DEPARTMENT OF THE ARMY Mr Morrow/sr/234-3350-4476
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC

16 SEP 1970

SUBJECT: Monthly QA Test of M16A1 Rifles and Ammunition, USATECOM Project No. 8-WE-600-016-003

69 Ja

Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-MT
Aberdeen Proving Ground, Md 21005

1. Reference letter, STEAP-MT-TI, APG, 8 Sep 1970, subject as above.

2. The results of Colt endurance tests for August are shown as failing to meet specifications because of an excessive number of malfunctions. The majority of these malfunctions are ascribed to the gunner holding the weapon so that the magazine was bearing against the sandbag rest.

3. The inference is that the weapon may not be at fault, but no comment or recommendation is provided that:

a. The test should be rerun or invalidated.

b. Comparative firings be conducted to verify the effect.

c. Firing procedures will be revised to assure noninterference with the magazine, and that this should be incorporated in specifications.

4. Several years ago, an extensive test was conducted by the Air Force for PM-Rifles in which the magazine was used as a hand hold during firing. No increase in malfunctions was noted, and this appears to be at odds with your comment in subject report.

5. Clarification and comment is required.

FOR THE COMMANDER:

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

AMSTE-BC 16 SEP 1970

SUBJECT: Monthly QA Test of M16A1 Rifles and Ammunition, USATECOM Project No. 8-WE-600-016-003

Copy furnished:
PM Rifles, USAWECOM

STEAP-MT-TI (16 Sep 70) 1st Ind IMichelson/esh/234-3350/3136
SUBJECT: Monthly QA Test of M16A1 Rifles and Ammunition, USATECOM Project No. 8-WE-600-016-003

DA, Aberdeen Proving Ground 29 SEP 1970

TO: Commanding General, US Army Test and Evaluation Command, ATTN: AMSTE-BC

1. Reference Paragraph 2 of basic letter. Only Colt Rifle No. 4147483 failed to meet the requirements of SAPD-253F. Colt Rifle No. 4155150 was satisfactory.

2. Reference Paragraph 3 of basic letter.

a. A total of four weapons were tested during the month of August. All four were tested by the same two gunners. Both alternately fired each weapon, 3000 rounds/weapon/gunner, for a total of 6000 rounds/weapon. When either gunner was firing a weapon, he did not hold or fire that specific rifle any differently than the other three. Therefore, when the gunner in question fired the four weapons, the magazines of all were being pushed against the sandbag rest. Only one of the weapons, Serial No. 4147483, was adversely affected. Six malfunctions occurred in 1500 rounds of firing with pressure exerted against the front of the magazine and three malfunctions occurred in 4500 rounds of firing with no pressure on the magazine. Four malfunctions of this type are permitted during the firing of 6000 rounds by SAPD-253F. Therefore, it is concluded that: (a) this particular weapon is marginal relative to functioning, and (b) the magazine-weapon relationship could be a dimensional problem.

b. The subject test is considered valid and a rerun is not recommended.

c. Comparative firings have already been accomplished during the testing of the other three samples.

3. Reference Paragraph 4 of basic letter. The Air Force test substantiates the tests performed by APG in that the weapon in question is unsatisfactory.

FOR THE COMMANDER:

s/ H. A. Beckstof

R. P. WITT
Associate Director
Materiel Testing Directorate

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

Mr Crider/sr/234-3350-3608

13 OCT 1970

AMSTE-BC

SUBJECT: Monthly QA Test of M16 Rifles and Ammunition, USATECOM Project No. 8-WE-600-016-003

Product Manager, Rifles
US Army Weapons Command
Rock Island, Ill 61201

1. References:

a. Letter, STEAP-MT-TI, APG, dated 8 Sep 70, subject as above.

b. Letter, AMSTE-BC, HQ USATECOM, dated 16 Sep 70, subject as above.

2. In response to references, the following additional information is provided:

a. A total of four weapons was tested during the month of August. All four were tested by the same two gunners. Both alternately fired each weapon, 3000 rounds/weapon/gunner, for a total of 6000 rounds/weapon. When either gunner was firing a weapon, he did not hold or fire that specific rifle any differently than the other three. Therefore, when the gunner in question fired the four weapons, the magazines of all were being pushed against the sandbag rest. Only one of the weapons, Serial No. 4147483, was adversely affected. Six malfunctions occurred in 1500 rounds of firing with pressure exerted against the front of the magazine and three malfunctions occurred when 4500 rounds of firing with no pressure on the magazine. Four malfunctions of this type are permitted during the firing of 6000 rounds by SAPD-253F. Therefore, it is concluded that: (a) this particular weapon is marginal relative to functioning, and (b) the magazine-weapon relationship could be a dimensional problem.

b. The subject test is considered valid and a rerun is not recommended.

B-349

AMSTE-BC

13 OCT 1970

SUBJECT: Monthly QA Test of M16A1 Rifles and Ammunition, USATECOM Project No. 8-WE-600-016-003

3. This command has taken action to assure that future firings will be conducted with the magazines unrestrained.

FOR THE COMMANDER:

V. KOVALEVSKY
Colonel, GS
Dir, Inf Mat Test

Copy furnished:
CO APG ATTN: STEAP-MT-TI

U. S. ARMY MATERIEL COMMAND
OFFICE OF THE PROJECT MANAGER, RIFLES
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61201

JA 22-1

15 OCT 1969

SUBJECT: USATECOM Project No. 8-8-0230-03
Monthly CA Test of M16A1 Rifles

Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Md. 21005

1. Reference:

a. AMCPM-RS DF dated 7 Oct 69, subject: M16A1 Rifle Endurance Test, Incl 1.

b. AMCPM-RS letter dated 9 June 1969, subject: FY70 M16A1 Rifle Endurance (Reliability) Test - USATECOM Project No. 8-8-0230-03.

c. AMCPM-RS Message No. 8229 dated 2 Apr 69, subject: M16A1 Rifle Endurance (Reliability) Test.

2. The test results obtained during subject tests of Colt's June and July 1969 production were not received by this office until the last week of September 1969.

3. The purpose for conducting the subject test is to provide this office with an independent evaluation of the M16A1 Rifle System in a timely manner so that corrective action may be taken, when appropriate, at the contractor's facility, prior to shipping additional rifles for field use.

4. It is of the utmost importance that your test be conducted immediately upon receipt of the test rifles and that significant malfunctions and unserviceable parts be promptly reported to this office. Expeditious action on the part of all concerned will preclude the need to recall or repair weapons issued to the troops. This is not only a costly procedure but has an adverse affect on troop morale.

5. The three rifle producers and corresponding DCAS Inspection Offices have been instructed by letter of the importance of shipping the test rifles to TECOM immediately upon acceptance of the rifle lot (copies inclosed).

AMCPM-RS
SUBJECT: USATECOM Project No. 8-8-0230-05
Monthly QA Test of M16A1 Rifles

15 OCT 1969

6. It is requested that immediately upon receipt of each test rifle an endurance test be conducted in accordance with Appendix G of RAPD-253F dated 22 November 1968 except the rifle shall be fired from the shoulder as specified in reference 1c above. Ammunition requirements for the test program, reference 1b, shall be coordinated with Frankford Arsenal.

7. It is further requested that each test be completed within four days after receipt of the test rifle, and that Mr. H. Martin, Quality Assurance Director, Office of the Project Manager, Rifles, Ext 6641 be informed during conduct of the test of any significant malfunction or unserviceable parts. A monthly written summary report of all tests completed during the month shall be forwarded to this office to arrive on or before the fourth day of the following month. The Office of the Project Manager Rifles shall be responsible for the distribution of this report.

2 Incl
as

ALWIN C. ISAACS
Colonel, OrdC
Project Manager, Rifles

CF:
ADCSLOG(P&R) COL Cumbie
AMCQA-P, Mr. Tiner
STEAP-MT-TI, Mr. Doiliny
SMUFA-B3000, COL Johnson

M16A1 Rifle Endurance Reliability Test

AMSWE-SMD-I AMCPM-RS 7 OCT 1969

Mr. Grace/cap/6818

1. Reference my DF dated 10 Jun 69, subject same as above (Incl 1).

2. When preparing the shipping instruction for each month, it is considered necessary that additional rifle selection instructions be included for the Government QAR and producer. The additional instructions should include selection method and shipping requirements. Recommend the following instructions be used as a note on the shipping directives.

a. For Contracts DAAF03-69-C-0021 and DAAF03-70-C-0001. "The Government QAR will randomly select one (1) rifle from each of the first four (4) lots of rifles accepted during the production period. Each rifle will be shipped to arrive at destination within five (5) days after acceptance."

b. For Contracts DAAF03-68-C-0045, DAAF03-68-C-0048 and DAAF03-70-C-0002. "The Government QAR will select one (1) rifle from each of two (2) lots of rifles during the production period. Each rifle will be shipped to arrive at destination within five (5) days after acceptance."

FOR THE PROJECT MANAGER:

1 Incl
as

CHARLES P. SLADEK
Chief
Supply-Maintenance Div.

Cy Furn:
AMSWE-QA
AMSWE-PPC
AMCPMSO-RS, LTC Semmler
AMCPM-RS-QA, Mr. Martin

M16A1 Rifle Endurance Reliability Test

AMSWE-SMD-I

AMCPM-RS

10 JUN 1969

Mr. Grace/cap/5383

1. The subject test, USATECOM project 8-8-0230-05, will be continued for rifles from production through June 1970. Rifles are required from each producer for each month as follows.

	Colts	GMC	H&R	Total
July 69	4	1	1	6
Aug	2	2	1	5
Sep	4	2	1	7
Oct	4	2	1	7
Nov	4	2	2	8
Dec	4	2	2	8
Jan 70	4	2	2	8
Feb	4	2	2	8
Mar thru Jun 70	To be provided at a later date			

2. The above weapons are included in the rifles allocated to the PMO for tests.

3. Rifles are to be shipped to the Materiel Test Directorate, Aberdeen Proving Ground, Md., marked for USATECOM Project 8-8-0230-05. Weapons will be selected by the government QAR in each plant and no more than one rifle will be taken from a lot of rifles. The required delivery date is no later than five (5) days after the production month.

FOR THE PROJECT MANAGER:

CHARLES P. SLADEK
Chief
Supply-Maintenance Div.

Cy Furn:
AMSWE-QA
AMCPM-RS, Mr. Martin
AMCPMSO-RS

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY WEAPONS COMMAND
ROCK ISLAND ARSENAL

9 OCT 1969

AMSWE-PPC

SUBJECT: M16A1 Rifle Endurance Reliability Test, USATECOM, Project 8-8-0230-05

Commander
Defense Contract Administration
Services District
557 Asylum Ave
Hartford, Connecticut 06105

The subject test is a requirement of higher Headquarters on an accelerated basis. To meet the direction received, request the required rifles from Contract DAAF03-69-C-0021 and DAAF03-70-C-0001 be selected and actions performed as follows.

a. Request the Government QAR randomly select one (1) rifle from each of the first four (4) lots of rifles accepted for shipment. The shipping instructions will be provided in the normal manner each month.

b. Request the selected rifles be shipped immediately upon acceptance without waiting for a consolidated shipment each month. Further, the rifles must be shipped by fastest means to arrive at destination within five (5) days after acceptance. This action is necessary to insure meaningful test results.

c. Request a procedure be established to notify this Office by telephone, extension 6818 or 6641, of each rifle shipment. Information required is name of carrier, bill of lading number, inspection lot number, rifle serial number and date shipped. This information is needed to coordinate performance of the tests.

ALBERT L. BOEMO
Procuring Contracting Officer

Cy Furn: AMSWE-SMD-I AMCPMSO-RS, LTC Semmler AMCPM-RS, Mr. Martin

Encl 2

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY WEAPONS COMMAND
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61201

9 OCT 1969

AMSWE-PPC

SUBJECT: M16A1 Rifle Endurance Reliability Test, USATECOM, Project 8-8-0230-05

Commander
Defense Contract Administration
Services District
1580 East Grand Blvd
Detroit, Mich 48211

The subject test is a requirement of higher Headquarters on an accelerated basis. To meet the direction received, request the required rifles from Contract DAAF03-69-C-0048 and DAAF03-70-C-0002 be selected and actions performed as follows.

a. Request the Government QAR randomly select one (1) rifle from each of two (2) different lots of rifles accepted for shipment. The shipping instructions will be provided in the normal manner each month.

b. Request the selected rifles be shipped immediately upon acceptance without waiting for a consolidated shipment each month. Further, the rifles must be shipped by fastest means to arrive at destination within five (5) days after acceptance. This action is necessary to insure meaningful test results.

c. Request a procedure be established to notify this Office by telephone, extension 6818 or 6641, of each rifle shipment. Information required is name of carrier, bill of lading number, inspection lot number, rifle serial number and date shipped. This information is needed to coordinate performance of the tests.

ALBERT L. BOEMO
Procuring Contracting Officerf

Cy Furn: AMSWE-SMD-I AMCPMSO-RS, LTC Semmler AMCPM-RS-QA, Martin

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY WEAPONS COMMAND
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61201

9 OCT 1969

AMSWE-PPC

SUBJECT: M16A1 Rifle Endurance Reliability Test, USATECOM, Project 8-8-0230-05

Commander
Defense Contract Administration
Services Region
666 Summer Street
Boston, Mass 02144

The subject test is a requirement of higher Headquarters on an accelerated basis. To meet the direction received, request the required rifles from Contract DAAF03-69-C-0045 be selected and actions performed as follows.

a. Request the Government QAR randomly select one (1) rifle from each of two (2) different lots of rifles accepted for shipment. The shipping instructions will be provided in the normal manner each month.

b. Request the selected rifles be shipped immediately upon acceptance without waiting for a consolidated shipment each month. Further, the rifles must be shipped by fastest means to arrive at destination within five (5) days after acceptance. This action is necessary to insure meaningful test results.

c. Request a procedure be established to notify this Office by telephone, extension 6818 or 6641, of each rifle shipment. Information required is name of carrier, bill of lading number, inspection lot number, rifle serial number and date shipped. This information is needed to coordinate performance of the tests.

ALBERT L. BOEMO
Procuring Contracting Officer

Cy Furn: AMSWE-SMD-I AMCPMSO-RS, LTC Semmler AMCPM-RS, Martin

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DEPARTMENT OF THE ARMY
UNITED STATES ARMY MATERIEL COMMAND
PROJECT MANAGER – RIFLES
ROCK ISLAND ARSENAL
ROCK ISLAND, ILLINOIS 61201

IN REPLY REFER TO:
AMCPM-RS

6 FEB 1968

SUBJECT: M16 Rifle and Ammunition Testing

TO: Commanding General
U. S. Army Test and Evaluation Command
Attn: AMSTE-BC
Aberdeen Proving Ground, Maryland 21005

1. Reference: Ltr, ADCSLOG (P&B), dtd 17 Jan 68, Subj: M16 Rifle and Ammunition Testing with inclosure, Memorandum for the Chief of Staff, dtd 2 Jan 68 (copy attached as inclosure 1).

2. Referenced letter directs that certain additional rifle and ammunition tests be undertaken in addition to rifle and ammunition acceptance tests currently prescribed for production.

3. Request that a Phase II Buffer Test be conducted by USATECOM in accordance with the referenced letter. This office will furnish funds, equipment, and ammunition for the conduct of this test. Request that this office be advised of the USATECOM Project Number and starting/completion date of the Phase II Buffer Test as soon as possible. Approximately 30,000 rounds of CR8136 ammunition are available for the test. In the event you require additional information on the purpose and intent of this Phase II Buffer Test, request you contact LTC Squires, OX 71695 or 50712, who will arrange for your consultation with the originator of the Memorandum from the Under Secretary of the Army.

4. Request that USATECOM conduct a monthly reliability test similar to that which is conducted at Colt's Inc. Attached as inclosure 2 is the Springfield Armory Purchase Description 253-B, dated 13 Dec 67, which outlines in paragraph 10.3 the reliability test which is to be conducted.

5. Frankford Arsenal (FA) has been directed by separate correspondence to provide ammunition and funds for the conduct of the monthly reliability test. The type of ammunition to be used is a M193 Ball lot different from that used at Colt's Inc. Frankford Arsenal will coordinate directly with you for the monthly shipment of ammunition.

For Official Use Only

PROTECTIVE MARKING WILL BE CANCELLED 6 Feb 69

6 FEB 1968

AMCPM-RS
SUBJECT: M16 Rifle and Ammunition Testing

6. This office will make arrangements to have one M16A1 Rifle a month shipped to APG. The first rifle from January 1968 rifle production will arrive at APG by 19 February 1968.

7. The results of the monthly reliability test should be forwarded to the Commanding General, U. S. Army Materiel Command, Attn: AMCPMSO-RS, LTC Squires, Washington, D. C. 20315, with information copies to this office and the Commanding Officer, Frankford Arsenal, Attn: SMUFA-H9000, LTC Johnson, Philadelphia, Pennsylvania 19137 to arrive three (3) working days prior to the 15th of each month. The first reliability test results are due 12 March 1968. The format shown on inclosure 3, Reliability Test Results, Contract DAAF03-66-C-0018, will be used for submitting the data on the Colt's reliability test. It is suggested that this format, supported by the data you consider necessary will facilitate understanding by recipients of the report.

8. The requirements indicated in paragraph 1 and the monthly reliability report from Colt's Inc will be handled by Frankford Arsenal and this office.

3 Incl
as

ALVIN C. ISAACS
Colonel, OrdC
Project Manager, Rifles

Copy furnished: w/o Incl
CO, FA, Attn: SMUFA-H9000 LTC Johnson
CG, USAMUCOM, Attn: AMSMU-RE-M Mr Spaulding

SP Guthrie/jlo/234-3350-3711

STEAP-MT-TI

16 MAR 1971

SUBJECT: Monthly QA Test of M16A1 Rifles and Ammunition, USATECOM Project No. 8-WE-600-016-009

Commanding General
US Army Weapons Command
ATTN: AMCPM-RS/Mr. Martin
Rock Island, Illinois 61201

1. Reference is made to letter STEAP-MT-TI, 11 February 1971, subject as above.

2. Investigation of the broken extractor springs which occurred during testing of Rifle No. 4365972 and reported by above reference has been completed. Details are contained in Laboratory Report No. 71-M-16, attached.

FOR THE COMMANDER:

1 Incl
as

G. A. GUSTAFSON
Chief, Infantry and Aircraft
Weapons Division
Materiel Testing Directorate

CF:
CGUSATECOM, ATTN: AMSTE-BC/
Mr. Crider

Comeback Cy for Sm Arms & Acft Wpns Br, Bldg 350

ENGINEERING MEASUREMENTS AND ANALYSIS BRANCH
PHYSICAL TEST SECTION REPORT

STEAP-MT-EP

METALLURGICAL EXAMINATION OF:

Extractor Springs from M16 Rifles.

OBJECT OF TEST:

To determine the cause of the spring failures.

INTRODUCTION:

Normally, the extractor springs withstand an average firing life of approximately 6000 rounds before failure. A new lot of springs was received and several failures were experienced after only approximately 1000 rounds. This laboratory was asked to attempt to determine the cause of the premature failures.

Report No. 71-M-16

Sheet 1 of 4

Dates of Test 9 - 24 Feb 71

Conducted For SP/4 Guthrie

Small Arms & Aircraft Wpns Br

Report Complete 2 March 1971

W.O. No. 304-24018-01

Reference Spring Corp

Material Spec AS-5A "High

Tensile Music Wire", Rock

Island Arsenal Dwg. No. 8448514

INSTRUMENTATION:

1. Metallurgical specimen mounting and polishing equipment.
2. Microhardness tester.
3. Research metallograph.
4. Various cameras and microscopes.

PROCEDURE:

1. Three extractor springs were examined. One was in the unused condition, one had failed after firing 1057 rounds and one had withstood approximately 6000 rounds of firing without failure.

2. Initially, the fractured spring was examined microscopically. This spring was then photographed alongside the unused spring (See Sheet 1, Appendix I). Each spring was then sectioned transversly and mounted in a transoptic material so that both longitudinal and transverse cross-sections of the spring wire were available for study.

Each specimen was polished and examined microscopically, both before and after etching, with a 2% Nital solution. Microhardness tests were made on all three springs. Finally, appropriate photomicrographs were taken (See Sheets 2 and 3, Appendix I).

RESULTS:

1. **Microhardness Tests**

	Distance From Edge(mm)	Knoop Hardness No.	Rockwell Hardness Conversion
Unused Spring	.04	646	C55.5
	.07	622	C54.5
	.10	671	C57
	.13	698	C58.5
	.16	671	C57
	.19	658	C56.5
	.21	684	C57.5
	.23	684	C57.5
	.33	622	C54.5
Broken Spring AF 1057 Rds	.05	712	C59
	.08	756	C61
	[illegible]	[illegible]	[illegible]
	.11	756	C61
	.14	756	C61
	.17	756	C61
	.20	756	C61
	.23	741	C60.5
	.26	756	C61
	.30	741	C60.5
	.40	712	C59
Used Spring AF 6000 Rds	.03	588	C52.5
	.06	684	C57.5
	.09	670	C57
	.12	698	C58.5
	.15	698	C58.5
	.18	698	C58.5
	.21	670	C57
	.24	670	C57
	.28	646	C56
	.35	646	C56

Associated Spring Corporation Material Specification AS-5A states that high tensile music wire of this diameter (0.024 inch) should have a tensile strength of 376,000 to 398,000 psi. An attempt was made to convert this tensile value to an appropriate hardness value but the standard hardness charts give values only to 329,000 psi. A conversion was made by extrapolation on the "Hardness Conversion Chart for Steels" (ASM Handbook 1939 Edition). The resultant hardness range is Rockwell C68 to C73. All three springs were considerably softer than the extrapolated conversion indicated and all three contained a very thin surface layer of decarburization.

2. Microstructure

Each spring evidenced a uniform quenched martensitic structure when etched with a 2% Nital solution. The unused spring contained a seam extending approximately 5/8 of the distance across the transverse cross-section of one coil (Sheet 2, Appendix I). A longitudinal cross-section of a coil of the broken spring revealed evidence of transverse cracking (Sheet 3, Appendix I) near the fracture area.

3. Visual Examination

The fracture surface (Sheet 1, Appendix I) was typical of a brittle martensitic material loaded in a torsional manner.

DISCUSSION:

1. The first tests to which the springs were subjected in this laboratory were dimensional checks and load calibrations. The results of these tests are included in PTS Report No. 71-L-32. It was noted during this testing that one compression of an unused spring, to the height specified on the drawing, resulted in a substantial permanent set. This indicates inadequate section or strength which tends to substantiate the results of the microhardness tests; however, the broken spring was the hardest of the three tested.

2. A flaw of even minute size in material in the hardness range of these springs will act to concentrate the stresses at this location. Surface cracks similar to those shown in the photomicrograph on Sheet 3 of the Appendix were a possible cause of the spring failure. Light surface decarburization could also contribute to the failure.

3. Two problems seem to be evident. When the springs are made soft enough to relieve some of the brittleness they are too weak to meet specifications and when they are made hard enough to meet specifications they are highly susceptible to failure caused by minute imperfections. The solution would seem to be more stringent quality

control exercised by the manufacturer or, if possible, redesign of the spring using a larger wire diameter and softer material.

CONCLUSIONS:

1. The hardness levels of all three springs are below the level resulting from extrapolating the specified tensile strength on a conversion chart.

2. The spring wire contained inherent processing defects (light surface decarburization, seams, and possible surface cracks).

3. The most probable single cause of failure was not positively identified.

RECOMMENDATIONS:

1. More stringent wire processing quality control should be employed.

2. If possible, the spring should be redesigned to use a larger wire diameter of a lower hardness level.

1 Incl
Appendix I

SUBMITTED:

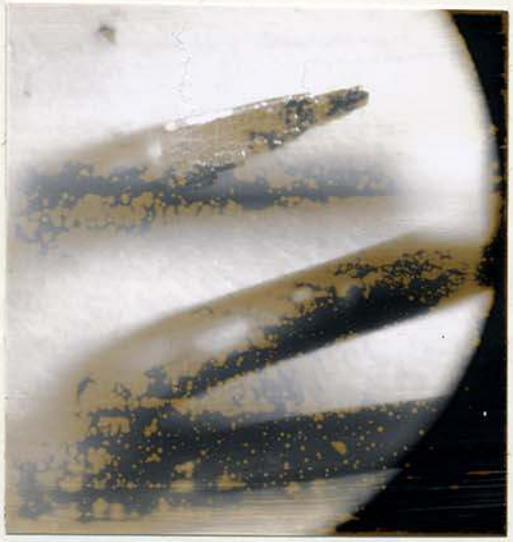
C. L. Hall
C. L. HALL
Materials Evaluation Unit

REVIEWED:

R. L. Huddleston
R. L. HUDDLESTON
Chief
Materials Evaluation Unit

APPROVED:

J. M. McKinley
J. M. McKINLEY
Chief
Physical Test Section



16X Fracture Surface of Failed Spring

Failed and Unused Spring
(Scale graduations are 1/16 In.)

APPENDIX I

100X
Etched cross-sectional surface of two coils of unused spring. Note seam through center of lower coil. Nital etch revealed quenched martensitic microstructure

APPENDIX I

100X
Transverse cracking on the inner coil of the failed spring adjacent to the fracture surface.

APPENDIX I

Pts. Rpt. 71-L-32

EXTRACTOR SPRINGS, M16 RIFLE

DWG. B 8448514

BOLT NO. 4354057

SPRING NO.	FREE LENGTH BEFORE TEST	SPRING LOAD AT a) .175"	b) .175"	c) .135"	FREE LENGTH AFTER TEST	WIRE DIAM.	SPRING DIAM. SMALL END	SPRING DIAM. LARGE END	
JAN 1	.244"	4.45 Lb	4.15 Lb	7.60 Lb	.240"	.0250	.144	.164	B.F.*
A	.293	8.94	6.55	10.05	.259	.0252	.144	.167	B.F
B	.292	8.89	8.60	10.15	.264	.0252	.146	.167	"
C	.295	8.95	8.75	10.20	.262	.0244	.148	.167	"
D	.295	8.39	8.25	9.60	.270	.0250	.145	.163	"
E	.298	9.02	8.80	10.05	.260	.0244	.145	.167	"
BOLT NO. 4365972									
JAN 2	.244	4.46	4.30	7.10	.243	.0242	.144	.164	A.F
A	.293	8.13	8.00	9.65	.270	.0250	.147	.164	B.F.
Specs.	.222 ±.005	4.2 Lb ±.4	4.2 Lb ±.4	7.5 Lb ±.9		.0240 ±.0003	.145 ±.005	.165 ±.003	

B.F = Before Firing
A.F = After Firing
* = After Assembly To Bolt

PTS RPT 71-L-32

BOLT
DWG. F8498510 Sh 2/2

Specs.	BOLT NO. JAN 1	JAN 2
.107 ±.002	.107	.105
.1015 +.0020	.102	.102
.030 ±.005	.030	.029
.040 ±.002	.040	.039
.665 ±.002	.666	.666
.135 ±.002	.134	.135

EXTRACTOR
DWG. F8498512

.1015 +.0010	.102	.102
.351 ±.005	.350	.353
3° ±1°	1°45'	1°40'
.156 +.003	.158	.159
.031 ±.002	.030	.030
.149 ±.002	.145	.144
.025 -.005	.025	.029

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

AMSTE-BC

18 MAY 1966

SUBJECT: AR-18 Rifle

TO: Commanding General
US Army Materiel Command
ATTN: AMCRD-DW (Cosgrove)
Washington, D. C. 20315

1. At a briefing at the CDC Infantry Agency on 10 May 1966, Lt Col DeBrocke requested a confirmation and amplification, if possible, of this command's position relative to subject weapon. (Reference "Engineering Test of Small Arms Weapons", dated Dec 65, USATECOM Project No. 8-5-0400-03.)

2. The specific point requiring confirmation as made in referenced report, para 1.6e, was to the effect that there were deficiencies in the AR-18 caused by inadequate design. The CDCIA notes that this statement is in opposition to BRL Memo Report No. 1635, subject: "A Kinematic Evaluation of the AR-18 Rifle Cal. .0223", dated Feb 65, wherein it is stated that the design is basically good and although deficiencies exist, no major redesign should be necessary.

3. The BRL report was based on studies made from July to November 1964 in conjunction with USATECOM Project No. 8-4-0110-01, "Military Potential Test of Rifle AR-18", Report DPS-1514, dated Dec 64, and Final USAIB Report 8-4-0110-02A, "Military Potential Test of Rifle 5.56mm, AR-18", dated 2 Nov 65. All these activities preceded the SAWS tests.

4. All testing of the AR-18, including military potential and SAWS, indicates common agreement that the weapon was not suitable with respect to functional reliability and durability, particularly beyond approximately 3000 rounds. The engineering rationale that led to a judgment of inadequate basic design is as follows:

a. The military potential tests in 1964 indicated that malfunctions were primarily failures to eject, extract, and feed; the weapon was sensitive to lack of lubrication, and buffer rod supports in two (out of five) rifles cracked, as did a lower receiver.

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b. The Armalite Corporation was provided test results (including USAIB, BRL, and D&PS) prior to SAWS and was in a position to incorporate modifications as they saw fit. However, the weapon submitted for SAWS did not demonstrate any improvement in performance over the model tested earlier and failures were in the same general areas, i.e., cracked receivers, broken guide rod assembly components, and extractor and firing pin spring failures. Stoppage rates in SAWS were high and were comparable with those obtained in earlier testing.

c. It was the opinion of engineering test personnel that these failures and lack of durability were due primarily to a lack of a variable-rate buffering system, which all experience indicates is required in a weapon which uses ammunition which yields high forces and has wide lot-to-lot variability, and which must perform in a wide range of temperatures and adverse conditions. (Weapons which operate successfully with buffering systems and stamped parts characteristic of the AR-18 are lower energy-rate systems, such as the Caliber .45 submachine gun, M3; the German MP 40; and the Soviet AK47.)

d. In connection with the above, it is of interest to note that SAWS tests have revealed that the XM16E1 rifle is unable to accommodate wide ammunition variables (port pressures, which yield higher cyclic rates than those for which the weapon was designed) and a variable-rate buffer which promises to relieve this problem for this weapon is currently undergoing developer tests.

5. The Armalite Corporation, by letter to this command, indicated agreement with the test findings and subsequently prepared a redesigned AR-18 with reinforced receiver, a new Guide Rod Plate at the base of the buffering springs, and a nylon buffer attached to the bolt carrier. This weapon was made available but was never tested at this command. Examination of the weapon did not, in the opinion of technical personnel, incorporate the features necessary to overcome what was felt to be the basic causes of failures. Time and the pressure of the SAWS activity did not permit a repetition of extensive engineering tests to confirm this viewpoint with a single sample.

6. Within the constraints of stamped parts, the basic mechanical design, a 6000 round life and low malfunction rates, the AR-18 does not appear capable of meeting requirements. This is not to say that were such constraints removed, the AR-18 could not be made into a suitable weapon, but

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these changes would be major and a successful redesign of the weapon could be expected to evolve in a design similar to the Colt-Stoner family. The simplicity and low cost features of the weapon would thereby be minimized. The BRL analysis concerned itself principally with the adequacy and potential of the dynamic mechanisms and only partially to the variability in the ammunition under which the mechanism must perform. The durability-performance of components was not intended to be addressed since this was the purpose of subsequent testing. No real contradiction exists.

7. This command confirms it's original conclusion and trusts the rationale provided clarified our position.

FOR THE COMMANDER:

Austin Triplett Jr

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Colonel GS
Dir, Inf Mat Test

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