1	15.2
903	3.2	5.9	2.7	2.9	8.9	18.3	9.0	9.2	10.7	20.3
904	3.8	4.2	2.2	2.4	13.7	12.9	7.0	7.6	14.1	13.8
Mean	3.2	4.5	2.8	3.1	10.3	13.9	9.0	9.9	12.3	16.4

HSD = Horizontal standard deviation
VSD = Vertical standard deviation
EHS = Extreme horizontal spread
EVS = Extreme vertical spread
ES = Extreme spread

4.4.2 Drop Test at -45.6° C (-50° F)

a. On two of the three weapons (M16A2 rifles No. 906 and 907), only scratches to the external components occurred as a result of dropping them from a 1.5 meter (5 ft) height in an environmental chamber at -45.6° C (-50° F). On the other weapon (M16A2 rifle No. 910), it was observed that the handguard was cracked as a result of the drop test mentioned above.

b. No malfunctions occurred during firing on any M16A2 rifles after the drop test.

c. Table 4-3 indicates the dispersion data, taken after the drop test, recorded at 91.4 meters (100 yd).

TABLE 4-3. M16A2 RIFLE DISPERSION DATA AFTER DROP TEST AT EXTREME TEMPERATURE OF -45.6° C (-50° F)

Rifle No.	Target No.	Target Statistics (cm) HSD	VSD	EHS	EVS	ES	N
906	1	3.3	2.7	11.5	8.4	12.3	10
	2	3.6	2.6	11.2	7.2	12.5	10
	3	2.9	2.3	10.8	5.8	10.8	10
907	1	3.0	3.6	8.8	11.1	12.2	10
	2	3.6	3.6	9.9	12.1	12.9	10
	3	2.6	2.3	9.1	8.0	10.5	10
910	1	3.2	2.6	9.5	9.0	12.9	10
	2	3.8	2.7	13.8	8.1	14.2	10
	3	2.3	2.3	7.0	7.9	9.1	10

HSD = Horizontal standard deviation (azimuth).
VSD = Vertical standard deviation (elevation).
EHS = Extreme horizontal spread.
EVS = Extreme vertical spread.
ES = Extreme spread.
N = No. of rounds fired.

d. Table 4-4 indicates average dispersion data for each weapon prior to and after the drop test. The dispersion data collected prior to the drop test were obtained during the function performance semiautomatic firing subtest.

e. No incidents occurred contributing to a degradation in safety.

TABLE 4-4. M16A2 RIFLE AVERAGE DISPERSION DATA BEFORE AND AFTER DROP TEST AT -45.6° C (-50° F)

	Average Target Measurements (cm)									
	HSD		VSD		EHS		EVS		ES	
Rifle No.	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop	Pre-Drop	Post-Drop
906	2.7	3.3	3.9	2.5	8.8	11.2	13.4	7.1	15.0	11.9
907	3.0	3.1	2.2	3.2	10.0	9.2	7.3	10.4	11.2	11.9
910	2.4	3.1	3.0	2.5	7.2	10.1	8.8	8.4	9.6	12.1
Mean	2.7	3.1	3.0	2.7	8.7	10.2	9.8	8.6	11.9	12.0

HSD = Horizontal standard deviation.
VSD = Vertical standard deviation.
EHS = Extreme horizontal spread.
EVS = Extreme vertical spread.
ES = Extreme spread.

4.5 Analysis

4.5.1 Drop Test at 68.3° C (155° F)

No significant difference at the 0.05 level was detected between the mean HSD of the M16A2 Rifle System prior to the drop test (3.2 cm) and the mean HSD after the drop test (4.5 cm). No significant difference was detected at the 0.05 level between the mean VSD of the M16A2 Rifle System prior to the drop test (2.8 cm) and the mean VSD after the drop test (3.1 cm).

4.5.2 Drop Test at -45.6° C (-50° F)

A significant difference was detected between the mean HSD of the M16A2 Rifle System before the drop test (2.7 cm) and the mean HSD after the drop test (3.1 cm) at the 0.05 level. No significant difference was detected between the mean VSD of the M16A2 Rifle System before the drop test (3.0 cm) and the mean VSD after the drop test (2.7 cm).

4.6 Conclusions

It is concluded that:

a. The M16A2 Rifle System is susceptible to damage after being dropped from a 1.5 meter height in a 68.3° C (155° F) environment. This damage, however, does not adversely affect the dispersion characteristics of the M16A2 Rifle System.

b. Dropping the M16A2 rifle in a -45.6° C (-50° F) environment from a 1.5 meter height does affect the HSD on the system. However, the M16A2 Rifle System VSD is not adversely affected.

c. Dropping the M16A2 Rifle System in a -45.6° C or 68.3° C environment does not affect the system's ability to function; however, frequency of handguard failures suggests a basic weakness in this item.

d. Safety of the M16A2 rifle was not degraded by the drop testing performed.

5. SAND AND DUST TEST

5.1 Objective

To evaluate the performance of the M16A2 Rifle System after exposure to a sand and dust environment.

5.2 Criterion

None.

5.3 Data Acquisition Procedure

a. The test procedures were obtained from paragraph 4.5.5.1 of TECOM TOP 3-2-045 (encl 2, ref 7).

b. Three M16A2 rifles were subjected to the dynamic sand and dust test. Four magazines were loaded for each rifle. The test was conducted with each rifle exposed to the dynamic dust environment during firing. The sand and dust mixture consisted of 42% No. 1 dry sand, 8% No. 3 Q-RGK sand, and 50% 140-mesh silica flour. The sand and dust feeder of the test facility was calibrated to dispense the mixture at a rate of 100 $\pm$ 25 g/min/m^2 over the area where the rifle was positioned.

c. The first magazine was fired with the rifle outside the chamber to insure weapon functioning. The second magazine was then installed, a round loaded into the chamber, and the dust cover closed. The weapon with the loaded magazine was then placed in the chamber. The remaining two magazines were stored in a plastic bag prior to being placed in the chamber.

d. The dust dispenser was started and operated for 1 minute before firing. Attempts were made to fire 90 rounds (three magazines) using the 3-round burst control with the dust dispenser operating.

5.4 Results

No malfunctions occurred on any of the three M16A2 rifles (rifles No. 911, 913, and 915) before or during firing in the sand and dust environment.

5.5 Analysis

No incidents occurred with the M16A2 Rifle System with M193 ball ammunition that would contribute to a degradation in safety.

5.6 Conclusions

It is concluded that:

a. A dynamic sand and dust environment does not adversely affect the functioning of the M16A2 Rifle System with M193 ball ammunition.

b. Safety of the M16A2 rifle firing M193 ball ammunition was not degraded by the dynamic sand and dust test environment.

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6. MUD TEST

6.1 Objective

To evaluate the performance of the M16A2 Rifle System after exposure to the mud environment.

6.2 Criterion

None.

6.3 Data Acquisition Procedure

a. Testing was conducted in accordance with paragraph 4.5.6.2 of TECOM TOP 3-2-045 (encl 2, ref 7). Three M16A2 rifles (rifles No. 911, 913, and 915) were cleaned, inspected, and lubricated and subjected to mud test No. 1. The same three M16A2 rifles were then cleaned, inspected, and lubricated before being subjected to mud test No. 2.

b. Thirty rounds were fired from each weapon using the 3-round burst control prior to placing the M16A2 rifles into the mud mixture to ensure the functioning of the M16A2 rifles.

c. The mud mixture consisted of 4.5 kg (10 lb) of montmorillonite clay, 0.9 kg (2 lb) of silica sand (No. 3 Q-ROK), and about 45.5 liters (48 qt) of water. The water content was limited to the quantity producing a mud viscosity of about 4600 centipoises as determined by a Brookfield viscometer.

d. Mud test No. 1 was conducted by setting the M16A2 rifle selector lever on the SAFE position. Tape was placed over the muzzle to prevent mud from entering the barrel. A fully loaded 30-round magazine was inserted in the weapon and the first round was then chambered. The weapon was then submerged horizontally into the mixture for 60 seconds. After removing the M16A2 rifles from the mud mixture, the M16A2 rifles were cleaned by wiping with bare hands. Further cleaning was performed by jarring the weapons without disassemblying. The tape was removed from the M16A2 rifle muzzle and 30 rounds were fired from the weapon using the 3-round burst control.

e. Mud test No. 2 was conducted in the same manner, except the M16A2 rifles were permitted to dry for at least 4 hours after removal from the mud mixture. The M16A2 rifles were then fired 30 rounds using the 3-round burst control.

6.4 Results

a. No malfunctions occurred on any of the M16A2 rifles that were fired before submerging in the mud mixture.

b. No malfunctions occurred with any M16A2 rifle during function firing after undergoing mud tests No. 1 and 2.

6.5 Analysis

No incidents occurred that would contribute to a degradation in safety.

6.6 Conclusions

It is concluded that:

a. The M16A2 Rifle System functioning characteristics when utilizing M193 ball ammunition is not adversely affected by being submerged in a mud environment.

b. Safety of the M16A2 Rifle System for use with M193 ball ammunition was not degraded after being submerged in a mud environment provided the muzzle is covered by some method to prevent mud from entering the barrel.

7. DISPERSION TEST

7.1 Objective

To determine the dispersion characteristics of the M16A2 Rifle System.

7.2 Criterion

None.

7.3 Data Acquisition Procedure

This test was conducted in accordance with TECOM TOP 3-2-045 (encl 2, ref 7). Firing was conducted from an M16A2 rifle mounted in a test stand at a range of 300 meters (328 yd). Dispersion data were collected on six M16A2 rifles by semiautomatic firing of three 10-round targets per weapon.

7.4 Results

Table 7-1 shows the dispersion data collected at 300 meters.

TABLE 7-1. 300 METER DISPERSION DATA OF M16A2 RIFLE

Rifle No.	Target No.	Target Statistics (cm) HSD	VSD	EHS	EVS	ES	N
		Weapons Previously Fired					
[a]905	1	10.1	10.6	33.5	31.9	33.9	10
	2	7.9	12.2	19.8	34.4	38.7	10
	3	13.4	5.5	34.1	16.8	34.6	10
	Mean	10.5	9.4	29.1	27.7	37.7	
[a]908	1	9.0	5.4	29.4	20.1	29.6	10
	2	8.5	7.9	22.5	21.9	26.5	10
	3	9.2	7.1	30.2	24.6	31.2	10
	Mean	8.9	6.8	27.3	22.2	29.1	
[a]912	1	14.1	10.8	50.2	36.9	58.7	10
	2	13.5	6.4	41.9	21.7	41.9	10
	3	12.8	15.2	42.4	51.4	60.1	10
	Mean	13.4	10.8	44.8	36.7	53.6	
		New Weapons					
[b]911	1	16.6	12.5	49.0	49.2	58.8	10
	2	31.0	4.7	100.9	16.0	100.9	10
	3	5.6	8.3	17.0	26.3	26.6	10
	Mean	17.7	8.5	55.7	30.5	62.1	

TABLE 7-1 (CONT'D)

Rifle No.	Target No.	Target Statistics (cm) HSD	VSD	EHS	EVS	ES	N
[b]913	1	15.0	20.4	51.6	74.1	83.3	10
	2	10.4	6.0	32.6	18.1	33.0	10
	3	8.7	10.2	26.3	35.2	35.5	10
	Mean	11.4	12.2	36.8	42.5	50.6	
[b]915	1	11.5	5.2	40.9	18.7	41.7	10
	2	9.8	8.9	30.8	29.1	33.2	10
	3	7.1	5.6	21.3	16.4	23.8	10
	Mean	9.4	6.5	31.0	21.4	32.9	

[a]Six thousand rounds were fired on these weapons at the manufacturer's facility.
[b]These rifles were previously fired in the sand, dust, and mud tests which were conducted before the 300 meter dispersion test.

HSD = Horizontal standard deviation
VSD = Vertical standard deviation
EHS = Extreme horizontal spread
EVS = Extreme vertical spread
ES = Extreme spread
N = Number of rounds

7.5 Analysis

a. Comparisons were made among three weapons (905, 908, and 912) with respect to mean HSD and mean VSD. These three weapons had been fired for 6000 rounds prior to this test. Likewise, comparisons were made among three weapons (911, 913, and 915) with respect to mean HSD and mean VSD. These weapons were considered relatively new. Four one-way analysis of variance models were used. In each model the main effect was weapons (3 levels) with three replications. It is assumed that HSD and VSD are normally distributed random variables. Significance testing was at the 0.05 level.

b. A significant difference was detected among weapons 905, 908, and 912 with respect to mean HSD. However, the small variation within targets resulted in the detection of a significant difference among weapons where a large variation was not apparent. This implies a statistically significant difference, but not necessarily a significant difference from a practical standpoint. There was no significant difference detected among weapons 905, 908, and 912 with respect to mean VSD. No significant differences were detected among the new weapons (911, 913, and 915) with respect to mean HSD or VSD.

c. A two-way nested analysis of variance model was used to compare the previously fired weapons to the relatively new weapons with respect to mean HSD and mean VSD. The main effect was age (new weapons versus old weapons). The nested effect was weapons within age group, with three replications each. Significance testing was at the 0.05 level.

d. No significant difference was detected between the weapons which had been fired 6000 rounds prior to the test and the relatively new weapons with respect to either mean HSD or mean VSD.

7.6 Conclusion

No conclusion can be made because no criteria for rifle functioning or dispersion were addressed since the M16A2 Rifle System was not designed for M193 ball-type ammunition (the ammunition that was furnished for this test). Although no conclusion was made, it was documented that the M193 ball ammunition when fired from the M16A2 rifle during the dispersion test did impact in close proximity around the targets.

(Page 36 Blank)

8. ENDURANCE TEST

8.1 Objective

To determine the effects of firing an additional 12,000 rounds on the M16A2 Rifle System.

8.2 Criterion

None.

8.3 Data Acquisition Procedure

a. This test was conducted in accordance with TECOM TOP 3-2-045 (encl 2, ref 7). One hundred 120-round firing cycles were performed on four M16A2 rifles that had previously been fired 6000 rounds each at the manufacturer's facility. The 120-round firing cycle consisted of the sequence shown in Table 8-1. The rifles were air cooled after the completion of each cycle.

TABLE 8-1. FIRING CYCLE OF M16A2 RIFLE DURING ENDURANCE SUBTEST

No. of Rd	Firing Mode	Firing Rate (spm)
60	Burst	a-
30	Semiautomatic	60
30	Semiautomatic	30

[a]Test plan did not specify a firing rate when using the burst control unit; however, a rate of 85 spm was used.

b. The following operations were performed after the completion of every ten cycles:

(1) The M16A2 rifles were cleaned, inspected, and lubricated.

(2) The following characteristics were measured:

(a) Trigger pull.

(b) Firing pin indent.

(c) Firing pin protrusion.

(d) Headspace.

(e) Barrel erosion.

c. Dispersion data were recorded at 91.4 meters (100 yd) on the semiautomatic firing of ten rounds from an M16A2 rifle mounted in a test stand. The instrumental velocity at 15 meters (49 ft) was recorded for each round.

d. Barrel chamber and bore measurements were recorded after the firing of each 6000 rounds at APG.

e. Since several failure-to-feed stoppages occurred on the M16A2 Rifle System where the bolt overriding the base of the round was the cause of these stoppages, the following operations were performed in an attempt to eliminate these malfunctions.

(1) After thirty 120-round firing cycles the 16 original magazines that were used at the start of the endurance test were replaced with magazines that were cleaned and had been used in the extreme temperature test at 68.3° C (155° F).

(2) These magazines were then replaced with four new magazines prior to the fifty-third round firing cycle. Four magazines were used with all of the rifles until the endurance test was completed. The original magazines were replaced with new magazines after an excessive amount of bolt override malfunctions occurred while using them.

(3) The gas tube, bolt ring set, bolt carrier key, and the airflow over the gas tube were measured during a cleaning cycle after 9600 APG rounds had been fired.

(4) The bolt ring set on each rifle was replaced with a new set.

8.4 Results

a. Table 8-2 indicates the M16A2 rifle measurement, after each ten cycles (1200 rounds fired), of the trigger pull, firing pin indent, firing pin protrusion, headspace, barrel erosion, and the average velocity of each rifle.

TABLE 8-2. M16A2 RIFLE MEASUREMENTS DURING ENDURANCE SUBTEST

			Measurements					
				Firing Pin				
Rifle No.	Cycle No.	Total Subtest Rounds[a]	Head Space (in.)	Protrusion (in.)	Indent[b] (in.)	Trigger Pull[b] (lb)	Barrel Erosion Gage (mm)	Average Velocity at 15 m (fps)
	0	0	1.4676	0.033	0.021	8.8	6	3085
902	10	1,200	1.4656	.032	.020	7.3	6	3084
	20	2,400	1.4676	.032	.022	8.6	5	3077
	30	3,600	1.4676	.033	.020	8.6	4	3068
	40	4,800	1.4676	.031	.022	8.8	3	3056
	50	6,000	1.4676	.033	.019	9.7	2	3144
	60	7,200	1.4686	.032	.021	9.8	2	3119
	70	8,400	1.4686	.032	.020	9.7	1	3075
	80	9,600	1.4686	.032	.021	9.5	0	3058
	90	10,800	1.4676	.032	.021	8.7	-1	3077
	100	12,000	1.4676	.033	.020	8.7	-1	3055

8.4 (Cont'd)

TABLE 8-2 (CONT'D)

Rifle No.	Cycle No.	Total Subtest Rounds[a]	Measurements: Head Space (in.)	Firing Pin: Protrusion (in.)	Firing Pin: Indent[b] (in.)	Trigger Pull[b] (lb)	Barrel Erosion Gage (mm)	Average Velocity at 15 m (fps)
905	0	0	1.4676	.032	.021	10.2	7	3095
	10	1,200	1.4676	.032	.021	9.2	7	3109
	20	2,400	1.4686	.032	.021	6.8	6	3103
	30	3,600	1.4686	.032	.021	7.3	5	3087
	40	4,800	1.4686	.032	.021	7.5	4	3075
	50	6,000	1.4676	.032	.021	8.2	4	3118
	60	7,200	1.4676	.031	.020	8.0	3	3123
	70	8,400	1.4686	.032	.021	8.2	3	3073
	80	9,600	1.4686	.031	.021	8.2	2	3079
	90	10,800	1.4686	.032	.021	8.2	2	3104
	100	12,000	1.4676	.032	.022	8.0	1	3072
908	0	0	1.4666	.031	.021	8.7	6	3107
	10	1,200	1.4666	.031	.021	7.5	6	3102
	20	2,400	1.4666	.031	.021	7.5	5	3092
	30	3,600	1.4666	.031	.021	7.8	4	3097
	40	4,800	1.4676	.031	.019	8.0	4	3133
	50	6,000	1.4666	.032	.022	8.0	3	3141
	60	7,200	1.4666	.030	.022	8.5	3	3137
	70	8,400	1.4676	.030	.019	7.8	2	3102
	80	9,600	1.4676	.031	.021	7.5	1	3084
	90	10,800	1.4676	.032	.021	7.7	1	3087
	100	12,000	1.4676	.031	.021	7.3	-1	3098
912	0	0	1.4656	.032	.021	9.0	6	3096
	10	1,200	1.4656	.032	.020	7.3	6	3111
	20	2,400	1.4666	.032	.021	8.3	5	3110
	30	3,600	1.4666	.032	.021	8.0	4	3068
	40	4,800	1.4666	.031	.020	8.0	3	3074
	50	6,000	1.4656	.032	.021	8.7	2	3103
	60	7,200	1.4666	.031	.021	9.8	2	3111
	70	8,400	1.4666	.030	.020	8.7	1	3089
	80	9,600	1.4666	.031	.021	8.8	0	3071
	90	10,800	1.4666	.031	.020	8.2	0	3077
	100	12,000	1.4666	.032	.020	8.2	-2	3059

[a]Six thousand rounds were previously fired at the manufacturer's facility.
[b]Average measurement of three trials.

FPS = Feet per second.

Note: It should be noted that when the bore erosion gage reads at 0, it indicates that the condition of the barrel (the lands and grooves) is approaching the reject area (lands and grooves may be worn considerably). Any reading of the bore erosion gage less than 0 is considered to be in the reject area.

8.4 (Cont'd)

b. Figure 8-1 shows a graph of the degradation of barrel erosion per weapon during a ten cycle interval.

c. Figure 8-2 shows a graph of the velocity of each weapon during an interval of ten cycles.

d. Enclosure 4 contains the chamber and bore measurements that were taken on the four weapons after 6000 and 12,000 rounds were fired at APG.

e. Table 8-3 indicates the type of malfunctions that occurred on each M16A2 rifle and the four rifles combined during cycles No. 1 to 52, cycles No. 53 to 90, and cycles No. 91 to 100. The malfunctions were arranged in this manner because during cycles No. 1 to 52 sixteen magazines were used, during cycles No. 53 to 90 four new magazines were used, and during cycles No. 91 to 100 new bolt ring sets were used.

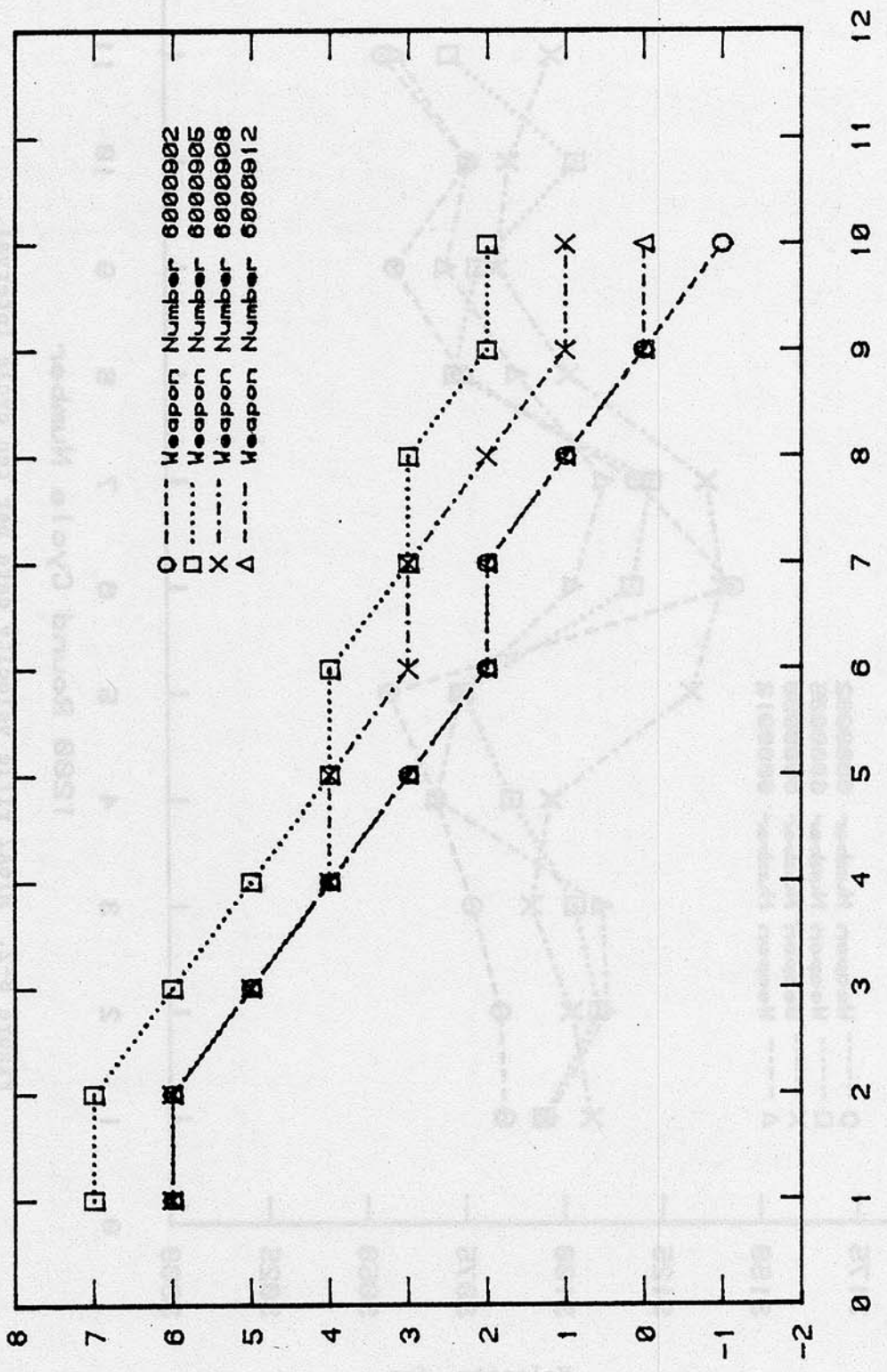


Figure 8-1. M16A2 rifle barrel erosion per ten cycle interval.

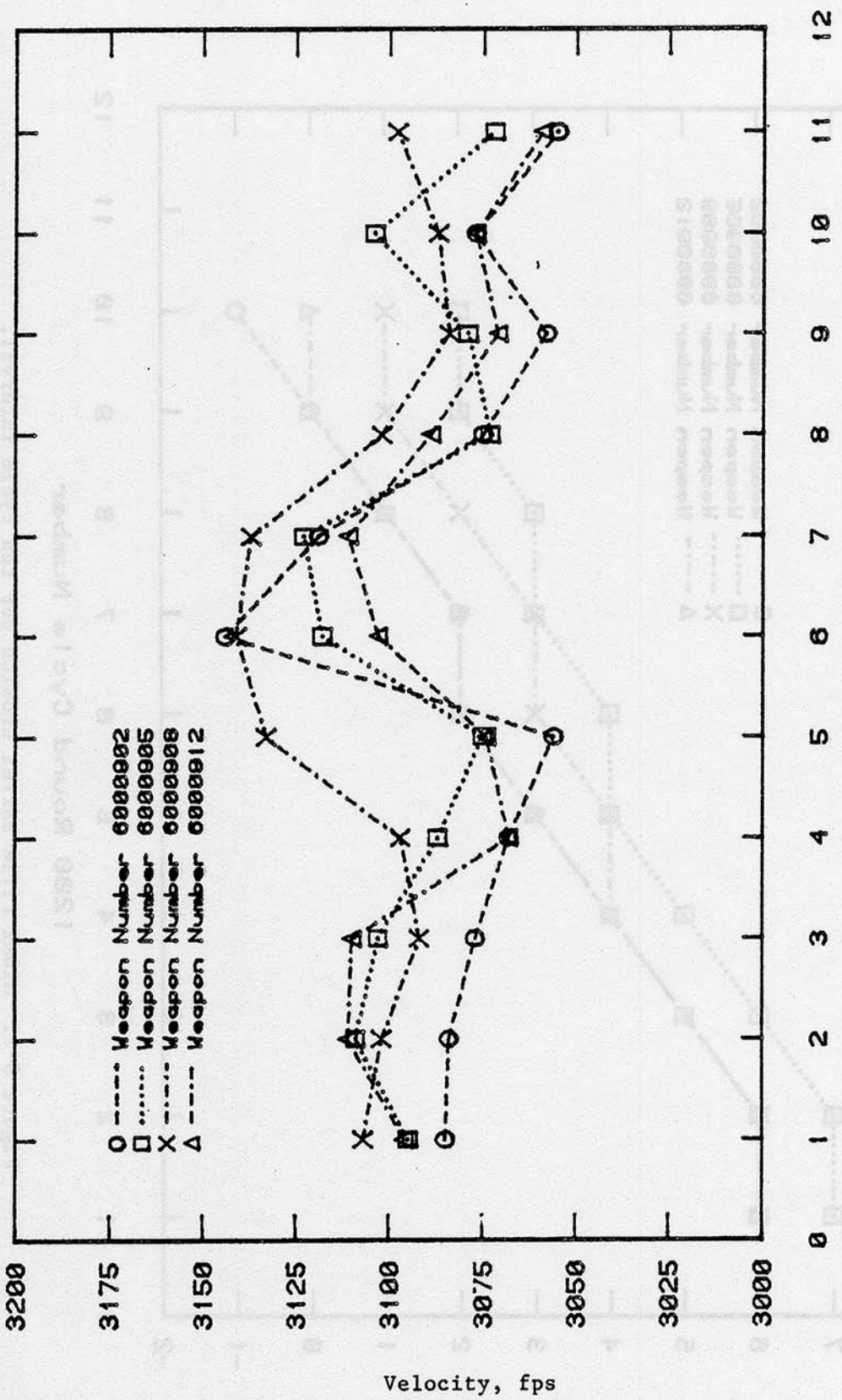


Figure 8-2. M16A2 rifle velocity data per ten cycle interval.

8.4 (Cont'd)

TABLE 8-3. MALFUNCTIONS - M16A2 RIFLE ENDURANCE SUBTEST

		Cycle Number							
		1 to 52		53 to 90		91 to 100			
		Firing Mode		Firing Mode		Firing Mode			
		SA	Burst	SA	Burst	SA	Burst	Total	
Rifle No.	Malf Type	No. Malf	No. Malf	No. Malf	No. Malf	No. Malf	No. Malf	Malfunctions SA	Burst
902	FFR	0	0	1	0	0	0		
	BOB	0	0	11	5	0	0		
	FF	0	0	0	1	0	0		
	FJE	0	0	4	2	0	0		
	FFTRB	0	0	0	0	0	0		
Total		0	0	16	8	0	0	16	8
905	FFR	1	0	0	0	13	5		
	BOB	2	1	17	8	2	0		
	FF	1	0	0	1	0	0		
	FJE	0	0	0	0	0	0		
	FFTRB	0	2	0	4	0	0		
Total		4	3	17	13	15	5	36	21
908	FFR	0	0	1	1	0	0		
	BOB	3	3	32	17	3	0		
	FF	7	3	0	0	0	0		
	FJE	0	0	0	0	0	0		
	FFTRB	0	0	0	1	0	0		
Total		10	6	33	19	3	0	46	25
912	FFR	0	0	0	0	0	0		
	BOB	10	19	8	0	2	0		
	FF	6	12	0	0	0	0		
	FJE	0	0	0	0	0	0		
	FFTRB	0	0	0	0	0	0		
	DF	0	1	0	0	0	0		
Total		16	32	8	0	2	0	26	32

8.4 (Cont'd)

TABLE 8-3 (CONT'D)

Rifle No.	Malf Type	Cycle Number 1 to 52 Firing Mode SA No. Malf	1 to 52 Firing Mode Burst No. Malf	53 to 90 Firing Mode SA No. Malf	53 to 90 Firing Mode Burst No. Malf	91 to 100 Firing Mode SA No. Malf	91 to 100 Firing Mode Burst No. Malf	Total Malfunctions SA	Total Malfunctions Burst
Malfunctions of four rifles combined:									
	FFR	1	0	2	1	13	5		
	BOB	15	23	68	30	7	0		
	FF	14	15	0	2	0	0		
	FJE	0	0	4	2	0	0		
	FFTRB	0	2	0	5	0	0		
	DF	0	1	0	0	0	0		
Total		30	41	74	40	20	5	124	86

SA = Semiautomatic
FFR = Failure-to-fire
DF = Double feed
BOB = Bolt over base
FF = Failure-to-feed
FJE = Failure-to-eject
FFTRB = Failure-to-fire 3-round burst
Malf = Malfunction

f. The measurements of the gas tube, bolt ring set, bolt carrier key, and the airflow over the gas port tube are contained in Table 8-4.

TABLE 8-4. M16A2 RIFLE GAS PORT TUBE MEASUREMENTS DURING ENDURANCE SUBTEST AT 9600 APG ROUNDS[a]

Component/ Parameter Measured	Typical Dimension of Component/ Parameter Measured[b]	Rifle No. 902	905	908	912
Bolt carrier key, mm	4.60	4.60	4.60	4.60	4.60
Gas tube, mm	4.55 [c]4.43	4.34	4.54	4.50	4.28
Bolt ring set length[d], mm	1.31	1.27	1.28	1.20	1.19

8.4 (Cont'd)

TABLE 8-4 (CONT'D)

Component/ Parameter Measured	Typical Dimension of Component/ Parameter Measured[b]	Rifle No. 902	905	908	912
Bolt ring diameter, mm	12.97	12.65	12.71	12.56	12.63
Airflow, lb	1.88	1.81	1.75	1.75	1.81

[a]Six thousand rounds were previously fired at the manufacturer's facility.
[b]These measurements were taken from new weapons.
[c]This gas tube measurement was taken from another weapon used in another test at APG.
[d]This measurement indicates the total length of the three rings.

g. Nine unscheduled maintenance actions were performed on the M16A2 Rifle System during the endurance subtest. Table 8-5 lists these unscheduled maintenance actions.

TABLE 8-5. UNSCHEDULED MAINTENANCE OF M16A2 RIFLE SYSTEM DURING ENDURANCE SUBTEST

Cycle No.	Life Period[a]	Subtest Round[a]	Rifle No.	Incident Description	Maintenance Action Performed	Replaced Parts From Rifle No.
51	6,181	6,045	905	FFTRB	Replaced burst disconnector (lever lock release)	915
84	10,080	9,960	908	FFTRB	Replaced burst disconnector	913
84	10,096	9,960	905	FFTRB	Replaced hammer[b]	915
91	10,890	10,800	902	FJE	Replaced ejector spring	915
91	10,890	10,800	902	BOB	Replaced gas port rings	c-
91	10,920	10,800	908	BOB	Replaced gas port rings	c-
91	10,933	10,800	912	BOB	Replaced gas port rings	c-

TABLE 8-5 (CONT'D)

Cycle No.	Life Period[a]	Subtest Round[a]	Rifle No.	Incident Description	Maintenance Action Performed	Replaced Parts From Rifle No.
91	10,936	10,800	905	BOB	Replaced gas port rings	c-
98	11,776	11,640	905	FFR	Replaced hammer spring	915

[a]Six thousand rounds that were not included in these totals had previously been fired at the manufacturer's facility.
[b]The hammer was replaced because the lever lock release from rifle No. 915 did not operate properly with the hammer from rifle No. 905.
[c]Small Arms stock.

FFTRB = Failure-to-fire 3-round burst.
FJE = Failure-to-eject.
BOB = Bolt-over-base.
FFR = Failure-to-fire.

h. Seven incidents occurred involving a failure-to-fire 3-round burst which contributed to a degradation in the performance of the weapons. These incidents occurred after the weapons had been fired between 12,000 to 16,000 rounds. It should be noted that during those incidents mentioned above, 1- and 2-round bursts were fired instead of the desired 3-round burst. During all the incidents mentioned above, the weapon did not fire uncontrolled when the trigger was released.

8.5 Analysis

a. There was no established criteria to compare the function performance of these weapons during the endurance test because of the use of M193 instead of M855 ball ammunition. However, for purposes of analogy, the total number of malfunctions that occurred during the first 50 cycles of firing (6000 rounds per weapon) were compared with the total number of malfunctions (22) allowable (for the first 6000 rounds per weapon) under M16 rifle specification MIL-R-45587A (encl 2, ref 7). A total of 51 malfunctions occurred during the first 50 cycles of firing on all four weapons. This total number exceeds the total allowable malfunctions of 22 (for four weapons) by a large margin. It should be noted that this comparison was for information only since the weapon was designed to shoot M855 and not M193 ball ammunition. It could not be determined if the cause of the malfunctions was due namely to the dirty magazines as was the case during the extreme temperature at -45.6° C (para 3.5.2a).

b. For further information regarding weapon performance with M193 ball ammunition, the following statistical analyses were performed.

8.5 (Cont'd)

(1) Table 8-6 indicates a point and interval estimate of the number of malfunctions that occurred on the M16A2 rifles during semiautomatic and burst firing mode in three groups of firing modes. Table 8-6 also shows estimates for the combined malfunctions occurring on all rifles in three groups of firing cycles. Estimates were calculated for three groups of firing cycles throughout this test because during cycles No. 1 to 52 sixteen magazines were used, during cycles No. 53 to 90 four new magazines were used, and during cycles No. 91 to 100 new bolt ring sets were used.

TABLE 8-6. M16A2 RIFLE MALFUNCTION POINT ESTIMATES AND INTERVAL ESTIMATES FOR ENDURANCE SUBTEST

			Firing Mode					
			SA			Burst		
Rifle No.	Cycle No.	No. Rd	Total Malf	Point Estimate (malf/ 1000 rd)	Upper 95% Conf Limit (malf/ 1000 rd)	Total Malf	Point Estimate (malf/ 1000 rd)	Upper 95% Conf Limit (malf/ 1000 rd)
902	1 to 52	3,120	0	0.0	1.0	0	0.0	1.0
	53 to 90	2,280	16	7.0	10.8	8	3.5	6.3
	91 to 100	600	0	0.0	5.0	0	0.0	5.0
905	1 to 52	3,120	4	1.3	2.9	3	1.0	2.5
	53 to 90	2,280	17	7.5	11.3	13	5.7	9.2
	91 to 100	600	15	25.0	38.2	5	8.3	17.4
908	1 to 52	3,120	10	3.2	5.6	6	1.9	3.8
	53 to 90	2,280	33	14.5	19.5	19	8.3	12.4
	91 to 100	600	3	5.0	12.9	0	0.0	5.0
912	1 to 52	3,120	16	5.1	7.9	32	10.3	13.9
	53 to 90	2,280	8	3.5	6.3	0	0.0	1.3
	91 to 100	600	2	3.3	10.5	0	0.0	5.0
Combined	1 to 52	12,480	30	2.4	3.3	41	3.3	4.3
	53 to 90	9,120	14	8.1	9.9	40	4.4	5.7
	91 to 100	2,400	20	8.3	12.2	5	2.1	4.4

SA = Semiautomatic
Conf = Confidence
Malf = Malfunction

Notes: During cycles No. 1 to 52, 16 magazines were used from the extreme temperature test.
During cycles No. 53 to 90, four new magazines were used on the M16A2 Rifle System.
During cycles No. 91 to 100, new bolt ring sets were used that had been replaced after the 90th firing cycle from Small Arms stock.

8.5 (Cont'd)

(2) Table 8-7 compares the number of malfunctions that occurred on each M16A2 rifle during cycles No. 53 to 90 and cycles No. 91 to 100 to determine if using four new magazines and replacing the bolt ring set had affected the malfunction rate.

TABLE 8-7. COMPARISON OF MALFUNCTION RATE OF M16A2 RIFLE DURING ENDURANCE SUBTEST

Rifle No.	Cycles Compared	No. Rd	No. of Malf SA	No. of Malf Burst
902	53 to 90	2280	b16	c 8
	91 to 100	600	0	0
905	53 to 90	2280	a17	c13
	91 to 100	600	15	5
908	53 to 90	2280	b33	b19
	91 to 100	600	3	0
912	53 to 90	2280	c 8	c 0
	91 to 100	600	2	0
Total	53 to 90	9120	c74	c40
	91 to 100	2400	20	5

[a]Significantly lower malfunction rate (1-sided; 0.05 level).
[b]Significantly higher malfunction rate (1-sided; 0.05 level).
[c]No significant difference (1-sided; 0.05 level).

SA = Semiautomatic
Malf = Malfunction

Notes: During cycles No. 53 to 90, four new magazines were used with the M16A2 Rifle System.
During cycles No. 91 to 100, new bolt ring key sets were used that had been replaced from Small Arms stock after the 90th firing cycle.

(3) Table 8-8 compares the number of malfunctions that occurred on each rifle during cycles No. 1 to 90 and cycles No. 91 to 100 to determine if replacing the bolt ring key sets had affected the malfunction rate.

8.5 (Cont'd)

TABLE 8-8. COMPARISON OF MALFUNCTION RATE OF M16A2 RIFLE DURING ENDURANCE SUBTEST

Rifle No.	Cycles Compared	No. Rd	No. of Malf SA	No. of Malf Burst
902	1 to 90	5,400	[c] 16	[c] 8
	91 to 100	600	0	0
905	1 to 90	5,400	[a] 21	[c]16
	91 to 100	600	15	5
908	1 to 90	5,400	[c] 43	[c]25
	91 to 100	600	3	0
912	1 to 90	5,400	[c] 24	[b]32
	91 to 100	600	2	0
Total	1 to 90	21,600	[c]104	[c]81
	91 to 100	2,400	20	5

[a]Significantly lower malfunction rate (1-sided; 0.05 level).
[b]Significantly higher malfunction rate (1-sided; 0.05 level).
[c]No significant difference (1-sided; 0.05 level).

SA = Semiautomatic
Malf = Malfunction

Note: During cycles No. 91 to 100, new bolt ring key sets were used that had been replaced from Small Arms stock after the 90th firing cycle.

(4) Table 8-9 shows the mean rounds between stoppages on the four combined rifle malfunctions.

TABLE 8-9. TOTAL M16A2 RIFLE MRBS OF ENDURANCE SUBTEST

No. of Rd	No. of Malf SA	No. of Malf Burst	MRBS Point Estimate SA	MRBS Point Estimate Burst
24,000	124	86	194	279

SA = Semiautomatic
Malf = Malfunction

(5) Table 8-10 contains mean dispersion data collected before the endurance subtest and mean dispersion data collected during the endurance subtest of each M16A2 rifle. A statistically significant difference at the 0.05 level was detected with the M16A2 rifles with respect to the mean HSD and mean VSD collected before the endurance subtest and during the endurance subtest.

8.5 (Cont'd)

TABLE 8-10. M16A2 RIFLE MEAN DISPERSION DATA PER CYCLE OF THE ENDURANCE SUBTEST

Rifle No.	Cycle No.	Mean Target Statistics (cm) HSD	VSD	EHS	EVS	ES
902	[a] 1	3.3	3.6	9.8	11.4	14.2
	11	2.9	3.6	9.2	10.9	11.2
	21	3.5	2.2	9.6	6.5	11.3
	31	2.0	5.1	7.0	19.0	19.1
	41	3.0	2.7	10.3	9.7	11.8
	51	4.1	3.6	13.6	13.7	16.7
	61	5.8	4.0	17.5	11.2	20.5
	71	2.9	4.0	8.1	11.5	12.0
	81	8.0	7.0	32.5	25.4	36.7
	91	4.9	10.5	18.4	38.1	38.8
	101	11.0	8.7	41.5	28.1	43.4
Mean		4.7	5.0	NA	NA	NA
905	[a] 1	3.8	2.7	12.2	8.2	13.0
	11	3.7	3.2	12.5	10.1	13.9
	21	2.6	4.4	7.0	15.9	15.9
	31	2.5	1.9	7.5	5.0	7.9
	41	3.4	2.6	12.6	7.9	13.7
	51	5.0	3.1	15.5	8.8	17.8
	61	6.1	3.1	19.8	11.1	20.5
	71	5.5	4.1	15.7	14.3	16.1
	81	15.4	4.9	46.7	16.6	47.1
	91	6.1	6.3	20.7	22.1	25.4
	101	6.9	7.2	20.3	24.9	28.3
Mean		5.5	4.0	NA	NA	NA
908	[a] 1	2.2	3.0	6.6	10.0	10.3
	11	6.4	2.2	21.5	6.0	22.1
	21	5.4	3.1	19.0	10.9	19.3
	31	3.8	3.1	14.2	10.0	14.3
	41	3.7	3.7	13.1	10.7	13.1
	51	6.6	5.2	19.7	17.4	20.4
	61	11.4	3.8	32.3	10.4	33.1
	71	4.5	8.3	13.9	29.7	29.9
	81	5.1	4.8	14.5	13.9	17.2
	91	6.1	5.6	19.0	20.5	20.5
	101	8.7	10.8	24.9	28.9	32.0
Mean		5.8	4.9	NA	NA	NA

See footnotes at end of table.

8.5 (Cont'd)

TABLE 8-10 (CONT'D)

Rifle No.	Cycle No.	Mean Target Statistics (cm) HSD	VSD	EHS	EVS	ES
912	[a] 1	4.3	5.1	14.7	16.6	20.7
	11	4.3	2.8	14.8	10.2	15.7
	21	10.7	4.3	28.0	13.1	28.0
	31	2.7	8.3	7.3	23.9	24.2
	41	3.1	3.2	11.0	9.7	11.6
	51	5.7	5.5	18.1	20.2	22.4
	61	3.3	3.9	10.8	12.0	13.7
	71	5.0	5.1	15.2	15.2	17.4
	81	5.5	5.6	16.1	15.6	19.7
	91	13.2	5.3	41.1	13.9	42.0
	101	5.6	4.0	17.4	15.9	23.5
Mean		5.8	4.8	NA	NA	NA

[a]Dispersion data during cycle No. 1 were taken from the Function Performance (para 2.4b(2)), prior to the endurnace test, and were used for baseline comparison.

HSD = Horizontal standard deviation
VSD = Vertical standard deviation
EHS = Extreme horizontal spread
EVS = Extreme vertical spread
ES = Extreme spread

(6) Table 8-11 indicates the mean HSD and mean VSD for the four rifles combined during each cycle.

TABLE 8-11. MEAN HSD AND VSD OF FOUR RIFLES COMBINED, ENDURANCE SUBTEST

Cycle No.	Mean HSD and VSD (cm) HSD	VSD
[a] 1	9.0	7.7
11	4.3	3.0
21	5.6	3.5
31	2.8	4.6
41	3.3	3.1
51	5.4	4.4
61	6.7	3.7
71	4.5	5.4
81	8.5	5.6
91	7.6	6.9
101	8.1	7.7

[a]Dispersion data during cycle No. 1 were taken from the Function Performance Test (para 2.4b(2)), prior to the endurance test, and were used for baseline comparison.

8.5 (Cont'd)

An analysis of Table 8-11 indicates that there was no significant difference detected among the four weapons with respect to mean HSD or VSD. Significance testing of the above mentioned findings were performed at the 0.05 level.

(7) Table 8-12 indicates the average mean radius, horizontal and vertical standard deviation of the M16A2 rifle dispersion targets and Figures 8-3 through 8-5 contain graphs of the mean radius, HSD and VSD of the M16A2 rifle dispersion target.

TABLE 8-12. M16A2 RIFLE AVERAGE MEAN RADIUS, AVERAGE HSD AND VSD OF THE ENDURANCE SUBTEST (CM)

Rifle No.	Average MR	Average HSD	Average VSD
902	5.6	4.7	5.0
905	5.7	5.5	4.0
908	6.5	5.8	4.9
912	6.6	5.8	4.8

(a) No significant difference was detected among the weapons at the 0.05 level with respect to the average mean radius.

(b) No significant difference at the 0.05 level was detected among the M16A2 rifles with respect to the HSD.

(c) No significant difference was detected among the rifles with respect to the VSD at the 0.05 level.

c. The M16A2 Rifle System was considered free of any defects that would cause any safety hazards.

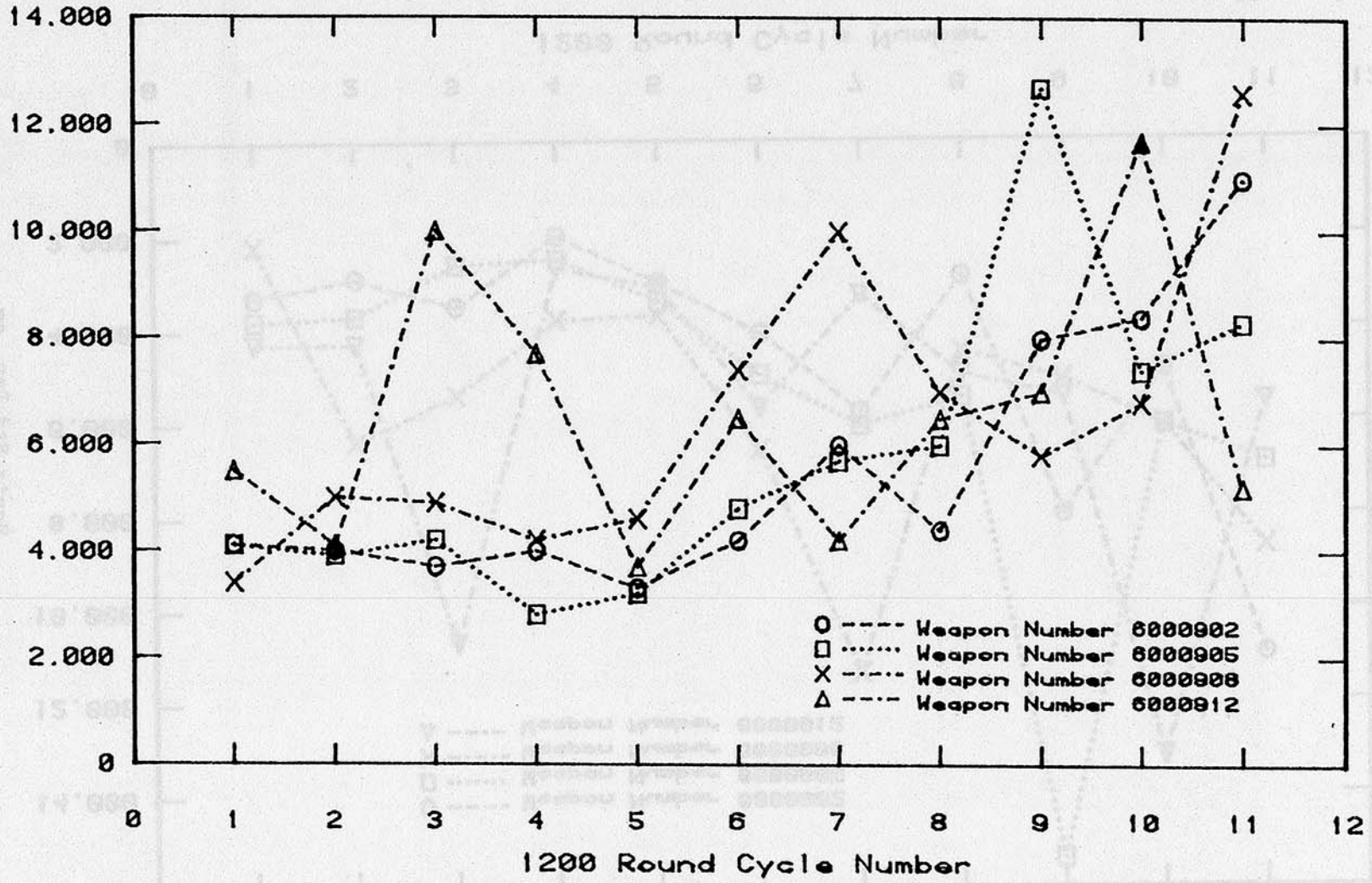


Figure 8-3. M16A2 rifle mean radius per ten cycle interval of the 10-round dispersion target.

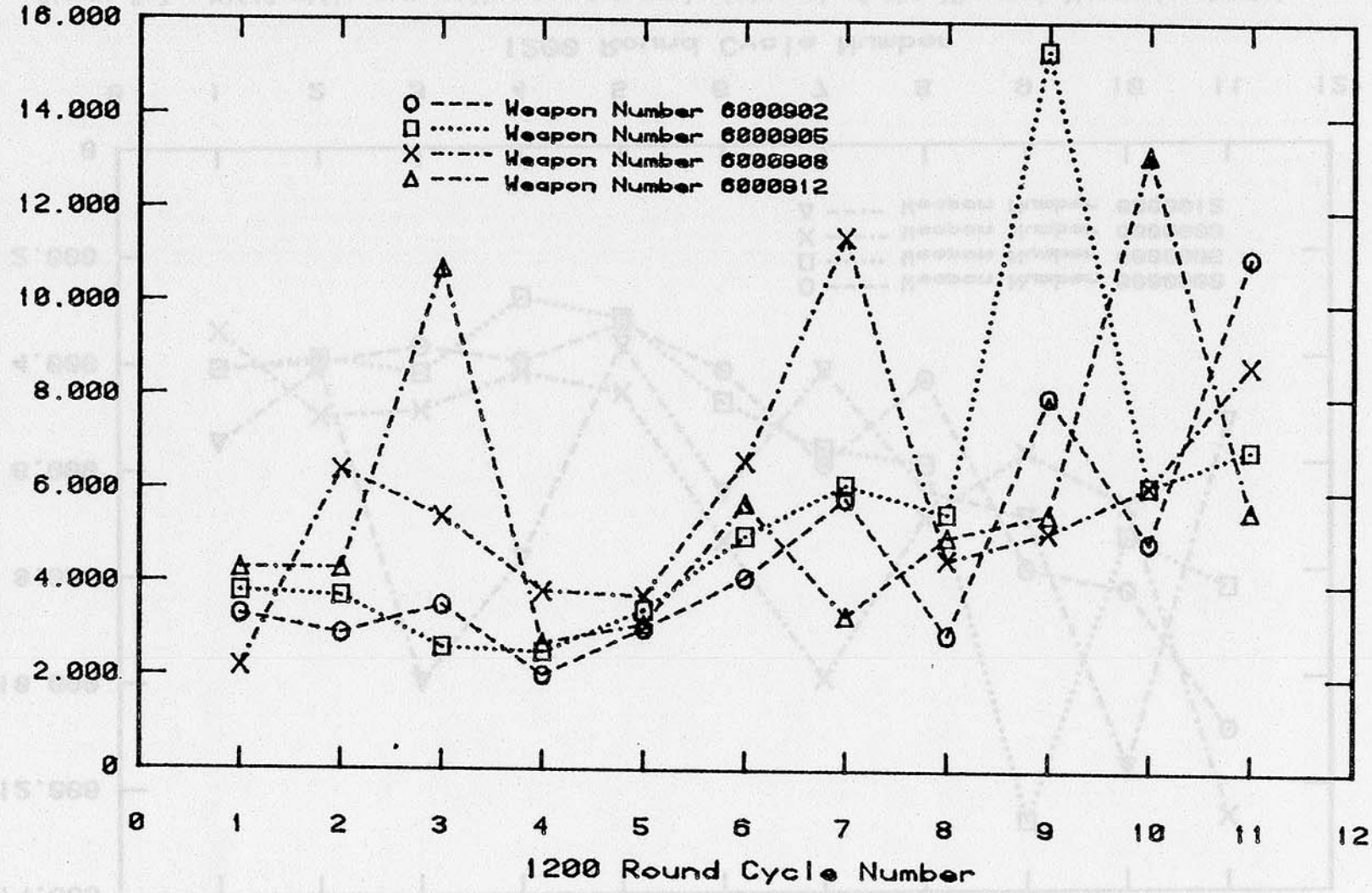


Figure 8-4. M16A2 rifle horizontal standard deviation per ten cycle interval of the 10-round dispersion target.

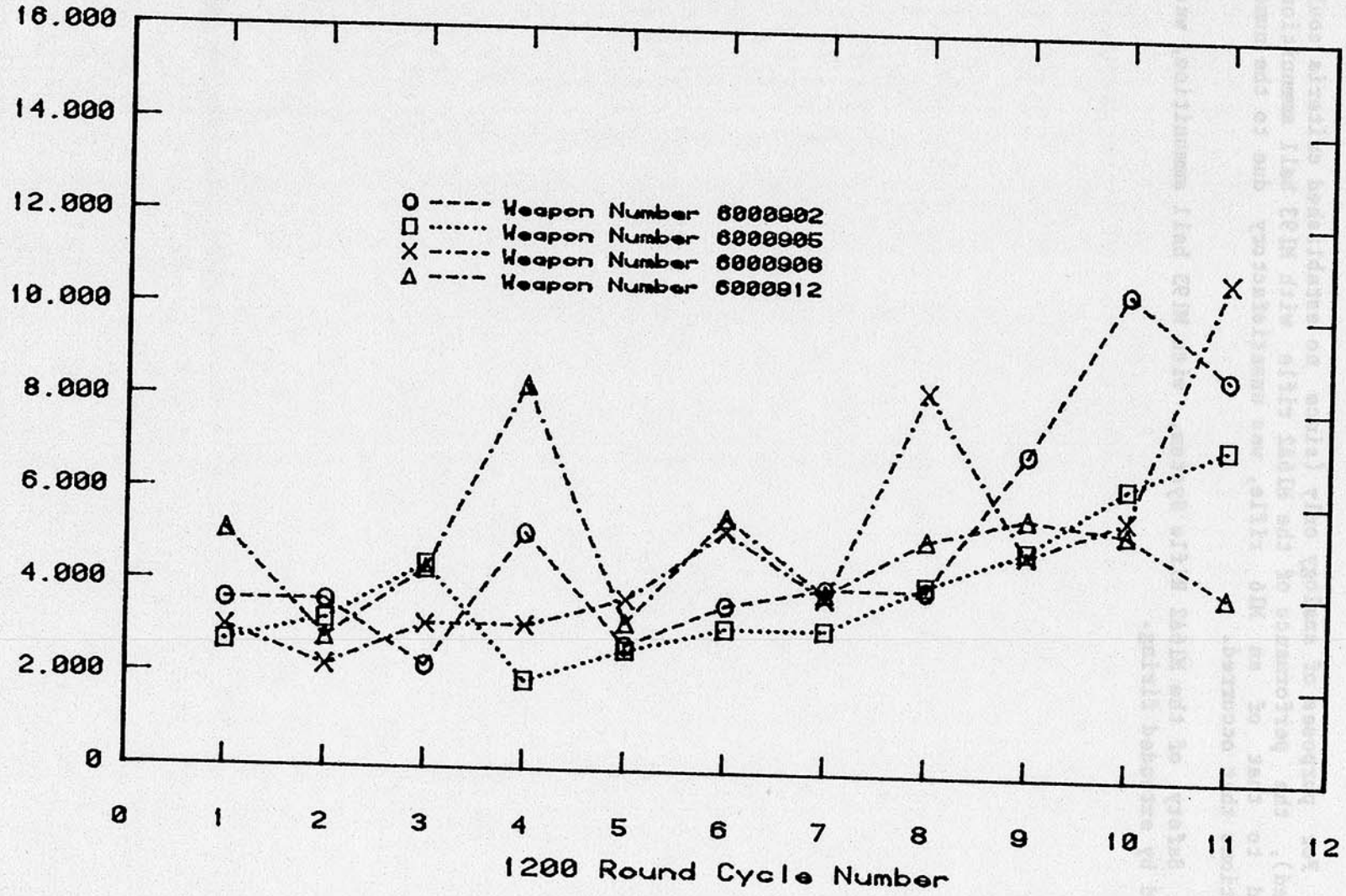


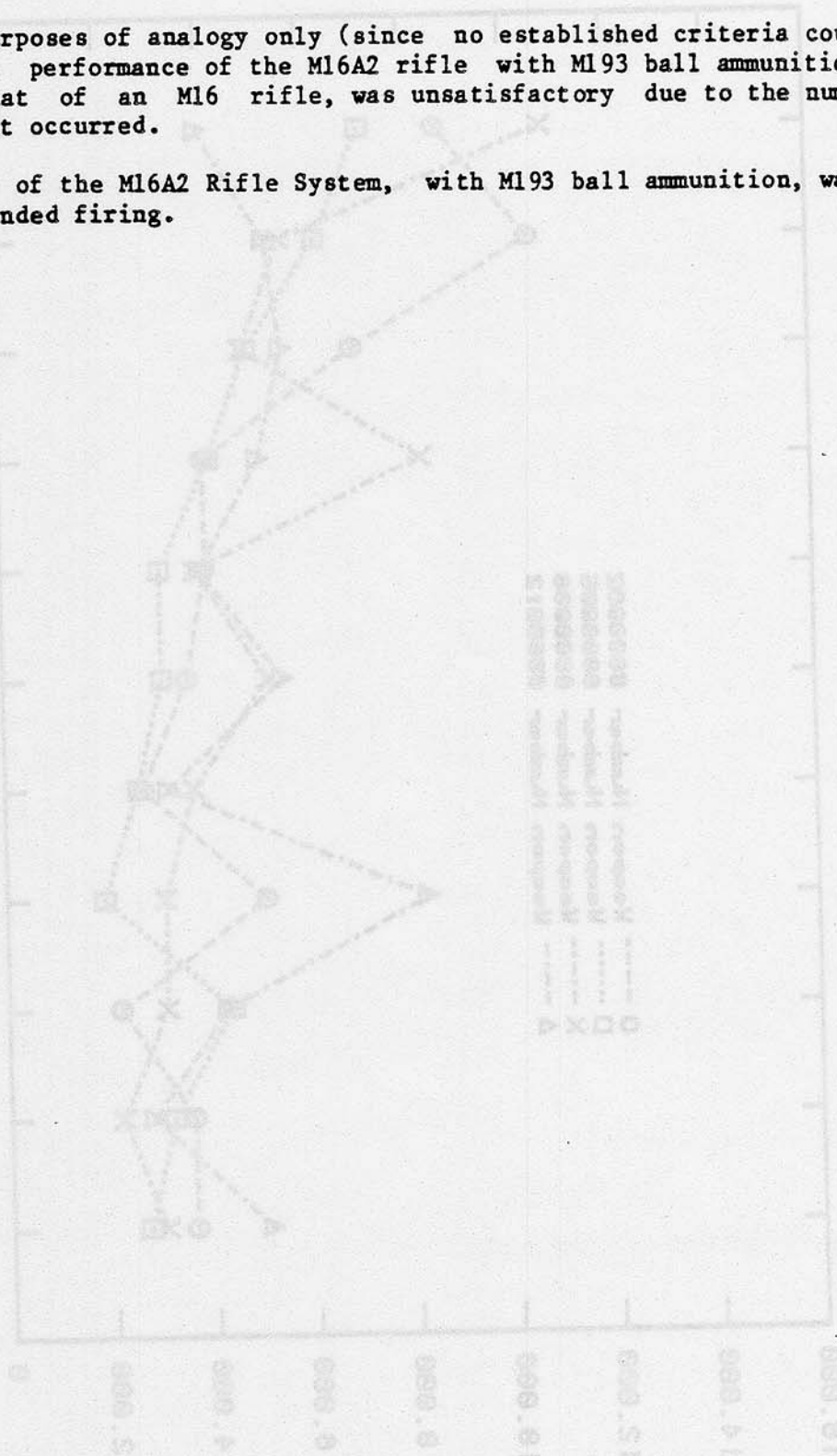
Figure 8-5. M16A2 rifle vertical standard deviation per ten cycle interval of the 10-round dispersion target.

8.6 Conclusions

It is concluded that:

a. For purposes of analogy only (since no established criteria could be addressed), the performance of the M16A2 rifle with M193 ball ammunition, as compared to that of an M16 rifle, was unsatisfactory due to the numerous malfunctions that occurred.

b. Safety of the M16A2 Rifle System, with M193 ball ammunition, was not degraded by extended firing.



9. SALT FOG TEST

9.1 Objective

The objective was to determine if the M16A2 rifle can withstand the effect of a salt fog environment without encountering operational difficulties.

9.2 Criterion

None.

9.3 Data Acquisition Procedure

a. Sixty rounds per rifle were fired before placing the M16A2 rifle in the salt fog environment. The first 30 rounds were fired in the 3-round burst mode, and the remaining 30 rounds were fired in the single-shot mode. This same firing schedule was used after the 48-hour salt fog exposure and after the 48-hour drying period.

b. Three hundred and sixty 5.56-mm cartridges, loaded into magazines, and M16A2 rifles No. 911, 913, and 915 were tested in accordance with MIL-STD-810D, Method 509.2, paragraph I-3.2(4)C, 19 July 1983. The test items were placed on rubber-covered racks in the salt fog chamber (fig. 9-1) and preconditioned at 35 ± 1.7° C (95 ± 3° F) for 16 hours. Following the preconditioning period the test items were subjected to a 48-hour salt fog test.

c. The salt fog was generated using a 5 ± 1%, by weight, saline (NaCl) solution. The temperature within the test chamber was maintained at 35 ± 1.7° C (95 ± 3° F). Six glass receptacles with a 10 cm opening (diameter) were placed around the test items to collect clean fog condensate. This condensate was used to determine the collection rate and the chemical content of the fog.

d. Following the 48-hour salt fog exposure, the test items were removed from the test chamber and their external surfaces visually inspected for evidence of deterioration or corrosion. The test items were not washed with running water prior to or after the inspection. Following the inspection, the test items were taken to the firing range, and 60 rounds were fired from each rifle. The rifles and the remaining 180 rounds were then stored at the prevailing room temperature of 26 ± 10° C (79 ± 18° F) for a drying period of 48 hours. At the end of the drying period, the test items were visually inspected again before being taken to the range and fired (60 rounds per rifle).

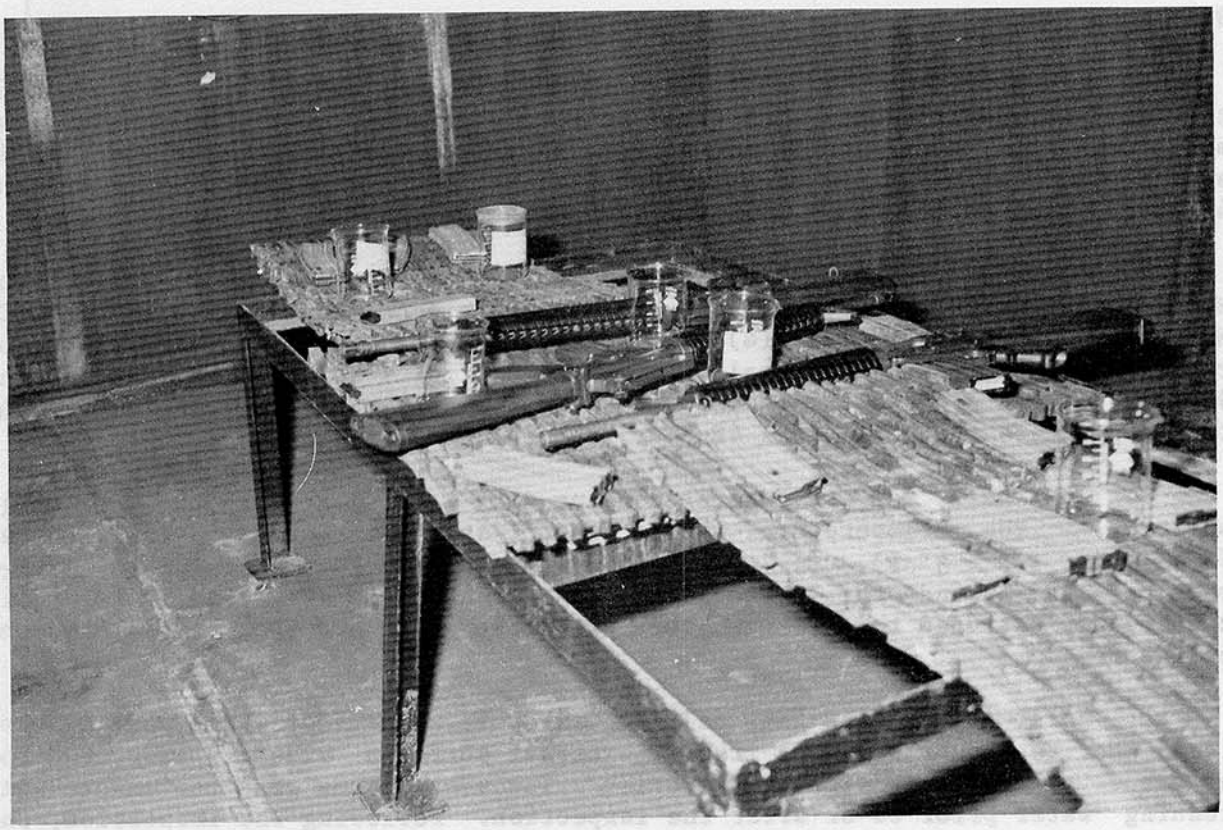


Figure 9-1. M16A2 Rifle System in salt fog chamber. This picture shows the setup of the three M16A2 rifles and the twelve 30-round loaded magazines in the salt-fog chamber.

9.4 Results

a. Before 48-hour salt fog test. No external evidence of damage was observed during the pretest inspection of the M16A2 rifles or rounds. No malfunctions occurred on any of the M16A2 rifles as a result of firing 60 rounds per rifle before placing in the salt fog environment.

b. After 48-round salt fog test.

(1) After the 48-hour salt fog test, the visual inspection revealed the following:

(a) The exterior surfaces of the M16A2 rifles and the magazines, were rusted (fig. 9-2 through 9-5).

(b) There were no observable salt deposits on the rifles.

(2) No malfunctions occurred on any of the M16A2 rifles as a result of firing after the 48-hour salt fog test.

c. After 48-hour drying period.

(1) After the 48-hour drying period, the inspection revealed the following:

(a) The exterior surfaces of the barrel (near the muzzle end) of the three rifles were rusty (fig. 9-6 through 9-8).

(b) No evidence of rust was observed inside the barrels of the three rifles.

(c) The rust accumulation was more extensive on the exterior of the rifles (fig. 9-9) than after the 48-hour salt fog test.

(2) No malfunctions occurred as a result of firing any of the M16A2 rifles after the 48-hour drying period.

d. No defects contributing to safety hazards were discovered before or after the salt fog test or after the drying period.

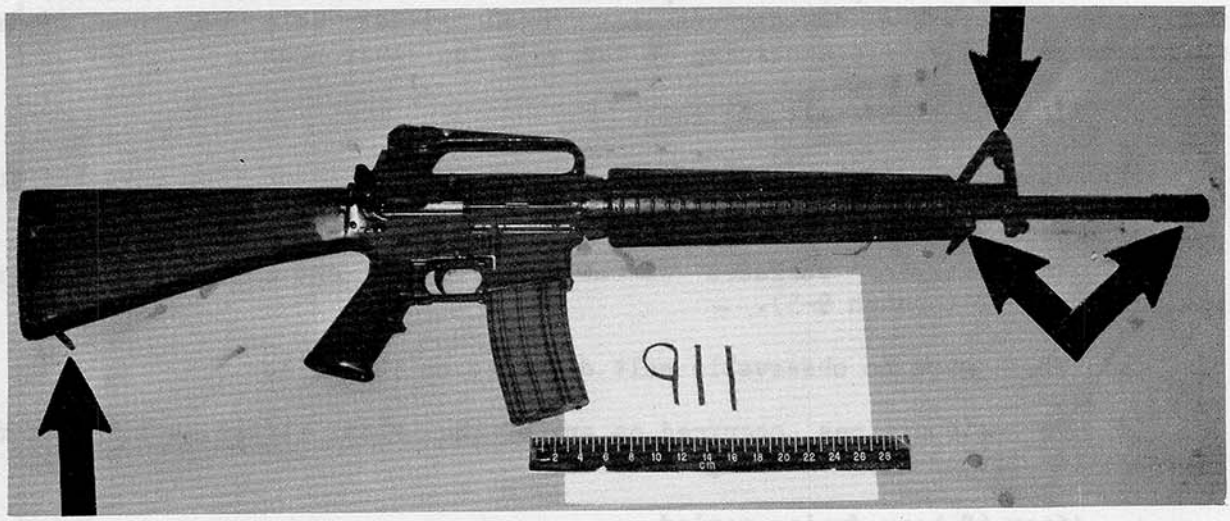


Figure 9-2. Rust condition of M16A2 rifle No. 911 after 48-hour salt fog environment. The arrows indicate the location of rust on the M16A2 rifle after 48 hours in a salt fog environment.

Figure 9-3. Rust condition of M16A2 rifle No. 913 after 48-hour salt fog environment. The arrows indicate the location of rust on the M16A2 rifle after 48 hours in a salt fog environment.

9.4 (Cont'd)

Figure 9-4. Rust condition of M16A2 rifle No.915 after 48-hour salt fog environment. The arrows indicate the location of rust on the M16A2 rifle after 48-hours in a salt fog environment.

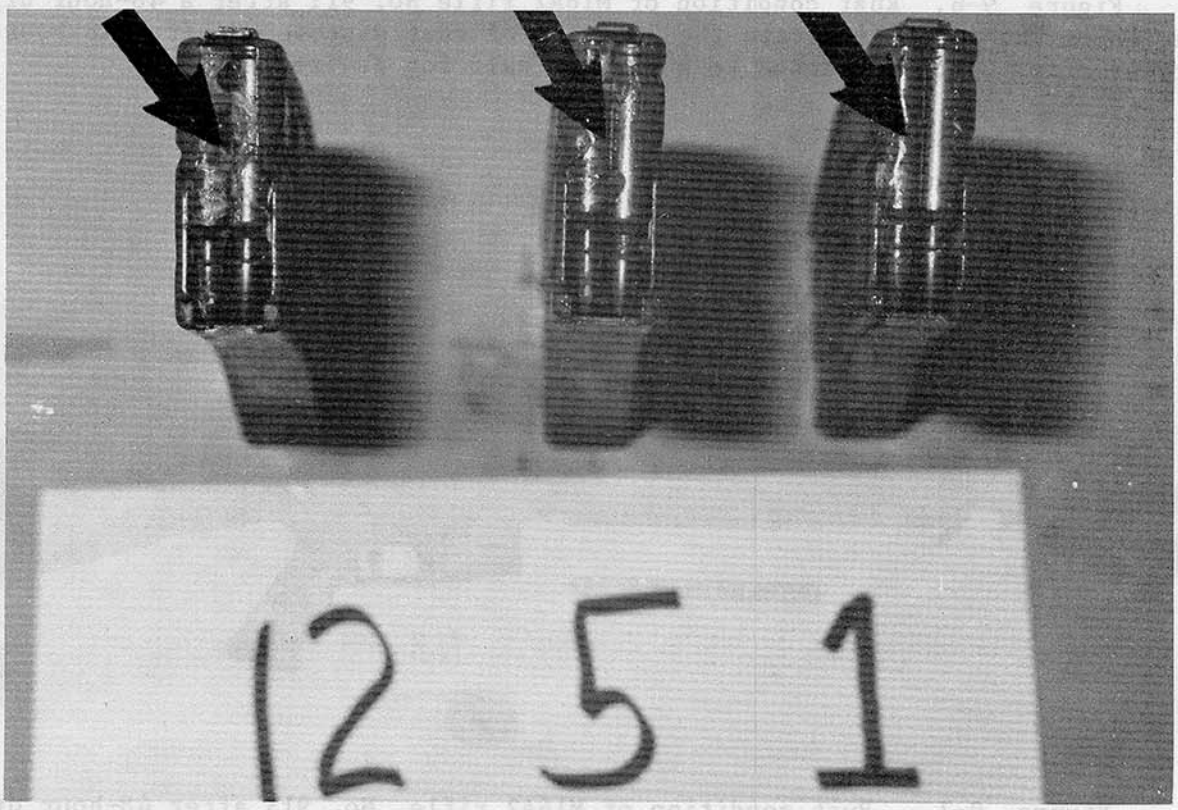


Figure 9-5. The condition of some representative samples of loaded magazines used in the salt fog test. The arrows indicate rust corrosion discovered on the magazines after a 48-hour salt fog test.

Figure 9-6. Rust condition of M16A2 rifle No. 911 after a 48-hour drying period. The arrows indicate the location of rust discovered after 48 hours of drying after being subjected to a 48-hour salt fog environment.

Figure 9-7. Rust condition of M16A2 rifle No. 913 after 48-hour drying period. The arrows indicate the location of rust discovered after 48 hours of drying after being subjected to a 48-hour salt fog environment.

9.4 (Cont'd)

Figure 9-8. Rust condition of M16A2 rifle No. 915 after 48-hour drying period. The arrows indicate the location of rust discovered after 48 hours of drying after being subjected to a 48-hour salt fog environment.

9.4 (Cont'd)

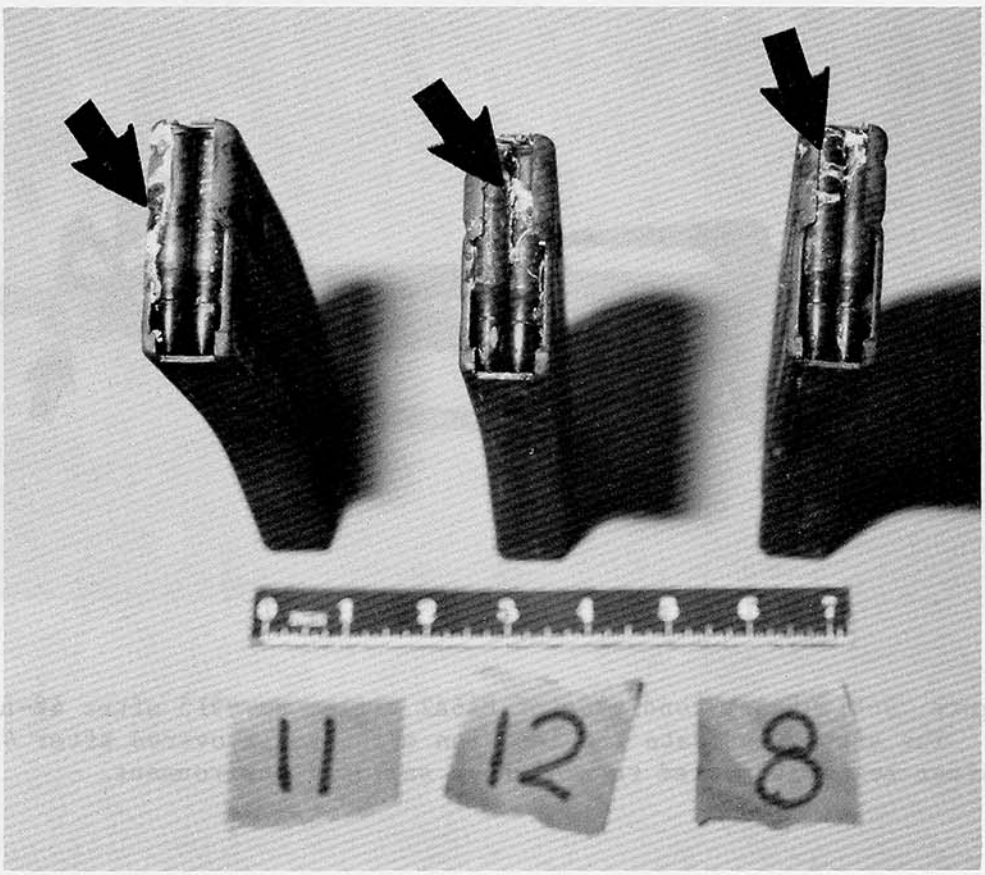


Figure 9-9. The condition of some representative samples of loaded magazines after 48 hours of drying. The arrows indicate the extensive rust corrosion that developed on the loaded magazines after 48 hours of drying after a 48-hour salt fog environment.

9.5 Analysis

The rust deposits on the exterior surfaces of ferrous metal parts are typical for the salt fog test. No incidents occurred with the M16A2 Rifle System with M193 ball ammunition that would contribute to a degradation in safety.

9.6 Conclusions

It is concluded that:

a. The M16A2 Rifle System will function satisfactorily with M193 ball ammunition after being subjected to the salt fog environment.

b. Safety of the M16A2 rifle with M193 ball ammunition was not degraded by the salt fog environment.

(Page 66 Blank)

10. FINAL INSPECTION

10.1 Objective

To determine if any defects occurred with the M16A2 Rifle System as a result of testing.

10.2 Criterion

None.

10.3 Data Acquisition Procedure

a. This test was conducted in accordance with TECOM TOP 3-2-045 (encl 2, ref 7). The thirteen M16A2 rifles that were tested at USACSTA were inspected at the conclusion of their respective subtests.

b. The following M16A2 rifle characteristics were measured.

(1) Trigger pull.

(2) Headspace.

(3) Firing pin indent.

(4) Firing pin protrusion.

(5) Barrel erosion.

c. A magnetic particle inspection (MPI) of the following components was conducted.

(1) Barrel.

(2) Bolt carrier.

(3) Sear.

(4) Bolt.

(5) Trigger.

(6) Bolt cam pin.

(7) Hammer.

(8) Selector lever.

(9) Extractor.

(10) Firing pin.

(11) Bolt catch.

(12) Magazine catch.

(13) Ejector.

(14) Burst selector sear.

(15) Disconnector.

d. The following components were inspected by the liquid penetrant method.

(1) Upper receiver.

(2) Lower receiver.

(3) Charging handle.

e. The barrel chamber and bore of each M16A2 rifle was measured except for those nine rifles not used in the endurance test. The barrel chamber and bore of those rifles were not measured because there were not enough rounds fired on those nine weapons to sufficiently change the initial barrel and bore dimensions.

10.4 Results

a. Table 10-2 of paragraph 10.5a contains the measurements of each weapon taken during the final and initial inspection phases.

b. Table 10-1 shows the results of the inspection conducted on the rifles by the magnetic particle and the liquid penetrant inspection methods.

TABLE 10-1. M16A2 RIFLE MAGNETIC PARTICLE INSPECTION DURING FINAL INSPECTION SUBTEST

Rifle No.	Defects Discovered
901[a]	None.
902[b]	Cracked extractor.
903[a]	None.
904[a]	None.
905[b]	None.
906[c]	None.
907[c]	None.
908[b]	None.
910[c]	Cracked swivel retainer and bolt catch.
911[d]	None.
912[b]	None.
913[d]	None.
915[d]	None.

See footnotes on following page.

TABLE 10-1 (CONT'D)

[a]These rifles were used in the drop test in a 68.3° C (155° F) temperature environment.
[b]These rifles were used in the endurance test where 12,000 rounds were fired at APG and 6000 rounds were previously fired at the manufacturer's facility.
[c]These rifles were used in the drop test in a -45.6° C (-50° F) temperature environment.
[d]These rifles were used in the sand, dust, mud, and salt fog tests.

Note: All cracked components were considered serviceable.

c. Figures 10-1 through 10-3 contain photographs of the defects that were discovered in the components of the M16A2 rifle during magnetic particle and liquid penetrant inspections.

10.4 (Cont'd)

(1) Figure 10-1 shows a 2-mm crack on the cartridge extractor of M16A2 rifle No. 902 that extends from the edge of the drilled hole over the top edge to the other side of the drilled hole.

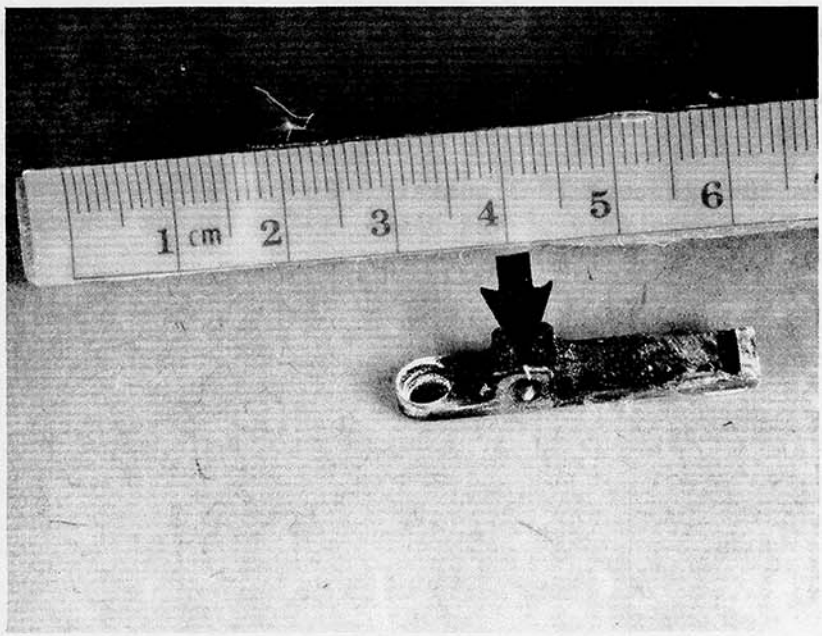


Figure 10-1. M16A2 rifle No. 902 cartridge extractor. The arrow shows the location of the defect.

10.4 (Cont'd)

(2) Figure 10-2 shows a picture of an approximate 10-mm length crack on the left side of the forward swivel retainer of m16A2 rifle No. 910.

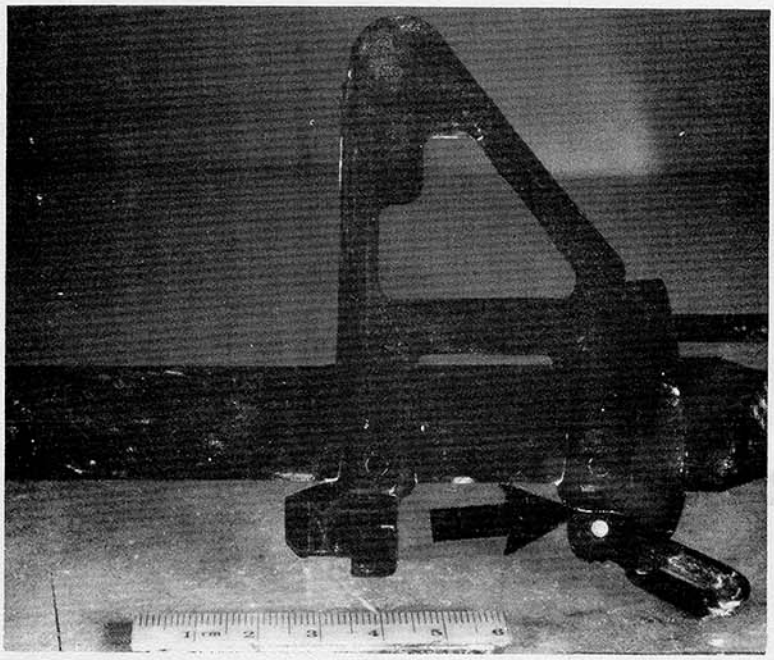


Figure 10-2. M16A2 rifle No. 910 forward swivel retainer. The arrow shows the location of the defect.

10.4 (Cont'd)

(3) Figure 10-3 shows a crack with an approximate length of 3-mm on the left side of the thumb depressor of the bolt catch of M16A2 rifle No. 910.

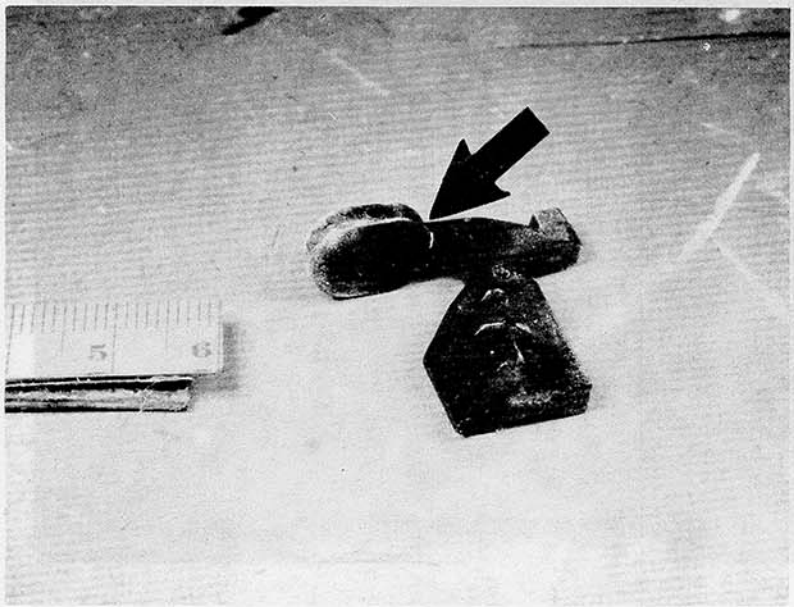


Figure 10-3. M16A2 rifle No. 910 bolt catch. The arrow shows the location of the defect.

d. The chamber and bore measurements taken during the 1200-round endurance phase (end of test) for each weapon, were also considered the final inspection measurements. These measurements are contained in Enclosure 4.

10.5 Analysis

a. Table 10-2 compares the M16A2 rifle component measurements collected during initial inspection with the measurements collected during the final inspection. There was little or no change in the final measurement in all of the components except for trigger pull and the bore erosion of rifles used in the endurance test.

b. The chamber measurements taken during the initial inspection (table 1 of encl 3) were compared to the chamber measurements taken during the final inspection (table 2 of encl 4). Similarly, the bore measurements taken during the initial inspection (contained in encl 3) were compared to the bore measurements taken during the final inspection (contained in encl 4). There was little or no change between initial and final barrel chamber measurements. A change was noted with initial and final bore measurements. This change was primarily the wear of the lands which is normal and to be expected due to usage of the weapons.

c. No defects were discovered during the final inspection that may constitute a safety hazard.

TABLE 10-2. COMPARISON OF M16A2 RIFLE COMPONENTS MEASUREMENT OF INITIAL AND FINAL INSPECTIONS

Rifle No.	Headspace (in.)		Firing Pin Protrusion (in.)		Firing Pin Indent[a] (in.)		Trigger Pull[a] (lb)		Bore Erosion (mm)	
	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
901[b]	1.4666	1.4666	0.031	0.031	0.022	0.020	9.3	8.5	11	11
902[c]	1.4676	1.4676	.033	.033	.021	.020	8.8	8.8	7	[f] -1
903[b]	1.4656	1.4656	.031	.032	.021	.020	10.2	8.5	11	11
904[b]	1.4666	1.4666	.032	.033	.021	.020	8.3	7.0	11	11
905[c]	1.4676	1.4676	.032	.032	.021	.022	10.2	7.8	7	1
906[d]	1.4676	1.4676	.033	.033	.022	.021	10.3	7.5	11	11
907[d]	1.4676	1.4676	.033	.033	.021	.021	8.7	8.2	11	11
908[c]	1.4666	1.4676	.031	.032	.021	.021	8.7	7.8	7	[f] -1
910[d]	1.4656	1.4666	.032	.032	.021	.020	10.0	7.7	11	11
911[e]	1.4656	1.4656	.033	.033	.022	.021	8.8	8.2	11	11
912[c]	1.4656	1.4666	.032	.032	.021	.021	9.0	7.8	7	[f] -1
913[e]	1.4646	1.4666	.033	.033	.022	.020	8.8	9.3	11	11
915[e]	1.4666	1.4666	.031	.033	.021	.020	9.5	8.5	11	11

[a] Average of three trials.
[b] These rifles were used in the drop test in a 68.3° C (155° F) temperature environment.
[c] These rifles were used in the endurance test where 12,000 rounds were fired at APG and 6000 rounds were fired at the manufacturer's facility.
[d] These rifles were used in the drop test in a -45.6° C (-50° F) temperature environment.
[e] These rifles were used in the sand, dust, mud, and salt fog tests.
[f] The -1 indicates that the bore erosion gage has gone beyond the reject line.

10.6 Conclusion

It is concluded that the M16A2 rifle is safe for personnel use with M193 ball ammunition.

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REFERENCES

1. Letter, DRSTE-CM-F, TECOM, 2 December 1983, subject: First Article - Initial Production Test of the M16A2 Rifle System, TECOM Project No. 2-WE-600-016-027.

2. First Indorsement, STEAP-MT-I, 22 December 1983, subject: Indorsement to Reference C.

3. Second Indorsement, DRSTE-CM-F, 1 February 1984, subject: Indorsement to Reference C.

4. Letter, STEAP-MT-IW-W, MTD, 1 March 1984, subject: Test Plan Outline for 5.56 MM M16A2 Rifle System, TECOM Project No. 2-WE-600-016-027.

5. First Indorsement, DRSTE-CM-F, 8 March 1984, subject: Indorsement to Reference F.

6. Letter, DRSTE-CM-F, TECOM, 19 March 1984, subject: First Article/Initial Production Test of M16A2 Rifle, TECOM Project No. 2-WE-600-016-027, With 1 Enclosure.

7. TECOM TOP 3-2-045, Automatic Weapons, Machine Guns, Hand and Shoulder Weapons, 21 December 1983.

8. TM 05538C-10/1, Rifle, 5.56-MM, M16A2 W/E, June 1983.

9. MIL-R-45587A (with C1), Rifle, 5.56-MM, M16, and M16A1, 25 June 1976.

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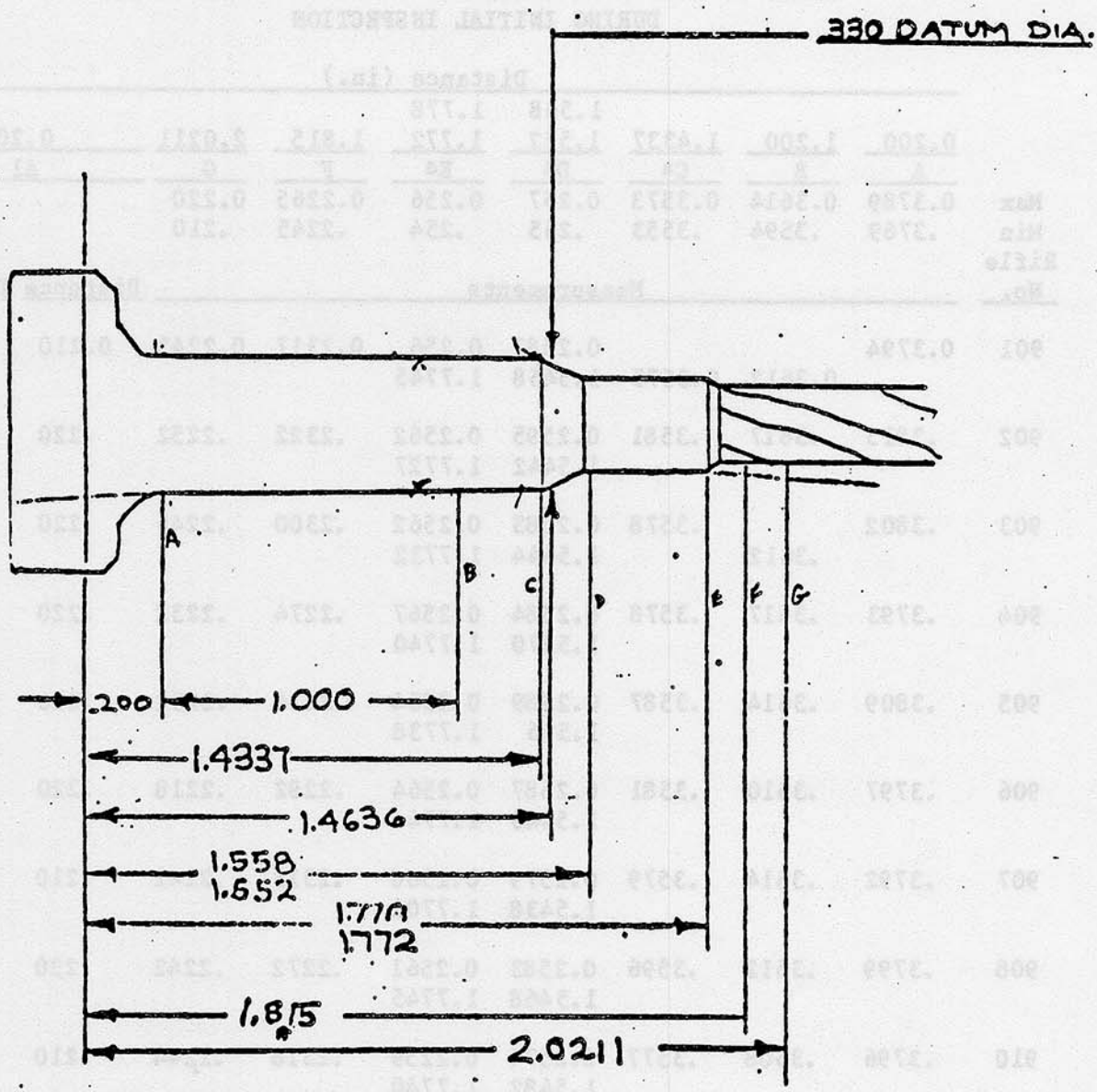
CHAMBER AND BORE MEASUREMENTS DURING INITIAL INSPECTION

TABLE 1. M16A2 RIFLE BARREL CHAMBER MEASUREMENTS DURING INITIAL INSPECTION

	Distance (in.)								
	0.200	1.200	1.4337	1.558 1.552	1.778 1.772	1.815	2.0211	0.200	
	A	B	Ca	Da	Ea	F	G	A1	
Max	0.3789	0.3614	0.3573	0.257	0.256	0.2265	0.220		
Min	.3769	.3594	.3553	.255	.254	.2245	.210		
Rifle No.	Measurements							Distance	Diameter
901	0.3794			0.2587	0.256	0.2317	0.2245	0.210	0.3782
		0.3612	0.3575	1.5458	1.7745				
902	.3815	.3617	.3581	0.2595	0.2562	.2322	.2252	.220	.3788
				1.5442	1.7727				
903	.3802		.3578	0.2583	0.2562	.2300	.2245	.220	.3785
		.3612		1.5444	1.7732				
904	.3793	.3617	.3578	0.2584	0.2567	.2274	.2232	.220	.3788
				1.5470	1.7740				
905	.3809	.3614	.3587	0.2589	0.2564	.2274	.2232	.220	.3789
				1.546	1.7738				
906	.3797	.3610	.3581	0.2587	0.2564	.2292	.2218	.220	.3787
				1.5446	1.7744				
907	.3792	.3614	.3579	0.2579	0.2560	.2313	.2242	.210	.3788
				1.5438	1.7702				
908	.3799	.3612	.3596	0.2583	0.2561	.2272	.2242	.220	.3789
				1.5468	1.7745				
910	.3796	.3608	.3577	0.2574	0.2259	.2318	.2244	.210	.3788
				1.5482	1.7740				
911	.3807	.3617	.3575	0.2590	0.2566	.2315	.2246	.210	.3787
				1.5459	1.7731				
912	.3789	.3615	.3578	0.2591	0.2566	.2316	.2242		
				1.5461	1.7731				
913	.3799	.3615	.3572	0.2594	0.2558	.2280	.2210	.240	.3788
				1.5443	1.7742				
915	.3799	.3617	.3578	0.2584	0.2561	.2279	.2236	.220	.3789
				1.5461	1.7731				

[a]Distance and diameter measurements are made to projected sharp corners.

Max = Maximum
Min = Minimum



5.56mm CHAMBER CAST

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1-4	2-5	3-6	GROOVES .2235 1-4	2-5	3-6
1.35	+.0007	+.0007	+0005	+.0009	+.0009	+.0009
2.00	0	1	1	5	4	5
3.00	0	2	+ 2	4	6	4
4.00	2	+ 1	0	6	4	6
5.00	- 1	- 1	- 1	2	2	2
6.00	2	1	1	2	2	2
7.00	3	1	2	1	2	1
8.00	2 *	1	2	3	2	3
9.00	- 3	- 1	- 3	2	2	2
10.00	+ 2	+ 2	+ 2	6	6	6
11.00	2	2	2	6	6	6
12.00	2	2	2	5	5	4
13.00	2	3	3	6	6	5
14.00	3	4	3	6	6	6
15.00	4	3	3	6	6	7
16.00	3	3	3	6	7	6
17.00	2	2	2	6	7	6
18.00	4	3	4	6	6	6
18.35	4	4	4	7	7	7
18.85	4	4	4	8	8	8
19.10	+.0008	+.0009	+.0003	+.0008	+.0007	+.0008

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands.starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands throughout the bore. A very few light, intermittent scratches and intermittent spiral tool marks on the land throughout the bore. Light erosion and light deposits on the front edge of the gas port. Tool steps in several lands ends at the muzzle.

* Dist. = 7.90 in. (Gas Port)

CASTING NUMBER:

MANUFACTURER: 2-WE-600 016 027 JOHN SCHEVREN
PROOF OFFICER W.O. 300-30426-40

MODEL: M16A2 HEAVY BARREL

NUMBER OF ROUNDS: 0

NUMBER: 6000901

FIRING STATUS (Check One): BEFORE X AFTER

5.56 MM Barrel

DATE OF GAUGING: 1 MARCH 84

STEAP-DS Form 106, 17 ...n 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch LANDS .2190" 1 - 4	2 - 5	3 - 6	GROOVES .2235 1 - 4	2 - 5	3 - 6
1.35	+.0006	+.0008	+.0008	+0009	+0008	+0009
2.00	5	3	5	5	7	6
3.00	1	3	5	3	4	4
4.00	3	3	3	4	5	3
5.00	1	1	2	4	4	4
6.00	1	3	2	5	4	4
7.00	2	1	2	5	3	4
8.00	2	2	1	5*	3	3
9.00	1	2	2	5	3	4
10.00	4	3	4	6	5	6
11.00	4	4	4	6	6	6
12.00	3	3	3	6	6	6
13.00	4	3	3	7	6	7
14.00	4	4	4	8	7	7
15.00	4	4	4	8	7	7
16.00	5	3	4	8	7	9
17.00	4	3	5	9	8	8
18.00	7	6	5	10	9	9
18.35	5	4	5	11	9	9
18.85	7	7	6	11	10	9
19.10	+.0043	+.0044	+.0045	12	10	10

CASTING NUMBER: X

MANUFACTURER: Z-WE-600 016 021
PROOF OFFICER JOHN SCHEURER
W.O. 300-30426-40

MODEL: M16 A2
HEAVY BARREL

NUMBER OF ROUNDS: 6000 START TEST

NUMBER: 6000 902

FIRING STATUS (Check One): BEFORE X AFTER

DATE OF GAUGING: 1 MARCH 84

5.56 MM Barrel

Land No. 1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:
Light circumferential tool marks (CTM) on the chamber. Light carbon deposits on the chamber and moderate deposits encircling the chamber front slope and centering cylinder. Light CTM on the centering cylinder and bullet seat. Light heat checking and moderate build-up of deposits on the origin of the rifling continuing forward to 2.75 inches from the rear face of the bore (RFB). Intermittent CTM and a moderate build up of deposits on the lands throughout the bore. Moderate build-up of deposits and light build-up of copper in the grooves on the driving side of the lands. Light to moderate erosion and light deposits on the front edge of the gas port.

NOTE! The 6000 rounds were fired at the manufacturer's facility.

* DIST = 2.90 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: 1-WE-600 016 027 PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16 A2 HEAVY BARREL NUMBER OF ROUNDS 0

NUMBER: 6000903 FIRING STATUS (Check One) AFTER / BEFORE X

5.56 MM Barrel DATE OF GAUGING 1 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch					
	LANDS			GROOVES .2235		
	1 - 4	.2190" 2 - 5	3 - 6	1 - 4	2 - 5	3 - 6
1.35	+.0007	+.0007	+.0008	+0009	+0009	+.0008
2.00	4	3	3	4	5	6
3.00	2	3	4	4	5	4
4.00	2	4	1	4	3	4
5.00	+ 2	+ 2	+ 2	3	3	4
6.00	0	0	0	3	2	3
7.00	0	0	0	1	2	3
8.00	0 *	0	- 2	1 *	1	2
9.00	- 1	0	- 1	1	2	2
10.00	+ 1	+ 2	+ 1	4	4	4
11.00	+ 2	2	2	3	4	5
12.00	0	1	+ 1	3	3	3
13.00	+ 1	1	0	3	3	3
14.00	+ 1	1	0	3	2	3
15.00	0	0	0	2	2	3
16.00	0	1	+ 1	3	3	4
17.00	+ 1	2	1	3	4	4
18.00	1	2	1	4	4	4
18.35	2	2	+ 1	4	4	4
18.85	1	+ 1	0	4	3	4
19.10	+.0001	0	0	+.0003	+.0003	4

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Moderate circumferential tool marks on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands throughout the bore. Very light longitudinal tool marks and a few very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port. One moderate CTM and several tool steps in the land ends at muzzle.

* DIST = 7.90 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: 1-WE-600 016 027

PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16A2

HEAVY BARREL

NUMBER OF ROUNDS: 0

NUMBER: 60009044

FIRING STATUS (Check One): BEFORE X, AFTER

5.56 MM Barrel

DATE OF GAUGING: 1 MARCH 84

Gage Meas. indicated in .0001 of an inch

Dist. (inches) From Face of Flash Suppressor	LANDS 1 - 4	LANDS .2190" 2 - 5	LANDS 3 - 6	GROOVES .2235 1 - 4	GROOVES 2 - 5	GROOVES 3 - 6
1.35	+.0005	+.0005	+.0003	+.0006	+.0006	+.0006
2.00	4	4	3	5	6	5
3.00	2	0	3	4	5	4
4.00	0	1	0	3	3	3
5.00	0	0	0	3	3	2
6.00	0	0	2	4	3	4
7.00	-.0001	0	0	3	3	3
8.00	.0000	0*	0	3	3	4
9.00	-.0001	0	-.0001	2	3	2
10.00	+.0001	0	.0000	3	4	3
11.00	1	1	+.0001	4	5	4
12.00	1	1	1	4	4	4
13.00	2	1	1	4	4	4
14.00	2	3	2	4	5	4
15.00	3	4	2	6	5	6
16.00	5	3	3	6	6	5
17.00	3	4	4	6	7	6
18.00	4	4	3	7	7	7
18.35	4	4	2	7	7	7
18.85	4	4	5	8	8	8
19.10	+.0004	+.0003	+.0006	+.0008	+.0009	+.0008

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Moderate circumferential tool marks on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands throughout the bore. Very light longitudinal tool marks and a very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port. One moderate CTM and several tool steps in the land ends at muzzle.

* Dist: .790 in (Gas Port)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: Z-WE-600 016 027

PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16 A2 HEAVY BARREL

NUMBER OF ROUNDS 6000 START OF TEST

NUMBER: 6000905

FIRING STATUS (Check one) BEFORE: X AFTER:

5.56 MM Barrel

DATE OF GAUGING 1 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch					
	LANDS .2190"			GROOVES .2235		
	1 - 4	2 - 5	3 - 6	1 - 4	2 - 5	3 - 6
1.35	+.0002	+.0001	+.0002	+.0003	+.0003	+.0002
2.00	1	1	1	3	2	2
3.00	2	2	2	3	3	4
4.00	1	2	2	3	4	3
5.00	1	1	1	3	4	3
6.00	1	1	1	4	5	3
7.00	1	1	0	3	3	3
8.00	1*	0	0	3	2*	2
9.00	1	-.0001	-.0001	1	2	1
10.00	1	0	0	3	3	2
11.00	2	+.0001	+.0001	3	3	3
12.00	2	3	2	4	5	4
13.00	1	2	2	4	4	3
14.00	2	1	1	5	3	3
15.00	4	3	2	4	4	6
16.00	1	5	5	3	7	5
17.00	2	1	1	5	6	3
18.00	4	2	2	7	4	6
18.35	4	2	4	7	5	6
18.85	3	2	3	6	8	9
19.10	+.0037	+.0039	+.0041	+.0005	+.0008	+.0009

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber. Light carbon deposits on the chamber and moderate deposits encircling the chamber front slope and centering cylinder. Light CTM on the centering cylinder. Light CTM on the centering cylinder and bullet seat. Light heat checking and moderate build-up of deposits on the origin of the rifling continuing forward to 2.75 inches from the rear face of the bore (RFB). Intermittent CTM and a moderate build-up of deposits on the lands throughout the bore. Moderate build-up of deposits and light build-up of copper in the grooves on the driving side of the lands. Light to moderate erosion and light deposits on the front edge of the gas port.

NOTE: The 6000 rounds were fired at the manufacturer's facility

* Dist.: 7.90 in (Gas Port)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER	MANUFACTURER	MODEL	NUMBER	FIRING STATUS (Check One)	
X	2-WE-600 016 027 PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40	M16A2 HEAVY BARREL NUMBER OF ROUNDS 0	6000906	AFTER	BEFORE

5.56 MM Barrel

DATE OF GAUGING 1 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch LANDS 1 - 4	LANDS .2190" 2 - 5	LANDS 3 - 6	GROOVES .2235 1 - 4	GROOVES 2 - 5	GROOVES 3 - 6
1.35	+.0005	+.0007	+.0005	+.0006	+.0008	+.0007
2.00	2	4	4	6	4	6
3.00	3	3	3	4	5	5
4.00	+ 1	2	2	4	4	4
5.00	0	+ 1	+ 1	3	3	4
6.00	+ 1	0	0	3	2	2
7.00	0	-.0001	-.0001	1	1	2
8.00	0	- 1	2	2*	1	2
9.00	-.0001	1	1	2	2	2
10.00	0	+.0001	+.0001	3	3	3
11.00	+.0001	1	1	3	3	3
12.00	1	1	1	3	2	3
13.00	0	1	1	3	2	2
14.00	0	1	1	3	2	2
15.00	+ 1	1	1	3	2	2
16.00	1	1	1	4	3	3
17.00	2	2	2	4	4	4
18.00	3	3	2	6	5	5
18.35	3	3	3	5	5	5
18.85	2	2	2	5	4	5
19.10	+.0002	+.0001	+.0002	+ 5	+.0004	+.0005

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Moderate circumferential tool marks on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands throughout the bore. Very light longitudinal tool marks and a very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port. One moderate CTM and several tool steps in thelands ends at muzzle.

* DIST = 7.90 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: Z-WE- 600 016 027

MANUFACTURER: PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16A2 HEAVY BARREL

NUMBER OF ROUNDS: 0

NUMBER: 6000907

FIRING STATUS (Check One): BEFORE X AFTER

5.56 MM Barrel

DATE OF GAUGING: 1 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch					
	LANDS .2190"			GROOVES .2235		
	1 - 4	2 - 5	3 - 6	1 - 4	2 - 5	3 - 6
1.35	+.0002	+.0004	+.0003	+.0006	+.0006	+.0005
2.00	1	2	1	5	5	5
3.00	1	2	3	5	6	5
4.00	1	2	1	6	4	4
5.00	+ 1	+ 1	+ 1	4	4	4
6.00	0	0	0	4	3	4
7.00	- 1	0	- 1	3	4	3
8.00	1 *	- 1	1	3 *	3	3
9.00	- 1	- 1	- 1	3	3	3
10.00	0	0	+ 1	3	4	5
11.00	0	+ 1	+ 1	4	5	4
12.00	+ 1	0	0	5	4	4
13.00	0	0	0	4	4	4
14.00	0	0	0	3	4	3
15.00	0	0	- 1	3	3	2
16.00	0	- 1	- 1	3	3	3
17.00	0	0	0	4	4	4
18.00	0	0	+ 1	4	5	4
18.35	0	+ 1	0	5	5	5
18.85	0	1	+ 1	5	4	5
19.10	0	+ 1	+ 2	+.0005	+.0004	+.0005

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Moderate circumferential tool marks (CTM) on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light intermittent CTM, light scratches and spiral tool marks 7.5 in. from the rear face of the barrel. Very light longitudinal tool marks and a few very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port. Intermittent moderate deposits throughout the bore.

* DIST = 7.90 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: 2-WE-600 016 027 — PROOF OFFICER JOHN SCHEHREN W.O. 300-30426-40

MODEL: M16A2 HEAVY BARREL — NUMBER OF ROUNDS START OF TEST: 6000

NUMBER: 6000908

FIRING STATUS (Check One): BEFORE X / AFTER

DATE OF GAUGING: 2 MARCH 64

5.56 MM Barrel

Dist. (Inches) From Face of Flash Suppressor | Gage Meas. indicated in .0001 of an inch

	LANDS .2190"			GROOVES .2235		
	1 - 4	2 - 5	3 - 6	1 - 4	2 - 5	3 - 6
1.35	+.0002	+.0004	+.0004	+.0004	+.0005	+.0005
2.00	1	0	1	4	4	3
3.00	0	0	1	3	3	3
4.00	0	+ 1	+ 1	4	4	3
5.00	0	0	0	4	4	3
6.00	− 1	0	− 1	3	3	3
7.00	2	− 3	2	1	1	+ 1
8.00	3	−.0003*	3	1*	1	0
9.00	1	2	2	1	2	+ 1
10.00	2	2	1	2	2	1
11.00	2	2	2	2	2	1
12.00	3	2	2	1	+ 1	+ 1
13.00	3	3	3	+ 1	0	0
14.00	− 2	3	− 3	0	+ 1	0
15.00	0	− 1	0	+ 3	3	+ 3
16.00	+ 1	+ 1	0	3	4	3
17.00	0	0	+ 1	3	4	3
18.00	− 1	− 1	− 2	4	3	3
18.35	1	+ 1	1	5	4	4
18.85	1	0	− 1	5	5	5
19.10	+.0044	+.0040	+.0043	+.0005	+.0006	+.0006

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber. Light carbon deposits on the chamber and moderate deposits encircling the chamber front slope and centering cylinder. Light CTM on the centering cylinder and bullet seat. Light heat checking and moderate build-up of deposits on the origin of the rifling continuing forward to 2.75 inches from the rear face of the bore (RFB). Intermittent CTM and a moderate build-up of deposits on the lands throughout the bore. Moderate build-up of deposits and light build-up of copper in the grooves on the driving side of the lands. Light to moderate erosion and light deposits on the front edge of the gas port.

NOTE! The 6000 rounds were fired at the manufacturer's facility.

* DIST = 2.85 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: 2-WE-600 016 027

MANUFACTURER: PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16 A2 HEAVY BARREL

NUMBER OF ROUNDS: 0

NUMBER: 600091O

FIRING STATUS (Check One): BEFORE X AFTER

5.56 MM Barrel

DATE OF GAUGING: 2 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch LANDS .2190" 1 - 4	2 - 5	3 - 6	GROOVES .2235 1 - 4	2 - 5	3 - 6
1.35	+.0003	+.0004	+.0004	+.0005	+.0006	+.0006
2.00	2	1	1	5	4	3
3.00	1	2	4	5	5	6
4.00	2	3	2	5	5	4
5.00	2	+ 3	+ 2	5	5	5
6.00	+ 1	0	0	4	4	4
7.00	0	0	0	3	3	3
8.00	0*	0	0	3 *	3	3
9.00	0	0	0	3	4	3
10.00	+ 2	+ 2	+ 2	6	6	6
11.00	1	2	2	6	5	5
12.00	2	3	2	5	6	6
13.00	3	3	3	6	6	5
14.00	2	3	2	5	4	4
15.00	3	3	3	5	4	5
16.00	2	3	3	5	6	5
17.00	3	4	4	7	8	7
18.00	3	3	4	8	7	7
18.35	4	2	4	7	6	8
18.85	3	2	4	5	6	7
19.10	+.0003	+.0005	+.0005	+.0007	+.0007	+.0006

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands throughout the bore Very light longitudinal tool marks and a few very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port. Several heavy CTM 1.0 in. from muzzle opening.

* DIST = 7.90 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: Z-WE-600 016 027
PROOF OFFICER JOHN SCHEUREN
W.O. 300-30426-40

MODEL: M16A2 HEAVY BARREL
NUMBER OF ROUNDS: 0

NUMBER: 6000911
FIRING STATUS (Check One): BEFORE X / AFTER

5.56 MM Barrel
DATE OF GAUGING: 2 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1 - 4	LANDS .2190" 2 - 5	LANDS .2190" 3 - 6	GROOVES .2235 1 - 4	GROOVES .2235 2 - 5	GROOVES .2235 3 - 6
1.35	+.0004	+.0003	+.0003	+.0004	+.0003	+.0005
2.00	4	2	4	4	3	3
3.00	2	3	3	2	4	2
4.00	3	2	2	4	3	2
5.00	3	2	5	3	3	4
6.00	2	2	3	3	4	3
7.00	1	1	2	3	3	3
8.00	2	1*	0	3*	3	2
9.00	2	1	2	3	3	3
10.00	4	4	4	5	5	4
11.00	5	4	4	5	5	5
12.00	3	4	4	5	5	6
13.00	4	4	4	5	5	6
14.00	5	4	5	6	5	6
15.00	4	5	4	6	6	5
16.00	6	5	4	7	5	6
17.00	6	5	6	7	7	7
18.00	6	6	7	6	8	8
18.35	6	6	7	7	8	9
18.85	6	7	7	8	9	8
19.10	+.0009	+.0009	+.0010	+0009	+.0009	+.0009

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:
Moderate circumferential tool marks on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Very light heat checking starting 7.0 in. from the rear face of the barrel. Light, intermittent CTM on the lands throughout the bore. Very light longitudinal tool marks and a few very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port.

* DIST = 7.90 IN (GAS PORT)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: 2-WE-600 016 027 PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16 A2 HEAVY BARREL NUMBER OF ROUNDS 6000 START OF TEST

NUMBER: 6000912 FIRING STATUS (Check One) BEFORE X AFTER

5.56 MM Barrel DATE OF GAUGING 5 MAR 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS 1 - 4	LANDS .2190" 2 - 5	LANDS 3 - 6	GROOVES .2235 1 - 4	GROOVES 2 - 5	GROOVES 3 - 6
1.35	+.0005	+.0005	+.0005	+.0004	+.0004	+.0004
2.00	3	4	5	1	1	3
3.00	.0000	3	3	0	.1	0
4.00	-.0001	.0000	.0000	1	0	2
5.00	.0000	0	0	1	1	1
6.00	0	+.0001	0	2	1	1
7.00	+.0001	1	-.0001	2	1	2
8.00	1	-.0001	.0000	5	1	4
9.00	-.0001	.0000	+.0001	2	2	0
10.00	2	-.0001	-.0001	3	1	2
11.00	.0000	.0000	2	3	3	4
12.00	-.0001	-.0001	.0000	3	4	2
13.00	2	+.0001	+.0002	6	4	3
14.00	+.0001	3	.0000	6	4	5
15.00	3	3	+.0002	5	5	5
16.00	3	2	4	5	6	4
17.00	2	4	4	7	5	4
18.00	1	1	-.0002	7	5	7
18.35	3	4	.0000	7	6	8
18.85	11	13	15	6	9	9
19.10	+.0041	+.0042	+.0043	+.0006	+.0009	+.0008

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber. Light carbon deposits on thechamber and moderate deposits encircling the chamber front slope and centering cylinder. Light CTM on the centering cylinder and bullet seat. Light heat checking and moderate build-up of deposits on the origin of the rifling continuing forward to 2.75 inches from the rear face of the bore (RFB). Intermittent CTM and a moderate build-up of deposits on the lands throughout the bore. Moderate build-up of deposits and light build-up of copper in the grooves on the driving side of the lands. Light to moderate erosion and light deposits on the front edge of the gas port.

NOTE: The 6000 rounds were fired at the manufacturers facility.

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel **A2 HEAVY BARREL**

CASTING NUMBER: X

MANUFACTURER: 2-WE-600 016 027

PROOF OFFICER JOHN SCHEUREN
W.O. 300-3042-40

MODEL: M16 A-2

HEAVY BARREL

NUMBER OF ROUNDS: 0

NUMBER: 6000913

FIRING STATUS (Check One): BEFORE X AFTER

5.56 MM Barrel

DATE OF GAUGING: 5 MARCH 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch LANDS .2190" 1 - 4	2 - 5	3 - 6	GROOVES .2235 1 - 4	2 - 5	3 - 6
1.35	+.0005	+.0008	+.0006	+.0006	+.0005	+.0006
2.00	5	2	4	6	5	6
3.00	2	3	4	4	6	5
4.00	4	4	3	4	5	3
5.00	3	2	1	3	3	3
6.00	1	2	1	3	3	2
7.00	1	1	2	2	3	3
8.00	2	2	-.0001	2*	3	2
9.00	2	1	+.0001	3	2	3
10.00	4	2	4	4	4	6
11.00	2	3	3	4	5	4
12.00	2	3	1	4	4	3
13.00	7	6	5	7	5	6
14.00	8	7	8	8	7	8
15.00	8	8	8	8	8	8
16.00	10	9	7	10	9	9
17.00	9	6	9	9	8	10
18.00	5	7	9	11	10	9
18.35	5	8	8	8	10	8
18.85	4	8	5	9	9	6
19.10	+.0004	+.0008	+.0004	+.0009	+.0008	+.0005

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands and intermittent groups of very light pits throughout the bore. Very light longitudinal tool marks and a few very light, intermittent scratches on the lands throughout the bore. Light erosion and light deposits on the front edge of the gas port..

* Dist. = 7.90in (Gas Port)

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: 2-WE-600 016 027 PROOF OFFICER JOHN SCHEUREN W.O. 300-30426-40

MODEL: M16 A2 HEAVY BARREL

NUMBER OF ROUNDS: 0

NUMBER: 6000915

FIRING STATUS (Check One): BEFORE X AFTER

5.56 MM Barrel

DATE OF GAUGING: 5 MAR 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1 - 4	LANDS .2190" 2 - 5	LANDS .2190" 3 - 6	GROOVES .2235 1 - 4	GROOVES .2235 2 - 5	GROOVES .2235 3 - 6
1.35	+.0005	+.0007	+.0005	+.0008	+.0006	+.0006
2.00	4	5	3	4	7	4
3.00	3	3	4	5	5	3
4.00	4	3	2	4	4	4
5.00	3	1	2	3	3	3
6.00	1	2	1	3	3	3
7.00	1	0	0	3	3	3
8.00	1*	0	-.0001	3*	2	2
9.00	1	1	0	3	3	3
10.00	2	3	1	4	4	2
11.00	2	1	1	3	3	3
12.00	1	1	1	3	4	3
13.00	1	3	2	4	4	3
14.00	4	2	1	3	3	3
15.00	3	2	2	3	3	4
16.00	2	3	3	4	4	4
17.00	4	6	3	7	7	6
18.00	5	7	5	7	7	7
18.35	5	4	5	7	8	8
18.85	4	6	6	8	8	8
19.10	+.0005	+.0007	+.0008	+.0008	+.0008	+.0008

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light circumferential tool marks (CTM) on the chamber and on the chamber front slope. Moderate CTM on the centering cylinder and bullet seat. Light carbon deposits in the grooves on the driving side of the lands starting at the origin of the rifling continuing throughout the bore. Light, intermittent CTM on the lands and intermittent groups of very light pits throughout the bore. Very light longitudinal tool marks and a very light, intermittent scratches on the lands throughout the bore. Light erosion, and light deposits on the front edge of the gas port.

* Dist = 7.90in (Gas Port)

STEAP-DS Form 106, 17 Jun 64 (Part I)

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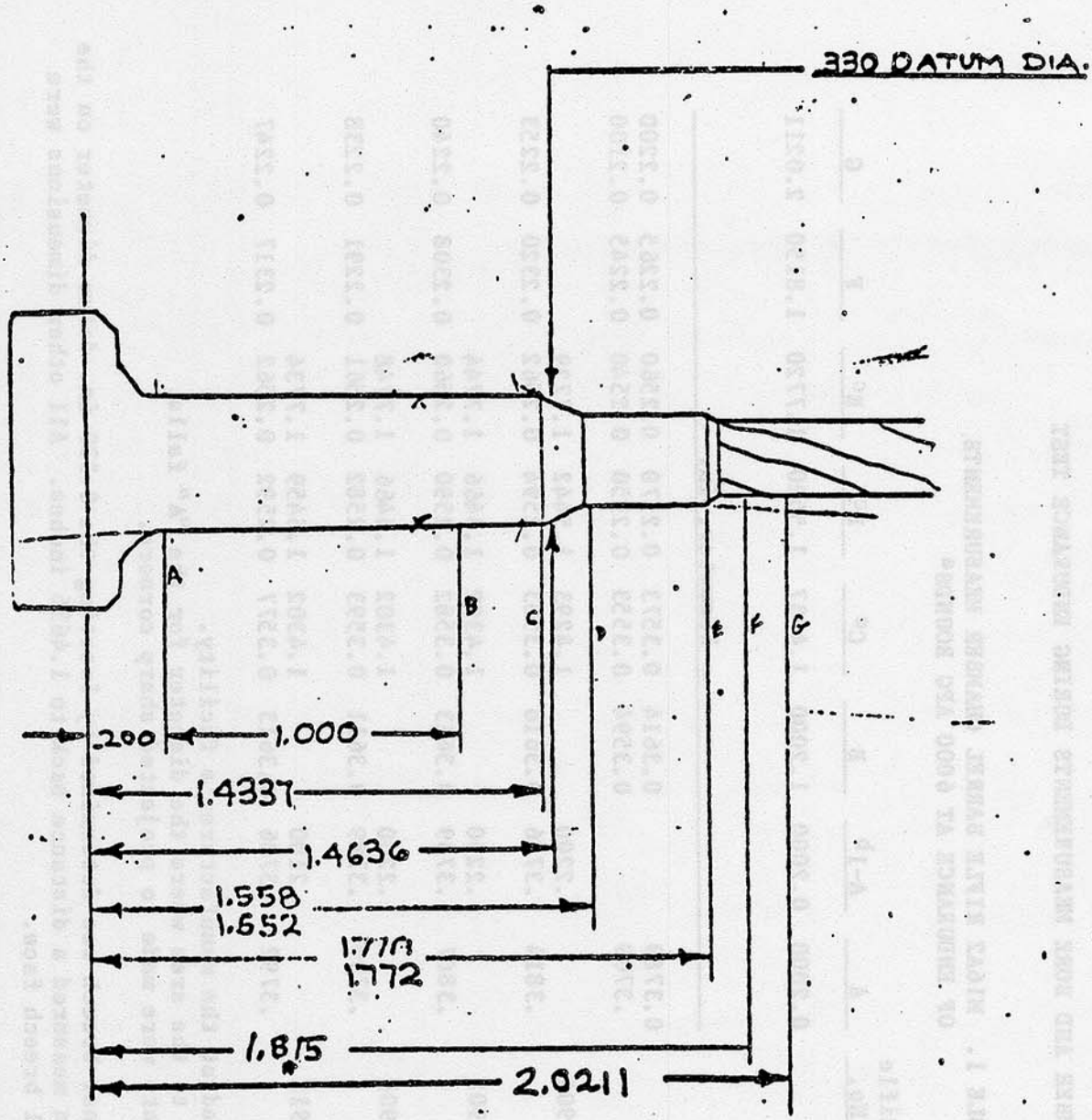
TABLE 1. M16A2 RIFLE BARREL CHAMBER MEASUREMENTS OF ENDURANCE AT 6000 APG ROUNDS[a]

	Rifle No.	A	A-1[b]	B	C[c]	D[c]	E[c]	F	G
Distance, from nominal breech face, in.		0.2000	0.2000	1.2000	1.4337	1.5520	1.7720	1.8150	2.0211
		Diameter, in.							
Maximum		0.3789		0.3614	0.3573	0.2570	0.2560	0.2265	0.2200
Minimum		.3769		0.3594	0.3553	0.2550	0.2540	0.2245	0.2100
Distance, in.	902		.2200		1.4293	1.5442	1.7729		
		.3814	.3786	0.3616	0.3583	0.2594	0.2562	0.2320	0.2253
Distance, in.	905		.2200		1.4302	1.5466	1.7744		
		.3807	.3789	0.3613	0.3582	0.2590	0.2560	0.2308	0.2240
Distance, in.	908		.2200		1.4302	1.5466	1.7748		
		.3799	.3789	0.3611	0.3593	0.2582	0.2561	0.2291	0.2238
Distance, in.	912		.2100		1.4302	1.5459	1.7734		
		.3792	.3786	0.3613	0.3577	0.2592	0.2562	0.2317	0.2247

[a]6000 rounds were previously fired at the manufacturer's facility.
[b]Distance measurements were made to the area where the diameter for the "A" falls.
[c]Distance and diameter measurements were made to projected sharp corners.

Notes: The position of the nominal breech was determined by locating the 0.330 in. datum diameter on the front chamber slope, then measured a distance back to 1.4636 inches. All other dimensions were referenced to the nominal breech face.

CHAMBER AND BORE MEASUREMENTS DURING ENDURANCE TEST



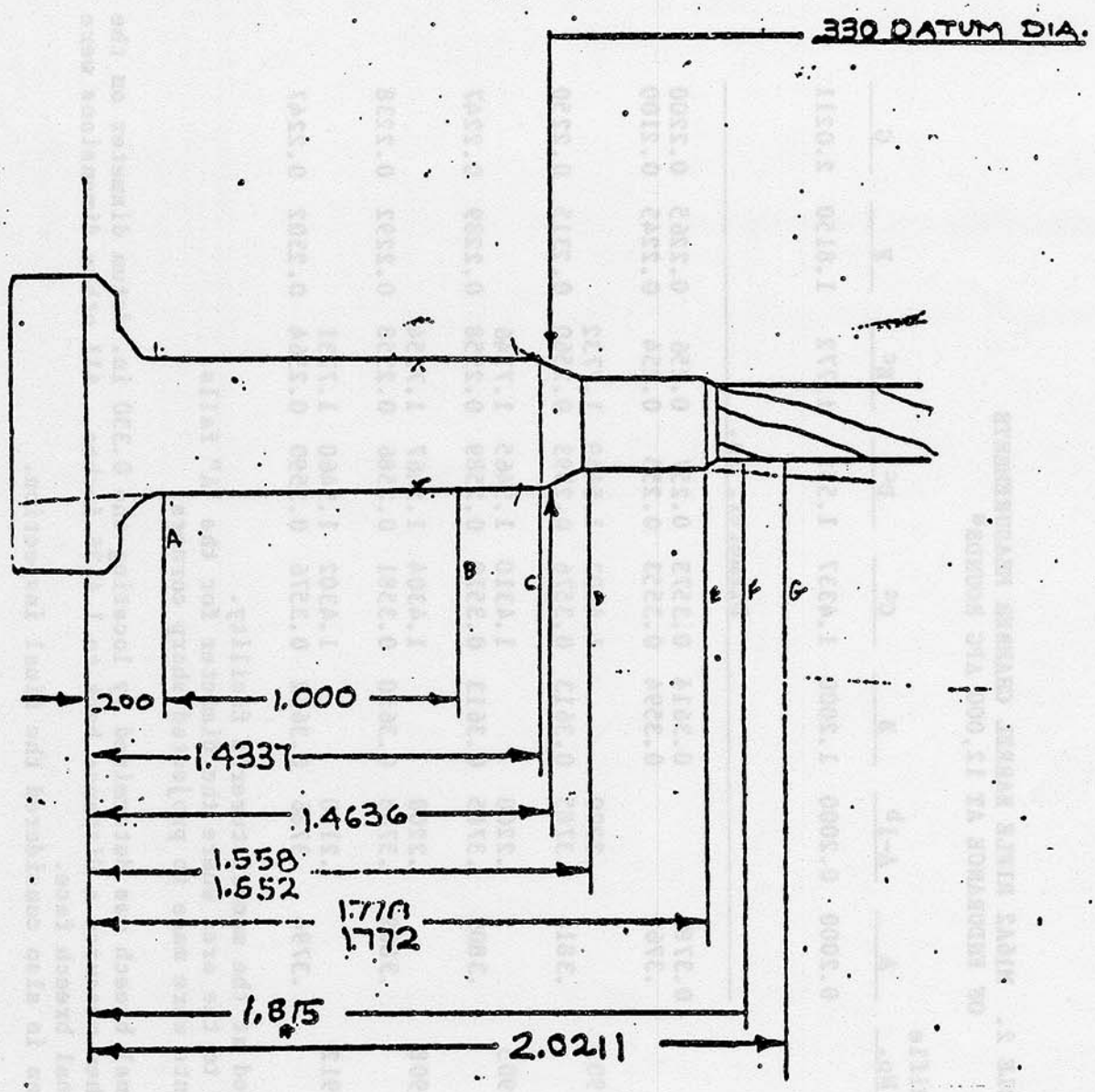
.5.56mm CHAMBER CAST

TABLE 2. M16A2 RIFLE BARREL CHAMBER MEASUREMENTS OF ENDURANCE AT 12,000 APG ROUNDS[a]

	Rifle No.	A	A-1[b]	B	C[c]	D[c]	E[c]	F	G
Distance, from nominal breech face, in.		0.2000	0.2000	1.2000	1.4337	1.552	1.772	1.8150	2.0211
		Diameter, in.							
Maximum		0.3789		0.3614	0.3573	0.257	0.256	0.2265	0.2200
Minimum		.3769		0.3594	0.3553	0.255	0.254	0.2245	0.2100
Distance, in.	902		.2200		1.4292	1.5449	1.7732		
		.3814	.3785	0.3613	0.3576	0.2593	0.2560	0.2315	0.2250
Distance, in.	905		.2200		1.4310	1.5465	1.7746		
		.3809	.3785	0.3613	0.3578	0.2589	0.2558	0.2289	0.2247
Distance, in.	908		.2200		1.4304	1.5467	1.7754		
		.3802	.3788	0.3610	0.3581	0.2586	0.2558	0.2292	0.2238
Distance, in.	912		.2100		1.4302	1.5460	1.7731		
		.3794	.3786	0.3612	0.3576	0.2590	0.2564	0.2302	0.2247

[a]6000 rounds were previously fired at the manufacturer's facility.
[b]Distance measurements were made to the area where the diameter for the "A" falls.
[c]Distance and diameter measurements were made to projected sharp corners.

Notes: The position of the nominal breech was determined by locating the 0.330 in. datum diameter on the front chamber slope, then measured a distance back to 1.4636 inches. All other dimensions were referenced to the nominal breech face.
This 1200-round inspection is also considered the final inspection.



5.56 mm CHAMBER CAST

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1 - 4	LANDS .2190" 2 - 5	LANDS .2190" 3 - 6	GROOVES .2235 1 - 4	GROOVES .2235 2 - 5	GROOVES .2235 3 - 6
1.35	+.0005	+.0006	+.0006	+.0010	+ 8	+ 9
2.00	4	2	3	6	6	5
3.00	3 2	2 2	3	5	4	4
4.00	3	2 2	3	4	3	2
5.00	2 2	2	2	4	3	3
6.00	2 2	2	2	4	3	3
7.00	2	1	2	4	3	4
8.00	1	3	+ 1	6*	3	3
9.00	2	1	0	4	3	3
10.00	3 3 3 2	2	+ 3	5	4	5
11.00	3	2	2	6	5	5
12.00	3 2	2	2	6	5	5
13.00	2	3	1	7	5	6
14.00	3	3	4	7	7	6
15.00	4	3	2	7	6	6
16.00	4	2	3	9	8	7
17.00	4	4	4	8	8	7
18.00	3	4	2	10	9	8
18.35	4	5	1	10	9	9
18.85	29	22	27	11	10	11
19.10	+.0046	+.0037	+.0036	+ 12	+ 12	+ 12

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder and forcing cone. Moderate erosion starting at the case clearance shoulder; 1.65 inches from the rear face of barrel (RFT), and extending forward into the lands and grooves to 2.50 inches from the RFT. The lands are chipped with heavy pitting, heat checking, light stress patterns and moderate copper and carbon deposits, starting at the origin of rifling and extending forward to 2.30 inches from the RFT. Moderate to heavy pitting in the grooves with light erosion and light to moderate carbon and copper deposits starting at the origin of rifling and extending forward to 8.35 inches from the RFT. Light to moderate carbon and copper deposits and light intermittent pitting throughout the remainder of the bore. Light intermittent tool chatter marks thoroughout the bore. Heavy erosion at the forward edge of the gas port.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

CASTING NUMBER: X

MANUFACTURER: Z-WE-600-016-021 PROOF OFFICER John Scheuren W.O. 300-30426-40

MODEL: M16A2 Heavy Barrel

NUMBER OF ROUNDS: 12,000

NUMBER: 6000902

FIRING STATUS (Check One): BEFORE ; AFTER ✓

DATE OF GAUGING: 17 May 84

5.56 MM Barrel

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: PROOF OFFICER Jones Scheuren — Z-WE-600-016-027 — W.O. 300-30426-40

MODEL: M16 A2 HEAVY BARREL — NUMBER OF ROUNDS 12K

NUMBER: 600905 — FIRING STATUS (Check One): AFTER ✓ BEFORE

5.56 MM Barrel — DATE OF GAUGING 17 MAY 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1 - 4	LANDS .2190" 2 - 5	LANDS .2190" 3 - 6	GROOVES .2235 1 - 4	GROOVES .2235 2 - 5	GROOVES .2235 3 - 6
1.35	+.0001	+.0001	+.0002	+.0003	+.0002	+.0003
2.00	1	1	1	2	1	2
3.00	1	1	1	3	3	2
4.00	1	2	1	4	3	2
5.00	2	1	1	3	3	3
6.00	1	1	2	4	3	2
7.00	1	1	1	2	2	2
8.00	*1	0	1	* 2	1	1
9.00	0	-1	-1	2	1	0
10.00	1	+1	+1	2	1	2
11.00	1	2	2	2	3	2
12.00	2	2	2	4	4	3
13.00	2	1	1	4	2	3
14.00	3	0	3	3	3	4
15.00	1	2	3	3	5	3
16.00	1	4	1	6	4	2
17.00	3	0	1	4	2	4
18.00	2	1	2	4	5	6
18.35	1	3	5	5	7	6
18.85	25	23	20	7	9	5
19.10	+.0046	+.0046	+.0045	+.0010	+.0011	+.0008

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder and forcing cone. Moderate erosion starting at the case clearance shoulder; 1.65 from the rear face of barrel (RFB), and and extending forward into the lands and grooves, ending 2.70 inches from the RFB. The lands are chipped with heavy pitting, heat checking, light stress patterns, and moderate copper and carbon deposits starting at the origin of rifling and extending forward to 3.10 inches from the RFB. Heavy pitting in the grooves with light erosion, and light to moderate carbon and copper deposits starting at the origin of rifling and extending forward to 8.10 inches from the RFB. Light to moderate carbon and copper deposits and light to moderate intermittent pitting throughout the remainder of the bore. Light to moderate intermittent tool chatter marks throughout the bore. Heavy erosion at the forward edge of the gas port.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

STEAP-DS Form 206, 4 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: PROOF OFFICER Jond Schuren W.O. 300-30426-40 2-WE-600016 027

MODEL: M16 A2 HEAVY BARREL

NUMBER OF ROUNDS: 12K

NUMBER: 6000908

FIRING STATUS (Check One): BEFORE ; AFTER X

DATE OF GAUGING: 17 MAY 84

5.56 MM Barrel

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1 - 4	LANDS .2190" 2 - 5	LANDS .2190" 3 - 6	GROOVES .2235 1 - 4	GROOVES .2235 2 - 5	GROOVES .2235 3 - 6
1.35	+.0003	+.0004	5	+.0004	+.0004	+.0004
2.00	3	2	2	4	4	4
3.00	1	0	1	1	3	2
4.00	0	1	1	2	3	2
5.00	+1	1	0	2	3	2
6.00	0	0	-1	1	2	1
7.00	-1	-1	2	0	0	0
8.00	2	* +4	2	* 3	0	* 1
9.00	1	-1	1	0	1	0
10.00	1	-1	1	1	1	1
11.00	2	1	1	1	2	1
12.00	2	2	2	0	0	0
13.00	-1	1	2	-1	0	-1
14.00	0	3	2	0	0	1
15.00	+1	-1	+1	+2	3	+3
16.00	0	+1	1	2	3	2
17.00	-1	0	1	2	3	2
18.00	0	0	-2	3	3	4
18.35	-3	0	1	4	4	4
18.85	+27	+24	+33	5	5	5
19.10	+.0052	+.0048	+.0049	+.0006	+.0008	+.0006

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling:

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder and forcing cone. Moderate erosion starting at the case clearance shoulder; 1.65 from the rear face of barrel (RFB), and extending forward into the lands and grooves, ending 2.70 inches from the RFB. The lands are chipped with heavy pitting, heat checking, light stress patterns, and moderate copper and carbon deposits starting at the origin of rifling and extending forward to 3.10 inches from the RFB. Heavy pitting in the grooves with light erosion, and light to moderate carbon and copper deposits starting at the origin of rifling and extending forward to 8.10 inches from the RFB. Light to moderate carbon and copper deposits and light to moderate intermittent pitting throughout the remainder of the bore. Light to moderate intermittent tool chatter marks throughout the bore. Heavy erosion at the forward edge of the gas port.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel A2 HEAVY BARREL

CASTING NUMBER: X

MANUFACTURER: PROOF OFFICER John Schueren W.O. 300-30426-40

MODEL: M16 A2 HEAVY Barrel

NUMBER OF ROUNDS: 12K

NUMBER: 60009 12

FIRING STATUS (Check One): AFTER ✓ BEFORE

5.56 MM Barrel

DATE OF GAUGING: 17 May 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. Indicated in .0001 of an inch LANDS .2190" 1 - 4	2 - 5	3 - 6	GROOVES .2235 1 - 4	2 - 5	3 - 6
1.35	+.0007	+.0008	+.0007	+.0008	+.0009	+.0009
2.00	5	7	8	8	8	7
3.00	5	6	6	5	7	5
4.00	4	4	4	4	4	3
5.00	4	3	3	2	3	4
6.00	2	3	3	2	4	2
7.00	3	3	1	3	3	2
8.00	3	* 3	1	2	3	2
9.00	1	0	3	0	3	3
10.00	1	2	1	2	3	1
11.00	2	2	0	4	2	3
12.00	2	0	2	2	2	4
13.00	1	2	3	3	6	4
14.00	2	4	2	5	6	3
15.00	4	3	3	6	5	5
16.00	4	2	4	4	6	6
17.00	2	4	5	4	7	4
18.00	3	4	1	6	6	4
18.35	3	2	3	8	6	6
18.85	38	35	34	9	8	9
19.10	+.0052	+.0051	+.0052	+.0011	+.0011	+.0012

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder and forcing cone. Moderate erosion starting at the case clearance shoulder: 1.65 from the rear face of barrel (RFB), and extending forward into the lands and grooves, ending 2.70 inches from the RFB. The lands are chipped with heavy pitting, heat checking, light stress patterns, and moderate copper and carbon deposits starting at the origin of rifling and extending forward to 3.10 inches from the RFB. Heavy pitting in the grooves with light erosion, and light to moderate carbon and copper deposits starting at the origin of rifling and extending forward to 8.10 inches from the RFB. Light to moderate carbon and copper deposits and light to moderate intermittent pitting throughout the remainder of the bore. Light to moderate intermittent tool chatter marks throughout the bore. Heavy erosion at the forward edge of the gas port. The lands at the twelve and one o'clock positions have deep partially stripped lands approximately 0.15 inches long, located between 2.10 and 2.25 inches from the RFB.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel

CASTING NUMBER	MANUFACTURER	PROOF OFFICER Scheiren W.O. 300-30436-40
	2-WE-600-016-027	

MODEL	NUMBER OF ROUNDS	FIRING STATUS (Check One)
M16A2 heavy barrel	18K (Finish)	AFTER ✓ / BEFORE
600902		

5.56 MM Barrel	DATE OF GAUGING 15 July 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch LANDS .2190" 1 - 4	2 - 5	3 - 6	GROOVES .2235 1 - 4	2 - 5	3 - 6
1.35	+.0005	+.0007	+.0007	+.0010	+.0010	+.0008
2.00	5	2	4	7	6	7
3.00	2	3	4	6	6	6
4.00	3	3	3	6	4	5
5.00	2	2	2	5	4	5
6.00	2	3	2	6	4	4
7.00	1	2	3	5	4	4
8.00	+ 3	4	+ 1	★ 6	4	4
9.00	0	1	0	5	5	3
10.00	+ 3	3	+ 4	5	6	5
11.00	4	4	3	6	5	5
12.00	3	3	3	6	5	5
13.00	3	3	3	6	6	6
14.00	2	3	4	6	6	6
15.00	3	4	2	7	6	6
16.00	4	3	2	7	6	7
17.00	5	3	3	7	7	7
18.00	5	3	2	10	8	9
18.35	3	4	3	10	10	9
18.85	52	51	55	12	12	11
19.10	+.0062	+.0063	+.0063	+.0012	+.0012	+.0012

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

★ 8.00" has a gas port. Actual reading taken at 8.10".

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder, and forcing cone. Moderate to heavy erosion around the periphery of the case clearance shoulder and extending into the lands and grooves. The chrome plating is chipped away with heat checking and intermittent deep pitting into the base metal. The lands are flattened with moderate to heavy erosion located between the origin of rifling and 3.00 inches from the rear face of the barrel (RFB). The lands in this section of the bore are chipped, pitted, and have intermittent pieces of metal stripped out with heat checking and light stress patterns of the base metal. The grooves have moderate erosion with a heavy concentration of chipped out chrome plating and deep pits into the base metal located between the case clearance shoulder and 4.00 inches from the RFB. Deep, more widely dispersed pitting in the grooves continues forward to 9.00 inches from the RFB. The gas port has heavy (deep) erosion at the forward edge extending into the adjacent land and groove. The erosion in the adjacent land and groove rapidly decreases in severity and ends 0.25 of an inch forward of the gas port. Intermittent light to moderate carbon and copper deposits throughout the bore. The lands at the muzzle end of the barrel are worn to a chisel point. Light to moderate intermittent tool chatter marks throughout the bore.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel

CASTING NUMBER: X

MANUFACTURER: J-WE-600-016-027 PROOF OFFICER Sorensen W.O. 300-30436-40

MODEL: M16A2 heavy barrel NUMBER OF ROUNDS 18K (FINAL)

NUMBER: 600905 FIRING STATUS (Check One) AFTER ✓ BEFORE

5.56 MM Barrel DATE OF GAUGING 25 July 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch					
	LANDS .2190"			GROOVES .2235		
	1 - 4	2 - 5	3 - 6	1 - 4	2 - 5	3 - 6
1.35	+.0004	+.0004	+.0003	+.0003	+.0002	+.0003
2.00	1	0	- 1	2	2	3
3.00	1	+ 1	0	3	4	2
4.00	1	0	- 1	3	2	3
5.00	2	0	- 1	3	3	2
6.00	2	+ 1	+ 1	3	3	2
7.00	2	+ 1	0	2	2	3
8.00 ★	2	0	- 1	★ 2	2	1
9.00	- 1	- 1	1	2	1	1
10.00	0	- 1	- 1	2	1	1
11.00	+ 1	+ 1	0	2	3	2
12.00	2	0	0	4	3	3
13.00	2	- 1	- 1	3	1	2
14.00	2	+ 1	0	1	3	3
15.00	0	+ 3	+ 1	2	4	2
16.00	0	0	- 1	4	3	1
17.00	2	- 1	2	4	1	3
18.00	+ 1	+ 1	- 1	4	5	6
18.35	0	2	+ 1	5	7	6
18.85	+ 56	53	52	8	10	6
19.10	+.0061	+.0063	+.0060	+.0012	+.0011	+.0010

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

★8.00" has a gas port. Actual READING taken at 8.10".

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder, and forcing cone. Moderate to heavy erosion around the periphery of the case clearance shoulder and extending into the lands and grooves. The chrome plating is chipped away with heat checking and intermittent deep pitting into the base metal. The lands are flattened with moderate to heavy erosion located between the origin of rifling and 3.00 inches from the rear face of the barrel (RFB). The lands in this section of the bore are chipped, pitted, and have intermittent pieces of metal stripped out with heat checking and light stress patterns of the base metal. The grooves have moderate erosion with a heavy concentration of chipped out chrome plating and deep pits into the base metal located between the case clearance shoulder and 4.00 inches from the RFB. Deep, more widely dispersed pitting in the grooves continues forward to 9.00 inches from the RFB. The gas port has heavy (deep) erosion at the forward edge extending into the adjacent land and groove. The erosion in the adjacent land and groove rapidly decreases in severity and ends 0.25 of an inch forward of the gas port. Intermittent light to moderate carbon and copper deposits throughout the bore. The lands at the muzzle end of the barrel are worn to a chisel point. Light to moderate intermittent tool chatter marks throughout the bore. Light to moderate intermittent pitting located between 9.00 inches from the RFB and the muzzle end of the barrel.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

STEAP-DS Form 106, 17 Jun 64 (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel

CASTING NUMBER: X

MANUFACTURER: 2-WE-600-016-027 PROOF OFFICER Scheuren W.O. 300-30436-40

MODEL: M16A2 heavy barrel

NUMBER OF ROUNDS: 18K (FINAL)

NUMBER: 600908

FIRING STATUS (Check One): BEFORE ____ AFTER X

5.56 MM Barrel

DATE OF GAUGING: 25 July 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch: LANDS .2190" 1 - 4	LANDS .2190" 2 - 5	LANDS .2190" 3 - 6	GROOVES .2235 1 - 4	GROOVES .2235 2 - 5	GROOVES .2235 3 - 6
1.35	+.0004	+.0004	+.0002	+.0005	+.0005	+.0005
2.00	+ 1	1	+ 2	4	3	4
3.00	0	1	0	3	3	3
4.00	+ 2	+ 1	0	4	3	4
5.00	0	0	+ 1	3	3	4
6.00	0	0	0	2	2	3
7.00	- 2	- 2	- 1	1	+ 1	1
8.00	1	2	2	1	0	2
9.00	2	2	1	1	+ 1	1
10.00	3	1	2	1	1	2
11.00	2	2	1	+ 1	1	+ 2
12.00	3	2	2	0	+ 1	0
13.00	4	3	3	0	0	0
14.00	2	- 8	- 2	0	0	- 1
15.00	- 7	0	0	+ 3	+ 2	+ 1
16.00	0	0	0	3	+ 1	1
17.00	0	0	- 1	2	0	1
18.00	- 1	0	1	2	+ 1	4
18.35	- 2	- 1	- 2	3	4	4
18.85	+ 54	+ .51	+ 52	6	7	6
19.10	+.0063	+.0060	+.0061	+.0009	+.0010	+.0010

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder, and forcing cone. Moderate to heavy erosion around the periphery of the case clearance shoulder and extending into the lands and grooves. The chrome plating is chipped away with heat checking and intermittent deep pitting into the base metal. The lands are flattened with moderate to heavy erosion located between the origin of rifling and 3.00 inches from the rear face of the barrel (RFB). The lands in this section of the bore are chipped, pitted, and have intermittent pieces of metal stripped out with heat checking and light stress patterns of the base metal. The grooves have moderate erosion with a heavy concentration of chipped out chrome plating and deep pits into the base metal located between the case clearance shoulder and 4.00 inches from the RFB. Deep, more widely dispersed pitting in the grooves continues forward to 9.00 inches from the RFB. The gas port has heavy erosion and deep scoring at the forward edge extending into the adjacent land and groove. The erosion in the adjacent land and groove rapidly decreases in severity and ends 0.25 of an inch forward of the gas port. Intermittent light to moderate carbon and copper deposits throughout the bore. The lands at the muzzle end of the barrel are worn to a chisel point. Light to moderate intermittent tool chatter marks throughout the bore.

NOTE : Six thousand rounds were fired at the manufacturer's facility prior to testing at APG.

STEAP-DS Form 106, 17 Jun... (Part I)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 MM Barrel

CASTING NUMBER	MANUFACTURER	MODEL	NUMBER	FIRING STATUS (Check One)	DATE OF GAUGING
X	2-WE-600-016-027 PROOF OFFICER SCHEUREN W.O. 300-30436-40	M16A2 heavy barrel NUMBER OF ROUNDS 18K (FINAL)	600912	AFTER ✓ BEFORE	25 July 84

Dist. (inches) From Face of Flash Suppressor	Gage Meas. indicated in .0001 of an inch LANDS .2190" 1 - 4	2 - 5	3 - 6	GROOVES .2235 1 - 4	2 - 5	3 - 6
1.35	+.0008	+.0007	+.0007	+.0008	+.0008	+.0007
2.00	7	8	5	8	8	8
3.00	6	5	5	6	6	6
4.00	5	3	4	5	4	4
5.00	3	3	2	3	4	4
6.00	3	3	1	3	2	2
7.00	3	1	+ 2	3	3	3
8.00	+★ 1	1	0	2	3	2
9.00	- 1	+ 3	0	1	3	3
10.00	+ 2	0	+ 1	2	1	1
11.00	+ 1	0	2	4	3	2
12.00	0	+ 2	1	2	4	4
13.00	+ 2	+ 3	1	3	4	3
14.00	4	0	4	5	2	2
15.00	2	+ 2	3	5	4	4
16.00	2	4	1	3	5	5
17.00	4	5	3	3	3	3
18.00	2	2	3	7	4	4
18.35	4	4	4	8	7	7
18.85	61	56	58	11	10	9
19.10	+.0063	+.0064	+.0063	+.0015	+.0016	+.0013

Land No.1 at 12 o'clock (Muzzle)

Twist of Rifling: 1/7

★ 8.00" Lasa gas port. Actual READING TAKEN at 8.10".

Borescope Remarks:

Light to moderate circumferential tool marks on the chamber front slope, centering cylinder, and forcing cone. Moderate to heavy erosion around the periphery of the case clearance shoulder and extending into the lands and grooves. The chrome plating is chipped away with heat checking and intermittent deep pitting into the base metal. The lands are flattened with moderate to heavy erosion located between the origin of rifling and 3.00 inches from the rear face of the barrel (RFB). The lands in this section of the bore are chipped, pitted, and have intermittent pieces of metal stripped out with heat checking and light stress patterns of the base metal. The grooves have moderate erosion with a heavy concentration of chipped out chrome plating and deep pits into the base metal located between the case clearance shoulder and 4.00 inches from the RFB. Deep, more widely dispersed pitting in the grooves continues forward to 9.00 inches from the RFB. The gas port has heavy (deep) erosion at the forward edge extending into the adjacent land and groove. The erosion in the adjacent land and groove rapidly decreases in severity and ends 0.25 of an inch forward of the gas port. Intermittent light to moderate carbon and copper deposits throughout the bore. The lands at the muzzle end of the barrel are worn to a chisel point. Light to moderate intermittent tool chatter marks throughout the bore. Light to moderate intermittent pitting located between 9.00 inches from the RFB and the muzzle end of the barrel.

NOTE : Six thousand rounds were fired at the manufactu prior to testing at APG.

STEAP-DS Form 106, 17 Jun 81 (Part I)

MALFUNCTIONS OF THE M16A2 RIFLE DURING EXTREME TEMPERATURE TEST AT -45.6° C (-50° F)

Rifle No.	Type of Malf	Firing Mode[a]	Life Period	Magazine Round No.	Subtest Round	Magazine No.	Cycle No.[b]
906	BD	B	214	5	124	6B	3
	BD	B	222	13	132	6B	
	BD	B	224	15	134	6B	
	FF	SA	422	3	332	6B	
	FF	SA	425	6	335	6B	
	FF	SA	429	10	339	6B	
	FF	SA	434	15	344	6B	
	FF	SA	513	4	423	6C	4
	FF	SA	516	7	426	6C	
	FF	SA	519	10	429	6C	
	FF	SA	521	12	431	6C	
	FF	SA	527	18	437	6C	
	FF	SA	535	26	445	6C	
	FF	B	604	5	514	6B	5
	FF	B	616	17	526	6B	
	FF	B	619	20	529	6B	
	FFR	SA	637	8	547	6C	
	FF	B	813	4	723	6C	7
	FF	B	816	7	726	6C	
	FF	B	819	10	729	6C	
	FF	SA	914	5	824	6C	
	FF	SA	924	15	834	6C	
	FF	SA	928	19	838	6B	
	FF	B	1083	4	993	6B	9
	FF	B	1086	7	996	6B	
	FF	B	1089	10	999	6B	
	FF	B	1095	16	1005	6B	
	FF	B	1173	4	1083	6B	10
	FF	B	1176	7	1086	6B	
	FF	B	1179	10	1089	6B	
	FF	B	1203	4	1113	6B	
	FF	B	1229	30	1139	6B	
	FF	SA	1356	7	1266	6A	11
	FF	B	1412	3	1322	6D	12
	FF	B	1414	5	1324	6D	
	FF	B	1416	7	1326	6D	
	FF	B	1418	9	1328	6D	
	FF	B	1420	11	1330	6D	
	FF	B	1422	13	1332	6D	
	FF	B	1424	15	1334	6D	
	FF	B	1426	17	1336	6D	
	FF	B	1428	19	1338	6D	
	FF	B	1430	21	1340	6D	
	FF	B	1432	23	1342	6D	
	FF	B	1434	25	1344	6D	
	FF	B	1436	27	1346	6D	
	FF	B	1438	29	1348	6D	

See footnotes at end of table.

Rifle No.	Type of Malf	Firing Mode[a]	Life Period	Magazine Round No.	Subtest Round	Magazine No.	Cycle No.[b]
906	FF	SA	1472	3	1382	6B	12
	FF	SA	1474	5	1384	6B	
	FF	SA	1476	7	1386	6B	
	FF	SA	1478	9	1388	6B	
	FF	SA	1480	11	1390	6B	
	FF	SA	1482	13	1392	6B	
	FF	SA	1484	15	1394	6B	
	FF	SA	1486	17	1396	6B	
	FF	SA	1488	19	1398	6B	
	FF	SA	1490	21	1400	6B	
	FF	SA	1492	23	1402	6B	
	FF	SA	1496	27	1406	6B	
	FF	SA	1502	3	1412	6C	
	FF	SA	1504	5	1414	6C	
	FF	SA	1506	7	1416	6C	
	FF	SA	1508	9	1418	6C	
	FF	SA	1510	11	1420	6C	
	FF	SA	1512	13	1422	6C	
	FF	SA	1514	15	1424	6C	
	FF	SA	1516	17	1426	6C	
	FF	SA	1518	19	1428	6C	
	FF	SA	1520	21	1430	6C	
	FF	SA	1522	23	1432	6C	
	FF	SA	1524	25	1434	6C	
	FF	SA	1526	27	1436	6C	
	FF	SA	1528	29	1438	6C	
	FF	SA	1861	2	1771	6B	15
	FF	B	2012	3	1922	6A	17
	FF	B	2014	5	1924	6A	
	FF	B	2016	7	1926	6A	
	FF	B	2018	9	1928	6A	
	FF	B	2020	11	1930	6A	
	BOB	B	2035	26	1945	6A	
	FF	SA	2222	3	2132	6A	18
	FF	SA	2224	5	2134	6A	
	FF	SA	2226	7	2136	6A	
	FF	SA	2228	9	2138	6A	
	FF	SA	2230	11	2140	6A	
	FF	SA	2232	13	2142	6A	
	FF	SA	2238	19	2148	6A	
	FF	SA	2240	21	2150	6A	
	FF	SA	2245	26	2155	6A	
	FF	B	2251	2	2161	6C	19
	FF	B	2281	2	2191	6D	
	FF	SA	2315	6	2225	6A	
	FF	SA	2317	8	2227	6A	
	FF	SA	2319	10	2229	6A	
	FF	SA	2321	12	2231	6A	

See footnotes at end of table.

Rifle No.	Type of Malf	Firing Mode[a]	Life Period	Magazine Round No.	Subtest Round	Magazine No.	Cycle No.[b]
906	FF	SA	2323	14	2233	6A	
	FF	SA	2325	16	2235	6A	
	FF	SA	2327	18	2237	6A	
	FF	SA	2346	7	2256	6B	
	FF	SA	2438	9	2348	6B	20
	FF	SA	3392	3	3302	6B	28
	FF	SA	3393	4	3303	6B	
	FF	SA	3394	7	3304	6B	
	FF	B	3481	2	3391	6B	29
	FF	B	3482	3	3392	6B	
907	BD	SA	182	3	92	7D	1
	BD	SA	189	10	99	7D	
	BD	SA	198	19	108	7D	
	FF	SA	542	3	452	7A	4
	FF	SA	544	5	454	7A	
	FF	SA	546	7	456	7A	
	FF	SA	552	13	462	7A	
	FF	SA	554	15	464	7A	
	FF	SA	558	19	468	7A	
	FF	SA	568	29	478	7A	
	FF	SA	632	3	542	7C	5
	FF	SA	634	5	544	7C	
	FF	SA	636	7	546	7C	
	FF	SA	638	9	548	7C	
	FF	SA	642	13	552	7C	
	FF	SA	644	15	554	7C	
	FF	SA	646	17	556	7C	
	FF	SA	648	19	558	7C	
	FF	SA	656	27	566	7C	
	FF	B	723	4	633	7C	6
	FF	B	726	7	636	7C	
	FF	B	729	10	639	7C	
	FF	B	735	16	645	7C	
	FF	B	738	19	648	7C	
	FF	B	814	5	724	7C	7
	FF	B	817	8	727	7C	
	FF	B	823	14	733	7C	
	FF	B	829	20	739	7C	
	FF	B	832	23	742	7C	
	FF	B	838	29	748	7C	
	FF	SA	896	27	806	7A	
	FF	SA	902	3	812	7B	8
	FF	SA	1021	2	931	7C	
	FF	SA	1024	5	934	7C	
	FF	SA	1026	7	936	7C	
	FF	SA	1036	17	946	7C	
	FF	SA	1112	3	1022	7C	9
	FF	SA	1114	5	1024	7C	

See footnotes at end of table.

Rifle No.	Type of Malf	Firing Mode[a]	Life Period	Magazine Round No.	Subtest Round	Magazine No.	Cycle No.[b]
907	FF	SA	1116	7	1026	7C	
	FF	SA	1118	9	1028	7C	
	FF	SA	1120	11	1030	7C	
	FF	SA	1122	13	1032	7C	
	FF	SA	1124	15	1034	7C	
	FF	SA	1126	17	1036	7C	
	FF	SA	1128	19	1038	7C	
	FF	SA	1130	21	1040	7C	
	FF	SA	1132	23	1042	7C	
	FF	SA	1134	25	1044	7C	
	FF	SA	1136	27	1046	7C	
	FF	SA	1138	29	1048	7C	
	FF	B	1173	4	1083	7B	10
	FF	B	1176	7	1086	7B	
	FF	B	1202	3	1112	7C	
	FF	B	1204	5	1114	7C	
	FF	B	1206	7	1116	7C	
	FF	B	1208	9	1118	7C	
	FF	B	1210	11	1120	7C	
	FF	B	1212	13	1122	7C	
	FF	B	1214	15	1124	7C	
	FF	B	1216	17	1126	7C	
	FF	B	1218	19	1128	7C	
	FF	B	1220	21	1130	7C	
	FF	B	1222	23	1132	7C	
	FF	B	1224	25	1134	7C	
	FF	B	1226	27	1136	7C	
	FF	B	1228	29	1138	7C	
	FF	B	1237	8	1147	7D	1
	BOB	SA	1259	30	1169	7D	
	FF	SA	1276	17	1186	7A	
	FF	SA	1712	3	1622	7D	14
	BOB	SA	1768	29	1678	7A	
	BOB	SA	1949	30	1859	7A	16
	BOB	B	1964	15	1874	7B	
	BOB	SA	2039	30	1949	7A	17
	FF	B	2238	19	2148	7A	18
	FF	SA	2242	23	2152	7A	
	FF	SA	2244	25	2154	7A	19
	FF	SA	2330	21	2240	7A	
	FF	SA	2336	27	2246	7A	
	FF	SA	2338	29	2248	7A	
	FF	SA	3538	9	3448	7D	30
910	BOB	SA	412	23	322	10A	3
	BD	B	472	23	382	10D	4
	FF	B	509	30	419	10B	
	FF	B	577	8	487	10A	5
	FFR	B	629	30	539	10B	

See footnotes at end of table.

Rifle No.	Type of Malf	Firing Mode[a]	Life Period	Magazine Round No.	Subtest Round	Magazine No.	Cycle No.[b]
910	BD	SA	686	27	596	10D	
	FF	SA	752	3	662	10D	6
	FF	SA	754	5	664	10D	
	FF	SA	756	7	666	10D	
	FF	B	906	7	876	10A	8
	FF	B	978	19	888	10A	
	FF	SA	1142	3	1052	10D	9
	FF	SA	1144	5	1054	10D	
	FF	SA	1146	7	1056	10D	
	FF	SA	1148	9	1058	10D	
	FF	SA	1150	11	1060	10D	
	FF	SA	1152	13	1062	10D	
	FF	SA	1154	15	1064	10D	
	FF	SA	1158	19	1068	10D	
	FF	SA	1262	3	1172	10A	10
	FF	SA	1264	5	1174	10A	
	FF	SA	1266	7	1176	10A	
	FF	SA	1268	9	1178	10A	
	FF	SA	1270	11	1180	10A	
	FF	SA	1272	13	1182	10A	
	FF	SA	1274	15	1184	10A	
	FF	SA	1278	19	1188	10A	
	FF	SA	1280	21	1190	10A	
	FF	SA	1286	27	1196	10A	
	FF	SA	1352	3	1262	10A	11
	FF	SA	1354	5	1264	10A	
	FF	SA	1356	7	1266	10A	
	FF	SA	1358	9	1268	10A	
	FF	SA	1360	11	1270	10A	
	FF	SA	1362	13	1272	10A	
	FF	SA	1364	15	1274	10A	
	FF	SA	1366	17	1276	10A	
	FF	SA	1376	27	1286	10A	
	BOB	SA	1498	29	1408	10B	12
	FF	B	1562	3	1472	6B	13
	FF	B	1564	5	1474	6B	
	FF	B	1566	7	1476	6B	
	FF	B	1568	9	1478	6B	
	FF	B	1570	11	1480	6B	
	FF	B	1572	13	1482	6B	
	FF	B	1574	15	1484	6B	
	FF	B	1576	17	1486	6B	
	FF	B	1578	19	1488	6B	
	FF	B	1580	21	1490	6B	
	FF	B	1582	23	1492	6B	
	FF	B	1584	25	1494	6B	
	FF	B	1586	27	1496	6B	
	FF	B	1588	29	1498	6C	

See footnotes at end of table.

Rifle No.	Type of Malf	Firing Mode[a]	Life Period	Magazine Round No.	Subtest Round	Magazine No.	Cycle No.[b]
910	FF	B	1592	3	1502	6C	
	FF	B	1594	5	1504	6C	
	FF	B	1596	7	1506	6C	
	FF	B	1598	9	1508	6C	
	FF	B	1600	11	1510	6C	
	FF	B	1602	13	1512	6C	
	FF	B	1604	15	1514	6C	
	FF	B	1606	17	1516	6C	
	FF	B	1608	19	1518	6C	
	FF	B	1610	21	1520	6C	
	FF	B	1612	23	1522	6C	
	FF	B	1614	25	1524	6C	
	FF	B	1616	27	1526	6C	
	FF	B	1618	29	1528	6C	
	FF	B	1798	29	1708	10C	15
	BOB	SA	1978	29	1888	10B	16
	FFR	B	2617	8	2527	10B	22

[a]Six thousand rounds were fired at the manufacturer's facility.
[b]One hundred twenty rounds were fired in each cycle.

FF = Failure-to-feed.
BD = Buffer disconnection.
FFR = Failure-to-fire.
BOB = Bolt over base.
B = Burst.
SA = Semi-automatic.
Malf = Malfunction.

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