



DEPARTMENT OF THE ARMY Mr. Barger/pmw/283-2420  
HEADQUARTERS, U. S. ARMY TEST AND EVALUATION COMMAND  
ABERDEEN PROVING GROUND, MARYLAND 21005

DRSTE-AR

4 061 1378

SUBJECT: First Interim Report on Prototype Qualification Test-Government  
(PQT-G) of the Mechanized Infantry Combat Vehicle Firing Port  
Weapon (Submachinegun, 5.56MM, XM231), TECOM Project No. 1-WE-  
400-FPW-007

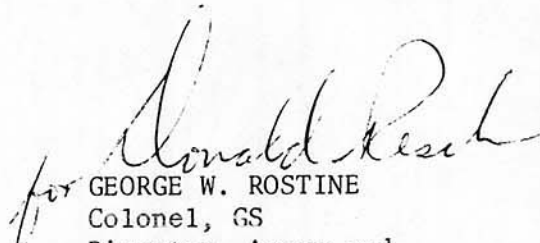
Project Manager, MICV Systems  
ATTN: DRCPM-MCV  
28150 Dequindre  
Warren, Michigan 48092

Inclosed is the TECOM approved First Interim Report on the Mechanized  
Infantry Combat Vehicle Firing Port Weapon. This report covers testing  
from 23 January to 17 August 1976.

FOR THE COMMANDER:

1 Incl (5 cys)  
Subj Rpt

Copies furnished:  
See Incl 4 of Subj Rpt

*for*   
GEORGE W. ROSTINE  
Colonel, GS  
Director, Armor and  
Automv Mat Test Dir



Digitized by:



DEPARTMENT OF THE ARMY  
U S ARMY ABERDEEN PROVING GROUND Connolly/she/283-3136  
ABERDEEN PROVING GROUND, MARYLAND 21005

STEAP-MT-I

9 SEP 1976

SUBJECT: First Interim Report of Prototype Qualification Test-Government (PQT-G) of the Mechanized Infantry Combat Vehicle Firing Port Weapon (Submachinegun, 5.56-MM, XM231), TECOM Project No. 1-WE-400-FPW-007

Commander  
US Army Test and Evaluation Command  
ATTN: DRSTE-AR

1. REPORTING PERIOD

From 23 January 1976 to 17 August 1976.

2. REFERENCES

a. Letter, TECOM, AMSTE-AR, 9 October 1975, subject: Planning Directive for the PQT-G of the Mechanized Infantry Combat Vehicle Firing Port Weapon (MICV/FPW), TECOM Project No. 1-WE-400-FPW-007.

b. Connolly, R., Test Plan for Development Test II (PQT-G) of the Mechanized Infantry Combat Vehicle Firing Port Weapon (U). TECOM Project No. 1-WE-400-FPW-007. US Army Aberdeen Proving Ground, April 1976 (Confidential Plan).

c. Connolly, R., Final Letter Report, Prototype Qualification Test-Contractor (PQT-C) of the Mechanized Infantry Combat Vehicle Firing Port Weapon (Submachinegun, 5.56-MM, XM231).

d. Letter, AMSAA, AMXSU-RW, 5 January 1976, Test Design Plan for DT II of the Mechanized Infantry Combat Vehicle Firing Port Weapon (MICV/FPW).

e. Reliability Review, Mechanized Infantry Combat Vehicle, Firing Port Weapon, US Army Armament Command, June 1975.

The use of trade names in this report does not constitute an official indorsement or approval of the use of such commercial hardware or software. This report may not be cited for purposes of advertisement.



STEAP-MT-I

SUBJECT: First Interim Report of Prototype Qualification Test-Government (PQT-G) of the Mechanized Infantry Combat Vehicle Firing Port Weapon (Submachinegun, 5.56-MM, XM231), TECOM Project No. 1-WE-400-FPW-007

- f. Minutes of MICV-FPW Reliability Scoring Conference, HQ, TECOM, Aberdeen Proving Ground, Maryland, 22 June 1976.
- g. TOP/MTP 3-2-059, Hand and Shoulder Weapons, 1 September 1971.
- h. TOP/MTP 3-2-045, Machine Guns and Automatic Weapons, 1 August 1971.
- i. TOP/MTP 2-2-614, Toxic Hazards Tests for Vehicles, 18 June 1968.
- j. MIL-STD-1474(MI), Military Standard Requirements for Noise Limits for Army Materiel, 1 March 1973.

### 3. GENERAL

The following subtests are covered in this report:

- a. The FPW Prototype Qualification Test-Contractor (PQT-C) functioning reliability tests, as extracted from reference c. These data have been included and combined with the PQT-G data for analysis purposes, where applicable.
- b. The functioning reliability, toxic fumes, and noise level subtests from the FPW PQT-G (reference b).

### 4. SUMMARY OF RESULTS

Detailed test procedures and data summaries are in inclosure 1; detailed data are in inclosures 2 and 3.

Major findings are as follows:

- a. During conduct of the PQT-C and PQT-G reliability and endurance subtests, the XM231 submachinegun (smg) had an observed overall mean rounds between clearable stoppages (MRBS) of 521; the M3A1 smg, 3600. For PQT-C testing the XM231 smg MRBS was 907 for phase I (the first 10,200 rounds fired), 567 for phase II (the second 10,200 rounds fired), and 756 overall; the M3A1 smg MRBS was 1943 for phase I, 2914 for phase II, and 2186 overall. For PQT-G testing the XM231 smg MRBS was 365 for phase I, 486 for phase II, and 398 overall (table 2.1-19 of inclosure 1); the M3A1 smg MRBS was 20,400 for phase I, 5100 for phase II, and 10,200 overall (table 2.1-20 of inclosure 1). Therefore none of the MRBS goals as specified in paragraph 2.1.2b of inclosure

STEAP-MT-I

SUBJECT: First Interim Report of Prototype Qualification Test-Government (PQT-G) of the Mechanized Infantry Combat Vehicle Firing Port Weapon (Submachinegun, 5.56-MM, XM231), TECOM Project No. 1-WE-400-FPW-007

1 (PQT-C goal of 1000, minimum acceptable value (MAV) of 2000, and best operating capability (BOC) of 4000) were met by the XM231 smg, nor was the BOC goal consistently met by the M3A1 smg.

b. The observed MRBS of the XM231 smg was adversely affected by the frequent occurrence of failures to eject (FJ's), and to a lesser extent failures to fire (FFR's), during testing. There were indications that these FJ's were largely caused by the design of the brass catcher bag for the XM231 smg (the M3A1 smg had a differently designed brass catcher bag which apparently did not create a spinback problem); therefore 16,800 5.56-mm rounds (13% of the total) were fired without utilizing the brass catcher. The mean rounds between failures to eject (MRBFJ) increased from 584 with the brass catcher to 4200 without the brass catcher. The lack of an adequate brass catcher for the XM231 smg is considered a shortcoming.

c. The XM231 smg had an observed overall mean rounds between chargeable failures (MRBF) of 9425; the M3A1 smg, 12,240. For PQT-C testing the XM231 smg MRBF was 10,200 for phase I, 20,400 for phase II, and 12,240 overall; the M3A1 smg MRBF was 10,200 for phase I, phase II, and overall. For PQT-G testing the XM231 smg MRBF was 10,232 for phase I, 5100 for phase II, and 7666 overall (table 2.1-19 of inclosure 1); the M3A1 smg MRBF was 20,400 for phase I, 10,200 for phase II, and 15,300 overall. The MRBF goals as specified in paragraphs 2.1.2b of inclosure 1 (PQT-C goal of 4600, MAV of 4500, and BOC of 8000) were all considered to be met by both smg's. The procedures specified in paragraph 1 of inclosure 1 for replacing worn or damaged parts during periods of scheduled maintenance acted as an "equalizer" of parts failure rates between the two smg types, as 21 parts were replaced during scheduled maintenance of the XM231 smg, while only six parts were replaced during scheduled maintenance of the M3A1 smg.

d. The requirement for a minimum barrel life of 8000 rounds was considered to be met by both the XM231 smg and the M3A1 smg.

e. Difficulties were encountered with both FPW mounts, as supplied by the MICV contractor. The linchpin which retains the XM231 smg in the ball mount failed to remain in assembly on one occasion during firing, and the restraining cable used to keep the M3A1 smg in the ball mount broke during firing. Backup safety wires to keep the FPW's in the ball mount should the primary restraints fail were designed and fabricated at APG, and were used during the remainder of the PQT-G tests. The lack of a suitably durable mounting method for either smg type is considered a deficiency of the MICV.

STEAP-MT-I

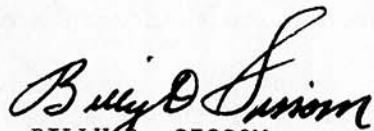
SUBJECT: First Interim Report of Prototype Qualification Test-Government (PQT-G) of the Mechanized Infantry Combat Vehicle Firing Port Weapon (Submachinegun, 5.56-MM, XM231), TECOM Project No. 1-WE-400-FPW-007

f. During the PQT-C, 22 FFR's occurred with the XM231 smg at a rate of one every 2782 rounds. During the PQT-G, this rate improved to one every 5111 rounds, with no FFR's noted during phase II of the PQT-G. Nonetheless, it is considered possible that the incidences of FFR's could increase substantially at low temperature, if a marginal energy-availability situation exists during temperate-zone (i.e., range-ambient) conditions.

g. The results of the toxic fumes test indicated that with the MICV gas evacuation system operating, crew members could safely perform up to three 1800-round full-complement firings of the XM231 FPW (based on the firing of 300 rounds simultaneously from each of six FPW's) within a 24-hour period. Five such 1800-round exposures could be tolerated with the M3A1 smg, with the use of a gas evacuation system but with the crew vent fans set on "HI". All exposure limits are based on carbon monoxide levels measured within the MICV.

h. The noise level data indicate that ear protection is not required for personnel in the rear "passenger" area of the MICV for single or multiple firings of FPWs, provided that the rear door and ramp of the vehicle are both closed. If the driver's and gunner's hatches are also closed, these crew members (the driver and gunner) also do not need ear protection. Ear protection (muffs or plugs) is required in all other situations, i.e., for the driver and gunner if either of the forward hatches is open, for all personnel if the rear door or ramp is open, or for personnel in the vicinity of the vehicle.

FOR THE COMMANDER:



BILLY D. SISSOM  
Associate Director  
Materiel Testing Directorate

- 4 Incl
- 1. Details of Test
- 2. Test Data
- 3. Results of Magnetic Particle Inspection
- 4. Distribution List

## DETAILS OF TEST

### 1. INTRODUCTION

Stoppages and failures were scored in accordance with the following scoring criteria, extracted from the ARMCOM Reliability Review (reference e):

- a. A system failure is defined as follows:
  - 1) Any unserviceable part encountered during a mission; excluding those expected below.
  - 2) Any unintended cessation of fire which cannot be corrected by the operator using on-equipment materiel (OEM) tools in 20 seconds.
- b. A stoppage is any unintended interruption of the firing cycle which can be corrected by the operator in less than 20 seconds.
- c. Stoppages attributable to an unserviceable part shall be discounted if traceable to that part and if they occur within 200 rounds prior to part replacement; however, replacement of said part is countable as a system failure. If continued testing indicates the stoppages were not attributable to the part replacement, the original part will be returned to testing without being counted as a failure.
- d. The replacement of an actual parts failure during scheduled maintenance shall not count as a system failure unless it had been the cause of stoppages, as specified. It is not the intent of this statement to allow either periodic replacement of parts during scheduled maintenance or to allow replacement of any parts which would not be recognized by the average operator as broken.
- e. The magazine shall count as either a stoppage or a system failure, dependent on the time the weapon is out of action. Consideration will be given to charging magazine malfunctions as system failures if an excessive number of stoppages occur.
- f. Ammunition failures shall not count as stoppages, but will be recorded. A thorough failure analysis must, however, indicate that the incident is in fact ammunition induced.
- g. Broken parts which do not affect weapon functioning will not be counted.
- h. Barrel performance will be determined separately to its own criteria.

The malfunctions were categorized as class I (clearable in 10 seconds or less), II (clearable, but requires more than 10 seconds), III (requires part or equipment available to operator), or IV (requires part or equipment not available to operator), in accordance with table IV of TOP/MTP 3-2-059.

During the FPW Reliability Scoring Conference which was held at Headquarters, TECOM, on 22 June 1976 (reference f), various interpretations were placed upon the above definitions which changed the count of stoppages and failures as was previously reported for the PQT-C (reference c). This report therefore updates and supersedes the information contained in reference c, in accordance with the results of the scoring conference.

Interpretations placed on FPW stoppage and failure definitions by the Scoring Conference are as follows:

- a. The FPW (weapon) was defined to be limited to the smg with magazine.
- b. The terms "weapon failure" and "clearable weapon stoppage" were used consistently to describe malfunctions.
- c. It was determined that in general, stoppages would not be charged against defective parts unless they occurred within 200 rounds of a related parts-replacement action. Previously (in reference c), stoppages occurring outside of the 200-round limit which were evidently caused by a defective part were charged to "weapon-repetitive". Herein, however, PQT-C and PQT-G results were re-evaluated so that all applicable stoppages occurring more than 200 rounds prior to a parts replacement action were each charged to the weapon. Exceptions were made for special situations where decisions were made during testing to complete a firing cycle rather than to stop and change a part, and where replacement parts were not immediately available (see inclosure 2 for details).
- d. It was determined that a need exists to properly categorize failures of FPW-peripheral equipment (mounting hardware, exhaust system, brass-catcher bag, etc) which are not attributable to the weapon.
- e. It was determined that there was a need to define the contents of the maintenance kit so that parts replacements which occurred during cleaning operations could properly be defined as non-chargeable or chargeable. Should replacement of a nonavailable part be required during cleaning, this is considered a chargeable failure. For the purposes of this report, it was assumed that all the broken parts encountered during test would be available to the operator (although in some instances as part of a sub-assembly).

In the analysis of stoppages and failures, it was assumed that the exponential distribution applied. Where statistical comparisons were done, the significance level was 0.05.

The brass catcher bags, weapon-exhaust evacuation systems, and FPW-mounting hardware used in this test were supplied by the MICV contractor. The FPW mounting hardware was different from that used during the FPW DT I, although a ball-and-socket mounted in the side of the MICV at each firing position was still employed. For the M3A1 smg, the muzzle was inserted into an axial through-hole in the ball, and was restrained in that position by a multistrand wire which was looped around the magazine part of the smg and anchored to the vehicle socket. The XM231 smg muzzle was also inserted into a hole in the ball for mounting, but was restrained therein by insertion of a detented linchpin inserted into a clevis welded on the ball, with a mating lobe which was welded on the smg barrel (figure 2 of inclosure 3). Neither of these restraining devices was satisfactorily durable, as noted herein.

Throughout all testing reported herein, all-tracer ammunition (M196, 5.56-mm and M26, caliber .45) was utilized. This is in contrast to most previous FPW testing, which utilized a 1- and 1-ball and tracer cartridge mix.

## 2. TECHNICAL PERFORMANCE

### 2.1 RELIABILITY AND ENDURANCE TESTS

#### 2.1.1 Objective

The objective was to demonstrate the functioning reliability and endurance characteristics of the test weapons.

#### 2.1.2 Criteria

- a. The currently approved FPW criteria applicable to this subtest are:
  - 1) The MICV FPW must have the capability to fire at a rate of 50 to 70 rounds per minute for 15 minutes without appreciable wear to the barrel or damage to other components. The MICV FPW must be designed to permit a barrel change in 1 minute or less. This barrel change, if necessary, must be accomplished in climatic categories 1 through 7 of AR 70-38, using only those tools authorized in the operator's maintenance kit or in the on-vehicle equipment for the MICV (para 1b(6), annex V, FPW, to MN for MICV).
  - 2) The MICV FPW must possess a barrel service life of 8000 to 10,000 rounds (para 1b(7), annex V, FPW, to MN for MICV).
  - 3) The MICV FPW must have no more than 10 stoppages, clearable within a total time of 200 seconds, within the initial life of 10,000 rounds. A stoppage is an unintended interruption of firing (weapon fails to feed, extract, or eject; does not include parts replacement) (para 1b(8), annex V, FPW, to MN for MICV).
  - 4) The MICV FPW must not require adjustment of headspace and timing (para 21, annex V, FPW, to MN for MICV).
  - 5) The MICV FPW must be constructed in such a manner to permit the operator to grasp and fire the weapon using one hand only; provision should also be made to preclude loose brass from collecting on the floor of the vehicle for safety reasons (para 2p, annex V, FPW, to MN for MICV).
  - 6) The MICV FPW shall have 0.91 to 0.93 probability of completing the firing of 750 to 1050 rounds in 15 minutes without a parts failure (para 3i, annex V, FPW, to MN for MICV). For the purpose of this portion of the MN, a failure is defined as stoppages or parts replacements in excess of those allowed in items 1b(7) and 1b(8) of the MN (items 2) and 3) above) (para 31, annex V, FPW, to MN for MICV).

b. A review of FPW reliability requirements, as prepared at ARMCOM, recommended the reliability and usage requirements be changed, as follows:

- 1) The MICV FPW shall have as a MAV a MRBF of 4500 rounds and as a BOC, 8000 rounds MRBF.
- 2) The MICV FPW shall have as a MAV a MRBS of 2000 rounds and as a BOC, 4000 rounds MRBS.
- 3) The initial life of the weapon shall be 10,000 rounds.
- 4) The PQT-C MRBF goal will be 4600 rounds. This criterion is based on the development acceptance in-process review, reliability, availability, and maintainability (DEVA IPR RAM) growth discussion, which indicated the need of demonstrating an MRBF of this value during DT II to obtain 8000 rounds by DT III.
- 5) The PQT-C MRBS goal will be 1000 rounds. This criterion is based on the current approved MRBS value.
- 6) The barrel service-life requirement of 8000 to 10,000 rounds will be addressed during PQT-C and PQT-G.

The above criteria are used in place of the criteria in paragraphs 2.1.2a1), 2), and 6), although they have not yet been finally approved. As of the date of this report, a revised MN is being circulated in draft form which contains these criteria. The ARMCOM requirements include a firing schedule of two 300-round cycles at 60 spm in lieu of that stated in paragraph 2.1.2a1).

### 2.1.3 Data Acquisition Procedure

The methods which follow were taken from TOP/MTP 3-2-059, Hand and Shoulder Weapons, paragraph 6.2.5.

2.1.3.1 PQT-C Testing. This testing was conducted at APG, to demonstrate that test materiel has a high probability of performing successfully during the PQT-G tests. Data are acceptable for use in the PQT-G, if the results are satisfactory and there are no design changes.

- a. Phase I. Four test and four control weapons were subjected to endurance testing from a MICV. Measurements and inspection of the bores with a borescope were made prior to endurance firing, and the weapons were disassembled, cleaned, lubricated, and assembled. Each weapon was fired three 30-round bursts for the recording of instrumental velocity at 20 feet (6.1 m) from the muzzle, cyclic rate of fire, and monitoring yaw at a 1000-inch (25.4-m) range target prior to endurance firing.

The ammunition allocated for monitoring of velocity was conditioned, at  $+70 \pm 2^{\circ}\text{F}$  ( $+21.1 \pm 0.1^{\circ}\text{C}$ ) at least 6 hours prior to firing.

Endurance testing with each of the eight weapons (four weapons of each type) was conducted as follows:

- 1) The eight weapons were fired in bursts of six to ten rounds for a cumulative firing total as follows:
    - a) Fire 300 rounds at 60 spm.
    - b) Cool to approximate ambient conditions.
    - c) Fire 300 rounds at 60 spm.
    - d) Cool and clean weapons.
    - e) Steps a) through d) above were repeated for a total of 17 cycles (10,200 rounds) for each weapon.
  - 2) Each weapon was fired one 30-round burst for the recording of instrumental velocity, cyclic rate of fire, and exhibit of projectile yaw after the 10th, 13th, 14th, 15th, 16th, and 17th cycles.
  - 3) After firing each cycle, the weapons were disassembled, cleaned, inspected, lubricated, and assembled.
  - 4) The bores were measured after the 6th, 12th, and 17th cycles.
  - 5) Each weapon was subjected to magnetic-particle examination upon completion of this portion of endurance firing.
- b. Phase II. Two of the above weapons of each type were fired an additional 10,000 rounds (approximately) in accordance with the above schedules, checks, and inspections after replacing components (including the barrels) needing replacement at that time.

2.1.3.2 PQT-G Testing. Four additional test and four additional control weapons were subjected to endurance testing from the MICV. The method used was identical to that presented in paragraph 2.3.2.3b.

2.1.3.3 Magnetic Particle Inspection. Fourteen XM231 smg were inspected at the firing intervals shown in table 2.1-1. Thirteen ferrous components were inspected by the magnetic particle method and four nonferrous components by the fluorescent liquid penetrant method for each smg. These components were assigned referenced no. (1 through 17) and are identified in figure 1 of inclosure 3. Each different area where a

crack pattern was noted was assigned an identification reference letter (A, B, C, etc.). These areas are photographically identified along with an example of a crack pattern in figures 2 through 15 in inclosure 3. Six mounting ports on the MICV were also inspected using a portable Parker Research model DA200 contour probe.

TABLE 2.1-1. FIRING INSPECTION INTERVALS FOR  
FOUR PQT-C AND TEN PQT-G XM231 SMG

<u>Serial No.</u>		<u>Before Firing</u>	<u>After 10,200 Rds (17 Cycles)</u>	<u>After 20,400 Rds (34 Cycles)</u>
<u>APG</u>	<u>US</u>			
	1C 5040166	a, c	a	
	2C 5054265	a, c	a, b	a
	3C 5054925	a, c	a, b	a
	4C 5055648	a, c	a	
	1G 5041858	a	a	
	2G 5053010	a	a	
	3G 5053432	a, b	a	a
	4G 5056579	a, b	a	a
	5G 5046368	a		
	6G 5046998	a		
	7G 5052275	a		
	8G 5053472	a		
	9G 5053772	a		
	10G 5058210	a		

a = Indicates complete smg was inspected.

b = Indicates extra barrels were inspected.

c = Indicates replacement barrels with vehicle mounting ball attached were inspected.

Note: Weapons No. 1C through 4C were utilized during the PQT-C, No. 1G through 4G during PQT-G endurance, and No. 5G through 10G were used during toxic fumes testing (para 2.2).

Fourteen M3A1 smg with thirteen components each were inspected at the firing intervals shown in table 2.1-2. These components were assigned reference No. 1 through 13 and are identified in figure 16 of inclosure 3. Each different area where a crack pattern was noted was assigned an identification reference letter (A, B, C, etc.). These areas are photographically identified along with an example of a crack pattern in figures 17 through 23 in inclosure 3.

TABLE 2.1-2. FIRING INSPECTION INTERVALS FOR  
FOUR PQT-C AND TEN PQT-G M3A1 SMG

<u>Serial No.</u>		<u>Before Firing</u>	<u>After 10,200 Rds (17 Cycles)</u>	<u>After 20,400 Rds (34 Cycles)</u>
<u>APG</u>	<u>US</u>			
1C	647129	x	x	x
2C	695562	x	x	x
3C	702341	x	x	
4C	707619	x	x	
1G	632666	x	x	
2G	647765	x	x	
3G	652107	x	x	x
4G	671231	x	x	x
5G	677332	x		
6G	676459	x		
7G	681146	x		
8G	693706	x		
9G	695088	x		
10G	702979	x		

x = Indicates that an inspection was performed.

Note: Weapons No. 1C through 4C were utilized during the PQT-C, No. 1G through 4G during PQT-G endurance, and No. 5G through 10G were used during toxic fumes testing (para 2.2).

#### 2.1.4 Results

Detailed results of the reliability and endurance tests are contained in inclosure 2, and are summarized below. Inclosure 3 contains the results of the magnetic-particle inspection data, and a summary of the bore measurements taken on the XM231 smg.

2.1.4.1 PQT-C. Clearable stoppages observed during testing are contained in tables 2.1-3 and 2.1-4. Chargeable failures are summarized in table 2.1-5.

TABLE 2.1-3. SUMMARY OF CLEARABLE STOPPAGE DATA OBSERVED WITH THE XM231 SMG DURING PQT-C TESTING

Weapon No.	Test Phase	No. of Rounds Fired	Type	Stoppages Attributed to					Class
				Weapon <sup>a</sup>	Inst	Ammo	Repetitive	Personnel	
1C	I	10,200	FFR	5					I
			FBR	1					I
			FF			1		1	I
			FJ	11					I
2C	I	10,200	FFR	5					I
			FJ	2	1				I
3C	II	10,200	FJ	16					I
			FFR	2					I
			FFR	4					I
	I	10,200	FBS	1					I
			FJ	7					I
			BSIB			1			II
			FJ	13					I
II	10,200	FBR	1					I	
		FFR	3				1	I	
		FF	1					I	
4C	I	10,200	FFR	3			6		I
			FJ	6			1		I

<sup>a</sup>These stoppages are chargeable to the weapon. Magazine-related stoppages are included.

- FFR = Failure to fire.
- FBR = Failure of the bolt to remain to the rear.
- FF = Failure to feed.
- FJ = Failure to eject.
- FBS = Failure of the bolt to sear.
- BSIB = Bullet stuck in bore.

TABLE 2.1-4. SUMMARY OF CLEARABLE STOPPAGE DATA OBSERVED WITH THE M3A1 SMG DURING PQT-C TESTING

Weapon No.	Test Phase	No. of Rounds Fired	Type	Stoppages Attributed to				Class
				Weapon <sup>a</sup>	Mag <sup>a</sup>	Ammo	Repetitive	
1C	I	10,200	FJ	4				I
			FF		2			I
	II	10,200	FJ	1				I
			FFR			1		I
			FBS	1			2	I
			FF		2			I

See footnote at end of table.

TABLE 2.1-4 (CONT'D)

Weapon No.	Test Phase	No. of Rounds Fired	Type	Stoppages Attributed to			Repetitive	Class
				Weapon <sup>a</sup>	Mag <sup>a</sup>	Ammo		
2C	I	10,200	FJ	1			9	I
			FF		6			I
	II	10,200	FBS				1	I
			FF		2			I
3C	I	10,200	FBS	1			43	I
			FJ					I
	II	10,200	FF	3	3			I
			FJ	3				I
4C	I	10,200	FBC		1			I
			FJ	1				I
			FF				1	I
			FBS				2	I
			FFR			1		I

<sup>a</sup>These stoppages are chargeable to the weapon.

FBC = Failure of the bolt to close.

TABLE 2.1-5. SUMMARY OF CHARGEABLE FAILURE DATA OBSERVED DURING PQT-C TESTING

SMG Type	No.	Test Phase	No. of Rounds Fired	No. of Chargeable Failures	Failed Parts	No. of Rd on Failed Item
		II	10,200	1	Sear	12,270
	2C	I	10,200	2	Sear, extractor, sear	7,620, 9,510,
		II	10,200	1		11,820
	3C	I	10,200	0	-	
	4C	I	10,200	2	Magazine, sear	255, 6,740
XM231	1C	I	10,200	1	Ejector spring	7,554
	2C	I	10,200	0	-	
		II	10,200	1	Charging handle latch	13,080
	3C	I	10,200	1	Charging handle	9,131
		II	10,200	0	-	
	4C	I	10,200	2	Ejector spring, charging handle	5,880, 8,970

Cyclic rates, velocities, and projectile yaw data that were recorded during the PQT-C reliability and endurance subtest are summarized in tables 2.1-6, -7, and -8.

TABLE 2.1-6. SUMMARY OF AVERAGES, STANDARD DEVIATIONS, AND 90% CI'S ON OBSERVED CYCLIC RATES DURING PGT-C TESTS

Phase	Gun Type	After Cycle	No. of Rates	Avg, spm	Std Dev, spm	90% CI, spm	
						Lower Limit	Upper Limit
I	XM231	Ref	12	979	58.6	948	1009
		10	4	1152	82.2	1055	1249
		13	4	1084	35.3	1043	1126
		14	4	1073	27.8	1040	1106
		15	4	1061	20.0	1038	1084
		16	4	1038	34.0	998	1078
		17	4	1058	27.1	1026	1090
	M3A1	Ref	12	429	8.2	425	433
		10	4	425	8.7	415	435
		13	4	426	8.7	416	436
		14	4	427	7.2	419	435
		15	4	423	10.5	410	435
		16	4	421	11.4	408	435
		17	4	425	10.7	412	438
II	XM231	Ref	6	982	103.7	897	1068
		6	2	1040	29.0	-	-
		10	2	1092	0.0	-	-
		13	2	1052	3.5	-	-
		14	2	1044	13.4	-	-
		15	2	1070	7.8	-	-
		16	2	1059	14.1	-	-
	M3A1	Ref	6	430	1.2	429	431
		6	2	420	0.0	-	-
		8	2	422	.7	-	-
		10	2	424	1.4	-	-
		13	2	422	1.4	-	-
		14	2	423	1.4	-	-
		15	2	425	2.8	-	-
		16	2	422	2.8	-	-
		17	2	423	0.0	-	-

Ref = Reference (at start of test).

TABLE 2.1-7. SUMMARY OF AVERAGES, STANDARD DEVIATIONS AND 90% CI'S ON OBSERVED VELOCITIES DURING PQT-C RELIABILITY AND ENDURANCE SUBTESTS<sup>a</sup>

Velocity Data, M231 smg, fps										Velocity Data, M3A1 smg, fps									
After Cycle	Gun No.	Sample Sized	Avg	Std Dev	Max	Min	EV	90% CI on Avg		After Cycle	Gun No.	Sample Sized	Avg	Std Dev	Max	Min	EV	90% CI on Avg	
								Lower Limit	Upper Limit									Lower Limit	Upper Limit
PHASE I																			
Ref	1C	85	2749	25.5	2849	2699	150	2744	2754	Ref	1C	83	923	17.8	972	889	83	920	926
	2C	81	2709	35.8	2832	2600	232	2702	2716	2C	2C	80	922	17.0	966	893	73	919	925
	3C	85	2722	34.1	2799	2632	167	2716	2728	3C	3C	73	910	10.5	942	890	52	908	912
	4C	83	2704	35.0	2788	2619	169	2698	2710	4C	4C	89	945	19.0	990	868	122	942	948
10	1C	29	2581	47.0	2673	2470	203	2566	2596	10	1C	30	957	18.2	997	927	70	951	962
	2C	30	2566	37.2	2674	2509	165	2555	2578	2C	2C	30	950	17.4	993	920	73	944	955
	3C	25	2558	41.8	2694	2495	199	2544	2572	3C	3C	30	949	16.1	985	909	76	944	954
	4C	25	2590	35.9	2658	2532	126	2578	2602	4C	4C	30	941	15.0	973	904	69	937	946
13	1C	28	2597	39.5	2682	2538	144	2584	2610	13	1C	30	951	15.8	990	915	75	946	956
	2C	29	2551	35.2	2629	2492	137	2540	2562	2C	2C	30	948	14.9	989	917	72	943	952
	3C	28	2554	27.1	2620	2514	106	2546	2563	3C	3C	30	938	12.6	963	903	60	934	942
	4C	29	2566	36.8	2638	2504	134	2554	2577	4C	4C	30	950	19.3	982	915	67	944	956
14	1C	28	2582	54.6	2684	2455	229	2564	2600	14	1C	30	952	14.0	974	912	62	947	956
	2C	28	2544	42.4	2616	2454	162	2531	2558	2C	2C	30	950	13.6	971	921	50	946	954
	3C	29	2559	39.7	2667	2509	158	2546	2571	3C	3C	30	939	19.9	984	900	84	933	945
	4C	30	2590	48.6	2726	2501	225	2574	2605	4C	4C	30	949	14.4	983	915	68	945	954
15	1C	28	2598	34.5	2699	2545	154	2587	2609	15	1C	30	952	15.1	982	912	70	947	957
	2C	29	2553	34.3	2610	2481	129	2542	2563	2C	2C	30	956	14.7	988	932	56	951	960
	3C	30	2547	22.4	2593	2507	86	2540	2554	3C	3C	30	951	14.4	973	924	49	947	956
	4C	30	2552	26.5	2597	2510	87	2544	2560	4C	4C	30	945	18.0	970	892	78	940	951
16	1C	30	2551	32.2	2611	2489	122	2548	2568	16	1C	30	962	13.8	987	932	55	958	966
	2C	29	2542	56.1	2671	2421	250	2524	2560	2C	2C	30	966	15.6	996	921	75	961	971
	3C	29	2560	56.1	2707	2457	250	2542	2577	3C	3C	30	948	26.0	1002	884	118	940	956
	4C	30	2573	39.0	2685	2508	177	2561	2586	4C	4C	30	944	25.2	996	893	103	937	952

See footnotes and legend at end of table.

TABLE 2.1-7 (CONT'D)

Velocity Data, XM231 smg, fps										Velocity Data, M3A1 smg, fps												
After Cycle	Gun No.	Sample Size	Avg	Std Dev	Max	Min	EV	90% CI			After Cycle	Gun No.	Sample Size	Avg	Std Dev	Max	Min	EV	90% CI			
								Lower Limit	Upper Limit	on Avg									Lower Limit	Upper Limit	on Avg	
17	1C	30	2587	40.1	2646	150	2496	2574	2599		17	1C	30	949	11.4	972	930	42	946	953		
	2C	30	2546	31.1	2608	135	2473	2537	2556			2C	30	954	17.6	978	913	65	949	960		
	3C	30	2555	37.2	2615	167	2448	2543	2566			3C	30	954	19.4	990	912	78	948	960		
	4C	30	2551	31.8	2598	120	2478	2541	2560			4C	29	949	15.8	981	907	74	944	954		
PHASE II																						
Ref	2C	90	2689	38.7	2789	2608	181	2682	2696		Ref	1C	83	923	17.8	972	889	83	920	926		
	3C	90	2717	27.2	2763	2649	114	2712	2722			2C	80	922	17.0	966	893	73	919	925		
6	2C	30	2715	35.0	2773	2594	179	2704	2726		6	1C	30	962	17.7	985	902	83	957	968		
	3C	30	2717	27.3	2762	2656	106	2708	2726			2C	30	937	20.8	976	891	85	930	943		
10	2C	30	2694	28.7	2758	2636	122	2686	2703		8	1C	30	955	16.7	987	913	74	950	960		
	3C	30	2704	34.2	2772	2646	126	2694	2715			2C	30	957	19.2	987	909	78	951	963		
13	2C	30	2693	47.7	2883	2621	262	2678	2708		10	1C	30	950	13.2	972	932	40	946	954		
	3C	30	2673	28.9	2744	2619	125	2664	2682			2C	30	954	17.0	984	925	59	948	959		
14	2C	28	2700	36.4	2786	2631	155	2688	2711		13	1C	30	959	16.2	994	925	69	954	964		
	3C	30	2678	29.7	2738	2616	122	2669	2688			2C	29	961	20.6	997	926	71	955	968		
15	2C	30	2681	37.4	2751	2606	145	2670	2693		14	1C	30	958	18.5	984	916	68	952	964		
	3C	30	2680	25.6	2726	2628	98	2672	2688			2C	29	962	15.6	989	910	79	957	967		
16	2C	30	2670	47.3	2754	2560	194	2655	2686		15	1C	30	950	16.5	979	912	67	945	955		
	3C	30	2678	28.9	2731	2631	100	2670	2688			2C	30	953	18.3	985	924	61	947	959		
17	2C	30	2612	28.1	2731	2611	120	2674	2691		16	1C	30	953	13.2	980	933	47	949	958		
	3C	30	2671	27.7	2736	2615	121	2663	2680			2C	30	953	19.6	997	920	77	947	959		
											17	1C	30	946	18.0	984	911	73	940	951		
												2C	30	945	19.2	978	914	64	939	951		

aVelocities were measured 20 feet (6.1 meters) from the weapon muzzle.  
 bThree 30-round bursts were used for reference data, taken at the start of test; one 30-round burst was fired thereafter.

EV = Extreme variation.

TABLE 2.1-8. SUMMARY OF YAW DATA OBTAINED AT 1000 INCHES  
(25.6 METERS) DURING PQT-C ENDURANCE TESTING<sup>a</sup>

Cycle No.	No. of Observed Projectile Yaws (>15°)							
	XM231 SMG No.				M3A1 SMG No.			
	1C	2C	3C	4C	1C	2C	3C	4C
Phase I								
Initial	1	<sup>b</sup> 3	1	1	0	0	0	0
10	0	0	2	1	0	0	0	0
13	0	0	1	2	0	0	0	0
14	2	0	0	1	0	0	0	0
15	0	1	3	2	0	0	0	0
16	0	0	1	3	<sup>c-</sup>	0	0	0
17	0	1	3	1	0	0	0	0
Phase II								
<sup>d</sup> Initial	-	0	0	-	<sup>e-</sup>	<sup>e-</sup>	-	-
6	-	<sup>f-</sup>	<sup>f-</sup>	-	0	0	-	-
8	-	<sup>f-</sup>	<sup>f-</sup>	-	0	0	-	-
10	-	0	0	-	0	0	-	-
13	-	0	0	-	0	0	-	-
14	-	0	0	-	0	0	-	-
15	-	0	0	-	0	0	-	-
16	-	0	0	-	0	0	-	-
17	-	0	0	-	0	0	-	-

<sup>a</sup>Initial data are for three 30-round targets; data for the remaining cycles are for one 30-round target.

<sup>b</sup>The three yaws occurred on one target.

<sup>c</sup>Data lost due to high winds.

<sup>d</sup>XM231 smg were rebarreled before the start of phase II.

<sup>e</sup>Yaw data were not required since the weapons were not rebarreled.

<sup>f</sup>Yaw data were not recorded at this time since the schedule for new barrels was followed.

2.1.4.2 PQT-G. Clearable stoppages observed during testing are summarized in tables 2.1-9 and 2.1-10. Chargeable failures are summarized in table 2.1-11.

TABLE 2.1-9. SUMMARY OF CLEARABLE STOPPAGE DATA OBSERVED WITH THE XM231 SMG DURING PQT-G TESTING

Weapon No.	Test Phase	No. of Rounds Fired	Type	Stoppages Attributed to					Class
				Weapon <sup>a</sup>	Mag <sup>a</sup>	Ammo	Part	Repetitive	
1G	I	10,329	FJ	29					I
			FFR	2		1			I
			FF		1			5	I
2G	I	10,200	FBR	1	2				I
			FJ	13			1	3	I
			FFR	2					I
3G	I	10,200	FF	2					I
			FBR	2					I
			FJ	40					I
	II	10,200	FFR	4					I
			FF	1	2				I
			FJ	27			1	4	I
4G	I	10,200	FF					4	I
			FFR	4					I
			FJ	6					I
	II	10,200	FF		1				I
			FJ	15					I

<sup>a</sup>These stoppages are chargeable to the weapon.

TABLE 2.1-10. SUMMARY OF CLEARABLE STOPPAGE DATA OBSERVED WITH THE M3A1 SMG DURING PQT-G TESTING

Weapon No.	Test Phase	No. of Rounds Fired	Type	Stoppages Attributed to					Class
				Weapon <sup>a</sup>	Mag <sup>a</sup>	Ammo	Part <sup>a</sup>	Repetitive	
1G	I	10,200	None						
2G	I	10,200	None						
3G	I	10,200	FJ	1					I
			FBS					1	I
	II	10,200	FF		1				I
			FJ			1	1	5	I
4G	I	10,200	FBS					1	I
			None						
	II	10,200	FF	1				1	I
			FBS	2					I
			FJ					8	I

<sup>a</sup>These stoppages are chargeable to the weapon.

TABLE 2.1-11. SUMMARY OF CHARGEABLE WEAPON FAILURE DATA OBSERVED DURING PQT-G TESTING

Weapon Type	Gun No.	Test Phase	No. of Rounds Fired	No. of Chargeable Failures	Failed Part	No. of Rd on Failed Item
M3A1	1G	I	10,200	0		
	2G	I	10,200	0		
	3G	I	10,200	2	Magazine, sear	14, 5,790
		II	10,200	0		
XM231	4G	I	10,200	0		
		II	10,200	2	Magazine, extractor	2,048, 16,268
	1G	I	10,329	2	Gas tube assy, magazine	5,709, 906
		II	10,200	1	Ejector spring	9,270
	2G	I	10,200	1	Trigger pin snap	1,312
	3G	I	10,200	1	ring, magazine,	2,744, 18,504
		II	10,200	4	gas tube, bolt, ejector spring	19,389, 8,838
	4G	I	10,200	0		
II		10,200	0			

Cyclic rates, velocities, and projectile yaw data that were recorded during the PQT-G reliability and endurance subtest are summarized in tables 2.1-12, 2.1-13, and 2.1-14.

TABLE 2.1-12. SUMMARY OF AVERAGES, STANDARD DEVIATIONS AND 90% CI ON CYCLIC RATES DURING PQT-G TESTS

Phase	Weapon Type	After Cycle	No. of Rates	Avg, spm	Std Dev, spm	90% CI, spm	
						Lower Limit	Upper Limit
I	XM231	Ref	12	1045	22.4	1033	1056
		10	4	1093	25.0	1064	1123
		13	4	1128	28.9	1094	1162
		14	4	1131	17.2	1111	1151
		15	4	1124	28.0	1091	1156
		16	4	1117	28.8	1083	1151
		17	4	1127	29.9	1092	1162
	M3A1	Ref	12	431	16.4	422	440
		10	4	432	5.1	426	438
		13	4	433	3.7	427	437
		14	4	433	2.9	430	437
		15	4	433	3.0	430	437
		16	4	432	3.3	428	435
		17	4	432	2.5	429	435

TABLE 2.1-12 (CONT'D)

Phase	Weapon Type	After Cycle	No. of Rates	Avg, spm	Std Dev, spm	90% CI, spm	
						Lower Limit	Upper Limit
II	XM231	Ref	6	1062	7.9	1055	1068
		2	2	1116	6.4	-	-
		4	2	1140	46.7	-	-
		6	2	1044	14.8	-	-
		8	2	1084	.7	-	-
		10	2	1108	1.4	-	-
		13	2	1100	71.4	-	-
		14	2	1130	31.8	-	-
		15	2	1098	60.1	-	-
		16	2	1116	62.9	-	-
	17	2	1166	1.4	-	-	
	M3A1	Ref	6	424	21.6	407	442
		2	2	427	1.4	-	-
		4	2	428	2.1	-	-
		6	2	430	3.5	-	-
		8	2	429	1.4	-	-
		10	2	424	2.1	-	-
		13	2	430	.7	-	-
14		2	428	2.8	-	-	

Ref = Reference (at start of test).

TABLE 2.1-13. SUMMARY OF AVERAGES, STANDARD DEVIATIONS, AND 90% CI'S ON OBSERVED VELOCITIES DURING PQT-G RELIABILITY AND ENDURANCE SUBTESTS<sup>a</sup>

Velocity Data, XM231 Smg, fps										Velocity Data, M3A1 Smg, fps											
After Cycle	Gun No.	Sample Size	Avg	Std Dev	Max	Min	EV	90% CI on Avg		Sample Size	Gun No.	After Cycle	Ref	Avg	Std Dev	Max	Min	EV	90% CI on Avg		
								Lower Limit	Upper Limit										Lower Limit	Upper Limit	
Phase I																					
Ref	1	90	2684	26.8	2752	2624	128	2679	2689	a83	1	Ref		925	22.8	971	855	116	921	929	
	2	88	2656	27.7	2722	2600	122	2651	2661	a84	2			910	16.0	956	870	86	907	913	
	3	85	2690	27.5	2761	2630	131	2685	2695	a87	3			932	20.4	996	858	138	928	936	
	4	87	2649	39.9	2727	2526	201	2642	2656	a67	4			896	17.5	943	865	78	892	900	
10	1	30	2553	54.5	2635	2366	269	2536	2570	26	1	10		953	17.5	993	921	72	947	958	
	2	30	2570	51.3	2675	2459	216	2554	2586	30	2			937	14.0	967	904	63	933	942	
	3	30	2603	39.3	2682	2528	154	2591	2615	30	3			944	14.1	973	920	53	939	948	
	4	30	2581	29.7	2626	2518	108	2572	2590	30	4			951	18.6	984	914	70	945	957	
13	1	21	2508	60.4	2604	2308	296	2486	2531	30	1	13		953	19.3	985	909	76	947	959	
	2	30	2553	47.4	2633	2439	194	2538	2568	30	2			948	16.4	979	909	70	943	954	
	3	29	2551	46.1	2657	2463	194	2536	2565	26	3			952	18.8	986	907	79	946	959	
	4	30	2555	38.4	2644	2472	172	2542	2567	30	4			949	17.6	992	904	88	944	955	
14	1	28	2521	46.1	2674	2446	228	2506	2536	30	1	14		950	14.5	974	919	55	945	954	
	2	29	2528	42.6	2610	2417	193	2515	2542	30	2			947	11.8	972	924	48	943	950	
	3	29	2544	35.6	2591	2455	136	2533	2556	29	3			956	16.2	992	921	71	951	961	
	4	30	2567	43.4	2648	2479	169	2553	2580	30	4			949	16.4	985	911	74	944	954	
15	1	28	2510	37.8	2596	2432	164	2498	2522	30	1	15		959	16.5	993	929	64	954	964	
	2	29	2558	47.1	2706	2489	217	2543	2573	30	2			958	17.5	985	923	62	952	963	
	3	27	2554	47.5	2673	2455	218	2538	2570	30	3			948	20.5	996	907	89	941	954	
	4	29	2561	40.2	2624	2492	132	2548	2573	30	4			946	23.3	988	905	83	922	970	
16	1	30	2548	48.2	2619	2448	171	2533	2563	30	1	16		962	15.3	987	934	53	955	964	
	2	30	2568	55.3	2690	2473	217	2551	2585	30	2			960	12.6	984	928	56	956	964	
	3	30	2586	57.3	2712	2481	231	2568	2604	30	3			954	14.7	985	922	63	949	958	
	4	30	2571	46.2	2677	2477	200	2557	2585	30	4			956	24.0	1002	896	106	948	963	
17	1	28	2549	40.9	2619	2471	148	2536	2562	30	1	17		952	16.2	991	926	65	947	957	
	2	30	2548	46.2	2636	2473	163	2534	2562	30	2			953	19.5	976	910	66	947	959	
	3	30	2560	52.0	2662	2438	224	2544	2576	29	3			953	15.4	977	913	64	948	958	
	4	30	2554	51.8	2619	2450	169	2538	2571	30	4			948	19.9	982	893	89	942	954	

See footnotes at end of table.

TABLE 2.1-13 (CONT'D)

Velocity Data, XM231 Smg, fps										Velocity Data, M3A1 Smg, fps									
After Cycle	Gun No.	Sample Size	Avg	Std Dev	Max	Min	EV	90% CI on Avg		After Cycle	Gun No.	Sample Size	Avg	Std Dev	Max	Min	EV	90% CI on Avg	
								Lower Limit	Upper Limit									Lower Limit	Upper Limit
Phase II																			
Ref	3G	85	2690	27.5	2761	2630	131	2685	2695	Ref	3G	a87	932	20.4	996	858	138	928	936
	4G	87	2649	39.9	2727	2526	201	2642	2656		4G	a67	896	17.5	943	865	78	892	900
2	3G	30	2535	42.3	2639	2437	202	2522	2548	2	3G	30	959	17.7	994	914	80	953	964
	4G	30	2518	57.5	2623	2336	287	2500	2536		4G	30	953	13.3	985	935	50	949	957
4	3G	30	2517	44.7	2520	2401	219	2503	2531	4	3G	30	960	14.2	992	930	62	956	965
	4G	30	2539	35.9	2623	2481	142	2528	2550		4G	30	959	13.0	988	933	55	955	963
6	3G	30	2512	34.8	2589	2452	137	2501	2523	6	3G	30	950	18.0	979	918	61	944	956
	4G	30	2513	34.3	2596	2444	152	2502	2523		4G	30	947	20.5	987	907	80	941	954
8	3G	30	2528	40.6	2609	2445	164	2516	2541	8	3G	30	939	18.2	967	908	59	936	942
	4G	30	2500	36.9	2574	2400	174	2489	2512		4G	30	946	15.9	977	921	56	941	951
10	3G	30	2517	34.3	2598	2449	149	2507	2528	10	4G	30	949	16.5	984	920	64	949	960
	4G	30	2503	39.2	2589	2416	173	2491	2515		4G	30	955	14.8	984	928	56	950	959
13	3G	28	2502	25.8	2540	2452	88	2491	2513	13	3G	30	946	13.3	966	913	53	941	950
	4G	30	2468	36.0	2530	2403	127	2457	2480		4G	30	952	16.4	978	904	74	946	957
14	3G	26	2492	31.9	2561	2429	132	2482	2503	14	3G	30	961	16.1	991	934	57	956	966
	4G	26	2466	36.6	2524	2395	129	2454	2478		4G	30	950	19.8	990	914	76	944	956
15	3G	29	2476	50.3	2573	2389	184	2465	2497	15	3G	30	945	18.4	984	905	79	940	951
	4G	29	c2481	44.6	2570	2371	199	2479	2490		4G	28	939	21.7	983	896	87	932	946
16	3G	30	2489	31.9	2561	2414	147	2476	2499	16	3G	30	950	19.3	985	921	64	944	956
	4G	30	2488	37.0	2561	2422	139	2494	2499		4G	30	950	17.8	988	919	69	944	955
17	3G	30	2506	40.2	2595	2440	155	2464	2518	17	3G	29	939	17.2	976	912	64	934	945
	4G	30	2478	32.9	2564	2373	191	2464	2491		4G	30	946	22.6	991	918	73	939	953

aVelocities were measured 20 feet (6.1 meters) from the weapon muzzle.  
 bThree 30-round bursts were used for reference data, taken at the start of test; one 30-round burst was fired thereafter.  
 cVelocity drop exceeds 200 fps (61 mps).

TABLE 2.1-14. SUMMARY OF YAW DATA OBTAINED  
 AT 1000 INCHES (25.6 METERS) DURING PQT-G  
 ENDURANCE DATA<sup>a</sup>

Cycle No.	No. of Observed Projectile Yaws ( $> 15^\circ$ ) <sup>a</sup>							
	XM231 Smg No.				M3A1 Smg No.			
	1G	2G	3G	4G	1G	2G	3G	4G
	Phase I							
Initial	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0
17	0	1	0	0	0	0	0	0
	Phase II							
Initial	-	-	0	0	-	-	0	0
6	-	-	0	0	-	-	0	0
8	-	-	0	0	-	-	0	0
10	-	-	0	0	-	-	0	0
13	-	-	0	0	-	-	0	0
14	-	-	0	0	-	-	0	0
15	-	-	0	0	-	-	0	0
16	-	-	0	0	-	-	0	0
17	-	-	0	0	-	-	0	0

<sup>a</sup>Initial data are for three 30-round targets; data for the remaining cycles are for one 30-round target.

### 2.1.5 Analysis

#### 2.1.5.1 PQT-G. Results are analysed as follows:

- a. Point estimates and confidence intervals (CI) on the MRBS which are charged to the weapon and the MRBF are contained in tables 2.1-15 (XM231 smg) and 2.1-16 (M3A1 smg).

TABLE 2.1-15. POINT ESTIMATES AND 80% CI'S ON THE TRUE MRBS  
AND MRBF FOR THE XM231 SMG, PQT-C

Weapon No.	Test Phase	No. of Rounds Fired	No. of Clearable Weapon Stoppages	MRBS			No. of Charge-able Weapon Failures	MRBF		
				Point Estimate	Lower	Upper		Point Estimate	Lower	Upper
1C 2C	I	10,200	17	600	432	852	1	10,200	2622	96,682
	I	10,200	7	1457	867	2619	0	a -	4430	a -
	II	10,200	18	567	412	796	1	10,200	2622	96,682
	Both	20,400	25	816	624	1083	1	20,400	5245	193,365
3C	I	10,200	12	850	574	1303	1	10,200	2622	96,682
	II	10,200	18	567	412	796	0	a -	4430	a -
	Both	20,400	30	680	532	878	1	20,400	5245	193,365
4C All	I	10,200	9	1133	718	1878	2	5,100	1916	19,173
	I	40,800	45	b 907	743	1113	4	c10,200	5104	23,381
	II	20,400	36	b 567	454	714	1	c20,400	5245	193,365
	Overall	61,200	81	b 756	652	878	5	c12,240	6599	25,159

<sup>a</sup>When no failures occur, the point estimate and upper confidence limit cannot be calculated.

<sup>b</sup>Significantly less than for the M3A1 smg (see table 2.1-16).

<sup>c</sup>No significant difference when compared to the M3A1 smg (see table 2.1-16).

TABLE 2.1-16. POINT ESTIMATES AND 80% CI'S ON THE TRUE MRBS AND MRBF FOR THE M3A1 SMG, PQT-C

Weapon No.	Test Phase	No. of Rounds Fired	No. of Clearable Weapon Stoppages	MRBS			No. of Charge-able Weapon Failures	MRBF				
				Point Estimate	Lower	Upper		Point Estimate	Lower	Upper		
1C	I	10,200	6	1700	968	3,236	0	a	-	4430	a	-
	II	10,200	4	2550	1276	5,845	1	10,200	2622	96,682		
	Both	20,400	10	2040	1324	3,279	1	20,400	5245	193,365		
2C	I	10,200	7	1457	867	2,619	2	5,100	1916	19,173		
	II	10,200	3	3400	1527	9,256	1	10,200	2622	96,682		
	Both	20,400	10	2040	1324	3,279	3	6,800	3053	18,512		
3C	I	10,200	6	1700	968	3,236	0	a	-	4430	a	-
	II	10,200	2	5100	1916	19,173	2	5,100	1916	19,173		
All	I	40,800	21	1943	1448	2,652	4	10,200	5104	23,381		
	II	20,400	7	2914	1733	5,237	2	10,200	3833	38,346		
	Overall	61,200	28	2186	1696	2,851	6	10,200	5811	19,416		

<sup>a</sup>When no failures occur, the point estimate and upper confidence limit cannot be calculated.

- b. Various statistical tests were performed at the 5% level, to determine the extent to which the results of phases I and II might be significantly different. The following comparisons were made:
- 1) MRBS for each of the two samples of each smg type which were subjected to testing in both phases I and II.
  - 2) MRBF, compared as noted above.
  - 3) MRBS for all of phase I (within smg type) compared to phase II.
  - 4) MRBF, compared as noted above.

There were no significant differences noted with regard to these comparisons, for the M3A1 smg. For the XM231 smg, the MRBS for gun No. 2C during phase I (1457) was significantly greater than for phase II (567), and the overall phase II MRBS for all guns (567) was significantly less than the overall phase I MRBS (907). No other significant differences were detected.

- c. There is considerable interest in the effect the brass catcher for the XM231 smg has on the reliability of the weapon, especially as it affects the frequency of FJ's. FJ frequencies observed during the PQT-C are contained in table 2.1-17.

TABLE 2.1-17. FJ FREQUENCY DATA WHEN FIRING THE XM231 SMG WITH AND WITHOUT THE BRASS CATCHER

Weapon No.	Test Phase	With Brass Catcher		Without Brass Catcher		All (With and Without Brass Catcher, Combined)								
		No. of No. Rounds of Fired FJ		No. of No. Rounds of Fired FJ		MRBFJ	No. of Clearable Stoppages Excluding FJ	MRBFJ	No. of Rounds of Fired FJ	MRBFJ	MRBS Excluding FJ	Total No. of Clearable Stoppages		
		FJ	MRBFJ	FJ	MRBFJ								MRBS including FJ	
1C	I	9,600	11	873	600	0	a-	10,200	11	927	6	1700	17	600
2C	I	9,600	2	4800	600	0	a-	10,200	2	5100	5	2040	7	1457
	II	10,200	16	638	0	-	-	10,200	16	638	2	5100	18	567
	Both	19,800	18	1100	600	0	a-	20,400	18	1133	7	2914	25	816
3C	I	9,600	7	1371	600	0	a-	10,200	7	1457	5	2040	12	850
	II	10,200	13	785	0	-	a-	10,200	13	785	5	2040	18	567
	Both	19,800	20	990	600	0	a-	20,400	20	1020	10	2040	30	680
4C	I	9,600	6	1600	600	0	a-	10,200	6	1700	3	3400	9	1133
All	I	38,400	26	b1477	2400	0	a-	40,800	26	1569	19	2147	45	907
	II	20,400	29	c 703	0	-	a-	20,400	29	703	7	2914	36	567
	Over-	58,800	55	d1069	2400	0	a-	61,200	55	d1113	26	2354	81	756
	all													

<sup>a</sup>When no malfunctions occur, the point estimate of MRBFJ cannot be calculated.

<sup>b</sup>Significantly less than the phase I MRBFJ for the M3A1 smg (4533).

<sup>c</sup>Significantly less than the phase II MRBFJ for the M3A1 smg (10,200).

<sup>d</sup>Significantly less than the phases I and II combined MRBFJ for the M3A1 smg (5564).

MRBFJ = Mean rounds between failures to eject.

For each XM231 smg and test phase, as well as over all XM231 smg and test phases, the following comparisons were made:

- 1) Phase I MRBFJ versus phase II MRBFJ.
- 2) Phase I MRBFJ with brass catcher only, versus phase II MRBFJ with brass catcher only.
- 3) Phase I MRBS excluding FJ versus phase II MRBS excluding FJ.
- 4) Overall MRBFJ with brass catcher, versus overall MRBFJ without brass catcher.

Table 2.1-18 summarizes the results of these significance tests, denoting significant differences where they occurred. In those instances where entire categories (subparagraphs 3 and 4 above) contained no significant differences, they are noted in the tables. Otherwise, if no note is present where a comparison is indicated, no significant difference was found.

TABLE 2.1-18. RESULTS OF SIGNIFICANCE TESTS (5% LEVEL)  
PERFORMED USING XM231 SMG CLEARABLE-STOPPAGE DATA

Weapon No.	Test Phase	Stoppage Rates				
		MRBS		MRBFJ		
		Incl FJ	Excl FJ	All Rounds Fired	Using the Brass Catcher	Without the Brass Catcher
1C	I	600	1700	927	873	a-
2C	I	1457	<sup>b</sup> 2040	<sup>c</sup> 5100	<sup>c</sup> 4800	a-
	II	567	5100	638	638	d-
3C	I	850	<sup>b</sup> 2040	1457	1371	a-
	II	567	2040	785	785	d-
4C	I	1133	3400	1700	1600	a-
All	I	907	<sup>b</sup> 2147	<sup>c</sup> 1569	<sup>c</sup> 1477	a-
	II	567	2914	703	703	d-

<sup>a</sup>MRBFJ cannot be calculated as no FJ malfunctions occurred. In all these instances, no significant differences was detected between with brass catcher versus without brass catcher with respect to MRBFJ.

<sup>b</sup>Phase I MRBS was not significantly different from phase II MRBS.

<sup>c</sup>Phase I MRBFJ was significantly higher than phase II MRBFJ.

<sup>d</sup>No firing was done without the brass catcher during phase II.

2.1.5.2 PQT-G. Results are analyzed as follows:

- a. Point estimates and CI's on the MRBS (weapon-chargeable) and MRBF (weapon-chargeable) are contained in tables 2.1-19 (XM231 smg) and 2.1-20 (M3A1 smg).
- b. The statistical tests described in paragraph 2.1.5.1b1) through 4) were repeated with the data contained in tables 2.1-19 and 2.1-20. No significant differences were found with the M3A1 smg. For XM231 smg No. 3G only, the phase II MRBS was significantly greater than the MRBS of phase I. No other significant differences were found.
- c. FJ frequencies observed with the XM231 smg during the PQT-G are contained in table 2.1-21.

TABLE 2.1-19. POINT ESTIMATES AND 80% CI'S ON THE TRUE MRBS AND MRBF FOR THE XM231 SMG, PQT-E

Weapon No.	Test Phase	No. of Rounds Fired	No. of Clearable Weapon Stoppages		MRBS 80% CI		No. of Chargeable Weapon Failures		MRBF 80% CI	
			Pt	Est	Lower	Upper	Pt	Est	Lower	Upper
1G	I	10,329	32	323	255	413	2	5,164	1941	19,415
2G	I	10,200	20	510	377	702	1	10,200	2622	96,682
3G	I	10,200	49	208	172	253	1	10,200	2622	96,682
	II	10,200	27	378	292	495	4	2,550	1276	5,845
	Both	20,400	76	268	231	314	5	4,080	2200	8,386
4G	I	10,200	11	927	615	1453	0	a -	4430	a -
	II	10,200	15	680	479	990	0	a -	4430	a -
	Both	20,400	26	785	603	1035	0	a -	8860	a -
All	I	40,929	112	b365	323	415	4	c10,232	5120	23,455
	II	20,400	42	b486	395	601	4	c 5,100	2552	11,691
	Overall	61,329	154	b398	358	443	8	c 7,666	4720	13,172

<sup>a</sup>When no failures occur, the point estimate and upper confidence limit cannot be calculated.

<sup>b</sup>Significantly less than for the M3A1 smg (see table 2.1-20).

<sup>c</sup>No significant differences when compared to the M3A1 smg (see table 2.1-20).

TABLE 2.1-20. POINT ESTIMATES AND 80% CI'S ON THE TRUE MRBS AND MRBF FOR THE M3A1 SMG, PQT-G

Weapon No.	Test Phase	No. of Rounds Fired	No. of Clearable Weapon Stoppages		MRBS		No. of Chargeable Weapon Failures		MRBF	
			Pt	Est	80% CI		Pt	Est	80% CI	
					Lower	Upper			Lower	Upper
1G 2G 3G	I	10,200	0	a	4430	a	0	a	4430	a
	I	10,200	0	a	4430	a	0	a	4430	a
	I	10,200	2	5,100	1916	19,173	2	5,100	1916	19,173
	II	10,200	1	10,200	2622	96,682	0	a	4430	a
Both		20,400	3	6,800	3053	18,512	2	10,200	3833	38,346
4G	I	10,200	0	a	4430	a	0	a	4430	a
	II	10,200	3	3,400	1527	9,256	2	5,100	1916	19,173
Both		20,400	3	6,800	3053	18,512	2	10,200	3833	38,346
All	I	40,800	2	20,400	7666	76,692	2	20,400	7666	76,692
	II	20,400	4	5,100	2552	11,691	2	10,200	3833	38,346
Overall		61,200	6	10,200	5811	19,416	4	15,300	7656	35,072

<sup>a</sup>When no failures occur, the point estimate and upper confidence limit cannot be calculated.

TABLE 2.1-21. FJ FREQUENCY DATA WHEN FIRING THE XM231 SMG WITH AND WITHOUT THE BRASS CATCHER

Weapon No.	Test Phase	With Brass Catcher				Without Brass Catcher				Total				
		No. of Rounds Fired		No. of FJ	MRBFJ	No. of Rounds Fired		No. of FJ	MRBFJ	No. of Clearable Stoppages Excluding FJ		MRBS Excluding FJ	Total No. of Clearable Stoppages	MRBS
		FJ	MRBFJ			FJ	MRBFJ			FJ	MRBFJ			
1G	I	6,129	29	211	4,200	0	a -	10,329	29	356	3	3443	32	323
2G	I	6,900	10	690	3,300	3	1100	10,200	13	785	7	1457	20	510
3G	I	7,200	39	185	3,000	1	3000	10,200	40	255	9	1133	49	208
	II	9,600	27	356	600	0	a -	10,200	27	378	0	a -	27	378
	Both	16,800	66	255	3,600	1	3600	20,400	67	304	9	2267	76	268
4G	I	7,500	6	1250	2,700	0	a -	10,200	6	1700	5	2040	11	927
	II	9,600	15	640	600	0	a -	10,200	15	680	0	a -	15	680
	Both	17,100	21	814	3,300	0	a -	20,400	21	971	5	4080	26	785
All	I	27,729	84	330	13,200	4	b3300	40,929	88	b 465	24	1705	112	365
	II	19,200	42	c 457	1,200	0	a -	20,400	42	c 486	0	a -	42	486
	Overall	46,929	126	d 372	14,400	4	d3600	61,329	130	d 472	24	2555	154	398

<sup>a</sup>When no malfunctions occur, the point estimate of MRBFJ cannot be calculated.

<sup>b</sup>Significantly less than the phase I MRBFJ for the M3A1 smg (40,800).

<sup>c</sup>Significantly less than the phase II MRBFJ for the M3A1 smg (20,400).

<sup>d</sup>Significantly less than the phase I and II combined MRBFJ for the M3A1 smg (30,600).

For each XM231 smg and for each test phase and over all guns and phases the following comparisons were made using procedures for comparing two means from exponentially distributed random variables.

- 1) Phase I versus phase II, relative to MRBFJ.
- 2) Phase I versus phase II, with brass catcher only, MRBFJ; without brass catcher, MRBFJ.
- 3) Phase I versus phase II excluding FJ, MRBS.
- 4) With brass catcher versus without brass catcher, MRBFJ.

Table 2.1-22 summarizes the results of these significance tests. The table denotes where significance differences occurred. All comparisons above were made; if not footnoted, no difference was detected.

TABLE 2.1-22. RESULTS OF SIGNIFICANCE TESTS (5% LEVEL)  
PERFORMED USING XM231 SMG CLEARABLE-STOPPAGE DATA

Weapon No.	Test Phase	Stoppage Rates				
		MRBS		MRBFJ		
		Incl FJ	Excl FJ	All Rounds Fired	Using the Brass Catcher	Without the Brass Catcher
1G	I	323	3443	356	211	a,b -
2G	I	510	1457	785	690	1100
3G	I	208	1133	255	185	b3000
	II	378	c,d -	378	e 356	a -
4G	I	927	2040	f1700	1250	a -
	II	680	c,d -	680	640	a -
All	I	365	1705	465	330	b3300
	II	486	c,d -	486	e 457	a -

<sup>a</sup>MRBFJ cannot be calculated as no FJ malfunctions occurred.

<sup>b</sup>MRBFJ without brass catcher significantly higher than MRBFJ with brass catcher.

<sup>c</sup>MRBS cannot be calculated as no malfunctions other than FJ occurred.

<sup>d</sup>Phase II MRBS excluding FJ's significantly higher than that of Phase I.

<sup>e</sup>Phase II MRBFJ significantly higher than that of Phase I.

<sup>f</sup>Phase I MRBFJ significantly higher than that of Phase II.

2.1.5.3 Combined Data (PQT-C and PQT-G). The combined MRBS and MRBF data are contained in table 2.1-23. The MRBFJ data are contained in table 2.1-24. These data are presented for information, i.e., without inference that the data presented are statistically combinable.

TABLE 2.1-23. POINT ESTIMATES AND 80% CI'S ON THE TRUE MRBS AND MRBF, COMBINED PQT-C AND PQT-G OF M3A1 AND XM231 SMG'S

Type	Wpn No.	Test, PQT-	No. of Rd Fired	No. of Clearable Weapon Stoppages	MRBS			No. of Chargeable Weapon Failures	MRBF		
					Pt Est	80% CI			Pt Est	80% CI	
						Lower	Upper			Lower	Upper
M3A1	1	C	20,040	10	2,040	1324	3,279	1	20,400	5245	193,365
		G	10,200	0	a -	4430	a -	0	a -	4430	a -
	2	C	20,400	10	2,040	1324	3,279	3	6,800	3053	18,512
		G	10,200	0	a -	4430	a -	0	a -	4430	a -
	3	C	10,200	6	1,700	968	3,236	0	a -	4430	a -
		G	20,400	3	6,800	3053	18,512	2	10,200	3833	38,346
	4	C	10,200	2	5,100	1916	19,173	2	5,100	1916	19,173
		G	20,400	3	6,800	3053	18,512	2	10,200	3833	38,346
All	C		61,200	28	2,186	1696	2,851	6	10,200	5811	19,416
	G		61,200	6	10,200	5811	19,416	4	15,300	7656	35,072
	Both		122,400	34	3,600	2862	4,572	10	12,240	7945	19,674
XM231	1	C	10,200	17	600	432	852	1	10,200	2622	96,682
		G	10,329	32	323	255	413	2	5,164	1941	19,415
	2	C	20,400	25	816	624	1,083	1	20,400	5245	193,365
		G	10,200	20	510	377	702	1	10,200	2622	96,682
	3	C	20,400	30	680	532	878	1	20,400	5245	193,365
		G	20,400	76	268	231	314	5	4,080	2200	8,386
	4	C	10,200	9	1,133	718	1,878	2	5,100	1916	19,173
		G	20,400	26	785	603	1,035	0	a -	8860	a -
All	C		61,200	81	756	652	878	5	12,240	6599	25,159
	G		61,329	154	398	358	443	8	7,666	4720	13,172
	Both		122,529	235	521	479	568	13	9,425	6463	14,172

<sup>a</sup>When no failures occur, the point estimate and upper confidence limit cannot be calculated.

TABLE 2.1-24. COMBINED FJ DATA WHEN FIRING THE XM231 SMG WITH AND WITHOUT THE BRASS CATCHER

XM231 Smg No.	Test	With Brass Catcher			Without Brass Catcher			Combined (With and Without the Brass Catcher)						
		No. of Fired	No. of FJ	MRBFJ	No. of Rounds Fired	No. of FJ	MRBFJ	No. of Rounds Fired	No. of FJ Malf	MRBFJ	No. of Clearable pages including FJ's	MRBS, Excluding FJ's	All Clearable Stoppages	MRBS
1C	C	9,600	11	873	600	0	a -	10,200	11	927	6	1700	17	600
1G	G	6,129	29	211	4,200	0	a -	10,329	29	356	3	3443	32	323
2C	C	19,800	18	1100	600	0	a -	20,400	18	1133	7	2914	25	816
2G	G	6,900	10	690	3,300	3	1100	10,200	13	785	7	1459	20	510
3C	C	19,800	20	990	600	0	a -	20,400	20	1020	10	2040	30	680
3G	G	16,800	66	255	3,600	1	3600	20,400	67	304	9	2267	76	268
4C	C	9,600	6	1600	600	0	a -	10,200	6	1700	3	3400	9	1133
4G	G	17,100	21	814	3,300	0	a -	20,400	21	971	5	4080	26	785
All PQT-C		58,800	55	1069	2,400	0	a -	61,200	55	1113	26	2354	81	756
All PQT-G		46,929	126	372	14,400	4	3600	61,329	130	472	24	2555	154	398
All combined		105,729	181	584	16,800	4	4200	122,529	185	662	50	2451	235	521

<sup>a</sup>When no malfunctions occur, the point estimate cannot be calculated.

2.1.5.4 Analysis of FFR Malfunctions with the XM231 Smg. Table 2.1-25 gives a summary of the occurrence of FFR stoppages throughout reliability and endurance testing of the XM231 smg.

TABLE 2.1-25. FFR MALFUNCTIONS OCCURRING WITH THE XM231 SMG

Test Type	Test Phase	No. of	No. of
		Rounds Fired	FFR
PQT-C	I	40,800	17
	II	20,400	5
	Both	61,200	22
PQT-G	I	40,929	12
	II	20,400	0
	Both	61,329	12

The point estimate and two-sided 80% CI on mean rounds between failure-to-fire stoppages (MRBFFR) are given in table 2.1-26.

TABLE 2.1-26. MRBFFR SUMMARY FOR THE XM231 SMG

Type Test	Test Phase	MRBFFR, rd		
		Point Estimate	Lower	Upper
PQT-C	I	2400	1728	3407
	II	4080	2200	8386
	Both	2782	2087	3768
PQT-G	I	3411	2302	5228
	II	<sup>a</sup> -	8860	<sup>a</sup> -
	Both	5111	3449	7833

<sup>a</sup>When no failures occur the upper confidence limit cannot be estimated.

Certain comparisons of MRBFFR were made. The results of these comparisons were:

- a. There was no significant difference between phases I and II, PQT-C.
- b. The phase II MRBFFR was significantly higher than that of phase I for the PQT-G.
- c. There was no significant difference between the PQT-C and PQT-G for phase I and for phases I and II taken together. For phase II, however, the PQT-G MRBFFR was significantly greater than that of the PQT-C.

2.1.5.5 Discussion. Criteria contained in paragraph 2.1.2 are evaluated as follows:

- a. Barrel Life (para 2.1.2a2) and 2.1.2b6)). The useful barrel life was considered to be ended, as specified in paragraph 6.2.2lc of TOP/MTP 3-2-045 (reference h), if 20% or more of the rounds in a burst exhibited yaw of 15° or more, or if the mean velocity of a burst dropped 200 fps (61 mps) or more below the mean velocity of the initial burst fired from the weapon. An inspection of the data in tables 2.1-7, 2.1-8, 2.1-13, and 2.1-14 provides the following information. During the PQT-C, six XM231 smg barrels and two M3A1 smg's were fired to 10,200 rounds each and two M3A1 smg's were fired to 20,400 rounds each without the occurrence of a barrel failure (the two XM231 smgs which entered phase II were rebarreled at the start of phase II; in the PQT-G, none of the M3A1 smg's were rebarreled). Inspection of the PQT-G data indicates that for XM231 smg No. 3G, the velocity drop requirement was slightly exceeded after cycles 15 (19,200 rounds fired) and 16 of phase II, but was not exceeded after cycle 17 of phase II. For XM231 smg No. 4G, the velocity drop requirement was met after 20,400 rounds. The other two XM231 smg's and all the XM231 smg's tested in the PQT-G were within the velocity-drop tolerance after firing 10,200 rounds. All the yaw data (PQT-C and PQT-G) were acceptable.

The barrel life criterion is considered met for both smg types.

- b. MRBS (paragraphs 2.1.2b2) and 2.1.2b5)). The XM231 smg had an observed overall MRBS of 521; the M3A1 smg, 3600 (table 2.1-23). For PQT-C testing the XM231 smg MRBS was 907 for phase I, 567 for phase II, and 756 overall (table 2.1-15); the M3A1 smg MRBS was 1943 for phase I, 2914 for phase II, and 2186 overall (table 2.1-16). For PQT-G testing the XM231 smg MRBS was 365 for phase I, 486 for phase II, and 398 overall (table 2.1-19); the M3A1 smg MRBS was 20,400 for phase I, 5100 for phase II,

and 10,200 overall (table 2.1-20). Therefore none of the MRBS goals as specified in paragraphs 2.1.2b (PQT-C goal of 1000, MAV of 2000, and BOC of 4000) were met by the XM231 smg, nor was the BOC goal consistently met by the M3A1 smg.

The observed MRBS of the XM231 smg was adversely affected by the frequent occurrence of FJ, and to a lesser extent FFR during testing. There were indications that these FJ's were largely caused by the design of the brass catcher bag for the XM231 smg (the M3A1 smg had a differently designed brass catcher bag which apparently did not create a spinback problem); therefore, 16,800 5.56-mm rounds (13% of the total) were fired without utilizing the brass catcher. The MRBFJ increased from 584 with the brass catcher to 4200 without the brass catcher (table 2.1-24). It is therefore clearly indicated that the brass catcher is the major contributing cause to the occurrence of FJ's in the XM231 smg. The lack of a suitable brass catcher bag for the XM231 smg is considered a shortcoming (of the MICV).

- c. MRBF (paragraphs 2.1.2b2) and 2.1.2b2)). The XM231 smg had an observed overall MRBF of 9425; the M3A1 smg, 12,240 (table 2.1-23). For PQT-C testing the XM231 smg MRBF was 10,200 for phase I, 20,400 for phase II, and 12,240 overall (table 2.1-15); the M3A1 smg MRBF was 10,200 for phase I, phase II, and overall (table 2.1-16). For PQT-G testing the XM231 smg MRBF was 10,232 for phase I, 5100 for phase II, and 7666 overall (table 2.1-19); the M3A1 smg MRBS was 20,400 for phase I, 10,200 for phase II, and 15,300 overall (table 2.1-20). The MRBF goals as specified in paragraphs 2.1.2b (PQT-C goal of 4600, MAV of 4500 and BOC of 8000) were all considered to be met by both smg's.

The procedures specified in paragraph 1 for replacing worn or damaged parts during periods of scheduled maintenance acted as an "equalizer" between the two smg types. During the PQT-C and PQT-G (combined) 21 parts were replaced during scheduled maintenance of the XM231 smg or parts which were found to be worn out at the completion of testing (not counting barrels or upper receiver assemblies); only six parts were replaced during scheduled maintenance of the M3A1 smg. These parts were not included as failures in the MRBF calculations.

- d. Other criteria (para 2.1.2a5), and 2.1.2b3)). These criteria were considered to be met, insofar as they were evaluated. The design of the weapons precludes adjustment of headspace and timing. The weapons could be grasped and fired with one hand, when mounted. Brass-catcher bags were provided; these were effective in containing ejected cartridge cases. Both weapons were considered to have an initial life of 10,000 rounds or more.

- e. Safety. No weapon-related safety problems were encountered, although failures of the weapon restraints for the XM231 and M3A1 smg provided by the vehicle contractor were noted during PQT-G testing as noted in inclosure 2. For this reason, additional safety wires, to hold the weapons positively in the mounts (should the mount restraints fail) were fabricated at APG and used for the remainder of the testing. Additional safety features of this type should be employed in using the FPW, until a more suitable mount for the FPW is designed and proven. The lack of a suitable mounting method for either smg type is considered a deficiency.

An ammunition-related safety problem occurred in the PQT-C while firing 5.56-mm M196 tracer cartridges from the XM231 weapon. An FFR stoppage was observed; an investigation indicated that the cartridge primer had been struck and had functioned, but the projectile had lodged in the weapon bore about 1-1/16 inches (27 mm) forward of its normal seated position. There was no indication of unburned propellant or propellant residue, although the tracer mix had burned and blackened the mouth area of the case. An informal investigation was performed by a Frankford Arsenal representative and it was concluded that the cartridge had not contained a propelling charge.

The above incident is classified as category III - Critical in accordance with MIL-STD-882; if another cartridge had been chambered and fired behind the stuck projectile, it could have caused a hazardous weapon failure. As previously noted, the incident was ammunition-related and therefore was not chargeable to the XM231 smg. Also, it occurred in the PQT-C, not the PQT-G.

- f. FFR Stoppage. The other significant type of stoppage (in addition to the FJ) noted with the XM231 smg was the FFR; 22 FFR occurred at an observed frequency of one every 2782 rounds during the PQT-C. During the PQT-G, an improved MRBFFR of 5111 was observed, with no FFR noted during phase II of the PQT-G. This observed frequency of occurrence will not cause a failure to meet the MRBS MAV requirement; however, due to the inertial (striker-fired) mechanism design of the XM231 smg the incidence of FFR could increase substantially at low temperature if the energy available to fire the cartridge is marginal during temperate-zone (i.e., range-ambient) conditions.
- g. Comment on Maintainability. Although the maintainability subtest of the PQT-G was not conducted during this reporting period, required maintenance functions were accomplished during the subtests as reported herein. The following comment on the maintainability of the XM231 smg is offered. The ability of the typical operator to identify incipient failures of components

as readily as was done during the subject tests and to make repairs with the equipment and facilities which are likely to be available to him in the field, is somewhat questionable. Therefore it is quite possible that in actual field experience with the XM231 smg, there will be a greater incidence of chargeable failures than is reported herein.

## 2.2 TOXIC FUMES

### 2.2.1 Objective

The objective was to identify hazardous toxic fumes (either carbon monoxide (CO) or ammonia (NH<sub>3</sub>)) concentrations that may be produced in the driving and operating compartments of the MICV due to firing of the FPW.

### 2.2.2 Criterion

The MICV FPW must not permit toxic fumes within the vehicles that are above the levels established in accordance with USAHEL STD S-2-64A, when all MICV weapons are fired simultaneously (para 2q, Annex V, FPW to MN for MICV).

### 2.2.3 Data Acquisition Procedure

The method that follows was taken from TOP/MTP 2-2-614, Toxic Hazards Test for Vehicles, paragraphs 6.1 and 6.2.2.. Firings were conducted by simultaneously firing all six FPWs, ten 30-round magazines each in 6- to 10-round bursts, within a 3-minute period. The MICV gas-evacuation system was in operation during firings with the XM231 smg; testing with the M3A1 smg was done both with and without the gas-evacuation system operating. The brass catchers for the M3A1 smg were modified at APG so as to be compatible with the gas-evacuation system.

During the testing, the vehicle engine was on idle, with all hatches closed and the crew vent fans both set on "Hi". Surface meteorological data were obtained hourly during the test. Both CO and NH<sub>3</sub> samples were drawn continuously from the following locations during each firing sequence:

- a. Right rear (side) FPW.
- b. Left forward FPW.
- c. Left rear (side) FPW.
- d. Right forward FPW.

CO samples were monitorized by four Lira model 200 and analyzers; NH<sub>3</sub> was measured utilizing four Billionaire analyzers.

#### 2.2.4 Results

The average peak CO and NH<sub>3</sub> concentration data are in table 2.2-1. The detailed results of CO and NH<sub>3</sub> measurements are in inclosure 2. Surface meteorological data are also in inclosure 2. The lengths of the firing cycles varied somewhat because of weapon malfunctions, which, on occasion, resulted in one or two weapons continuing to fire sporadically after the other had finished. The approximate lengths of each firing cycle are in inclosure 2, together with the total number of rounds fired for each trial.

TABLE 2.2-1. SUMMARY OF CO AND NH<sub>3</sub> CONCENTRATION MEASUREMENTS

Characteristic	X:M231 Smg				Data M3A1 Smg				M3A1 Smg							
	A ON	B ON	C ON	D ON	A OFF	B OFF	C OFF	D OFF	A ON	B ON	C ON	D ON	A ON	B ON	C ON	D ON
Crew position <sup>a</sup> FPW gas-evacuator system Average No. of rounds fired CO:																
Average maximum CO concentration, ppm	720	980	530	1065	438	314	219	347	89	74	95	110				
Equivalent exposure time <sup>b</sup> , minutes	15.15	15.51	10.57	15.2	9.52	6.20	5.23	12.00	2.31	1.54	1.60	2.85				
Maximum allowable exposures each 24 hours	4.0	3.9	5.7	4.0	6.3	9.7	11.5	5.0	26.0	39.0	37.5	21.1				
Maximum NH <sub>3</sub> concentration, ppm	7	27	<5	33	0	0	0	<5	0	0	0	0				

a Position Code      Location

- A Right rear side FPW
- B Left forward FPW
- C Left rear side FPW
- D Right forward FPW

<sup>b</sup>Calculated by the method in draft TOP 2-2-614, 9 December 1975, restated as follows: "The method for computing equivalent exposure time for concentrations measured under transient conditions should be one that will evaluate the definite integral

$$100 \int_0^t c(t)dt$$

to a reasonable degree of accuracy. The concentration c(t) is a function of real time t over the exposure interval (0,t), probably available as a strip recording or as discrete measurements, not in a mathematical form suitable for analytical integration. An approximate evaluation of the integral may be made by any convenient method suitable for the instrumentation and measurements used.

"A fairly good approximation of equivalent exposure time in minutes is

$$100 \sum_{i=1}^{n-1} 1/2(c_i + c_{i+1}) \Delta t = 50 \sum_{i=1}^{n-1} (c_i + c_{i+1}) \Delta t$$

TABLE 2.2-1 (CONT'D)

where  $c_i$  = actual exposure concentration in percent, measured or recorded at  $n$  equally spaced time points over the transient exposure time interval  $(0,t)$ ,

and  $\Delta t = t/(n-1)$ .

"The number of time points  $n$  over the interval  $(0,t)$  should be as large as possible within practical considerations.

"Multiple exposures of lesser duration or percent are converted to equivalent exposure times. The cumulative equivalent exposure times should not exceed 60 minutes for a 24-hour period. This is based on a half life of carboxyhemoglobin of 250 minutes."

### 2.2.5 Analysis

The analysis is based on the criteria in draft TOP 2-2-614, Toxic Hazards Tests for Vehicles and Other Equipment, 9 December 1975, as restated in table 2.2-1, because the referenced criteria in paragraph 2.2.2 do not provide emergency limits for single exposures or a specific method for analyzing multiple exposures to CO concentrations. The method of data analysis in the TOP is more restrictive than a literal interpretation of the referenced criteria.

The maximum number of rounds that can be safely fired by a single crew within a 24-hour period, together with the ammunition stowage capacity for each type of weapon, is in table 2.2-2.

TABLE 2.2-2. FIRING LIMITATIONS AND AMMUNITION STOWAGE CAPACITY

Weapon	Gas Evacuation System	Avg No. of Rds Fired	Max Allow. Expos/24 Hr	Rd/Crew 24 Hr	Ammo Stowage Capacity, rd
XM231 (5.56-mm)	On	1,782	3.9	6,950	2,400
M3A1 (.45 caliber)	Off	1,668	5.0	8,340	4,000
M3A1 (.45 caliber)	On	1,800	21.1	37,980	4,000

Based on the interpretation of results in table 2.2-2, an MICV crew can safely fire from 20% to 446% more ammunition from the M3A1 smg than from the XM231 smg in a 24-hour period, depending on whether or not the gas-evacuation system is utilized.

Both weapon types, as tested, meet the more stringent criteria in draft TOP 2-2-614 with respect to CO and NH<sub>3</sub>.

It is likely (although not known) that firing the XM231 smg without the gas-evacuation system would result in hazardous levels of toxic gases; however, it is assumed that the gas-evacuation system will be in operation during all firings.

Because the concentrations of NH<sub>3</sub> in the exhaust gases are slight compared to the CO concentrations, the NH<sub>3</sub> will not be a hazard to the crew members during any allowable exposure to the CO.

## 2.3 NOISE LEVEL

### 2.3.1 Objective

The objective was to determine the noise-level characteristics when firing the test and control weapons.

### 2.3.2 Criterion

Firing of the MICV FPW must not expose personnel inside the carrier to a noise level in excess of that established in MIL-STD-1474 (MI) (para 2r, Annex V, FPW to MN for MICV). (Applicable impulse noise limits are identified by the expected number of daily exposures and the type of hearing protection required for use. Table 6 of MIL-STD-1474 (MI) identifies the required hearing protection for the respective impulse noise limits and the expected number of daily exposures; the corresponding peak levels and "B" duration values are in figure 3 of MIL-STD-1474 (MI). Impulse noise shall not exceed the limits specified for limit W as shown in table 6 of MIL-STD-1474 (MI). Limit W meets the unprotected exposure criteria of TB MED 251. Limits X, Y, or Z, for which hearing protection is mandatory, shall be selected only if it can be clearly documented that the cost of reducing the noise level to that specified for limit W is prohibitive or that system effectiveness will be seriously degraded by reducing the noise level to that specified for limit W. Limit W, Y, or Z shall be selected only with the approval of the procuring activity subject to reduction of the level to the lowest value consistent with the state-of-the-art and the cost and effectiveness factors noted above. Impulse noise levels above limit W (i.e., anything greater than 140 dB) require hearing protectors for any number of exposures each day. To be acceptable for use under the impulse noise-limit category selected in paragraph 5.4.1.1 of MIL-STD-1474 (MI), the peak pressure level and "B" duration of a single noise exposure shall be below the appropriate impulse noise requirement, as shown in figure 3 of MIL-STD-1474 (MI).

### 2.3.3 Data Acquisition Procedure

The method was taken from TOP/MTP 3-2-811, Noise and Blast Measurements, paragraphs 6.2.2, 6.2.2.1a(1) (with the weapon mounted and the sensor in vehicle), and paragraph 6.2.2.1g, as modified by MIL-STD-1474 (MI).

Transient-noise-level characteristics were determined during the firing of the test and control FPWs from the MICV. Each weapon was mounted and fired singly from the vehicle for the test, in accordance with the approved test plan.

The MICV was positioned with the right side facing downrange. No reflecting surfaces were within 50 feet (15.4 meters) of the vehicle or the recording microphones. The microphones were mounted in positions simulating the following ear positions: driver, gunner, shooter, and the

aft-most person on the left side of the vehicle. Noise levels at the driver and gunner ear positions were measured under two separate conditions. Reference to the gunner indicates the turret gunner, not the FPW shooter. One simulated the position of these crewmen when they were seated low in the vehicle with the hatches closed; the other simulated the position of their heads protruding above the open hatches. The other personnel positions were not changed since their relative ear positions do not vary according to whether the hatches are open or closed. A microphone was also placed 25 feet (7.6 meters) to the rear of the vehicle to simulate the ear position of the driver of an adjacent vehicle. The rear door and ramp of the MICV remained closed during testing.

The weapons were mounted one at a time on the right side of the MICV, in the aft-most FPW gun port. Five single-shot rounds were fired from each weapon with the hatches open and again with the hatches closed. Microphone outputs were recorded on a multichannel magnetic-tape recorder. The data were later transcribed to oscillogram form for reduction.

The instrumentation consisted of:

- a. Magnetic-tape recorder, Sangamo Sabre III. The frequency response was 80 kHz and the tape speed of the recorder was 60 inches per second (1.5 m/s).
- b. Two-channel power supply, Bruel & Kjaer, type 2803.
- c. One-quarter-inch-diameter (6.3-mm) microphones, Bruel & Kjaer cartridge type, model 4136.

The instrumentation was calibrated (by the voltage-substitution method) in the laboratory prior to the test and was checked in the field both prior to and after the test.

#### 2.3.4 Results

Transient-noise-level data, based on five rounds for each condition at the specified microphone locations, are in tables 2.3-1 through 2.3-5.

TABLE 2.3-1. SOUND-PRESSURE LEVELS (SPLS) RECORDED  
AT THE DRIVER'S EAR POSITION

Rd No.	Data			Rd No.	Data		
	XM231 Smg				M3A1 Smg		
	Peak dB	Duration, ms	Duration, ms		Peak dB	Duration, ms	Duration, ms
Hatches Open							
1	133	1.0	51.8	1	129	0.8	12.4
2	133	1.0	35.7	2	129	.7	12.2
3	132	1.0	47.3	3	129	.7	12.7
4	132	1.1	38.5	4	128	.7	13.0
5	133	1.0	36.8	5	130	.7	12.9
Hatches Closed							
1	121	0.6	94.8	1	110	0.4	62.4
2	122	1.8	88.6	2	111	.5	73.3
3	122	0.4	90.2	3	111	.6	78.0
4	122	1.2	90.5	4	110	.4	78.8
5	122	1.2	85.8	5	110	.5	77.7

TABLE 2.3-2. SPLS RECORDED AT THE GUNNER'S EAR POSITION

Rd No.	Data			Rd No.	Data		
	XM231 Smg				M3A1 Smg		
	Peak dB	Duration, ms	Duration, ms		Peak dB	Duration, ms	Duration, ms
Hatches Open							
1	149	0.6	57.4	1	141	0.5	4.9
2	149	0.6	44.5	2	140	0.5	7.8
3	148	0.6	45.4	3	140	0.5	8.9
4	149	0.6	39.9	4	141	0.6	7.1
5	148	0.5	46.2	5	141	0.6	8.8
Hatches Closed							
1	127	1.0	98.6	1	121	1.1	65.5
2	127	0.9	92.7	2	120	0.8	93.6
3	127	0.8	94.8	3	122	0.9	93.9
4	128	1.3	101.4	4	121	1.0	97.9
5	127	0.9	98.9	5	121	0.8	66.7

TABLE 2.3-3. SPLS RECORDED AT THE SHOOTER'S EAR POSITION

Rd No.	Data			Rd No.	Data		
	Peak dB	XM231 Smg			Peak dB	M3A1 Smg	
		"A" Duration, ms	"B" Duration, ms			"A" Duration, ms	"B" Duration, ms
Hatches Open							
1	130	0.2	63.6	1	125	0.2	63.6
2	129	.1	57.4	2	125	.2	70.8
3	129	.1	57.7	3	124	.1	73.0
4	130	.1	49.6	4	124	.2	76.0
5	129	.1	76.4	5	126	.1	75.1
Hatches Closed							
1	129	0.1	88.4	1	119	0.6	75.5
2	129	.1	85.5	2	115	.4	95.2
3	130	.1	87.0	3	117	.6	88.3
4	129	.2	88.9	4	117	.1	102.6
5	129	.2	88.3	5	122	.1	71.4

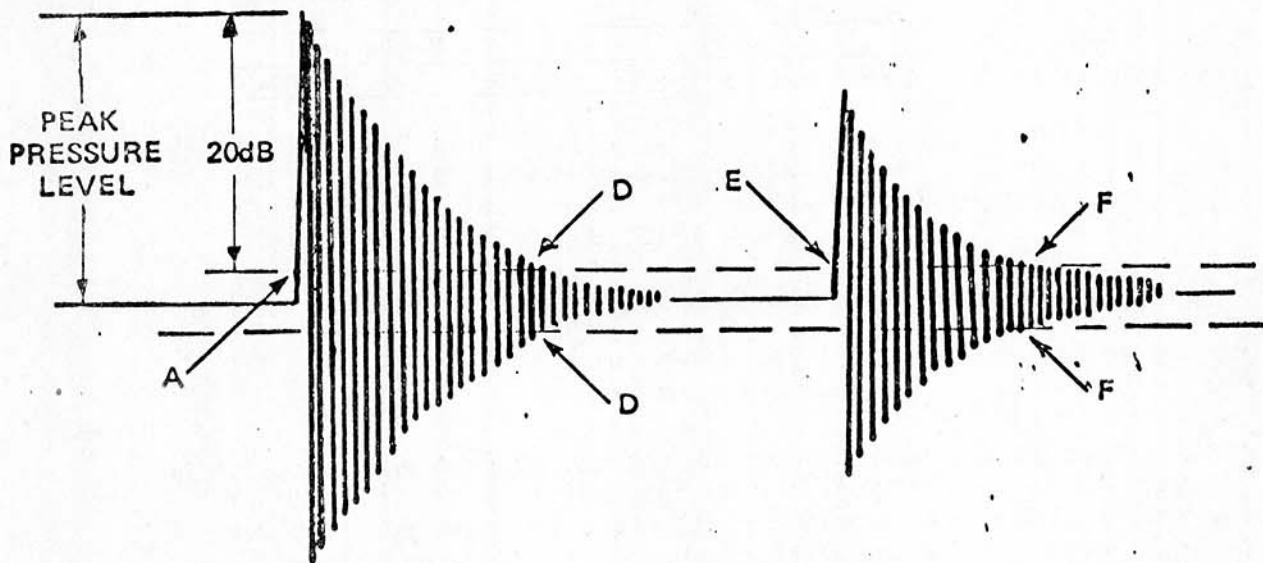
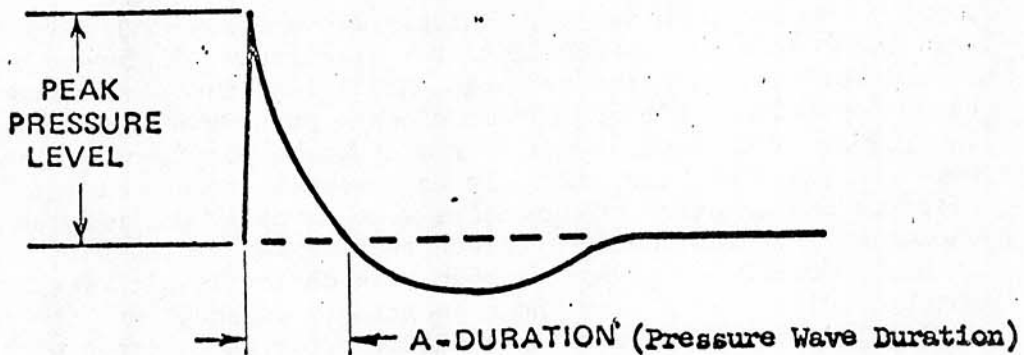
TABLE 2.3-4. SPLS RECORDED AT THE EAR POSITION OF THE AFT-MOST SEAT, ON THE LEFT SIDE OF THE MICV

Rd No.	Data			Rd No.	Data		
	Peak dB	XM231 Smg			Peak dB	M3A1 Smg	
		"A" Duration, ms	"B" Duration, ms			"A" Duration, ms	"B" Duration, ms
Hatches Open							
1	126	0.2	60.5	1	114	0.1	48.6
2	126	.1	58.3	2	116	.5	68.6
3	126	.3	55.5	3	116	.5	68.3
4	126	.2	46.8	4	116	.4	68.3
5	126	.3	74.9	5	118	.6	65.8
Hatches Closed							
1	125	0.1	88.3	1	117	0.2	75.2
2	126	.1	82.4	2	115	.1	85.8
3	126	.2	85.2	3	114	.3	79.8
4	126	.1	86.1	4	116	.4	81.1
5	126	.1	86.1	5	118	.4	93.6

TABLE 2.3-5. SPLS RECORDED 25 FEET (7.6 METERS) TO THE REAR OF THE MICV, PERPENDICULAR TO THE LINE OF FIRE OF THE FPWS

Data				Data			
XM231 Smg				M3A1 Smg			
Rd No.	Peak dB	"A" Duration, ms	"B" Duration, ms	Rd No.	Peak dB	"A" Duration, ms	"B" Duration, ms
1	145	0.4	3.3	1	139	0.4	4.4
2	144	.5	4.4	2	137	.4	5.0
3	144	.5	3.6	3	135	.2	5.4
4	144	.6	3.3	4	132	.5	14.1
5	143	.5	4.2	5	132	.5	11.2

A description of what constitutes peak pressure duration and pressure-envelope duration during an idealized pressure-time history of an impulse noise is shown in figure 2.3-1. Peak pressure level is the highest level achieved in decibels (dB). "A" duration (pressure-wave duration) is the time required for the pressure to rise to its initial or principal positive peak and return momentarily to ambient pressure. "B" duration (pressure-envelope duration) is the total time that the envelope of pressure fluctuations (positive and negative) is within 20 dB of the peak pressure level. Included in this time is the duration of that part of any recorded reflection pattern that is within 20 dB of the peak pressure level.



B-duration (pressure envelope duration): time difference AD (+EF when a reflection is present).

Figure 2.3-1. Idealized pressure - time history of an impulse noise.

### 2.3.5 Analysis

2.3.5.1 General. A two-way analysis of variance with five replications was used to analyze the SPL data for significant differences between the values obtained with the two smgs (XM231 test and M3A1 control) and the hatch conditions (either open or closed) being the effects considered. The results from each of the four microphone positions within the MICV were analyzed independently. It was assumed throughout that the peak pressure and duration measurements were normally distributed random variables. Statistical comparison testing was at the 0.05 significance level. Table 2.3-6 gives the mean peak dB levels with respect to weapon, hatch condition, and microphone position. In addition, the mean peak dB levels combined over hatch conditions for each weapon with respect to the microphone position are included. Those combined values that were significantly higher are so noted.

TABLE 2.3-6. SUMMARY OF MEAN PEAK SPLS, IN DB, INCLUDING DATA COMBINED OVER HATCH CONDITIONS

Microphone Position	Data					
	XM231 Smg			M3A1 Smg		
	Hatches			Hatches		
	Open	Closed	Comb.	Open	Closed	Comb.
Driver	132.6	121.8	<sup>a</sup> 127.2	129.0	110.4	119.7
Gunner	148.6	127.2	<sup>a</sup> 137.9	140.6	121.0	130.8
Shooter	129.4	129.2	<sup>a</sup> 129.3	124.8	118.0	121.4
Aft <sup>b</sup>	126.0	125.8	<sup>a</sup> 125.9	116.0	116.0	116.0

<sup>a</sup>Significantly higher than the combined value for the other weapon (0.05 level).

<sup>b</sup>Aft-most seat on the left side of the MICV.

For the microphone positions of the driver, gunner, and shooter, the interaction between weapons and hatch conditions was significant. Further analysis showed that for all three of these positions the mean peak dB for the XM231 smg with the hatch open and the mean with the hatch closed were each significantly higher than the corresponding means for the M3A1 smg. Overall, with regard to mean peak dB levels, the XM231 smg (130.1 dB) was significantly higher than the M3A1 smg (122.0 dB). The within-cell variation was so small relative to all other variations that all tests for equality of means were rejected.

For the microphone position 25 feet (7.6 meters) to the rear of the MICV perpendicular to the line of fire, a one-way analysis of variance was used. The mean peak dB for the XM231 smg (144 dB) was significantly higher than for the M3A1 smg (135 dB), at the 0.05 significance level.

2.3.5.2 "A" Duration. Table 2.3-7 gives the mean "A" duration (time) levels with respect to weapon, hatch condition, and microphone position.

Included in this summary are the mean "A" duration levels combined over hatch conditions for each weapon with respect to microphone position. Those combined values that were significantly higher are so noted.

TABLE 2.3-7. SUMMARY OF MEAN "A" DURATION TIME IN MILLISECONDS, INCLUDING DATA COMBINED OVER HATCH CONDITIONS

Microphone Position	Data					
	XM231 Smg			M3A1 Smg		
	Hatches			Hatches		
	Open	Closed	Comb.	Open	Closed	Comb.
Driver	1.02	1.04	<sup>a</sup> 1.03	0.72	0.48	0.60
Gunner	0.58	0.98	0.78	.54	.92	.73
Shooter	0.12	0.14	0.13	.16	.36	.26
Aft <sup>b</sup>	0.22	0.12	0.17	.42	.28	<sup>a</sup> .35

<sup>a</sup>Significantly higher than the combined value for the other weapon (0.05 level).

<sup>b</sup>Aft-most seat on the left side of the MICV.

Overall, the test and control weapons do not appear to be significantly different with regard to mean "A" duration.

For the microphone position 25 feet (7.6 meters) to the rear of the MICV perpendicular to the line of fire, a one-way analysis of variance was used. No significant difference existed at the 0.05 level between the mean "A" duration levels for the two smgs.

2.3.5.3 "B" Duration. Table 2.3-8 gives the mean "B" duration levels with respect to weapon, hatch condition, and microphone position. Included in this summary are the mean "B" duration levels combined over hatch conditions for each weapon with respect to microphone position. Those combined values were significantly higher are so noted.

Table 2.3-8. COMBINED SUMMARY OF MEAN "B" DURATION TIME IN MILLISECONDS, INCLUDING DATA OVER HATCH CONDITIONS

Microphone Position	Data					
	XM231 Smg			M3A1 Smg		
	Hatches			Hatches		
	Open	Closed	Comb.	Open	Closed	Comb.
Driver	42.02	89.98	<sup>a</sup> 66.00	12.64	74.04	43.34
Gunner	46.68	97.28	<sup>a</sup> 71.98	7.50	83.52	45.51
Shooter	60.94	87.62	74.28	71.70	86.60	79.15
Aft <sup>b</sup>	59.20	85.62	72.41	63.92	83.10	73.51

See footnotes on following page.

TABLE 2.3-8 (CONT'D)

<sup>a</sup>Significantly higher than the combined value for the other weapon (0.05 level).

<sup>b</sup>Aft-most seat on the left side of the MICV.

In both cases above where there was a significant difference between weapons, the interaction between weapons and hatch conditions was also significant. Further analysis revealed that for both driver and gunner microphone positions the mean "B" duration for the XM231 smg with the hatch open and the mean with the hatch closed were each significantly higher than the corresponding mean values for the M3A1 smg. For information, an overall comparison of the XM231 smg and M3A1 smg, with regard to the mean "B" duration, indicated that the XM231 smg time (71.17 ms) was significantly greater (0.05 level) than the M3A1 smg time (60.38 ms). This was based on a three-way analysis of variance, with microphone position being the third factor, and must be viewed as a difference between systems taken over both the other factors (hatch condition and microphone position). The previous statements based on the two-way analyses for each microphone position provide more specific statements of differences.

For the microphone position 25 feet (7.6 meters) to the rear of the MICV perpendicular to the line of fire of the FPWs, a one-way analysis of variance was used. No significant difference (0.05 level) existed between the mean "B" duration level for the XM231 smg (3.76 ms), and the mean "B" duration level for the M3A1 smg (8.02 ms).

The effects of multiple-weapon firings on the peak noise level to which a crewman may be exposed may readily be calculated, using data from single-weapon firings.

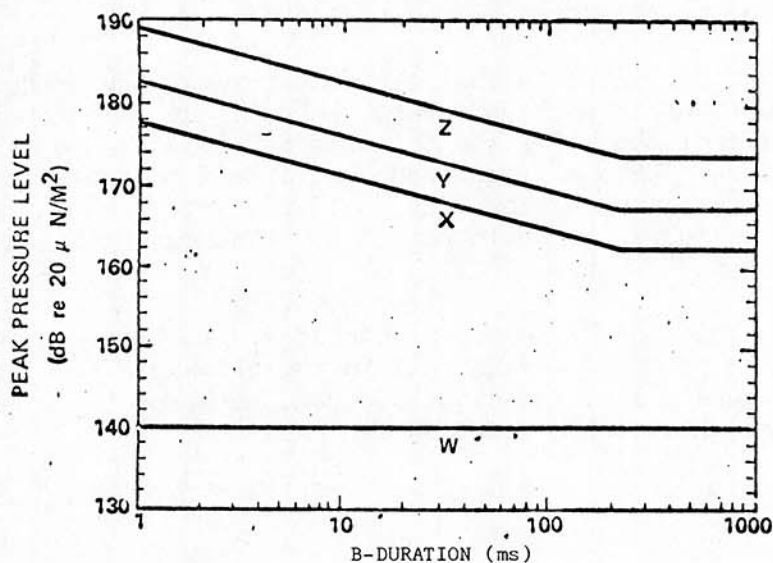
As an example, a worst-case (but unlikely) situation is considered, where SPLs of 130 dB from six FPWs arrive simultaneously at a shooter's ear, with the vehicle hatches closed. The SPLs are logarithmic (log) values to the base 10, with a multiplier of 10.

Logs cannot be combined directly, but must first be converted to antilog form. The antilog of  $130/10 = 13$  is  $1 \times 10^{13}$ . Six times the antilog is  $6 \times 10^{13}$ . The log of 6 is 0.78; the log of  $10^{13}$  is 13. Added, they become 13.78, or 137.8 dB, an increase of less than 8 dB over the 130-dB SPL obtained from one FPW. Any of the SPL data in tables 2.3-1 through 2.3-4 may be adjusted in a similar manner for six FPWs providing identical SPLs at a shooter's ear, by adding 7.8 dB. Were the SPLs from each FPW not identical, the adjustment to the highest SPL would always be less than 7.8 dB.

The characteristic sound-pressure-versus-time plot created by the expanding gases and the projectile fired in this test is clearly defined by a sharp rise and then a rapid decay in magnitude for the one channel having its microphone outside the vehicle, with no obstructions between it and the gun muzzle; however, the characteristics of the waveform recorded inside the vehicle, especially with the hatch doors closed, were entirely different. Characteristics of the internal surfaces of the vehicle structure reflect much of the sound, which reverberates for relatively long periods with respect to the excitation force. For example, pressure-envelope durations at the gunner's ear position (hatches closed) were up to 101.4 ms when firing the XM231 smg and up to 97.9 ms when firing the M3A1 smg.

The SPLs recorded at the gunner's ear position and the driver's ear position with the hatches open were greater than when the hatches were closed, since in the hatches-open position the ear was exposed more directly to the SPL from the muzzle during firing.

Noise-measurement data obtained during this test were compared to figure 3 of MIL-STD-1474 (MI) (figure 2.3-2), which shows the permissible peak pressure level (as a function of "B" duration) that should not be exceeded. The impulse noise-limit selection criteria in table 6 of MIL-STD-1474 (MI) (table 2.3-9) were also used to determine whether or not hearing protectors are required. Higher levels than curve Z are not permitted due to the possibility of other (nonauditory) physiological injury.



Note: Use of levels in excess of limit W requires mandatory hearing protection per TB MED 251.

Figure 2.3-2: Peak pressure level and "B" duration limits for impulse noise.

TABLE 2.3-9. IMPULSE NOISE-LIMIT  
SELECTION CRITERIA

Expected No. of Exposures per Day <sup>a</sup>	Impulse Noise-Limit Data		
	No Protection	Either Plugs or Muffs	Both Plugs and Muffs
1000	W	X	Y
100	W	Y	Z
5	W	Z	b_

<sup>a</sup>A single exposure consists of either (1) a single impulse (not more than one impulse per second) for non-repetitive systems (e.g., semi-automatic weapons) or (2) a burst for systems normally producing more than one impulse per second (e.g., automatic weapons).

<sup>b</sup>Higher levels than curve Z not permitted due to the possibility of other (nonauditory) physiological injury.

The data indicate that ear protection is not required for personnel in the "passenger" area of the MICV for single or multiple firings of FPWs, provided that the rear door and ramp of the vehicle are closed. If the driver's and gunner's hatches are closed, these crew members (the driver and gunner) also do not need ear protection. Ear protection (muffs or plugs) is required in all other situations, i.e., for the driver and gunner if either of the forward hatches is open, or for all personnel if the rear door or ramp is open.

The data in table 2.1-1 indicate that ear protection is not required for the driver if the hatch is open; however, the data are based on firing from the right side of the MICV; the driver's hatch is at the left front of the vehicle. Were firings conducted from the left side of the MICV with the hatches open, higher SPLs would result, as shown in table 2.3-2 for the turret gunner's position. (The turret hatch is on the right front of the vehicle.)

Both the XM231 smg and the M3A1 smg are considered to have met the criterion since the pressure levels fall in the allowable area below the Z curve in figure 2.3-2, and since adequate ear protection can be obtained, where required, with standard equipment.

TEST DATA

Table of Contents

	<u>PAGE</u>
Malfunctions and Unserviceable Parts Data, PQT-C and PQT-G	2 thru 29
Bore Measurement Summary for XM231 smg	30 thru 31
Toxic Fumes Test Data	32 thru 34
Plots of Average Velocity Versus Test Cycle Number	35 thru 38

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FW  
XM231 SMG APG NO. 1c, SERIAL NO. 5040166

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase I							
1	FFR	2	I	Wpn			
	FBR	1	I	Wpn			
2	FF	1	I	Pers			
3	FJ	1	I	Wpn			
4		0					
5	FJ	2	I	Wpn			
6	FJ	4	I	Wpn			
7		0					
8	FF	1	I	Ammo			
	FJ	1	I	Wpn			
9		0					
10		0					
11	FFR	2	I	Wpn			
12	FJ	3	I	<sup>a</sup> Wpn, 2 Part 1	Ejector Spring. This is classified as a chargeable weapon failure.	7554	
13		0					
<sup>b</sup> 14		0					
15	FJ	1	I	Wpn			
	FFR	1	I	Wpn			
16		0					
17		0					

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 1c

<u>Rds Fired On Endurance</u>	<u>No. Of Clearable Weapon Stoppages</u>	<u>No. Of Chargeable Weapon Failures</u>	<u>Point Estimate Of MRBS MRBF</u>	
10200	17 <sup>c</sup> 6	1	600 <sup>b</sup> 1700	10200

<sup>a</sup>One of the FJ's was not counted in the MRBS calculations since it was traceable to an unserviceable ejector spring within 200 rounds of replacement.

<sup>b</sup>Fired without the brass catcher.

<sup>c</sup>Disregarding FJ malfunctions.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FFW  
XM231 SMG APG NO. 2c, SERIAL NO. 5054265

Test Cycle Number	Malfunctions				Unserviceable Parts	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
Phase I						
1	FFR	1	I	Wpn		
	FJ	1	I	Wpn		
2		0				
3		0				
4		0				
5		0				
6	FFR	1	I	Wpn		
	FJ	1	I	Wpn		
7	FFR	1	I	Wpn		
8	FJ	1	I	Inst		
9		0				
10		0				
11		0				
12		0			<sup>a</sup> Ejector Spring	7440
13		0				
<sup>b</sup> 14	FFR	2	I	Wpn		
15		0				
16		0				
17		0			<sup>c</sup> Bolt Carrier Assembly, Barrel, and Gas Tube	10590
Phase II						
1		0				
2	FJ	3	I	Wpn		
3	FJ	1	I	Wpn		
4	FJ	2	I	Wpn	<sup>d</sup> Charging Handle Latch, This is classified as a chargeable weapon failure.	13080
5	FFR	1	I	Wpn		
6		0				
7	FJ	3	I	Wpn		
8		0				

Test Cycle Number	Type	Malfunctions			Unserviceable Parts	
		Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
9	FJ	1	I	Wpn		
10	FJ	1	I	Wpn		
11	FFR	1	I	Wpn		
12	FJ	1	I	Wpn	Ejector Port Cover Latch. Not counted in MRBF calculations since it does not affect weapon functioning.	17940
13		0			<sup>a</sup> Extractor Spring	7950
14	FJ	0	I	Wpn		
15		0				
16	FJ	2	I	Wpn		
17	FJ	1	I	Wpn	<sup>g</sup> Ejector Spring <sup>g</sup> Bolt Catch Pin <sup>g</sup> Alignment Pin	10500 21090 21090

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 2c

Phase	Rds Fired On Endurance	No. Of Clearable Weapon Stoppages	No. Of Chargeable Weapon Failures	Point Estimate Of MRBS	Point Estimate Of MRBF
I	10200	7 f <sub>5</sub>	0	1457 f <sub>2040</sub>	
II	10200	18 f <sub>2</sub>	1	567 f <sub>5100</sub>	10200

<sup>a</sup>This is not scored since it was replaced during normal care and cleaning at the end of a test cycle.

<sup>b</sup>Fired without the brass catcher.

<sup>c</sup>Inspection during normal care and cleaning at the end of the 17th cycle revealed that the bolt carrier assembly required replacement. By direction of RIA representative, a new barrel was installed prior to the second phase. A new gas tube (assembled at RIA) was attached to the barrel collar. These are not classified as chargeable weapon failures.

<sup>d</sup>This chargeable weapon failure did not cause the FJ malfunctions.

<sup>e</sup>After the ninth cycle, the RIA representative added a 1/16-inch steel washer to the drive spring guide to decrease the rearward travel of the bolt carrier (the bolt carrier key was impacting against the back of the lower receiver).

<sup>f</sup>Disregarding FJ malfunctions.

<sup>g</sup>Unserviceable parts discovered at the conclusion of testing would not be chargeable.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FFW  
XM231 SMG APG No. 3c, SERIAL NO. 5054925

Test Cycle Number	Malfunctions				Unserviceable Parts	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
Phase I						
1	FFR	1	I	Wpn		
	FBS	1	I	Wpn		
2		0				
3		0				
4	FFR	1	I	Wpn		
5		0				
6	FJ	1	I	Wpn		
7		0				
8		0				
9		0			a_	
10	FJ	1	I	Wpn		
11	FJ	2	I	Wpn		
12		0			b Bolt Rings.	7421
13		0				
c14		0				
15	BSIB	1	II	Ammo		
	FJ	1	I	Wpn	d Charging Handle. This is classified as a charge-able weapon failure.	9131
16	FFR	2	I	Wpn		
17	FJ	2	I	Wpn		
					e Bolt Carrier Assembly. Barrel and Gas Tube.	10601
Phase II						
1	FJ	1	I	Wpn		
	FBR	1	I	Wpn		
	FFR	1	I	Pers		
2		0				
3		0			b Flash Suppressor Lock Washer (not counted in failure calculations since it does not affect weapon functioning).	12491
4		0				
5		0				
6	FJ	2	I	Wpn		
7	FJ	1	I	Wpn		
8		0				

Test Cycle Number	Type	Malfunctions			Unserviceable Parts	
		Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
f9	FJ	1	I	Sys	<sup>d</sup> Brass Catcher Bag. This is classified as a system failure (not charged against weapon).	30090
10	FJ	1	I	Wpn		
	FFR	1	I	Wpn		
11	FJ	2	I	Wpn		
12		0				
13		0				
14	FJ	1	I	Wpn		
	FF	1	I	Wpn		
15	FJ	3	I	Wpn		
	FFR	1	I	Wpn		
16	FJ	1	I	Wpn		
17	FFR	1	I	Wpn	Ejector Spring. (Unserviceable part discovered at the conclusion of 17 cycles, would not be chargeable).	10500

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 3c

Phase	Rds Fired On Endurance	No. Of Clearable Weapon Stoppages	No. Of Chargeable Weapon Failures	Point Estimate Of MRBS	Point Estimate Of MRBF
I	10200	12 g5	1	850 g2040	10200
II	10200	18 g5	0	567 g2040	

<sup>a</sup>The gas evacuator motor on the MICV failed prior to this cycle. It was repaired. This is classified as a system failure, not to be counted as a weapons-related failure.

<sup>b</sup>This is not scored since it was noted during normal care and cleaning at the end of a test cycle.

<sup>c</sup>Fired without the brass catcher.

<sup>d</sup>This failure did not cause the FJ malfunction.

<sup>e</sup>Inspection during normal care and cleaning at the end of Phase I testing assembly required replacement. By direction of the RIA representative, a new barrel was installed prior to the second phase. A new gas tube (assembled at RIA) was attached to the barrel collar. These are not classified as chargeable weapon failures.

<sup>f</sup>After the ninth cycle, the RIA representative added a 1/16 inch thick steel washer to the drive spring guide to decrease the rearward travel of the bolt carrier (the bolt carrier key was impacting against the back of the lower receiver).

<sup>g</sup>Disregarding FJ malfunctions.

BSIB - Bullet stuck in bore. This incident was attributed to lack of a complete propelling charge load in the 5.56-mm cartridge.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FFW  
XM231 SMG APG NO. 4c, SERIAL NO. 5055648

Test Cycle Number	Malfunctions				Unserviceable Parts	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
Phase I						
1	FFR	1	I	Wpn		
2		0				
3	FJ	1	I	Wpn		
4	FJ	1	I	Wpn		
5	FJ	2	I	Wpn		
6		0				
7	FFR	1	I	Wpn		
8		0				
9		0				
10	FJ	2	I	Part 1 Part-rep, 1	Ejector Spring. This replacement is classified as a chargeable weapon failure. The FJ was not counted in MRBS calculations since it was traceable to an unserviceable ejector spring.	5880
11	FJ	1	I	Wpn		
12		0				
13		0				
<sup>a</sup> 14		0				
15	FFR	7	I	Part 1	Charging Handle. This replacement is classified as a chargeable weapon failure. The FFR was not counted in MRBS calculations since it was traceable to an unserviceable charging handle.	8970
16	FFR	1	I	Wpn		
17	FJ	1	I	Wpn		

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 4c

Rds Fired On Endurance	No. Of Clearable Weapon Stoppages	No. Of Chargeable Weapon Failures	Point Estimate Of MRBS	Point Estimate Of MRBF
10200	9 b3	2 -	1134 b3402	5100 -

<sup>a</sup>Fired without the brass catcher.

<sup>b</sup>Disregarding FJ malfunctions.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FW  
M3A1 SMG APG NO. 1c, SERIAL NO. 647129

Test Cycle Number	Malfunctions				Unserviceable Parts	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
Phase I						
1		0				
2		0				
3	FJ	1	I	Wpn		
4	FJ	2	I	Wpn		
	FF	1	I	Wpn (mag)		
5		0				
6		0				
7	FJ	1	I	Wpn		
8		0				
9		0				
10		0				
11		0				
12	FF	1	I	Wpn (mag)		
13		0				
14		0				
15		0				
16		0				
17		0				
Phase II						
1	FJ	1	I	Wpn		
2	FFR	1	I	Ammo		
3	FBS	1	I	Wpn		
	FF	1	I	Wpn (mag)		
	FBS	3	I	Part 1	The FBS was not counted in MRBS calculations since it was traceable to an un-serviceable sear.	
				Part- rep, 2	Sear. Classified as a chargeable weapon failure.	12270
4		0				
5	FF	1	I	Wpn (mag)	aExtractor.	13470
6		0				
					aLocating Plate	13470
7		0				
8		0				
9		0				
10		0				
11		0				
12		0				

Test Cycle Number	Type	Malfunctions			Unserviceable Parts	
		Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
13	0	0				
14		0				
15		0				
16		0				
17		0				

Summary of Weapon-Related Malfunctions  
M3A1 SMG No. 1c

Phase	Rds Fired On Endurance	No. Of	No. Of	Point Estimate Of	
		Clearable Weapon Stoppages	Chargeable Weapon Failures	MRBS	MRBF
I	10200	6	0	1700	-
II	10200	4	1	2550	10200

<sup>a</sup>These part replacements are not scored since they were accomplished during normal care and cleaning at the end of a test cycle.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FFW  
M3A1 SMG APG NO. 2c, SERIAL NO. 695562

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase I							
1	FJ	1	I	Wpn			
	FF	1	I	Wpn (mag)			
2		0					
3		0					
4		0					
5	FF	2	I	Wpn (mag)			
6		0					
7		0					
8		0					
9		0					
10		0					
11		0					
12	FF	3	I	Wpn (mag)			
13	FBS	2	I	Part 1 Part-rep, 1	Sear. This is clas- sified as a chargeable weapon failure. The FBS was not counted in MRBS calculations since it was traceable to an unserviceable sear.	7620	
14		0					
15		0					
16	FJ	0	I	Part 1 Part-rep, 9	Extractor. This is classified as a charge- able weapon failure. The FJ was not counted in MRBS calculations since it was traceable to an unserviceable extractor.	9510	
17		0			Oiler. This is not clas- sified as a chargeable weapon failure.	10440	
Phase II							
1		0					
2	FF	2	I	Wpn (mag)			
3	FBS	4	I	Part 1 Part-rep, 3	No new sear available. The FBS malfunction was not counted in MRBS calculations since it was traceable to an unserviceable sear.	11820 (No replace- ment avail- able).	
4	FBS	20	I	Part-rep, 20			
5	FBS	20	I	Part-rep, 20	Sear. This is clas- sified as a chargeable weapon failure.	13470	

Test Cycle Number	Malfunctions			Attributed To	Unserviceable Parts	
	Type	Number	Class		Part Name, Remarks	Total Rds On Part At Replacement
6		0				
7		0			<sup>a</sup> Locating Plate	14700
8		0				
9		0				
10		0				
11	FJ	1	I	Wpn		
12		0				
13		0				
14		0				
15		0				
16		0				
17		0				

Summary of Weapon-Related Malfunctions  
M3A1 SMG No. 2c

Phase	Rds Fired On Endurance	No. Of Clearable Weapon Stoppages	No. Of Chargeable Weapon Failures	Point Estimate Of	
				MRBS	MRBF
I	10200	7	2	1457	5100
II	10200	3	1	3400	10200

<sup>a</sup>This is not scored since it was noted during normal care and cleaning at the end of a test cycle.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
 PQT-C OF MICV FW  
 M3A1 SMG APG NO. 3c, SERIAL NO. 702341

Test Cycle Number	<u>Malfunctions</u>				<u>Unserviceable Parts</u>	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
Phase I						
1	FF	1	I	Wpn (mag)		
2		0				
3		0				
4	FJ	1	I	Wpn		
5		0				
6		0				
7		0				
8		0				
9		0				
10		0				
11	FJ	1	I	Wpn		
12	FJ	1	I	Wpn		
13		0				
14	FF	1	I	Wpn (mag)		
15	FF	1	I	Wpn (mag)		
16		0				
17		0				

Summary of Weapon-Related Malfunctions  
 M3A1 SMG No. 3c

<u>Rds Fired On Endurance</u>	<u>No. Of Clearable Weapon Stoppages</u>	<u>No. Of Chargeable Weapon Failures</u>	<u>Point Estimate Of</u>	
			MRBS	MRBF
10200	6	0	1700	-

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-C OF MICV FW  
M3A1 SMG APG NO. 4c, SERIAL NO. 707619

Test Cycle Number	Malfunctions				Unserviceable Parts	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Parts At Replacement
Phase I						
1	FBC	1	I	Wpn (mag)		
2		0				
3	FJ	1	I	Wpn		
4		0				
5	FF	2	I	Wpn (mag) 1 Mag-rep, 1	Magazine. This is classified as a chargeable weapon failure. The FF was not counted in MRBS calculations since it was traceable to an unserviceable magazine.	255
6		0				
7		0				
8		0				
9		0				
10		0				
11	FBS	1	I	Part	New sear not available. Sear. This is classified as a chargeable weapon failure. The FBS was not counted in MRBS calculations since it was traceable to an unserviceable sear.	6740
12	FBS	2	I	Part-rep		7340
13	FFR	1	I	Ammo		
14		0				
15		0				
16		0				
17		0				

Summary of Weapon-Related Malfunctions  
M3A1 SMG No. 4c

Rds Fired On Endurance	No. Of Clearable Weapon Stoppages	No. Of Chargeable Weapon Failures	Point Estimate Of MRBS	Point Estimate Of MRBF
10200	2	2	5100	5100

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FFW  
XM231 SMG APG NO. 1g SERIAL NO. 5041858

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase I							
a1	FJ	1	I	Wpn			
2	FJ	2	I	Wpn			
	FFR	1	I	Wpn			
3	FJ	4	I	Wpn			
b4	FJ	3	I	Wpn			
5	FJ	4	I	Wpn			
	FFR	2	I	Wpn, 1 Ammo, 1			
a6	FJ	2	I	Wpn			
7	FJ	8	I	Wpn			
a,c8	FJ	2	I	Wpn			
b,d9	FJ	2	I	Wpn			
10	FJ	1	I	Wpn			
	FFR	1	I	Wpn	<sup>e</sup> Gas Tube Assembly. The FFR was not counted in MRBS calculations since it was traceable to an unserviceable gas tube assembly.		5709
Note: The cycle was fired over since only 129 rounds were fired on the cycle prior to the gas tube breakage. (10th cycle.)							
f10		0					
f11		0					
f12		0					
f13		0			Quick-Release Pin. This is classified as a system failure, not counted as a weapon failure.		35270
f14	FF	1	I	Wpn (mag)			
f15		0					
16	FF	6	I	Wpn (mag), 1 Magazine. This is classified as a chargeable weapon failure. The FF was not counted in MRBS calculations since it was traceable to an unserviceable magazine.			906
17		0			Ejection Port Cover Latch. This is not classified as a chargeable weapon failure. (This occurred during velocity firing.)		10689
					<sup>g</sup> Ejector Spring, Sear, Bolt Carrier.		10689

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 1g

Rds Fired On Endurance	No. Of	No. Of	Point Estimate Of	
	Clearable Weapon Stoppages	Chargeable Weapon Failures	MRBS	MRBF
10329	32	2	323	5164
	<sup>h</sup> 3	-	<sup>h</sup> 3443	-

<sup>a</sup>The second 300-round complement of the 600-round cycle was fired without malfunction.

<sup>b</sup>The first 300-round complement of the 600-round cycle was fired without malfunction.

<sup>c</sup>Fired without the brass catcher for the second 300-round complement.

<sup>d</sup>Fired without the brass catcher for the first 300-round complement.

<sup>e</sup>This is classified as a chargeable weapon failure.

<sup>f</sup>Fired without the brass catcher for both 300-round complements.

<sup>g</sup>The Ejector Spring, Sear, and Bolt Carrier were unserviceable, as noted during normal care and cleaning performed upon completion of testing. These are not classified as chargeable weapon failures.

<sup>h</sup>Disregarding FJ malfunctions.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FW  
XM231 SMG APG NO. 2g SERIAL NO. 5053010

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase I							
1	FBR	1	I	Wpn			
2		0					
a3	FJ	3	I	Wpn			
4	FJ	2	I	Wpn			
5	FJ	4	I	Wpn			
a6	FJ	1	I	Wpn			
b7	FFR	1	I	Wpn			
8		0			Filler Pin and Retainer. This is not classified as a chargeable weapon failure as there was no related stoppage.		4980
9		0					
c10		0					
c11		0					
c12		0					
c13		0					
c14	FF	1	I	Wpn			
	FJ	1	I	Wpn			
	FFR	1	I	Wpn			
e15	FJ	f6	I	Wpn, 2 Part, 4	dBolt Cam Pin. Ejector Spring. (Chargeable Weapon Failure.) The FJ was not counted in MRBS calculations since it was traceable to an unserviceable ejector spring.		8640 9270
16	FBR	2	I	Wpn (mag)			
	FF	1	I	Wpn			
17		0			Bolt Carrier and Ejection Port Cover Latch. Noted upon completion of testing; not chargeable as weapon related failures.		10560

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 2g

<u>Rds Fired On Endurance</u>	<u>No. Of Clearable Weapon Stoppages</u>	<u>No. Of Chargeable Weapon Failures</u>	<u>Point Estimate Of</u>	
			<u>MRBS</u>	<u>MRBF</u>
10200	20	1	510	10200
	87	-	81457	-

<sup>a</sup>The first 300-round complement of the 600-round cycle was fired without malfunction.

<sup>b</sup>The second 300-round complement of the 600-round cycle was fired without malfunction.

<sup>c</sup>Fired without the brass catcher for both 300-round complements.

<sup>d</sup>During normal care and cleaning after the 14th cycle, it was noted that the bolt cam pin was broken in half. Therefore, this is not scored.

<sup>e</sup>Fired without the brass catcher for the first 300-round complement of the 600-round cycle. The two FJs chargeable against the weapon occurred during the first 300-round complement.

<sup>f</sup>Two FJs were noted during the first 300-round complement (without the brass catcher) and four FJs were noted during the second 300-round complement (with the brass catcher).

<sup>g</sup>Disregarding FJ malfunctions.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FFW  
XM231 SMG APG NO. 3g, SERIAL NO. 5053432

Test Cycle Number	Malfunctions				Unserviceable Parts	
	Type	Number	Class	Attributed To	Part Name, Remarks	Total Rds On Part At Replacement
Phase I						
a <sub>1</sub>	FBR	2	I	Wpn		
2	FJ	4	I	Wpn	Brass Catcher Bag (Hole in back portion at 22265 rounds). This is classified as a system failure. (Not charged against the weapon).	22500
	FFR	1	I	Wpn		
	FSO	1	IV	Part	Trigger Pin Snap Ring. (Trigger pin backed out.) This is classified as a failure. The FSO was not counted in MRBS calcula- tions since it was traceable to the trigger pin backing out.	1312
3	FJ	6	I	Wpn		
4	FJ	5	I	Wpn		
	FFR	2	I	Wpn		
	FF	1	I	Wpn (mag)		
5	FJ	3	I	Wpn		
6	FJ	8	I	Wpn		
7	FJ	4	I	Wpn		
b <sub>8</sub>	FFR	1	I	Wpn		
	FF	1	I	Wpn (mag)		
	FJ	4	I	Wpn	Ejector Spring. This is not scored as a failure since it was replaced during normal care and cleaning at the end of a test cycle.	4980
a,c <sub>9</sub>	FJ	5	I	Wpn		
10	FJ	1	I	Wpn		
d <sub>11</sub>		0				
d <sub>12</sub>		0				
d <sub>13</sub>		0				
d <sub>14</sub>		0				
15		0				
16	FF	1	I	Wpn		
17		0				
					Charging Handle Latch.	10530
					Ejector Spring. The un- serviceable charging handle and ejector spring were noted at the end of the 17 cycles of testing; therefore, these unservice- able parts were not charged as failures against the weapon.	5580

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
 PQT-G OF MICV FFW  
 XM231 SMG APG NO. 3g, SERIAL NO. 5053432

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase II							
d <sub>1</sub>		0					
2	FJ	2	I	Wpn			
3	FJ	2	I	Wpn			
f <sub>4</sub>	FJ	1	I	Wpn			
a <sub>5</sub>	FJ	1	I	Wpn	<sup>e</sup> Bolt Cam Pin.		13650
a <sub>6</sub>	FJ	1	I	Wpn			
a <sub>7</sub>	FJ	1	I	Wpn			
f <sub>8</sub>	FJ	2	I	Wpn			
9	FJ	3	I	Wpn	Ejector Port Cover. Not counted in MRBF calculations since weapon functioning was not affected.		16110
10		0					
a <sub>11</sub>	FJ	1	I	Wpn			
12	FF	5	I	Wpn (mag), 1 Mag-rep, 4	Magazine. This is classified as a charge- able weapon failure. The FF was not counted in MRBS calculations since it was traceable to an unserviceable magazine.		2744
	FJ	3	I	Wpn			
13	FJ	2	I	Wpn	Gas Tube. This is clas- sified as a chargeable weapon failure.		18504
					<sup>e</sup> Extractor Spring.		18540
f <sub>14</sub>	FJ	3	I	Wpn	<sup>e</sup> Bolt Ring (front).		19170
15	FJ	8	I	Wpn, 3 Part 1 Part rep, 4	Bolt. This is clas- sified as a charge- able weapon failure. The FJ was not counted in MRBS calculations since it was traceable to an unserviceable ejector spring.		19389
					Ejector Spring. This is classified as a charge- able weapon failure.		8838
16		0					
a <sub>17</sub>	FJ	2	I	Wpn			

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 3g

<u>Phase</u>	<u>Rds Fired On Endurance</u>	<u>No. Of Clearable Weapon Stoppages</u>	<u>No. Of Chargeable Weapon Failures</u>	<u>Point Estimate Of</u>	
				<u>MRBS</u>	<u>MRBF</u>
I	10200	49 89	1 -	208 81133	10200 -
II	10200	27 80	4 -	378 -	2550 -

<sup>a</sup>The second 300-round complement of the 600-round cycle was fired without malfunction.

<sup>b</sup>The first 300-round complement of the 600-round cycle was fired without the brass catcher. The only malfunction that occurred during the first 300-round complement was the FF.

<sup>c</sup>The second 300-round complement was fired without the brass cathcer.

<sup>d</sup>Fired without the brass catcher for both 300-round complements.

<sup>e</sup>This is not scored since it was noted during normal care and cleaning at the end of a test cycle.

<sup>f</sup>The first 300-round complement of the 600-round cycle was fired without malfunction.

<sup>g</sup>Disregarding FJ malfunctions.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FFW  
XM231 SMG APG NO. 4g, SERIAL NO. 5056579

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase I	FFR	1	I	Wpn			
a <sub>1</sub>	FJ	1	I	Wpn	Brass Catcher (hole). This is classified as a system failure (not charged against the weapon).		22200
	FFR	1	I	Wpn			
a <sub>3</sub>	FFR	1	I	Wpn			
a <sub>4</sub>	FJ	2	I	Wpn			
5		0					
a <sub>6</sub>	FFR	1	I	Wpn			
7		0					
8	FJ	2	I	Wpn			
a <sub>9</sub>	FJ	1	I	Wpn			
b <sub>10</sub>		0					
c <sub>11</sub>		0					
c <sub>12</sub>		0					
c <sub>13</sub>		0					
c <sub>14</sub>		0					
15	FF	1	I	Wpn (mag)	<sup>d</sup> Bolt Ring.		9285
16		0					
17		0			<sup>f</sup> Ejector Spring		10575
Phase II							
c <sub>1</sub>		0					
2	FJ	2	I	Wpn	<sup>d</sup> Bolt Cam Pin.		11775
3		0					
a <sub>4</sub>	FJ	1	I	Wpn			
5		0					
a <sub>6</sub>	FJ	2	I	Wpn	<sup>d</sup> Bolt.		14235
7	FJ	2	I	Wpn			
8		0			<sup>d</sup> Extractor Spring.		15465
a <sub>9</sub>	FJ	1	I	Wpn			
a <sub>10</sub>		0					
a <sub>11</sub>	FJ	1	I	Wpn			
12		0	I		Ejection Port Cover Latch broken. The FJ was not counted in MRBF calculations since weapon functioning was not af- fected.		17895 (Not Re- placed)
a <sub>13</sub>	FJ	1	I	Wpn	<sup>d</sup> Firing Pin. <sup>d</sup> Bolt Cam Pin. <sup>d</sup> Extractor Spring.		18495 6720 3030

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FFW  
XM231 SMG APG NO. 4g, SERIAL NO. 5056579

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
<sup>a</sup> 14	FJ	1	I	Wpn	Ejection Port Cover. The FJ was not counted in MRBF calculations since it doesn't affect weapon functioning.	19125	(Removed, not replaced.)
<sup>d</sup> 15	FJ	1	I	Wpn			
16		0					
17	FJ	3	I	Wpn	<sup>f</sup> Ejector Spring. <sup>f</sup> Sear Pin Snap Ring.	10470 21045	

Summary of Weapon-Related Malfunctions  
XM231 SMG No. 4g

Phase	Rds Fired On Endurance	No. Of Clearable Weapon Stoppages	No. Of Chargeable Weapon Failures	Point Estimate Of MRBS	Point Estimate Of MRBF
I	10200	11 85	1 -	927 2040	10200 -
II	10200	15 80	0 -	- -	- -

<sup>a</sup>The first 300-round complement of the 600-round cycle was fired without malfunction.

<sup>b</sup>The second 300-round complement of the 600-round cycle was fired without the brass catcher.

<sup>c</sup>Fired without the brass catcher.

<sup>d</sup>This was not scored since it was replaced during normal care and cleaning at the end of a test cycle.

<sup>e</sup>The second 300-round complement of the 600-round cycle was fired without malfunction.

<sup>f</sup>Unserviceable parts discovered at the conclusion of 17 cycles of testing, not chargeable.

<sup>g</sup>Disregarding FJ malfunction.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FFW  
M3A1 SMG APG NO. 1g, SERIAL NO. 632666

Test Cycle Number	Malfunctions			Attributed To	Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class		Part Name, Remarks		
Phase I							
1	FF	1	II	Pers	<sup>a</sup> Magazine		11
2		0					
3		0					
4		0					
5		0					
6		0			Restraining Cable Assembly. This is a peripheral-equip- ment failure.		26670
7		0					
8		0					
9		0			Extractor. Noted during inspection after the 9th cycle; therefore, not scored as a failure since the part was replaced during normal care and cleaning at the end of a test cycle.		5520
10		0					
11		0					
12		0					
13		0					
14		0					
15		0					
16		0					
17		0			Locating Plate. Noted during inspection after the 17th cycle; therefore, not counted as a charge- able weapon failure.		10500

Summary of Weapon-Related Malfunctions  
M3A1 SMG APG No. 1g

<u>Rds Fired On Endurance</u>	<u>No. of Clearable Weapon Stoppages</u>	<u>No. of Chargeable Weapon Failures</u>	<u>Point Estimate of</u>	
			<u>MRBS</u>	<u>MRBF</u>
10200	0	0	-	-

<sup>a</sup>Inspection revealed that the magazine was damaged. Several magazines, including this one, were found to be in unsuitable condition for test upon receipt at APG. This magazine was inadvertently included in the test; therefore, this FF is not charged against the system.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FPW  
M3A1 SMG APG NO. 2g, SERIAL NO. 647765

Test Cycle Number	Malfunctions			Attributed To	Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class		Part Name,	Remarks	
Phase I							
1	FF	1	II	Pers	<sup>a</sup> Magazine		6
2		0					
3		0					
4		0					
5		0					
6		0					
7		0					
8		0					
9		0					
10		0					
11		0					
12		0					
13		0					
14		0					
15		0					
16		0					
17		0			Locating Plate. Noted during inspection after the 17th cycle; therefore, not counted as a chargeable weapon failure.		10473

Summary of Weapon-Related Malfunctions  
M3A1 SMG APG No. 2g

Rds Fired On Endurance	No. of Clearable Weapon Stoppages	No. of Chargeable Weapon Failures	Point Estimate of	
			MRBS	MRBF
10200	0	0	-	-

<sup>a</sup>A damaged magazine was inadvertently used at the start of the test. See the comment regarding M3A1 SMG Serial No. 632666. Not to be charged against the weapon.

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
 FQT-G OF MICV FFW  
 M3A1 SMG APG NO. 3g SERIAL NO. 652107

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
Phase I							
1		0					
2	FFR	1	I	Wpn (mag)	Magazine. The bullet was stubbed due to a defective magazine. The primer was lightly indented. This is classified as a chargeable weapon failure. The FFR was not counted in MRBS calculations since it was traceable to an unserviceable magazine.		14
3		0					
4		0					
5		0					
6		0					
7		0					
8	FJ	1	I	Wpn			
9		0					
10	FBS	1	I	Part	Sear. This is classified as a chargeable weapon failure; however, no replacement sear was available at the time. The FBS was not counted in MRBS calculations since it was traceable to an unserviceable sear.		5790 (Not Replaced)
11		0					
12		0			<sup>a</sup> Extractor		
13	FBS	1	I	Part-rep			
14	FF	1	I	Wpn (mag)			
15		0					
16		0					
17		0					
Phase II							
1		0					
2	FJ	1	I	Part-rep			
	FBS	1	I	Part-rep			
3	FJ	1	I	Ammo	(Possibly a short powder charge since the projectile traveled approx. 50 meters, slowly)		

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
PQT-G OF MICV FFW  
M3A1 SMG APG NO. 3g, SERIAL NO. 652107

Test Cycle Number	Malfunctions				Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks		
4		0					
5		0					
6		0					
7		0			<sup>b</sup> Locating Plate		14790
8	FJ	1	I	Part-rep			
9	FJ	1	I	Part-rep			
10		0			<sup>c</sup> Sear		16620
11		0					
12		0					
13	FJ	1	I	Part-rep			
14	FJ	1	I	Part-rep			
15		0					
16	FJ	1	I	Part-rep			
17		0					

Summary of Weapon-Related Malfunctions  
M3A1 SMG APG No. 3g

Phase	Rds Fired On Endurance	No. of Clearable Weapon Stoppages	No. of Chargeable Weapon Failures	Point Estimate of	
				MRBS	MRBF
I	10200	2	2	5100	5100
II	10200	1	0	10200	-

<sup>a</sup>During normal care and cleaning (after the 12th cycle), it was noted that the extractor lip was damaged. No replacement part was available. After the 7th cycle of the second phase, it was noted that there was a small chip out of the extractor lip. The FJs are attributed to the damaged extractor after the 12th cycle of Phase I, and are not charged to the weapon.

<sup>b</sup>This was noted after the 7th cycle during normal care and cleaning; therefore, it was not scored as a failure.

<sup>c</sup>The sear replacement was not classified as a failure since it was previously classified as such (see the 10th cycle of Phase I).

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA  
 PQT-G OF MICV FFW  
 M3A1 SMG APG NO. 4g, SERIAL NO. 671231

Test Cycle Number	Malfunctions			Unserviceable Parts		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name, Remarks	
Phase I						
1		0				
2		0				
3		0				
4		0				
5		0				
6		0				
7		0				
8		0				
9		0				
10		0				
11		0				
12		0				
13		0			<sup>a</sup> Sear	
14		0				
15		0				
16		0				
17		0				
Phase II						
1	FF	2	I	Part (mag), 1	Magazine. This was classified as a chargeable weapon failure. FF was not counted in MRBS calculation since it was traceable to an unserviceable magazine.	2048
				Part-rep, 1		
2		0				
3		0				
4		0				
5	FBS	1	I	Wpn		
6		0				
7		0				
8	FF	1	I	Wpn		
	FJ	1	I	Part	FF was not counted in MRBS calculations since it was traceable to an unserviceable extractor.	
9	FJ	2	I	Part-rep, 2		
10	FJ	6	I	Part-rep, 6	Extractor. This is classified as a chargeable weapon failure.	16268
				<sup>b</sup> Sear.		16650

MALFUNCTIONS AND UNSERVICEABLE PARTS DATA

PQT-G OF MICV FFW

M3A1 SMG APG NO. 4g, SERIAL NO. 671231

Test Cycle Number	<u>Malfunctions</u>				<u>Unserviceable Parts</u>		Total Rds On Part At Replacement
	Type	Number	Class	Attributed To	Part Name,	Remarks	
11		0					
12	FBS	1	I	Wpn			
13		0					
14		0					
15		0					
16		0					
17		0					

Summary of Weapon-Related Malfunctions

M3A1 SMG APG No. 4g

Phase	Rds Fired On Endurance	No. of Chargeable Weapon Stoppages	No. of Chargeable Weapon Failures	Point Estimate of MRBS	Point Estimate of MRBF
I	10200	0	0	-	-
II	10200	3	2	3400	5100

<sup>a</sup> During normal care and cleaning after the 13th cycle it was noted that the sear was worn; however, there was no replacement sear available at this time.

<sup>b</sup> During normal care and cleaning after the 10th cycle the sear was replaced. This is not scored.

Summary of Bore Measurement Data for the XM231 SMG  
Taken 10.30 inches (26.2cm) from the Face of the Flash Suppressor

No. of Test Rounds Fired on Barrel	<sup>a</sup> Land Diameters, inches			<sup>a</sup> Groove Diameters, inches		
	1 to 4	2 to 5	3 to 6	1 to 4	2 to 5	3 to 6
None	XM231 smg No. 1G (SN 5041858)					
3600	0.2203	0.2200	0.2198	0.2239	0.2240	0.2240
7200	.2253	.2252	.2257	.2253	.2257	.2255
10,200	.2260	.2252	.2253	.2254	.2254	.2257
Change in dia.	.2278	.2277	.2278	.2262	.2259	.2258
	+ .0075	+ .0077	+ .0080	+ .0023	+ .0019	+ .0018
None	XM231 smg No. 2G (SN 5053010)					
3600	0.2192	0.2194	0.2193	0.2239	0.2239	0.2239
7200	.2255	.2245	.2256	.2252	.2257	.2254
10,200	.2262	.2265	.2268	.2245	.2242	.2245
Change in dia.	.2277	.2278	.2280	.2249	.2250	.2249
	+ .0085	+ .0084	+ .0087	+ .0010	+ .0011	+ .0010
None	XM231 smg No. 3G (SN 5053432)					
3600	0.2196	0.2197	0.2200	0.2239	0.2243	0.2241
7200	.2255	.2256	.2256	.2253	.2251	.2253
10,200	.2266	.2269	.2270	.2246	.2245	.2247
Change in dia.	.2275	.2275	.2274	.2249	.2248	.2247
	+ .0079	+ .0078	+ .0074	+ .0010	+ .0005	+ .0006

<sup>a</sup>The No. 1 land is at the 12 o'clock position. The remaining lands and grooves are counted clockwise, from the muzzle end.

No. of Test Rounds Fired on Barrel	<sup>a</sup> Land Diameters, inches			<sup>a</sup> Groove Diameters, inches		
	1 to 4	2 to 5	3 to 6	1 to 4	2 to 5	3 to 6
13,800	XM231 smg No. 3G, phase II	0.2237	0.2240	0.2238	0.2240	0.2235
17,400		.2283	.2282	.2282	.2280	.2263
20,400		.2285	.2284	.2285	.2278	.2276
Change in dia.		+ .0089	+ .0087	+ .0085	+ .0035	+ .0035
None	XM231 smg No. 4G (SN 506579), phase I	0.2198	0.2197	0.2198	0.2240	0.2240
3600		.2251	.2245	.2248	.2247	.2248
7200		.2266	.2270	.2265	.2240	.2242
10,200		.2274	.2274	.2274	.2246	.2246
Change in dia.		+ .0076	+ .0077	+ .0076	+ .0006	+ .0006
13,800	XM231 smg No. 4G, phase II	0.2244	0.2244	0.2244	0.2294	0.2297
17,400		.2285	.2286	.2285	.2261	.2254
20,400		.2286	.2287	.2287	.2273	.2278
Change in dia.		+ .0088	+ .0090	+ .0089	+ .0033	+ .0038

DATA SHEET

Name of Test Item: XM723 MICV Plot No. 5  
 Date(s): 3-4 APRIL 75

For use of this form, see EET Pro 70-1; Subtest TOXIC FUMES INVESTIGATION  
 Name of Person: JM ROUSE

the proponent is Eng & Env Test Sec. Title of XM231 & M3A1 FFW  
 Recording Data: GF WORKINGER

CREW POSITION TRIAL		WEAPONS XM231 XM231		CARBON MONOXIDE (CO) DATA			
1	2*	3	4	5*	6	7	8
WEAPONS XM231 XM231	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
FPW GAS EVACUATION SYSTEM	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
ROUNDS FIRED	1800	1498	1763	1535	1707	1800	1800
EQUIVALENT EXPOSURE TIME (MIN)	15.70	11.95	14.60	6.86	38.75	12.17	1.98
MAX. ALLOWABLE EXPOSURES (24 HR)	3.8	5.0	4.1	8.7	1.5	4.9	30.3
MAXIMUM CO CONCENTRATION (PPM)	690	630	750	275	2040	600	90
CREW POSITION TRIAL		WEAPONS XM231 XM231		LEFT FORWARD FFW			
1	2	3	4	5	6	7	8
WEAPONS XM231 XM231	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
FPW GAS EVACUATION SYSTEM	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
ROUNDS FIRED	1800	1498	1763	1535	1707	1800	1800
EQUIVALENT EXPOSURE TIME (MIN)	16.13	12.26	14.88	3.61	13.22	8.78	1.08
MAX. ALLOWABLE EXPOSURES (24 HR)	3.7	4.9	4.0	16.6	4.5	6.8	55.4
MAXIMUM CO CONCENTRATION (PPM)	860	660	1100	168	1000	460	68
CREW POSITION TRIAL		WEAPONS XM231 XM231		LEFT REAR SIDE FFW			
1	2	3	4	5	6	7	8
WEAPONS XM231 XM231	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
FPW GAS EVACUATION SYSTEM	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
ROUNDS FIRED	1800	1498	1763	1535	1707	1800	1800
EQUIVALENT EXPOSURE TIME (MIN)	11.20	9.33	9.94	4.93	18.69	6.53	1.47
MAX. ALLOWABLE EXPOSURES (24 HR)	5.4	6.4	6.0	12.2	3.2	10.9	40.9
MAXIMUM CO CONCENTRATION (PPM)	540	458	520	173	920	265	115
CREW POSITION TRIAL		WEAPONS XM231 XM231		RIGHT FORWARD FFW			
1	2	3	4	5	6	7	8
WEAPONS XM231 XM231	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
FPW GAS EVACUATION SYSTEM	ON	ON	OFF	OFF	ON	ON	M3A1 M3A1
ROUNDS FIRED	1800	1498	1763	1535	1707	1800	1800
EQUIVALENT EXPOSURE TIME (MIN)	16.4	15.25	13.82	15.99	35.86	8.01	1.82
MAX. ALLOWABLE EXPOSURES (24 HR)	3.7	3.9	4.3	10.0	1.7	7.5	33.0
MAXIMUM CO CONCENTRATION (PPM)	1170	1110	960	285	1980	408	95

STEAP-117 Form 234, 1 Aug 75 Edition of 11 Apr 72 may be used

*length of firing cycle*

DATA SHEET

Name of Test Item XM1723 MICV PILOT No. 5 Test Date(s) 3-4 APRIL 76  
 For use of this form, see EET Pro 70-1; Subtest TOXIC FUMES INVESTIGATION Name of Person J.M. ROUSE  
 the proponent is Eng & Env Test Sec. Title of XM231 & M3A1 FPW Recording Data GF WORKINGER

TRIAL	WEAPON XM231	AMMONIA (NH <sub>3</sub> ) DATA	8
1	XM231	5	M3A1
2	ON	M3A1	7
3	OFF	OFF	ON
4	1535	1800	1800
5	1763	1800	1800
6	RIGHT REAR SIDE FPW		
7	6	0	0
8	LEFT FORWARD FPW		
9	26	7	0
10	31	0	0
11	LEFT REAR SIDE FPW		
12	<5	0	0
13	RIGHT FORWARD FPW		
14	33	<5	0
15	2.9	2.8	2.8
16	3.0	3.5	4.2
17	3.0	3.7	4.2
18	3.0	3.3	4.2
19	3.0	3.3	4.2
20	3.0	3.3	4.2
21	3.0	3.3	4.2
22	3.0	3.3	4.2
23	3.0	3.3	4.2
24	3.0	3.3	4.2
25	3.0	3.3	4.2
26	3.0	3.3	4.2
27	3.0	3.3	4.2
28	3.0	3.3	4.2
29	3.0	3.3	4.2
30	3.0	3.3	4.2
31	3.0	3.3	4.2
32	3.0	3.3	4.2
33	3.0	3.3	4.2
34	3.0	3.3	4.2
35	3.0	3.3	4.2
36	3.0	3.3	4.2
37	3.0	3.3	4.2
38	3.0	3.3	4.2
39	3.0	3.3	4.2
40	3.0	3.3	4.2
41	3.0	3.3	4.2
42	3.0	3.3	4.2
43	3.0	3.3	4.2
44	3.0	3.3	4.2
45	3.0	3.3	4.2
46	3.0	3.3	4.2
47	3.0	3.3	4.2
48	3.0	3.3	4.2
49	3.0	3.3	4.2
50	3.0	3.3	4.2

Note: Firing cycle time intervals varied because of weapon malfunction which resulted in one or two weapons firing sporadically after the other had finished.

\* Data obtained during Trial 2 and 5 were not used in the overall evaluation since there were considerable malfunctions during the 2nd trial and the air evacuation system was not turned on until firing started for the 5th trial.

# MICV-FPW TOXIC FUMES TEST

3 APRIL 76

4 APRIL 76

<u>TIME</u>	<u>WIND SPEED (MPH)</u>	<u>WIND DIRECTION</u>
0700	9	WNW
0800	10	NNW
0900	10	WNW
1000	13	W
1100	15	W
1200	13	WNW
1300	11	NW
1400	13	NW

<u>TIME</u>	<u>WIND SPEED (MPH)</u>	<u>WIND DIRECTION</u>
0700	6	W
0800	10	WNW
0900	4	SE
1000	5	SE
1100	4	SE
1200	3	SE
1300	3	SE

~~Facing~~  
Facing South



Back  
of  
Vehicle

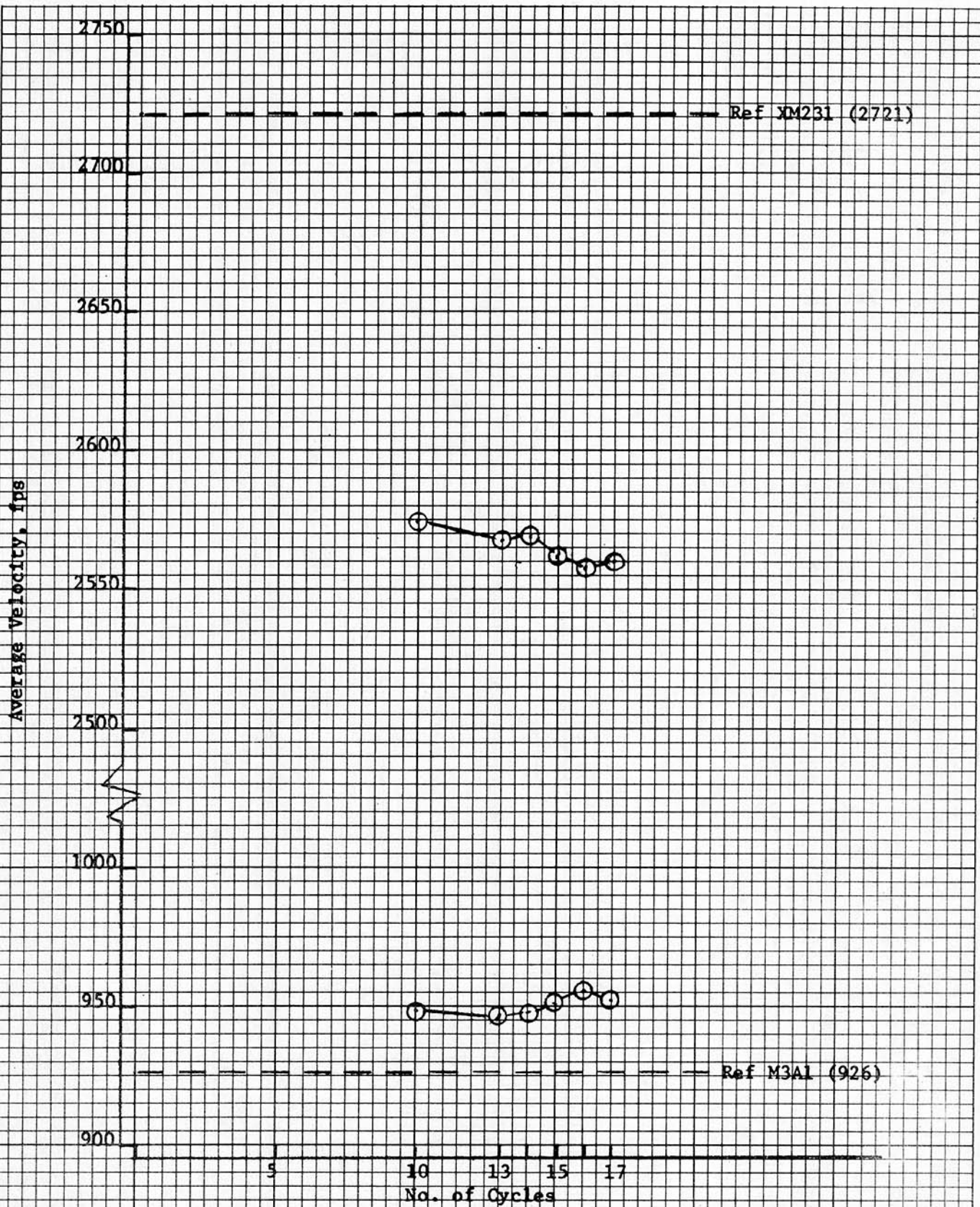


Figure 1. Average Initial Velocity Versus Test Cycle Number, During PQT-C (Phase I).

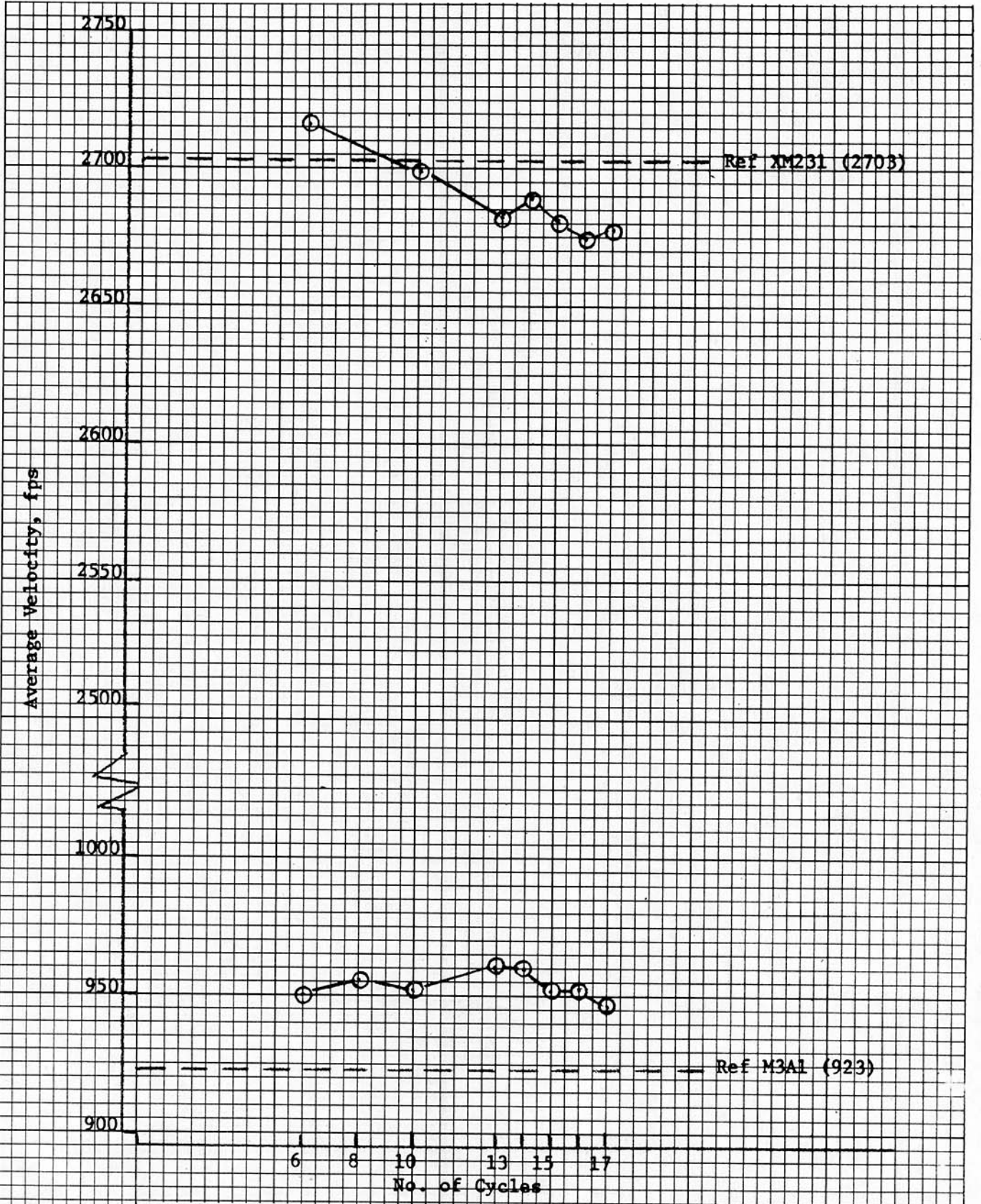


Figure 2. Average Initial Velocity Versus Test Cycle Number, During PQT-C (Phase II).

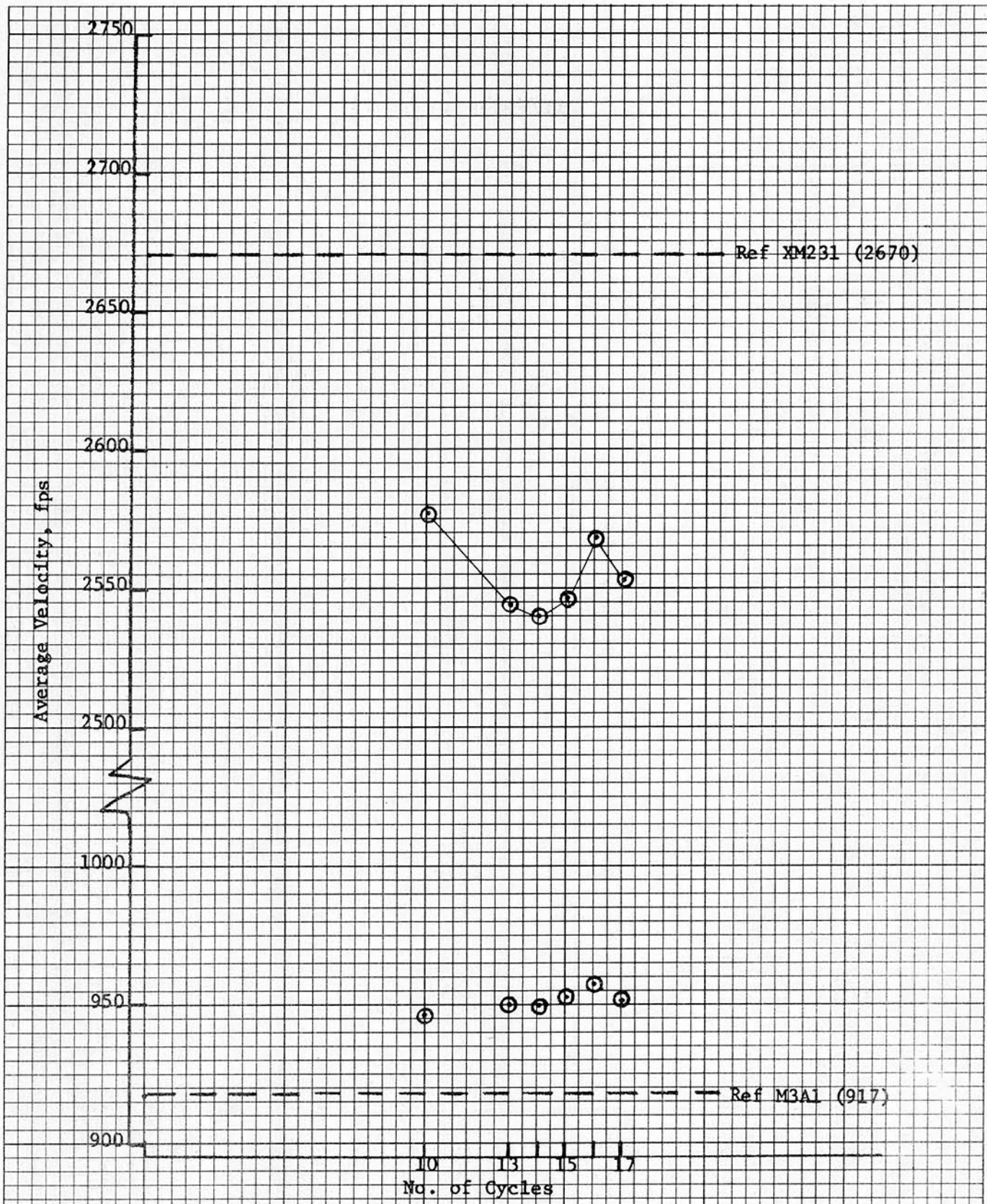


Figure 3. Average Initial Velocity Versus Test Cycle Number, During PQT-G (Phase I).

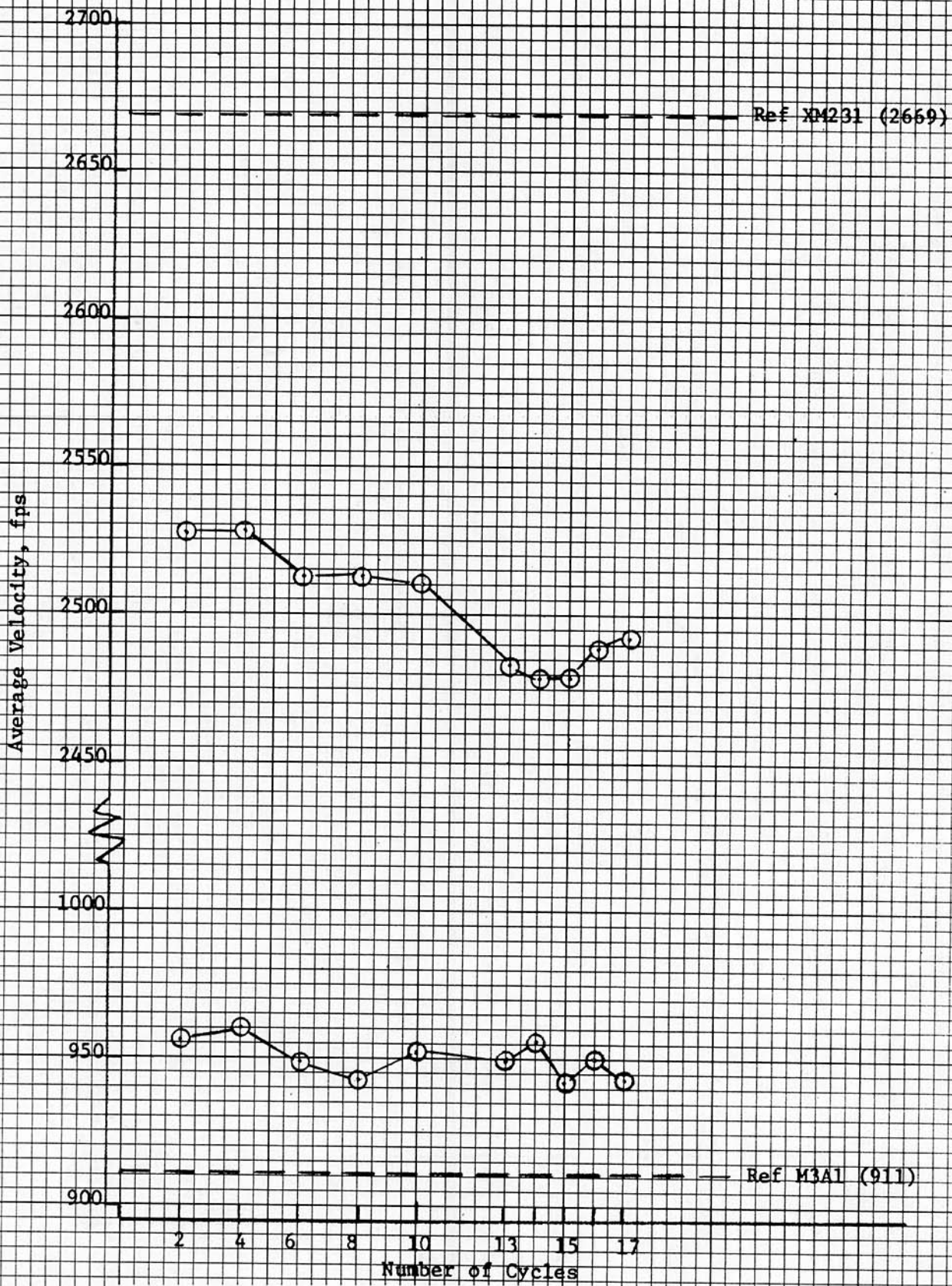


Figure 4. Average Initial Velocity Versus Test Cycle Number, During PQT-G (Phase II).

## RESULTS OF MAGNETIC PARTICLE INSPECTION

### 1. XM231 Smg APG No. 1C (SN 5040166)

Before and after firing 10,200 rounds, no crack patterns were noted in the component reference No. 2 through 5 and 7 through 17. A discontinuity or crack pattern was noted in one area in component reference No. 1 and 3 areas in component No. 6.

#### a. Component Reference No. 1

Area A: After firing 10,200 rounds, a 0.20-inch (5-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld.

#### b. Component Reference No. 6

Area A: After firing 10,200 rounds, a 0.20-inch (5-mm) length crack pattern was noted on the bolt carrier key at the right and left sides of the rear locking screw and a 0.05-inch (1-mm) length crack pattern at the right and left sides of the forward locking screw.

Area B: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the bottom right forward corner of an elongated slot. The pattern extended over an edge inside the piece for a 0.05-inch (1-mm) distance.

Area C: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the bottom right and left rear corners of an elongated slot. These patterns extended over an edge inside the piece for a 0.05-inch (1-mm) distance.

### 2. XM231 Smg APG No. 2C (SN 5054265)

During the inspection intervals for 20,400 rounds, no crack patterns were noted in the component reference No. 2 through 5, 7 through 14 and 17. A discontinuity or crack pattern was noted in 2 areas in component reference No. 1 and 6, and 1 area in component reference No. 7 and 16.

#### a. Component Reference No. 1

Area A: After firing 10,200 rounds, a 0.20-inch (5-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld. This component (barrel only) was replaced, the new barrel was inspected before and after it was fired 10,200 rounds and no crack patterns were noted.

Area B: After firing 20,400 rounds, the upper receiver attached to the barrel was inspected using the Zygló method and contained a 0.05-inch (1-mm) length crack pattern on each inside corner of the ejector port cover cut-out.

b. Component Reference No. 6

Area A: After firing 10,200 rounds a 0.20-inch (5-mm) length crack pattern was noted on the bolt carrier key at the right and left sides of the rear locking screw and a 0.05-inch (1-mm) length crack pattern at the right and left sides of the forward locking screw. A new bolt carrier assembly was installed (prior to second phase) and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing.

Area B: After firing 10,200 rounds a 0.05-inch (1-mm) length crack pattern was noted in the bottom right forward corner of an elongated slot. The pattern extended over an edge inside the piece for an 0.05-inch (1-mm). A new bolt carrier assembly was installed (prior to second phase) and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing.

c. Component Reference No. 7

Area A: After firing 20,400 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the rear fillet of the first and second lugs at the sides of an elongated slot.

d. Component Reference No. 15

Area A: After firing 20,400 rounds, two 0.05-inch (1-mm) length crack patterns were noted on the inside walls at each end of the firing pin hole.

e. Component Reference No. 16

Area B: After firing 20,400 rounds a crack pattern was noted extending completely around the firing pin.

3. XM231 Smg APG No. 3C (SN 5054925)

During the inspection intervals for firing 20,400 rounds, no crack patterns were noted in the components reference No. 1 through 5, 8 through 12, and 14 through 17. Crack patterns were noted in 3 areas in component reference No. 6 and 1 area in component reference No. 7, 13, and 15.

a. Component Reference No. 6

Area A: After firing 10,200 rounds, a 0.20-inch (5-mm) length crack pattern was noted on the bolt carrier key at the right and left sides of the rear locking screw and a 0.05-inch (1-mm) length crack pattern at the right and left sides of the forward locking screw. A new bolt carrier assembly was installed (prior to second phase) and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing. After firing 20,400 rounds, an additional 0.10-inch length crack pattern was noted on the top of the carrier key extending through the center of the weld, between the two locking screws.

Area B: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the bottom right forward corner of an elongated slot. The pattern extended over the edge inside the piece for a 0.05-inch (1-mm) distance. After firing 20,400 rounds the crack pattern was 0.10- by 0.10-inch (3- by 3-mm) in length.

Area C: After firing 20,400 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the bottom left rear corner of an elongated slot. The pattern extended over the edge inside the piece 0.05-inch (1-mm).

b. Component Reference No. 7

Area A: After firing 20,400 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the rear fillet of the first lug on each side of the elongated slot.

c. Component Reference No. 13

Area A: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the sear cam fillet. After firing 20,400 rounds the crack pattern increased to 0.10-inch (3-mm) in length.

d. Component Reference No. 15

Area A: After firing 20,400 rounds two 0.05-inch (1-mm) length crack patterns were noted on the inside wall at one of the firing pin holes.

4. XM231 Smg APG No. 4C (SN 5055648)

Before and after firing 10,200 rounds, no crack patterns were noted in the components reference No. 1 through 5 and 8 through 17. A crack pattern was noted in 1 area in component reference No. 6 and 7.

a. Component Reference No. 6

Area A: After firing 10,200 rounds a 0.02-inch (0.5-mm) length crack pattern was noted on the bolt carrier key at the right and left sides of the rear locking screw, and a 0.05-inch (1-mm) length crack pattern at the right and left sides of the forward locking screw.

b. Component Reference No. 7

Area B: After firing 10,200 rounds a 0.10- by 0.15-inch (3- by 4-mm) length crack pattern was noted across the edge of the bolt retainer pin hole. The component was declared unserviceable.

5. XM231 Smg APG No. 1G (SN 5041858)

Before and after firing 10,200 rounds no crack patterns were noted in the component reference No. 2 through 5, 7 through 14, 16, and 17. A discontinuity or crack pattern was noted in 1 area in component reference No. 1, 6 and 15.

a. Component Reference No. 1

Area A: After firing 10,200 rounds, a 0.20-inch (5-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld.

b. Component Reference No. 6

Area A: After firing 10,200 rounds, a 0.15-inch (4-mm) length crack pattern was noted on the bolt carrier key on the right side and a 0.20-inch (5-mm) length crack pattern on the left side near the rear locking screw. A 0.05-inch (1-mm) length crack pattern was noted on the right and a 0.20-inch (5-mm) length crack pattern on the left side near the front locking screw.

c. Component Reference No. 15

Area A: After firing 10,200 rounds two 0.05-inch (1-mm) length crack patterns were noted on the inside wall at one end of the firing pin hole. This component was declared unserviceable.

6. XM231 Smg APG No. 2G (SN 5053010)

Before and after firing 10,200 rounds, no crack patterns were noted in the components reference No. 2 through 5 and 8 through 15. A discontinuity or crack pattern was noted in 1 area in components reference No. 1, 7, 16, and 17, and 3 areas in component reference No. 6.

a. Component Reference No. 1

Area A: After firing 10,200 rounds, a 0.15-inch (4-mm) length discontinuity was noted on the front section of the tank mounting bracket along the edge of a weld.

b. Component Reference No. 6

Area B: Before firing, a 0.05-inch (1-mm) length crack pattern was noted in the bottom left forward corner of an elongated slot. The pattern extended 0.05 inch (1 mm) over an edge onto the inside of the piece and remained unchanged after firing 10,200 rounds. After firing 10,200 rounds a similar crack was noted in the bottom right forward corner of the slot (0.05 by 0.05 inch, or 1 mm length).

Area A: After firing 10,200 rounds, a 0.15-inch (4-mm) length crack pattern was noted on the bolt carrier key near the right and left sides of the rear locking screw and a 0.05-inch (1-mm) length crack pattern near the right and left sides of the forward locking screw.

c. Component Reference No. 7

Area B: After firing 10,200 rounds, a 0.20- by 0.25-inch (4- by 5-mm) length crack pattern was noted across the edge of the bolt retainer pin hole. The component was declared unserviceable.

d. Component Reference No. 16

Area B: After firing 10,200 rounds a crack pattern extended intermittently around the firing pin.

e. Component Reference No. 17

Area A: After firing 10,200 rounds, a crack pattern extended through the partition at both extractor pin holes.

7. XM231 Smg APG No. 3G (SN 5053432)

During the inspection intervals for 20,400 rounds no crack patterns were noted in the component reference No. 2 through 5, 8 through 12, 14, 16 and 17. A discontinuity and/or crack pattern was noted in 1 area in component reference No. 1, 6, 7, 13 and 15 and in 3 areas in component reference No. 6

a. Component Reference No. 1

Area A: Before firing, a 0.05-inch (1-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld which remained unchanged while firing 20,400 rounds. No cracks were noted in the spare barrel.

b. Component Reference No. 6

Area D: Before firing a 0.60-inch (15-mm) length discontinuity was noted on the bottom right side of a lug. This indication was removed by wear while firing 10,200 rounds and it was not seen thereafter.

Area E: Before firing, a 0.05-inch (1-mm) length crack pattern was noted in the top right rear corner of an elongated slot which extended 0.05 inch (1 mm) over the edge. This pattern increased to 0.10 by 0.10 inch (3 by 3 mm) after firing 10,200 rounds and to 0.15 by 0.15 inch (4 by 4 mm) after 20,400 rounds.

Area B: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the bottom forward right and left corners of an elongated slot. They remained unchanged after 20,400 rounds.

c. Component Reference No. 7

Area B: After firing 10,200 rounds, a 0.05- by 0.10-inch (1- by 3-mm) length crack pattern was noted across the edge of the bolt retainer pin hole. The component was declared unserviceable and replaced after 15th cycle of 2nd phase. The replacement did not contain any crack patterns after the weapon was fired at total of 20,400 rounds of endurance testing.

d. Component Reference No. 13

Area A: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted in the sear cam fillet, which remained unchanged after firing 20,400 rounds.

e. Component Reference No. 15

Area A: After firing 10,200 rounds, two 0.05-inch (1-mm) length crack patterns were noted on the inside wall end of the firing pin hole. A new bolt cam pin was installed after the 5th cycle of the 2nd phase and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing.

8. XM231 Smg APG No. 4G (SN 5056579)

During the inspection intervals for 20,400 rounds no crack patterns were noted in the components reference No. 1 through 5, 8 and 10 through 15. A crack pattern was noted in 1 area in the component reference No. 7, 9 and 16. And 2 areas in component reference No. 6. A spare component reference No. 1 (barrel without upper receiver) contained a discontinuity in 1 area.

a. Component Reference No. 1

Area A: Before firing (spare barrel), a 0.20-inch (5-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld. This barrel was a spare and therefore not fired during this test.

b. Component Reference No. 6

Area A: After firing 10,200 rounds 0.05-inch (1-mm) length crack pattern were noted on the bolt carrier key at the right and left sides of the forward locking screw. They remained unchanged after firing 20,400 rounds.

c. Component Reference No. 7

Area A: After firing 14,235 rounds a 0.10-inch (3-mm) length crack pattern was noted in the rear fillet of the first lug at each side of the elongated slot.

Area B: After firing 14,235 rounds a 0.40- by 0.40-inch (10- by 10-mm) length crack pattern extended across the edge of the retainer pin hole. This component was declared unserviceable. A new bolt was therefore installed (this installation was after the 6th cycle phase II).

d. Component Reference No. 16

Area B: After firing 10,200 rounds, an intermittent crack pattern was noted around the firing pin. The firing pin was noted to be broken after the 13th cycle, phase II and was replaced at that time. An intermittent crack pattern was noted around the firing pin after the gun was fired a total of 20,400 rounds of endurance testing.

e. Component Reference No. 17 (See Figure 15)

Area A: After firing 20,400 rounds, a crack pattern extended through the edge of both extractor pin holes.

9. XM231 Smg (APG 5G (SN 5046368)

Before firing, no crack patterns were noted in the components reference No. 2 through 17. A discontinuity or crack pattern was noted in 1 area in component reference No. 1.

Component Reference No. 1

Area A: Before firing, a 0.15-inch (4-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld.

10. XM231 Smg APG 6G (SN 5046998)

Before firing, no crack patterns were noted in components reference No. 2 through 17. A discontinuity or crack pattern was noted in 1 area in component reference No. 1.

Component Reference No. 1

Area A: Before firing, a 0.15-inch (4-mm) length discontinuity was noted on the front section of the tank mounting bracket along the edge of a weld.

11. XM231 Smg APG 7G (SN 5052275)

Before firing, no crack patterns were noted in components reference No. 2 through 17. A discontinuity or crack pattern was noted in 1 area in component reference No. 1.

Component Reference No. 1

Area A: Before firing, a 0.10-inch (3-mm) length discontinuity was noted on the front section of the tank mounting bracket along the edge of a weld.

12. XM231 Smg APG 8G (SN 5053472)

Before firing, no crack patterns were noted in component reference No. 2 through 17. A discontinuity or crack pattern was noted in 1 area in component reference No. 1.

Component Reference No. 1

Area A: Before firing, a 0.15-inch (4-mm) length discontinuity was noted on the front section of the mounting bracket along the edge of a weld.

13. XM231 Smg APG 9G (SN 5053772)

Before firing, no crack patterns were noted in components reference No. 2 through 17. A discontinuity or crack pattern was noted in 1 area in component reference No. 1.

Component Reference No. 1

Area A: Before firing, a 0.20-inch (5-mm) length discontinuity was noted on the front section of the tank mounting bracket along the edge of a weld.

14. XM231 Smg APG 10G (SN 5058210)

Before firing, no crack patterns were noted in components reference No. 2 through 5 and 7 through 17. A discontinuity or crack pattern was noted in 1 area in components reference No. 1 and 6.

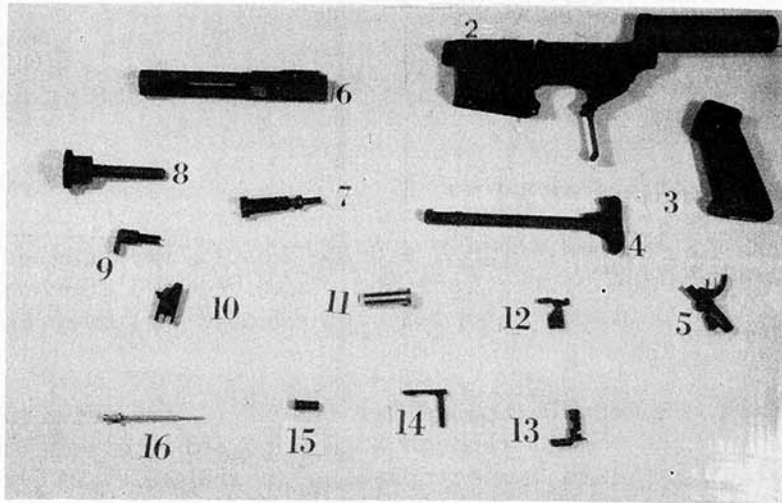
a. Component Reference No. 1

Area A: Before firing, a 0.10-inch (3-mm) length discontinuity was noted on the front section of the tank mounting bracket along the edge of a weld.

b. Component Reference No. 6

Area B: Before firing, a 0.05-inch (1-mm) length crack pattern was noted in the bottom left and right forward corners of an elongated slot. The patterns extended 0.05 inch (1 mm) over an edge inside the piece.

15. Four MICV FPW mounting balls for the XM231 smg were inspected before firing XM231 smg 1C through 4C and no defects were noted. Six mounting balls were also inspected while on the MICV. Five of these mounting balls contained no discontinuities or crack patterns. The mounting ball located on the left side, near the rear of the MICV contained a light intermittent discontinuity along the edge of a weld.



Comp No.	Nomenclature	Part No.	Comp No.	Nomenclature	Part No.
a1	Upper receiver with barrel	73C21166 73F21172	9	Plunger, sear	8448545
2	Lower receiver	74F20762	10	Sear	74D20757
3	Grip	8448632	11	Inertia guide rod	
4	Handle, charging	8448518	12	Latch, charging	8448519
5	Trigger	74B20756	13	Lever, selector	8448630
6	Bolt carrier	74D20759	14	Catch, magazine	8448638
7	Bolt	8448510	15	Pin, bolt, cam	8448502
8	Guide, operating spring	74C20748	16	Pin, firing	8448503
			a17	Extractor	8448512

<sup>a</sup>Not shown.

Figure 1. XM231 smg major components. The seventeen components were inspected either by the magnetic particle or the zyglu method. The component nomenclature and part numbers are listed above.

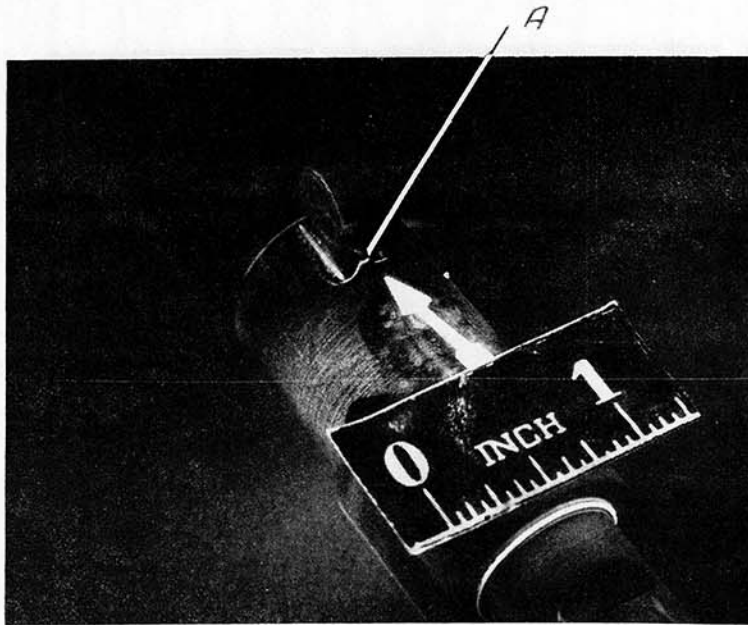


Figure 2. Component reference No. 1. Barrel, part No. 73F21172, from XM231 smg number APG 2G (SN 5053010), before firing: magnetic-particle pattern around mounting lug shown under blacklight.

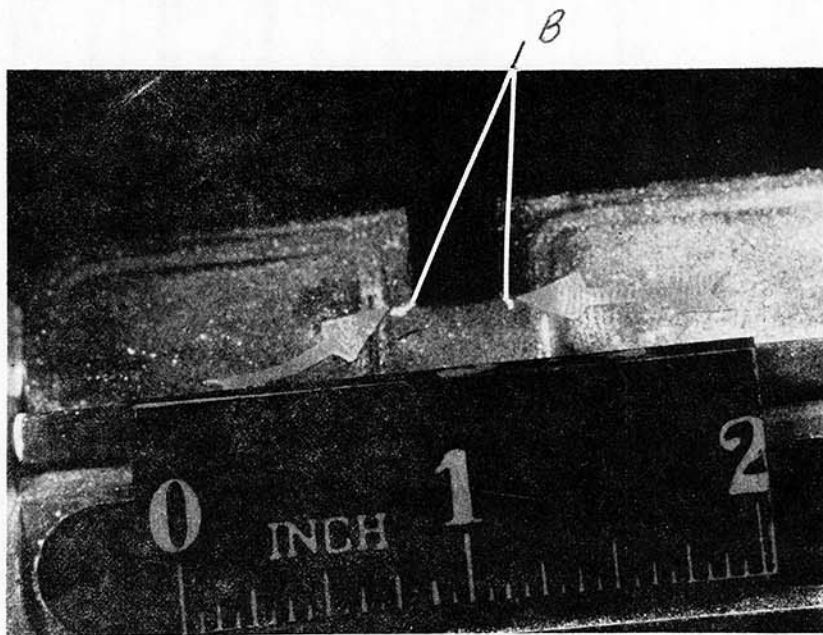


Figure 3. Component reference No. 1, upper receiver part No. 73C21165, from XM231 smg number APG 2C (SN 5054265) after firing 20,400 rounds: penetrant crack pattern in ejection port cover shown under blacklight.

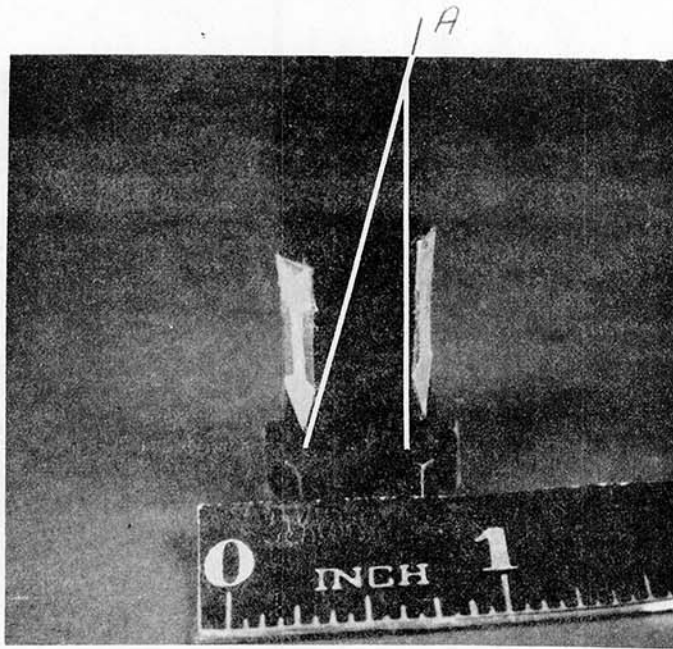


Figure 4. Component reference No. 7, bolt, part No. 8448510, from XM231 smg No. APG 2C (SN 5054265) after firing 20,400 rounds: magnetic-particle crack pattern shown under blacklight.

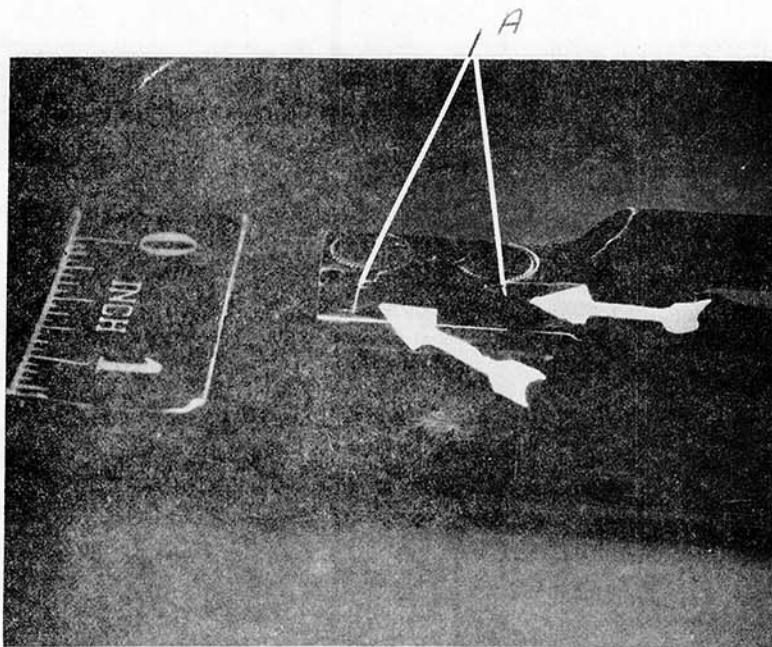


Figure 5. Component reference No. 6, bolt carrier, part No. 74D20759, from XM231 smg No. APG 1C (SN 5040166) after firing 10,200 rounds. Magnetic-particle crack patterns shown under blacklight.

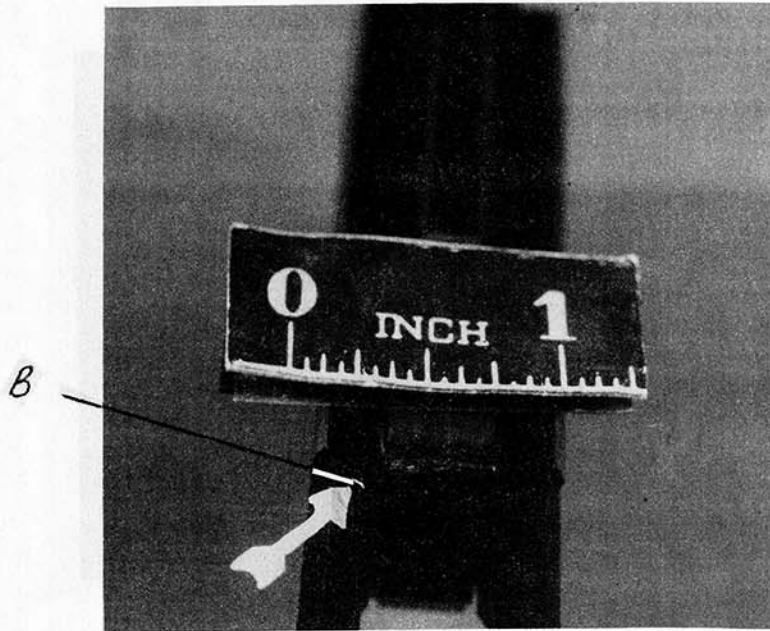


Figure 6. Component reference No. 6, bolt carrier part No. 74D20759, from XM231 smg No. APG 2C (SN 5054265) before firing: magnetic-particle crack pattern shown under blacklight.

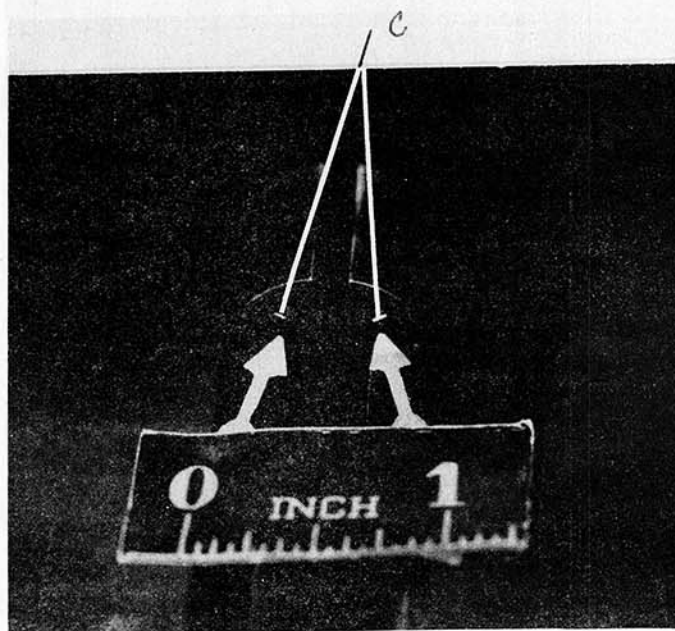


Figure 7. Component reference No. 6, bolt carrier, part No. 74D20759, from XM231 smg No. APG 1C (SN 5040166) after firing 10,200 rounds: magnetic-particle crack patterns shown under blacklight.

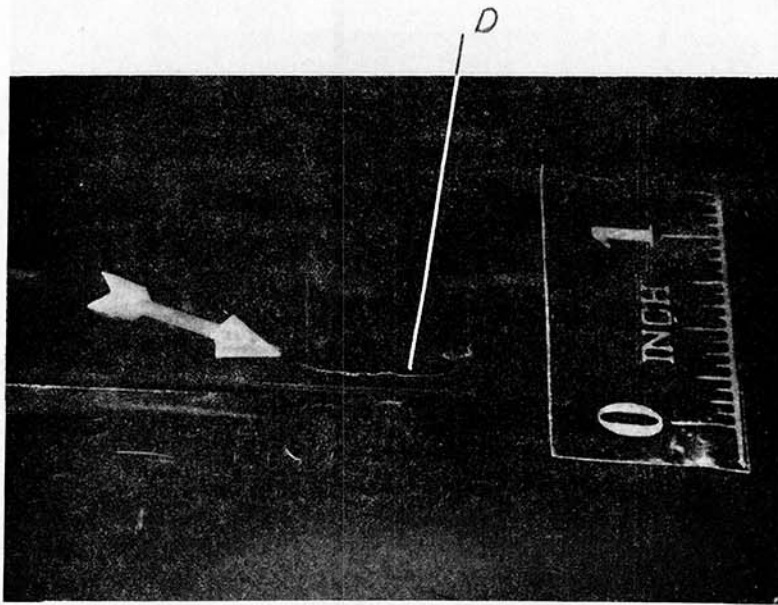


Figure 8. Component reference No. 6. Bolt carrier, part No. 74D20759, from XM231 smg No. APG 3G (SN 5053432) before firing: magnetic-particle pattern shown under blacklight.

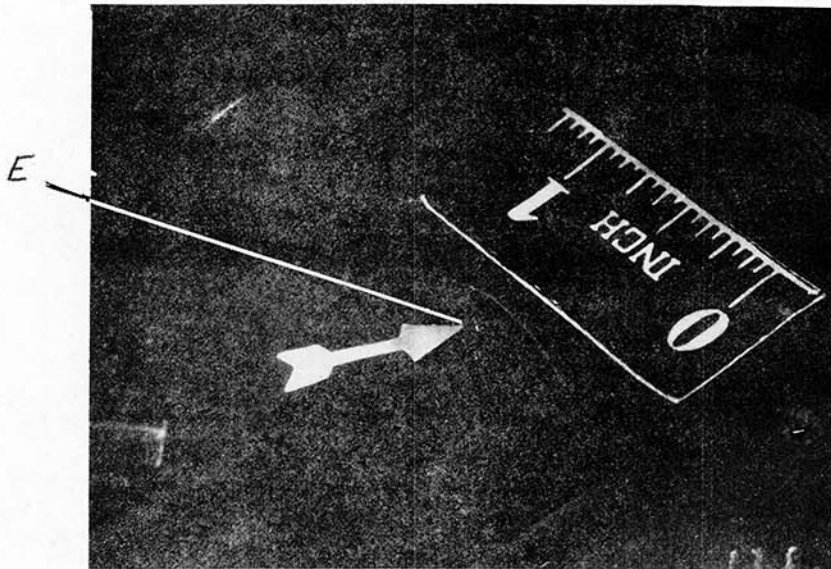


Figure 9. Component reference No. 6. Bolt carrier, part No. 74D20759, from XM231 smg No. APG 3G (SN 5053432) before firing, magnetic-particle crack pattern shown under blacklight.

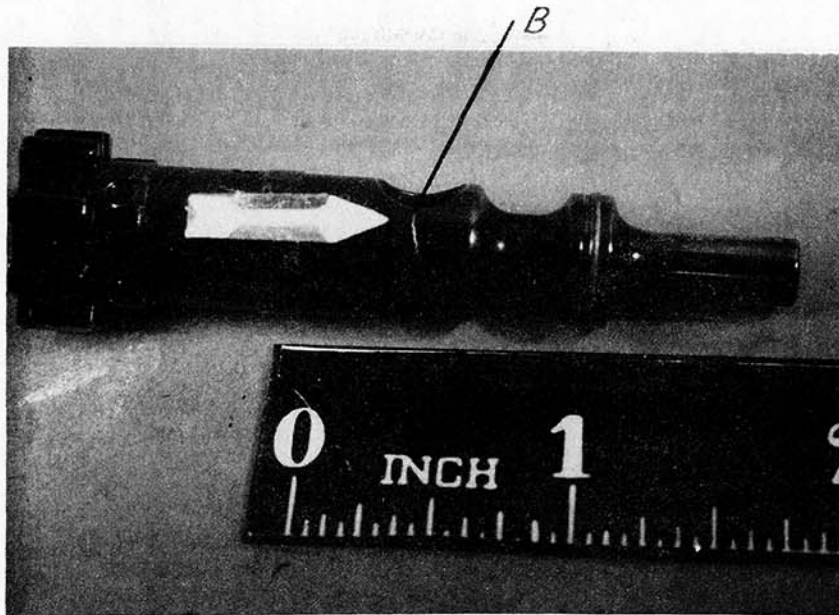


Figure 10. Component reference No. 7. Bolt, part No. 8448510, from XM231 smg No. APG 2G (SN 5053010) after firing 10,200 rounds: magnetic-particle crack pattern shown under blacklight.

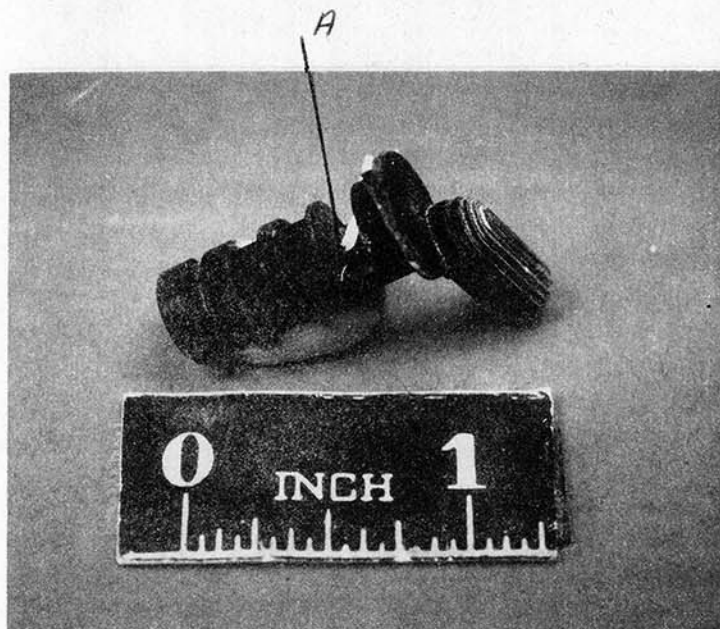


Figure 11. Component reference No. 13. Lever, selector, part No. 8448630, from XM231 smg No. APG 3G (SN 5053432) after firing 10,200 rounds: magnetic-particle crack pattern shown under blacklight.

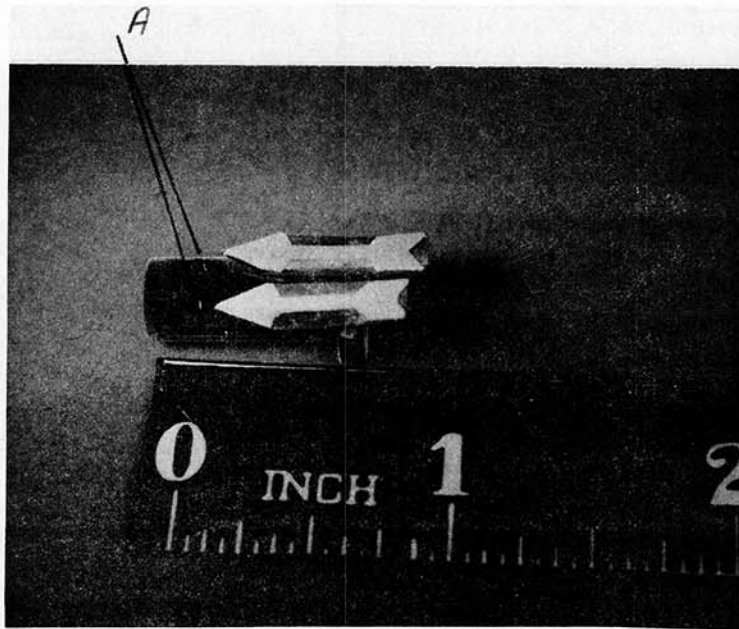


Figure 12. Component reference No. 15. Pin, bolt cam, part No. 8448502, from XM231 smg No. APG 1G (SN 5041858) after firing 20,400 rounds: magnetic-particle crack pattern shown under blacklight.

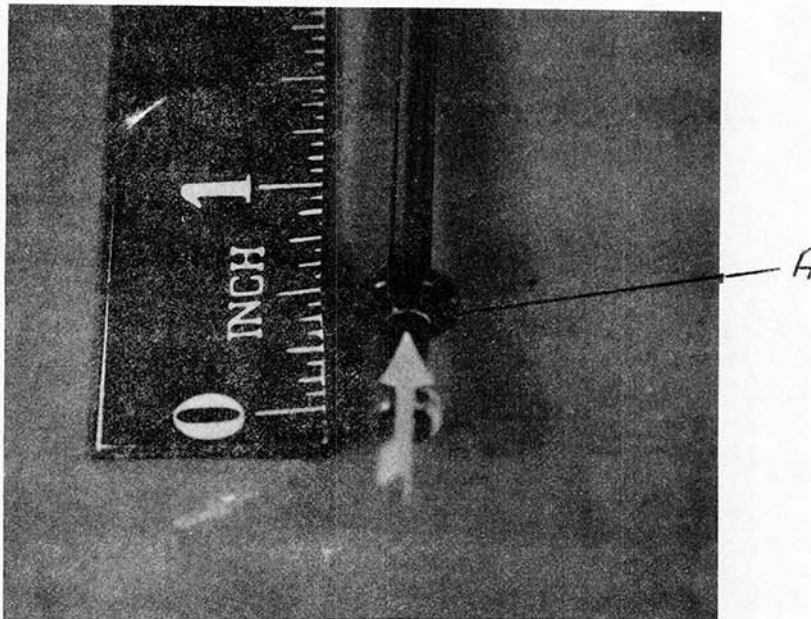


Figure 13. Component reference No. 16, pin, firing, part No. 8448503, from XM231 smg APG 4G (SN 5056579) after firing 10,200 rounds: magnetic-particle crack pattern shown under blacklight.

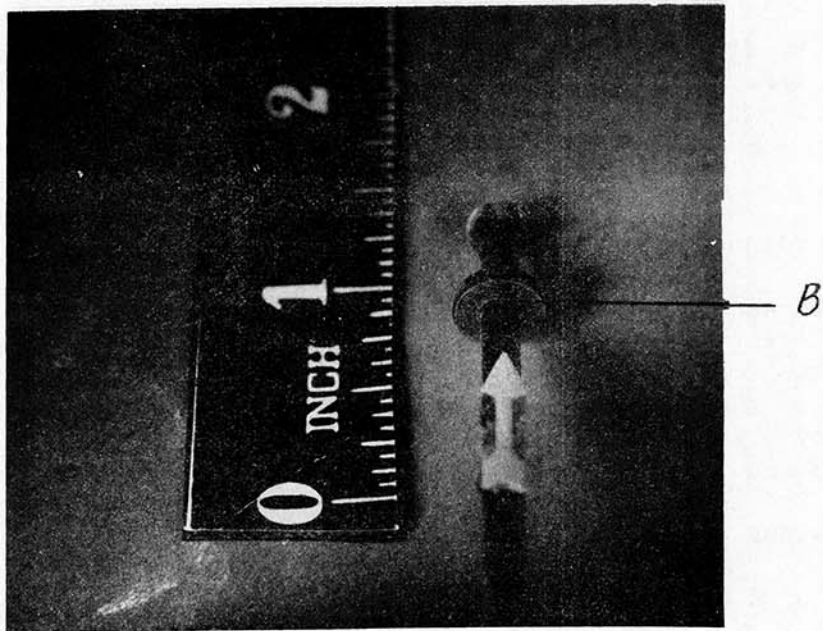


Figure 14. Component reference No. 16. Pin, firing, part No. 8448503, from XM231 smg APG 2G (SN 5053010) after firing 10,200 rounds: magnetic-particle crack pattern shown under blacklight.

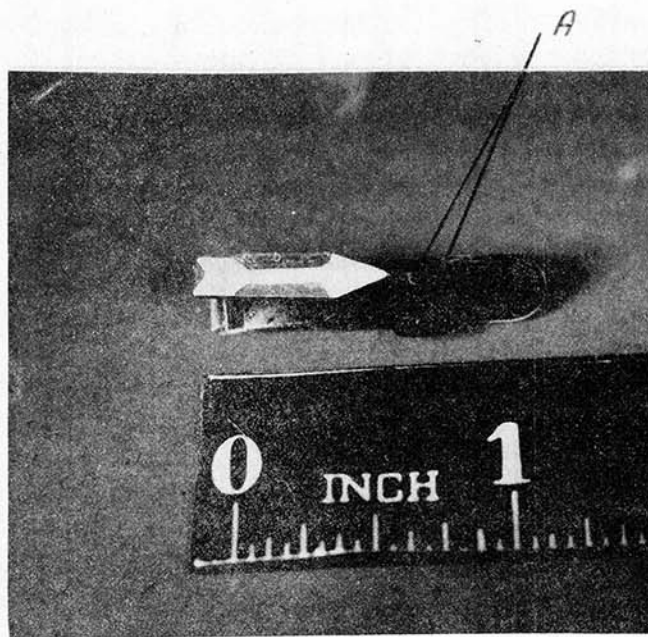


Figure 15. Component reference No. 17, extractor, part No. 8448512, from XM231 smg No. APG 2G (SN 5053010) after firing 10,200 rounds: magnetic-particle crack pattern shown under blacklight.

16. M3A1 Smg APG No. 1C (SN 647129)

During firing of 20,400 rounds and/or the final inspection no crack patterns were noted in the component reference No. 2, 3 and 6 through 13. Crack patterns were noted in 3 areas in component reference No. 1, 1 area in component reference No. 4, and 1 area in component reference No. 5.

a. Component reference No. 1

Area A: After firing 10,200 rounds, a crack was noted extending completely through the partition between the larger diameter hole and the two smaller diameter holes on the right and left sides of the component. The lengths of the crack patterns were each 0.15 by 0.20 inch (4 by 5 mm). A new component was installed (after the 5th cycle, phase II), and it contained cracks nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing.

Area B: After firing 10,200 rounds, a crack pattern was noted on the face of the component which extended across the edge onto the wall of the larger diameter hole (0.10 by 0.05 inch (3 by 1 mm) length). A similar crack pattern was noted at the opposite side of the hole (0.20 by 0.05 inch (5 by 1 mm) length). A new component was installed (after the 5th cycle, phase II) and no crack patterns were noted in this area after the gun was fired a total of 20,400 rounds of endurance testing.

Area C: After firing 10,200 rounds, a crack pattern was noted extending across the edge of one of the smaller diameter holes toward the outer edge of the component (0.05 by 0.10 inch (1 by 3 mm) length). A new component was installed (after the 5th cycle, phase II) and no crack patterns were noted in this area after the gun was fired a total of 20,400 rounds of endurance testing.

b. Component reference No. 4

Area A: After firing 10,200 rounds, a 0.70-inch (18-mm) length crack pattern was noted extending along a fillet near the catch button. This crack remained unchanged after an additional 10,200 rounds were fired.

c. Component reference No. 5

Area A: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted on the inside of a bent area. This crack remained unchanged after an additional 10,200 rounds were fired.

17. M3A1 Smg APG No. 2C (SN 695562)

While firing 20,400 rounds and/or during the final inspection, no crack patterns were noted in the component reference No. 2, 3, 5 through 9, and 11 through 13. Crack patterns were noted in 3 areas in component reference No. 1, 2 areas in component reference No. 10.

a. Component reference No. 1

Area A: After firing 10,200 rounds, a crack was noted extending completely through the partition between the larger diameter hole and the two smaller diameter holes on the right and left sides of the component. The lengths of the crack patterns were each 0.15 by 0.20 inch (4 by 5 mm). A new component was installed (after the cycle, phase II) and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing.

Area B: After firing 10,200 rounds, two crack patterns were noted on the front face of the component which extended across the edge onto the wall of the larger diameter hole (0.10 by 0.05 inch (3 by 1 mm)) length. A new component was installed (after the 7th cycle, phase II) and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing.

Area C: After firing 10,200 rounds, two crack patterns were noted extending across the edge of each smaller diameter hole toward the outer edges of the component (0.05 by 0.10 inch (1 by 3 mm)) length. A new component was installed (after the 7th cycle, phase II) and it contained crack patterns nearly identical to the cracks noted in the initial component after the gun was fired a total of 20,400 rounds of endurance testing. This component was marked unserviceable.

b. Component reference No. 4

Area A: After firing 10,200 rounds, a 0.05-inch (1-mm) length crack pattern was noted on the top edge near the catch button. This crack remained unchanged after an additional 10,200 rounds were fired.

c. Component reference No. 10

Area A: After firing 10,200 rounds, a series of crack patterns were noted on the left rod approximately four inches (1 cm) from the shoulder rest. The patterns ranged from 0.05 to 0.10 inch (1 to 3 mm) in length. They remained unchanged after an additional 10,200 rounds were fired.

Area B: After firing 10,200 rounds, three transverse crack patterns were noted across a bend in the rod near a welded area (0.10 0.15 and 0.10 inch (3, 4 and 3 mm) length). They remained unchanged after an additional 10,200 rounds were fired.

18. M3A1 Smg APG No. 3C (SN 702341)

While firing 10,200 rounds and/or during the final inspection, no crack patterns were noted in the component reference No. 2 through 13. Crack patterns were noted in 3 areas in component reference No. 1.

Component reference No. 1

Area A: After firing 10,200 rounds, a crack was noted extending completely through the partitions between the larger diameter hole and the two smaller diameter holes on the right and left sides of the components. The lengths of the crack patterns were each 0.15 by 0.20 inch (4 by 5 mm).

Area B: After firing 10,200 rounds, numerous crack patterns were noted on the face of the component which extended onto the wall of the larger diameter hole and the outside edge of the piece. Similar crack patterns were noted at the opposite side of the hole. They ranged from 0.05 to 0.25 inches (1 to 6 mm) in length on the side of the piece.

Area C: After firing 10,200 rounds, two crack patterns were noted extending across the edge of each smaller diameter hole toward the outer edges of the component (0.05 by 0.10 inch (1 by 5 mm)) length.

19. M3A1 Smg APG No. 4C (SN 707619)

While firing 10,200 rounds and/or during the final inspection, no crack patterns were noted in the component reference No. 2 through 13. Crack patterns were noted in 1 area in component reference No. 1.

Component reference No. 1

Area A: After firing 10,200 rounds, a crack was noted extending completely through the partition between the larger diameter hole and the two smaller diameter holes on the right and left sides of the component. The lengths of the crack patterns were 0.15 by 0.20 inch (4 by 5 mm)). This component was marked unserviceable.

20. M3A1 Smg APG No. 1G (SN 632666)

While firing 10,200 rounds and/or during the final inspection, no crack patterns were noted in the component reference No. 2 through 11 and 13. Crack patterns were noted in 1 area in component reference No. 1 and 1 area in component reference No. 12.

a. Component reference No. 1

Area A: After firing 10,200 rounds, a crack was noted extending completely through the partition between the larger diameter hole and the two smaller diameter holes on the right and left sides of the component. The lengths of the crack patterns were each 0.15 by 0.20 inch (4 by 5 mm). This component was marked unserviceable.

b. Component reference No. 12

Area A: Before firing, a 0.10 inch (3 mm) length discontinuity was noted along the edge of a weld. The discontinuity appeared to be a rough overlapping edge of the weld and it remained unchanged after 10,200 rounds were fired.

21. M3A1 Smg APG No. 2G (SN 647765)

While firing 10,200 rounds and/or during the final inspection, no crack patterns were noted in the component reference No. 2 through 13. Crack patterns were noted in 1 area in component reference No. 1.

Component reference No. 1

Area A: After firing 10,200 rounds, a crack was noted extending completely through the partition between the larger diameter hole and the two smaller diameter holes on the right and the left sides of the component. The lengths of the crack patterns were each 0.15 by 0.20 inch (4 by 5 mm). This component was marked unserviceable.

22. M3A1 Smg APG No. 3G (SN 652107)

While firing 20,400 rounds and/or during the final inspection, no crack patterns were noted in the component reference No. 2 through 13. Crack patterns were noted in 1 area in component reference No. 1.

Component reference No. 1

Area A: A new component was installed after the 7th cycle, phase II. After firing 20,400 rounds, a crack was noted extending halfway through the partitions between the larger diameter hole and the two small diameter holes on the right and left sides of the component. The length of these crack patterns were 0.15 by 0.20 inch (4 by 5 mm). This component was marked unserviceable.

23. M3A1 Smg APG No. 4G (SN 671231)

While firing 20,400 rounds and/or during the final inspection no crack patterns were noted in the components reference No. 2, 3 and 5 through 13. Crack patterns were noted in 1 area in component reference No. 1 and 1 area in component reference No. 4.

a. Component reference No. 1

Area A: After firing 20,400 rounds, a crack was noted extending halfway through the partitions between the larger diameter hole and the two smaller diameter holes on the right and left sides of the component. The lengths of the crack patterns were each 0.15 by 0.20 inch (4 by 5 mm). This component was marked unserviceable.

b. Component reference No. 4

Area B: After firing 20,400 rounds, a 0.15-inch (4-mm) length crack pattern was noted on the top edge near the catch button.

24. M3A1 Smg's APG No. 5G (SN 677332), APG No. 6G (SN 676459), APG No. 7G (SN 681146) and APG No. 8G (SN 693706)

Before firing, no crack patterns were noted in the 13 components. No additional inspections were performed.

25. M3A1 Smg APG No. 9G (SN 695088)

Before firing, no crack patterns were noted in the component reference No. 1 through 9 and 11 through 13. Discontinuities were noted in 2 areas in component reference No. 10. No additional inspections were performed.

Component reference No. 10

Area C: Before firing, two 0.05-inch (1-mm) and one 0.30-inch (4-mm) length discontinuities were noted along the edges of a weld.

Area D: Before firing, a 0.05-inch (1-mm) length crack pattern was noted across the end of the weld.

26. M3A1 Smg APG No. 10G (SN 702979)

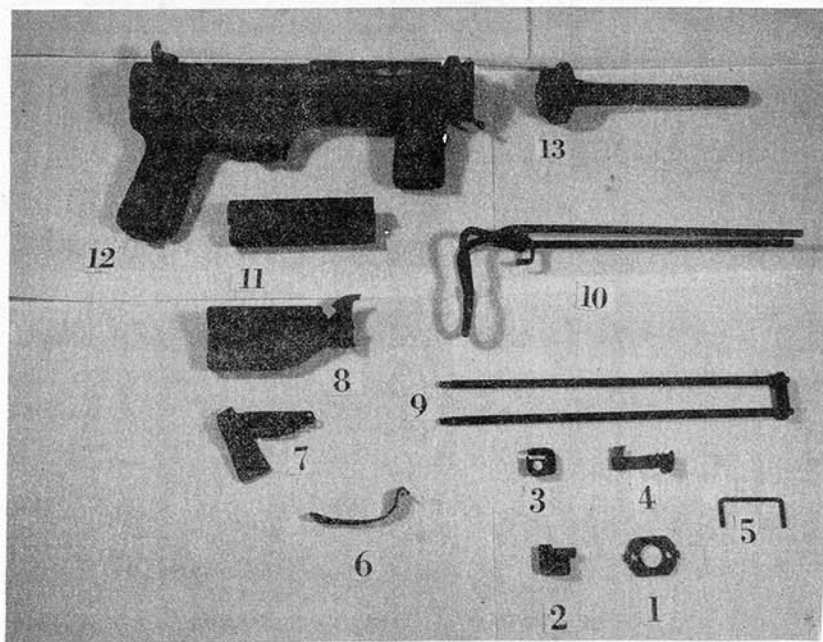
Before firing, no crack patterns were noted in the component reference No. 1 through 9, 12 and 13. A crack pattern was noted in 1 area in component reference No. 10 and 1 area in component reference No. 11. No additional inspections were performed.

a. Component reference No. 10

Area D: Before firing, a 0.05-inch (1-mm) length crack pattern was noted in the center of a weld.

b. Component reference No. 11

Area A: Before firing, two 0.25-inch (6-mm) length crack patterns were noted on the wall of a drilled-out area. One of the crack patterns extended over the edge of an additional 0.05-inch (1-mm) distance.



<u>Comp Ref No.</u>	<u>Nomenclature</u>	<u>Dwg No.</u>	<u>Comp Ref No.</u>	<u>Nomenclature</u>	<u>Dwg No.</u>
1	Locating plate	5351195	7	Trigger	6301472
2	Sear	7162774	8	Housing, trigger	7161927
3	Shield	7160997	9	Rod	6301449
4	Catch, magazine	6031453	10	Stock extension	7161812
5	Holder, sear	5349942	11	Bolt, breech	7161926
6	Guard, trigger	6301456	12	Receiver	7161930
			13	Barrel	7791433

Figure 16. M3A1 smg, caliber .45. Thirteen major components which were inspected by the magnetic-particle method.

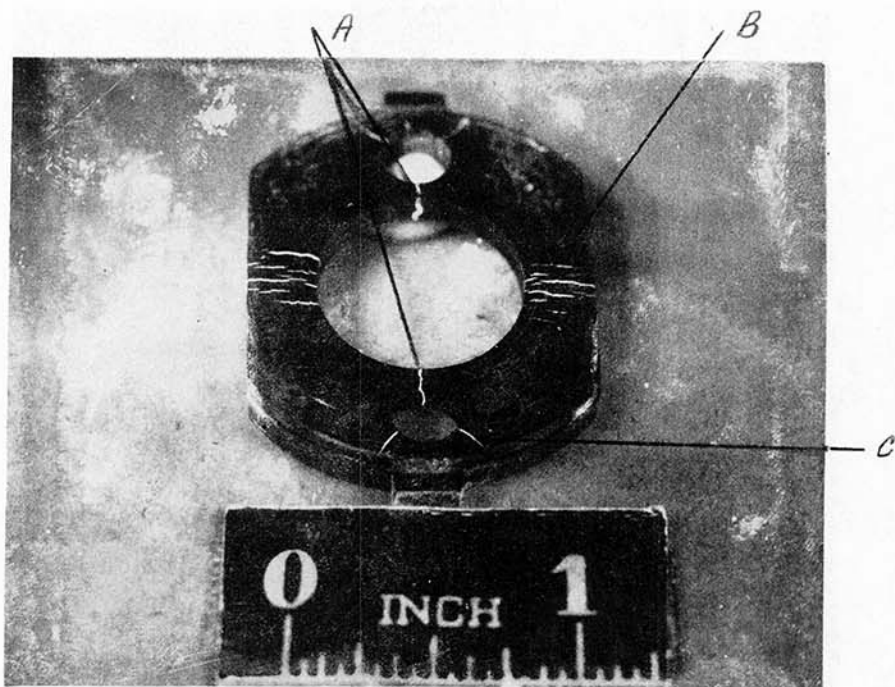


Figure 17. Component reference No. 1. Locking plate, drawing No. 5351195; from M3A1 smg APG No. 3C (SN 702341). Magnetic-particle crack patterns noted after firing 10,200 rounds.

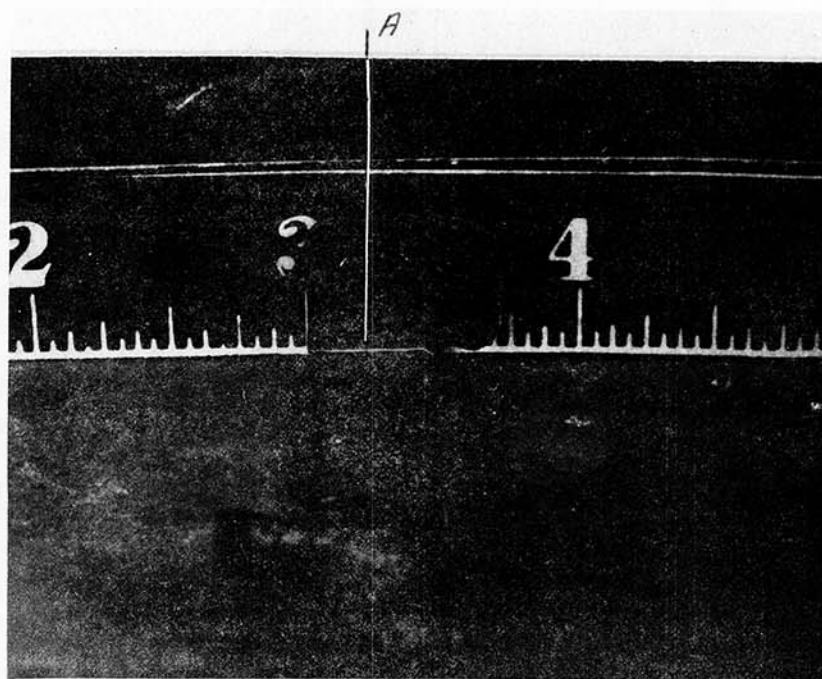


Figure 18. Component reference No. 4, catch, magazine, drawing No. 6031453; from M3A1 smg APG No. 1C (SN 647129). Magnetic-particle crack pattern noted after firing 10,200 rounds.

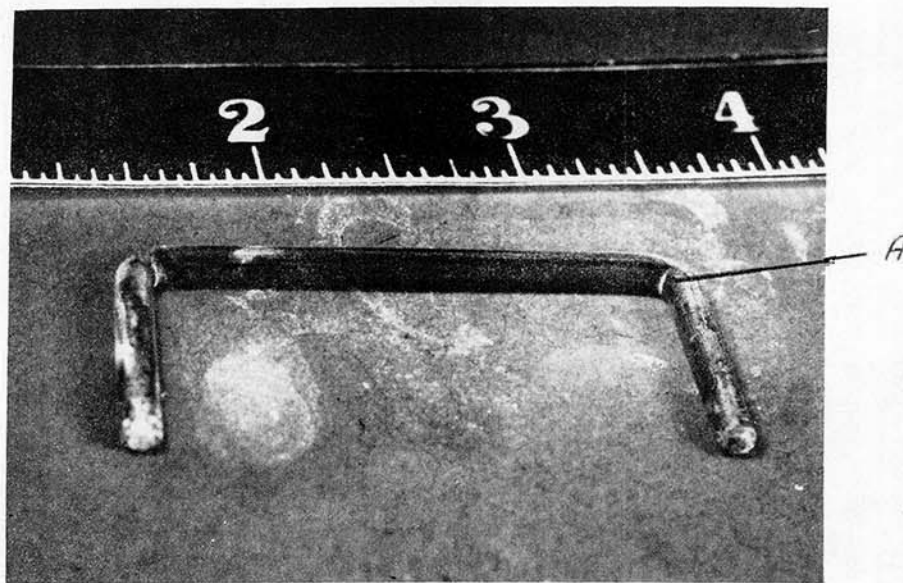


Figure 19. Component reference No. 5, holder, sear, drawing No. 5349942; from M3A1 smg APG No. 1C (SN 647129). Magnetic-particle crack pattern noted after firing 10,200 rounds.

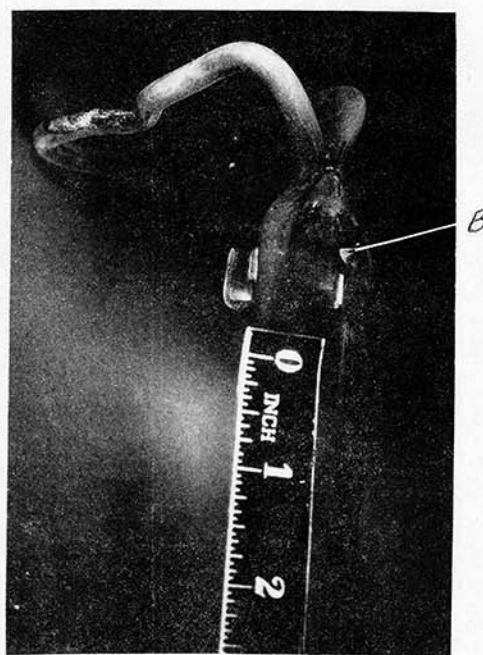
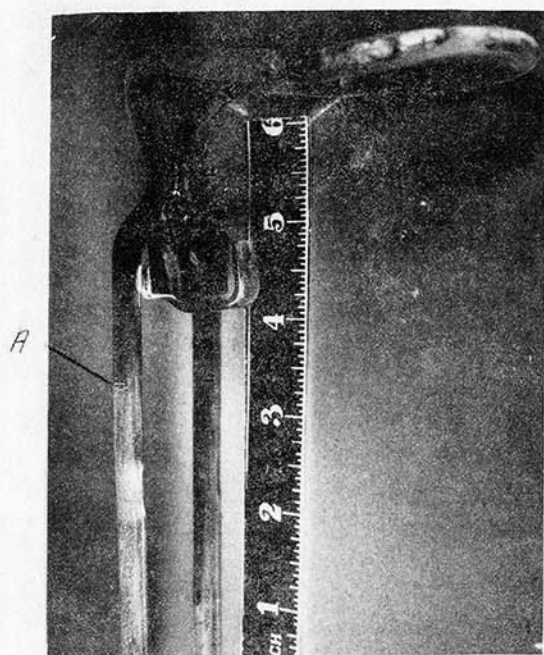


Figure 20. Component reference No. 10, stock extension, drawing No. 7161812; from M3A1 smg APG No. 2C (SN 695562). Magnetic-particle crack patterns noted after firing 10,200 rounds.

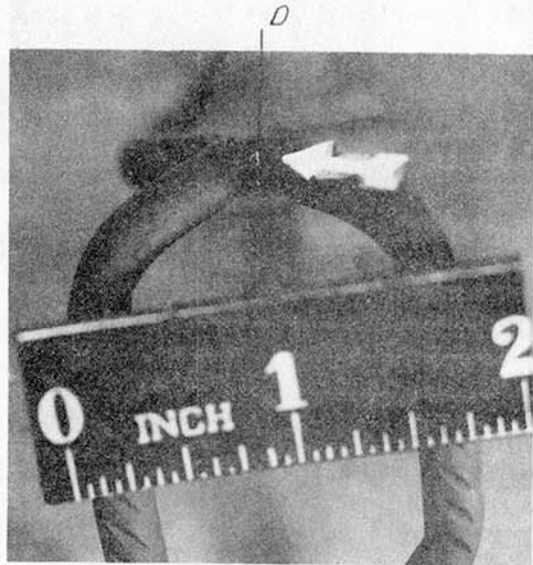
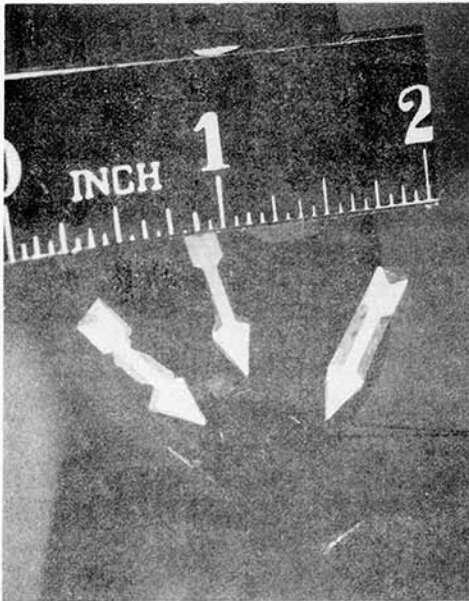


Figure 21. Component reference No. 10, stock extension, drawing No. 7161812; from M3A1 smg APG No. 2C (SN 695562). Magnetic-particle crack patterns noted before firing.

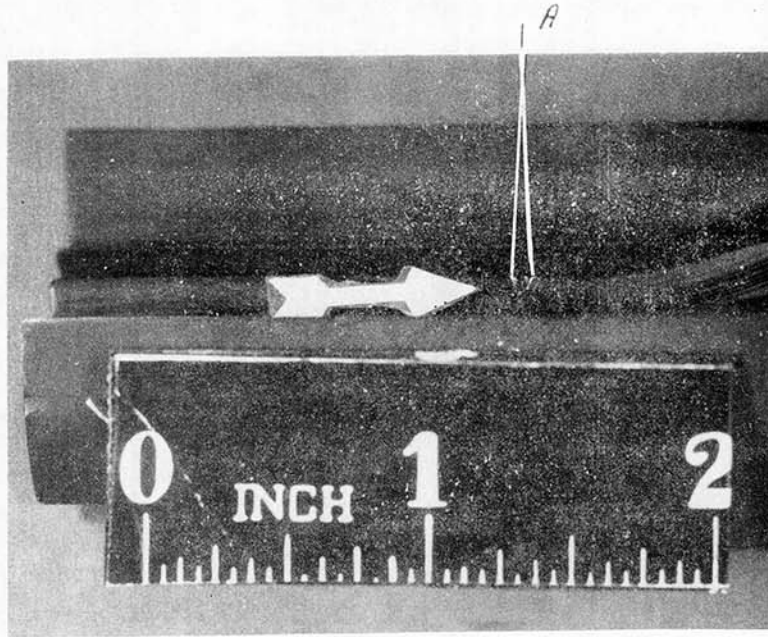


Figure 22. Component reference No. 11, bolt, breech, drawing No. 7161926; from M3A1 smg APG No. 10 (SN 702979). Magnetic-particle crack patterns noted before firing.

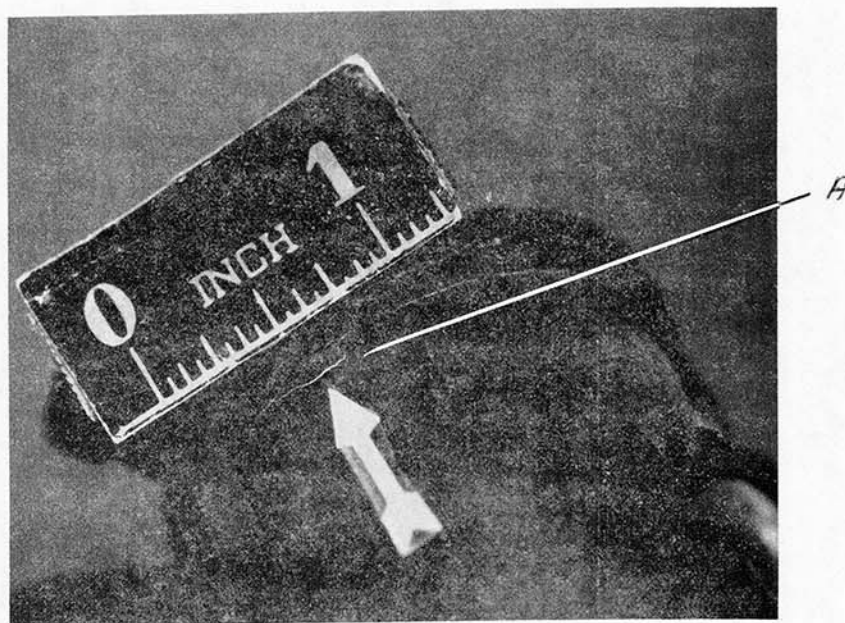


Figure 23. Component reference No. 12, receiver drawing No. 7161930; from M3A1 smg APG No. 1G (SN 632666). Magnetic-particle crack pattern along the edge of a weld before firing.

DISTRIBUTION LIST

Addressee	Interim Report
Commander US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005 ATTN: DRSTE-AR	5
Commander US Army Materiel Development and Readiness Command 5001 Eisenhower Avenue Alexandria, Virginia 22333 ATTN: DRCSF	1
Commander US Army Training and Doctrine Command Aberdeen Proving Ground, Maryland 21005 ATTN: TRADOC Liaison Office, TECOM	5
Commander US Army Yuma Proving Ground Yuma, Arizona 85364 ATTN: STEYP-MT	1
Commander TRADOC Combined Arms Test Activity Fort Hood, Texas 76544 ATTN: ACTAC-OP	1
Commander US Army Operational Test and Evaluation Agency 5600 Columbia Pike Falls Church, Virginia 22041 ATTN: DACS-T-EO	3
Commander US Army Arctic Test Center APO Seattle 98733	1
Commander US Army TRADOC Systems Analysis Activity White Sands Missile Range, New Mexico 88002 ATTN: ATAA-TD (Mr. Winans)	1

<u>Addressee</u>	<u>Interim Report</u>
Commander US Army Maintenance Management Center Lexington, Kentucky 40507 ATTN: DRXMD-E	2
Commander US Army Environmental Health Agency Aberdeen Proving Ground, Maryland 21005 ATTN: HSE-OB	1
Commander US Army Training and Doctrine Command Fort Monroe, Virginia 23651 ATTN: ATCD-PM ATCD-TM	1 1
Commander US Army Armament Command Rock Island, Illinois 61201 ATTN: DRSAR-RDG	1
Commander Rock Island Arsenal Rock Island, Illinois 61201 ATTN: SARRI-LS-I	3
HQDA (DAMA-PPM-T)	1
HQDA (DAMO-FD)	1
HQDA (DALO)	1
HQDA (DALO-SMM-E)	1
Washington, D. C. 20310	
HQDA (DAPC-PMO)	1
Alexandria, Virginia 22331	
Project Manager, MICV Systems 28150 Dequindre Warren, Michigan 48092 ATTN: DRCPM-MCV-TM	5
Commandant US Army Infantry School Fort Benning, Georgia 31905 ATTN: ATSH-CD-MV	1

<u>Addressee</u>	<u>Interim Report</u>
Director Development Center Marine Corps Development and Education Command Quantico, Virginia 22134	1
Director US Army Materiel Systems Analysis Activity Aberdeen Proving Ground, Maryland 21005 ATTN: DRXSY-GI	1
Director US Army Materiel Development and Readiness Command Field Safety Agency Charlestown, Indiana 47111 ATTN: DRXOS-ES	1
US Marine Corps Liaison Office Headquarters, TECOM Aberdeen Proving Ground, Maryland 21005	1
FMC Corporation Ordnance Engineering Division 1105 Coleman Avenue, Box 760 San Jose, California 95106 ATTN: Mr. Dean Carl	1
Commander US Army Aberdeen Proving Ground Aberdeen Proving Ground, Maryland 21005 ATTN: STEAP-MT-I	4
STEAP-MT-X	1