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Report No. DPS-2754

FINAL REPORT ON

PRODUCT IMPROVEMENT TEST

OF

SUBMACHINE GUN, 5.56-MM, XM177E2

BY

GEORGE HENDRICKS
ALLAN WILSON

JUNE 1968

ABERDEEN PROVING GROUND

ABERDEEN PROVING GROUND, MARYLAND

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

AMSTE-BC

8 JUL 1968

SUBJECT: Approval of Final Report on Product Improvement Test of Submachine Gun 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01

Commanding General
US Army Materiel Command
ATTN: AMCPM-RS
Rock Island, Illinois 61200

1. References:

a. Report, AMSTE-BC, dated January 66, Subject: Analysis of Results of SAWS Engineering and Service Tests, USATECOM Project Numbers 8-5-0400-03 thru 06.

b. Final Report DPS 2215, dated December 1966 on Engineer Design Test of Modified Flash Suppressor for 5.56mm, Car-15 Submachine Gun.

c. Message, USATECOM 10219, dated 8 December 67, Subject: PI Test of XM177E2, Submachine Gun, USATECOM Project No. 8-7-0220-01/02.

d. Final Report, dated June 68, Report No. DPS 2754, subject as above, inclosed.

2. The primary purpose of this test was to evaluate the product improvements imposed on the submachine gun since the SAWS activity of 1965-66, ref 1a, and was not intended to serve as an engineering test leading to type classification. Originally the suppressor was subjected to safety tests only as a separate activity in late 1966 with an objective of reducing flash signatures, ref 1b. In order to provide additional information concerning the capabilities of the system, especially with respect to the flash suppressor, it was considered necessary to utilize a broad spectrum of available ammunition. The product improvements were:

a. Chrome plated chambers.

b. Delrin charging handle latch.

c. Hand-guard slip ring.

AMSTE-BC 8 JUL 1968

SUBJECT: Approval of Final Report on Product Improvement Test of Submachine Gun 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01

d. Cadmium plated slip ring spring.

e. Shot-peened receiver, nylon-coated buttstock and release lever.

f. One and one-half inch increase in barrel length.

3. With the exception of the delrin charging handle latch, the improvements are acceptable and are applicable to the M16A1 rifle as appropriate. Potential improvements in areas of corrosion resistance in paragraph 2c,d and e above require confirmation in long term field environment conditions.

4. A summary of test results and a discussion of each subtest are contained in paragraph 1.4. Findings which have a significant impact on system performance and reliability are:

a. Tracer cartridges regardless of the propellant loading are incompatible with subject weapon due to severe yaw and some projectile breakup. Also, and independent of tracer cartridges, yaw of 10 to 20 degrees was observed with ball projectiles, but at a reduced frequency as compared to the tracer cartridge.

b. All test ammunition exhibited large variations in round-to-round cyclic rates within an automatic burst. The first 2 rounds in a magazine of ball cartridges loaded with ball propellant accounted for a significant portion of this variation.

5. The conclusions and recommendations of subject report are approved by this command and are as follows:

a. Conclusions:

(1) The XM177E2 submachine gun as presently designed is incompatible with the spectrum of ammunition as investigated in this test, especially in those areas of performance affected by the buffer, and noise - flash suppressor.

(2) Both the XM177E1 and XM177E2 weapons gave unsatisfactorily high malfunction rates in the low temperature fouling test, and both weapons demonstrated more severe fouling in the operating mechanism with ball propellant than the IMR 8208M propellant.

(3) The XM177E2 weapons with chrome-plated chambers were superior to XM177E1 weapons with regard to failure-to-extract stoppages.

AMSTE-BC 8 JUL 1968

SUBJECT: Approval of Final Report on Product Improvement Test of Submachine Gun 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01

(4) The delrin charging-handle latches on the E2 weapons were inferior to the latches on E1 weapons because of structural failure at -65°F.

(5) Within the scope of this test, no advantages in corrosion resistance were demonstrated for the shot-peened receivers, nylon-coated buttstock and release lever, and cadmium-plated slip ring spring of the E2 weapons.

(6) The XM148 launcher spacer and the increased barrel length of the E2 weapon permit assembly of the XM148 grenade launcher.

(7) The angled slip ring on the XM177E2 weapons (no structural failures) proved superior to the flat slip rings on the E1 weapons with respect to ease of assembly and disassembly on the hand guard.

b. Recommendations:

(1) Further development of the XM177E2 submachine gun buffer, and noise-flash suppressor be accomplished.

(2) The delrin charging-handle latch be considered unacceptable.

(3) The remaining product improvements under test be considered suitable for the XM177E2 submachine gun and, as appropriate, the M16A1 rifle.

FOR THE COMMANDER:

LeROY S. STANLEY
Colonel, GS
Dir, Inf Mat Test Dir

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USATECOM PROJECT NO. 8-7-0220-01

PRODUCT IMPROVEMENT TEST OF SUBMACHINE GUN, 5.56-MM, XM177E2

FINAL REPORT

BY

GEORGE HENDRICKS
ALLAN WILSON

JUNE 1968

ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND
21005

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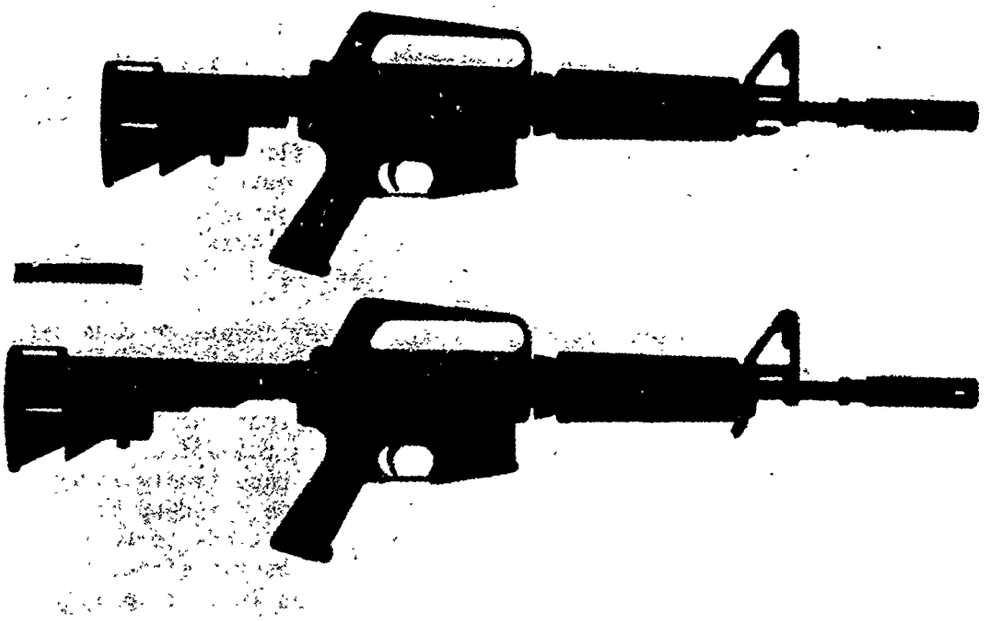
ABSTRACT

At the request of US Army Weapons Command, a product improvement test of the 5.56-mm submachine gun, XM177E2, was conducted at Aberdeen Proving Ground, Maryland between 1 August 1967 and 15 April 1968. The product improved components of the test weapons were: chrome-plated chambers, buffer, 1-1/2 inch increased barrel length, delrin charging-handle latch, hand-guard slip ring, cadmium-plated slip ring spring, shot-peened upper and lower receivers, nylon coated buttstock and release lever, and grenade launcher spacer (for attaching an XM148 grenade launcher). With the exception of the delrin charging handle latch, which proved susceptible to breakage at -65°F, durability of all the product improvements was satisfactory throughout the test. The chrome-plated chambers demonstrated improvement over nonplated chambers in reducing failures to extract and the hand-guard slip ring offers advantages over the previous design in ease of assembly and disassembly of hand-guards. Kinematics studies showed that the energy-absorbing characteristics of the urethane end cap on the buffer are subject to change under repetitive impacts, causing undesirably large variations in cyclic rate within a burst. Progressive build-up of fouling in the flash - sound suppressor during firing tends to increase muzzle flash and sound level and apparently has an adverse effect on bullet stability and flight. It was recommended that further development of the XM177E2 submachine gun buffer and noise - flash suppressor be accomplished, that the delrin charging handle latch be considered unacceptable, and that the remaining product improvements under test be considered suitable for use on the XM177E2 submachine gun and, as appropriate, the M16A1 rifle.

FOREWORD

Aberdeen Proving Ground was responsible for preparing the test plan, conducting the test, and preparing the test report.



SUBMACHINE GUN, 5.56-MM, XM177E2

Weight of weapon	6.2 lb
Weight of weapon with sling and loaded 20-round magazine	7.2 lb
Length (over-all)	29.7 in.
Length (over-all) with buttstock extended	33.0 in.
Length of barrel (from muzzle end of flash suppressor to face of bolt)	15.4 in.
Length of barrel (from muzzle end of barrel to face of bolt)	11.6 in.
Operation	Gas-operated, front-locking rotary bolt
Rifling	One turn in 12 in.
Muzzle velocity	Approx. 2780 fps
Type of fire	Semi- and full automatic
Stock	Telescoping buttstock
Ammunition	5.56-mm, M193 ball and M196 tracer

Data Compiled: August 1967.

Characteristics Photograph

ABERDEEN PROVING GROUND
ABERDEEN PROVING GROUND, MARYLAND 21005

USATECOM PROJECT NO. 8-7-0220-01

FINAL REPORT ON PRODUCT IMPROVEMENT TEST OF SUBMACHINE GUN, 5.56-MM, XM177E2

1 AUGUST 1967 TO 15 APRIL 1968

SECTION 1. INTRODUCTION

1.1 BACKGROUND

During 1965 and 1966 ten 5.56-mm submachine guns, along with a number of other small arms weapons systems, were subjected to an extensive engineering test (References 1 and 2). The submachine guns were identified variously as the CAR-15 or C-SMG at the time of the test. After the engineering test, a modified flash suppressor and a new buffer design were submitted for an engineer design test (Reference 7) and the weapon was designated XM177E1. A number of other product-improved components were then subsequently incorporated and the designation of the weapon was changed to XM177E2. In March 1967, USATECOM concurred in a recommendation from USAMC to type classify the CAR-15 for temperate zone use but withheld comment on the suitability of the XM177E2 until a test of the product improvements, the subject of this report, was conducted.

Of related interest in the development of the XM177E2 submachine gun is the recent introduction of a new extruded-grain cartridge propellant identified as IMR-8208M to be used in the loading of M193 and M196 cartridges. The M193 and M196 cartridges are the standard ball and tracer cartridges, respectively, for the XM177E2 as well as the M16A1 rifle. In addition, substantial quantities of M196 cartridges are now being loaded with ball propellant, a projectile and propellant combination not previously evaluated in either CAR-15 or XM177E2 weapons. By USATECOM direction, the new projectile - propellant combinations of M193 and M196 cartridges were to be tested simultaneously with the testing of the product improved version of the submachine gun.

1.2 DESCRIPTION OF MATERIEL

A description of the XM177E2 submachine gun is contained in paragraph 2 of Appendix II.

The product improvements on XM177E2 weapons which constitutes the difference between the XM177E1 and XM177E2 weapons are as follows:

a. Chrome-plated chambers to minimize corrosion and promote extraction.

b. One and one-half-inch increased barrel length and XM148 grenade launcher spacer for mounting XM148 grenade launcher.

c. Delrin charging handle latch to minimize wear on upper receiver.

d. Hand-guard slip ring shaped to provide ease of assembly.

e. Cadmium-plated slip ring spring to minimize corrosion.

f. Shot-peened upper and lower receiver to minimize corrosion.

g. Nylon coated buttstock and release lever to minimize corrosion.

h. Although the buffers of the XM177E2 and those of the XM177E1 in this test are the same, they were of a different design from those used in the small arms weapons system test (Reference 2).

Ammunition used in test is as follows:

a. Type A cartridge, 5.56-mm, M196, tracer, lot LC-12081 (ball propellant).

b. Type B cartridge, 5.56-mm, M196, tracer, lot TW-18007 (8208M propellant).

c. Type C cartridge, 5.56-mm, M193, ball, lot LC-12194 (ball propellant).

d. Type D cartridge, 5.56-mm, M193, ball, lot TW-18191 (8208M propellant).

e. Reference cartridge, 5.56-mm, M193, ball, lot LC-Y-5.56-501 (WC-846 propellant).

1.3 TEST OBJECTIVES

To evaluate the physical and technical characteristics of the XM177E2 submachine gun.

To evaluate weapon performance when using both extruded-grain and ball-propellant-loaded cartridges with both ball and tracer projectiles.

To evaluate test results regarding suitability of the XM177E2 product improvements for application to the M16A1 rifle.

1.4 SUMMARY OF RESULTS

1.4.1 Introduction

In view of the small sample of weapons available for test (two of each model in most subtests) all combinations of the ball and tracer rounds with 8208M and ball propellants could not be used equally by both projectile and propellant type in a manner to provide uniform exposure of all types to the many conditions of test. That is, the "start" and "finish" phases of test could not be controlled, where initial rounds may be most critical with regard to weapon function or subsequent rounds may produce functioning characteristics reflecting effects of previous rounds. In consideration of this, distinction was made with regard to weapon function, where appropriate, only between the rounds loaded with ball propellant and those loaded with 8208M propellant.

1.4.2 Product Improvements

1.4.2.1 Chrome-Plated Chambers. In the dust test, two failures to extract occurred on E1 weapons (nonplated chambers) while E2 weapons (chrome-plated chambers) were free from extraction problems. In the salt water immersion test nine failures to extract occurred in firing 381 salt-water-corroded rounds from E1 weapons (one each 42 rounds), and six occurred in firing 490 rounds from E2 weapons (one each 82 rounds).

1.4.2.2 Delrin Charging-Handle Latch. In the -65°F test, one charging handle latch broke during normal use in retracting the bolt. No difference could be detected between the delrin charging-handle latch of the E2 weapons and the metal latch of the E1 weapons with respect to receiver wear.

1.4.2.3 Hand-Guard Slip Ring. Based on gunner reaction and observations made throughout the test, the angled slip ring for the hand-guard of the E2 weapons provides a better gripping surface for ease of assembly and disassembly over that of the flat slip ring on the E1 weapon. The angled slip ring exhibited no failures during test.

1.4.2.4 Cadmium-Plated Slip Ring Spring. The cadmium-plated slip ring spring on the E2 weapon and the nonplated one for the E1 weapon exhibited corrosion to approximately the same degree when exposed to conditions of the salt-water immersion test. Corrosion on both springs was moderate. No failure of either spring occurred.

1.4.2.5 Shot-Peened Receiver and Nylon-Coated Buttstock and Release Lever. The shot-peened receiver and nylon-coated buttstock and release lever of the E2 weapons displayed no deleterious effects from the salt-water immersion test; similarly, the components of the E1 weapons were not visibly affected.

1.4.2.6 One and One-Half-Inch Increase in Barrel Length, and XM148 Grenade Launcher Spacer. The increased barrel length and launcher spacer of the E2 weapon did not degrade the ease of handling of the weapon, and permits assembly of the XM148 grenade launcher. The effects of the longer barrel on ballistic performance were as follows:

a. Based on comparison with velocity results of XM177E1 firings in Reference 2, the increase in muzzle velocity of M193 ammunition fired in the XM177E2 weapon is 229 fps, and 104 fps for M196 ammunition. This comparison is made between ball-propellant-loaded cartridges and ignores the effects of different lots.

b. The accuracy of E2 weapons showed slight improvement over that of E1 weapons fired in Reference 7. The average mean radius was 2.7 inches for E1 weapons compared with 2.4 inches for E2 weapons in this test.

c. The sound pressure level of the E2 weapon was 155.0 db as compared to 156.5 db for the E1 weapon recorded in Reference 7.

d. There was no significant difference in muzzle flash produced by the E1 weapon in Reference 7 and that of the E2 weapon in this test.

1.4.2.7 Buffer. Kinematic studies showed that the energy absorbing characteristics of the urethane end cap on the buffer are subject to change under repetitive impacts, causing undesirably large variations in cyclic rate within a burst. Further analysis of buffer performance is given in paragraph 2.16.

1.4.3 Subtest Findings

1.4.3.1 Inspection. The XM177E2 model is 0.2 pound heavier and 1.6 inches longer than the XM177E1 model. Usability and ease of handling of the E2 was comparable to that of the E1 model.

1.4.3.2 Velocity and Accuracy. All four lots of test cartridges met the velocity and accuracy criteria when fired in the XM177E2 weapons.

1.4.3.3 Flash. The muzzle flash performance of E1 weapon fired in Reference 7 and the E2 weapons fired in this test was comparable; there was, however, a significant reduction in flash with the 8208M-propellant-loaded lots of M193 and M196 cartridges over that of lots loaded with ball propellant.

1.4.3.4 Smoke. No difference in target obscuration or position detection effects was revealed between ammunition types or E1 and E2 weapon models.

1.4.3.5 High Temperature, High Humidity. The performance of E2 weapons was comparable to that of the E1 weapons.

1.4.3.6 Mann Barrel Firing. Cartridge, M193, ball, lot TW-18191 gave an average velocity of 3206 fps, which is 4 fps below the minimum specification limit. The M193 ammunition loaded with 8208M propellant, lot TW-18191, was 885 psi above the maximum chamber pressure permitted and 400 psi under minimum port pressure permitted when fired at +70°F. All other lots met the criteria specified in paragraph 2.13d and e.

1.4.3.7 Sound. At the gunner's ear position when firing the XM177E2 with a new barrel and flash suppressor (fired more than 30 but less than 1000 rounds), the criteria established in paragraph 2.15.2 was met with each of the four ammunition test lots. When firing with the used barrel and flash suppressor (fired approximately 9000 rounds) none of the four lots met the criteria. The lot of ammunition producing the highest sound - pressure measurement of 156 decibels with a new barrel and flash suppressor produced an increase to 160 decibels when firing with a used barrel and flash suppressor. This increase was attributed to the accumulation of fouling in the baffles of the suppressor.

1.4.3.8 Sustained Fire. Functioning performance of the four XM177E2 weapons with the four test types of ammunition (one weapon for each ammunition type) indicated no significant difference in weapon functioning associated with ammunition type. With the exception of the weapon fired with M193, lot LC-12194, ball-propellant-loaded ammunition, which produced a malfunction rate of 0.0034, none of the weapon - ammunition combinations exceeded the permissable malfunction rate of 0.003.

The M196 cartridges, both 8208M- and ball-propellant-loaded, gave excessive dispersion and yaw beginning early in the firings and

continuing throughout the sustained fire exercise; dispersion and yaw were comparatively slight with the M193 cartridges. Both M196 and M193 projectiles exhibited more yawing with the ball-propellant-loaded lots than with the 8208M-propellant-loaded lots.

The weapons were considered to have met the performance levels specified in paragraph 2.9.2 when firing M193 ball ammunition, but failed to meet the required levels when firing M196 tracer ammunition because of excessive yaw and dispersion. The reason for this incompatibility with tracer ammunition could not be established within the scope of the test. The X-ray photographs shown in paragraph 2.9.5 provide evidence that the stability of the tracer bullet is affected by the suppressor; however, the prevalence of this condition round-to-round and the effect on ultimate bullet flight are not known. Additionally, it is not known the extent to which build-up of fouling in the baffles of the suppressor (ref Figures 2.2.4.2-1 through -7) affects launch attitude and flight of the projectile.

1.4.3.9 Time of Flight. Tables 2.4-I and 2.4-II contain summaries of exterior ballistics data for the XM177E2 weapon firing the four lots of ammunition used in test.

The projectiles of the ammunition lots loaded with ball propellant, both M196 tracer and M193 ball, exhibited lack of stability in flight as evidenced by erratic flight of the M196 and an increased rate of velocity loss in flight for the M193 compared to M193 with 8208M propellant. The cause of this apparent contribution of ball propellant to bullet instability was not identified; however, it is most probably associated with the effects of residual muzzle pressures on bullet stability in launching and passage through the suppressor, and indicates that a difference in muzzle pressures exists between ball and 8208M propellants.

1.4.3.10 Low Temperature Fouling Test (+20°, -65°, and -40°F). The results of the low temperature fouling test as a whole show the XM177E2 to be inferior to the XM177E1. The malfunction rate for the entire low temperature test was 2.8 per 100 rounds for the E2 weapons and 1.4 for E1 weapons. However, a direct comparison of performance is hardly valid since E2 weapons were subjected to over 4000 rounds of firing in the sustained-fire subtest prior to these tests and the E1 weapons were not fired in that subtest.

Carbon accumulation in the bolt was prevalent on weapons firing ammunition loaded with ball propellant at +20°F, resulting in firing pin seizures in two weapons. In firing ammunition loaded with 8208M propellant, no malfunctions attributable to carbon accumulation occurred.

The entire low temperature test malfunction rate for ball-propellant-loaded ammunition was 9.6 per 100 rounds compared to 3.7 for 8208M-propellant-loaded ammunition.

1.4.3.11 Nonstandard Cleaners. The urethane end cap on the new type buffer used in this test became soft and tacky on the outside surface after immersion in insect repellent; however, light application of the repellent, as from contact with the hands, had no apparent effect. None of the other product improvements of the E2 weapon were affected by any of the fluids or greases.

1.4.3.12 Kinematic (Displacement-Time) Studies. The displacement-time studies were conducted under carefully controlled conditions to evaluate mechanism characteristics only. The influence of propellant fouling in either the mechanism or the gas tube was intentionally held to a minimum by observing short-interval maintenance periods during the relatively limited firing exercises. The pertinent findings of the study are summarized below and an analytic discussion of each of the findings is contained in par. 2.16.

a. At low rates of fire, marginal cyclic performance of the XM177E2 submachine gun can be expected to occur at a level of approximately 635 rds per min for any single round. This is estimated to be 50 rds per min more than the minimum marginal rate in the M16A1 rifle.

   The upper restraint in cyclic rate of fire for both the XM177E2 and the M16A1 has been previously established (Reference 10) at a rate of approximately 975 rds per min for the final round in a magazine and is associated with a failure of the bolt stop mechanism which is an identical subassembly in both weapons.

b. M193 ball projectile cartridges loaded with WC846 propellant offered the least round-to-round cyclic variation at near optimum energy levels during burst fire among the four cartridge types tested.

c. Reduced loading of the magazine (less than 20 rounds) does not aid in overcoming low cyclic rate levels for the initial rounds in a burst.

d. The barrel and gas tube assembly of the XM177E2 have the capability of withstanding as much as 9000 rounds of firing while continuing to serve as a suitable power source system for the mechanism.

e. Bolt carrier rebound with the XM177E2 is negligible and does not interfere with hammer fall or otherwise degrade cycling performance.

1.5 CONCLUSIONS

It is concluded that:

a. The delrin charging-handle latches on the E2 weapons were inferior to the latches on E1 weapons because of structural failure at -65°F (ref par. 2.11).

b. Within the scope of this test, no advantages in corrosion resistance were demonstrated for the shot-peened receivers, nylon-coated buttstock and release lever, and cadmium-plated slip ring spring of the E2 weapons (ref par. 2.12.5).

c. The XM148 launcher spacer and the increased barrel length of the E2 weapon permit assembly of the XM148 grenade launcher (ref STEAP-DS-TI letter, 2 October 1967, Appendix II).

d. The XM177E2 weapons with chrome-plated chambers were superior to XM177E1 weapons with regard to failure-to-extract stoppages (ref par. 2.12).

e. The angled slip ring on the XM177E2 weapons (no structural failures) proved superior to the flat slip rings on the E1 weapons with respect to ease of assembly and disassembly of the hand-guard (ref par. 1.4.2.3).

f. Both the XM177E1 and XM177E2 weapons gave unsatisfactorily high malfunction rates in the low temperature fouling test, and both weapons demonstrated more severe fouling in the mechanism with ball propellant than with 8208M propellant.

g. The XM177E2 submachine gun as presently designed is incompatible with the spectrum of ammunition as investigated in this test, especially in those areas of performance affected by the buffer and noise - flash suppressor.

1.6 RECOMMENDATIONS

It is recommended that:

a. Further development of the XM177E2 submachine gun buffer and noise - flash suppressor be accomplished.

b. The delrin charging-handle latch be considered unacceptable.

c. The remaining product improvements under test be considered suitable for use on the XM177E2 submachine gun and, as appropriate, the M16A1 rifle.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

2.1.1 Criteria

The majority of the test criteria are based on performance levels obtained during the engineering test of the CAR-15 (designated as C-SMG during the engineering test). The engineering test data are reported in References 1 and 2 and the source of the criteria are identified by paragraph designations from the pertinent report.

2.1.2 Ammunition

Four projectile - propellant combinations of 5.56-mm cartridges were fired in approximately equal numbers throughout the test (some exceptions are noted in certain subtests). The cartridge types are as follows:

a. Cartridges, M196 tracer projectile and ball propellant, lot LC-12081.

b. Cartridges, M196 tracer projectile and IMR-8208M propellant, lot TW-18007.

c. Cartridges, M193 ball projectile and ball propellant, lot LC-12194.

d. Cartridges, M193 ball projectile and IMR-8208M propellant, lot TW-18191.

The acceptance-test data sheets for each lot are contained in Appendix I.

2.1.3 Maintenance

The weapons were disassembled, cleaned, inspected, and lubricated with MIL-L-46000A (Reference 8), except for the low temperature tests where MIL-L-14107A was used. This maintenance was performed before the start of each subtest and after approximately each 600 rounds of firing, except for the continuous firings without maintenance in the high and low temperature tests.

2.1.4 Control Weapons

Where test methodology has substantially changed since the engineering test, XM177E1 control weapons were also fired and the performance of the control weapons established the minimum acceptable criteria for the test weapons.

2.1.5 Legends

Malfunction

FFR - Failure to fire.
FF - Failure to feed.
FX - Failure to extract.
FJ - Failure to eject.
FJLR - Failure to eject the case of the last round of the magazine.
BOB - Bolt overrode base of round in feeding.
FF1 - Failure to feed the first round from the magazine.
DF - Double feed.
F2R - Fired two rounds with one rearward movement of the trigger when firing semiautomatic fire.
FBO - Failure of the bolt to open before firing, without bumping buttstock on wooden bench while applying rearward force on the charging handle.
FBR - Failure of the bolt to remain to the rear after firing the last round from the magazine.
FFA - Failed to fire automatic.
BAF - Bolt assist failed to function.
BDP - Broken or damaged part.
S - Semiautomatic.
I-B - Interrupted burst.
SAT - Satisfactory.

Ammunition

Type A = Cartridge, 5.56-mm, M196, tracer lot LC-12081 (ball propellant).
Type B = Cartridge, 5.56-mm, M196, tracer lot TW-18007 (8208M propellant).
Type C = Cartridge, 5.56-mm, M193, ball lot LC-12194 (ball propellant).
Type D = Cartridge, 5.56-mm, M193, ball lot TW-18191 (8208M propellant).

2.2 INSPECTION

2.2.1 Objective

To determine that the test items were received in proper condition for test and to measure the physical characteristics of the test items.

2.2.2 Criteria

Criteria are as follows:

a. The weight of the test weapon, with sling and loaded 20-round magazine but no other ancillary equipment, shall not exceed the weight of the engineering test model (7.3 pounds) (Reference 1, par. 2.1.3).

b. The length of the test weapon with the telescoping buttstock closed, shall not exceed the length of the engineering test model (27.3 inches) by more than 2 inches (Reference 1, par. 2.1.3).

c. The chamber dimensions of plated barrel chambers shall be within the specifications of nonplated chambers.

2.2.3 Method

Photographs were obtained of the assembled weapon, right and left side, and of the disassembled weapon in a field-stripped condition.

The flash suppressor was X-rayed at the beginning and periodically throughout testing.

Weights and measurements were recorded to include internal bore dimensions, rate of twist, chamber dimensions, and other pertinent information.

2.2.4 Results

The diameter of the gas ports in the barrels of the XM177E2 weapons are 0.067 inch and 0.072 inch in XM177E1 weapons. The inspection results are illustrated and summarized in Figures 2.2-1 through 2.2-4 and Tables 2.2-I and 2.2-II. Bore dimensions are contained in Appendix I.

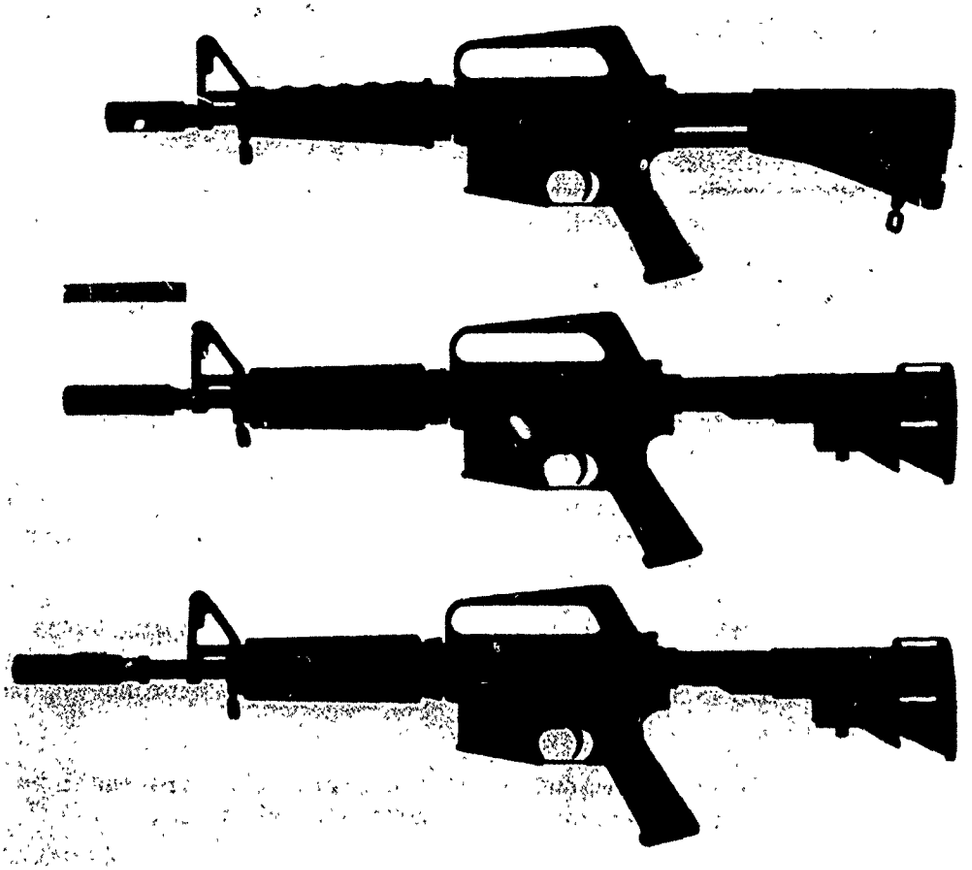


Figure 2.2-1: Left-Side View of C-SMG, TOP; XM177E1, CENTER; and XM177E2, BOTTOM.

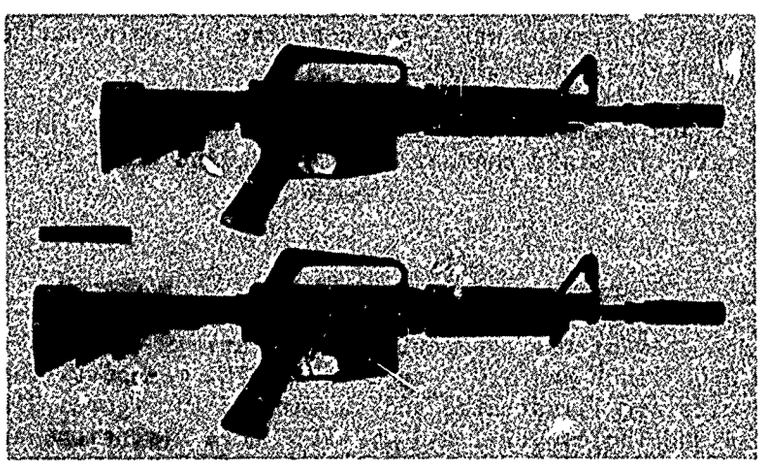


Figure 2.2-2: Right-Side View of XM177E2; Top View Is with Buttstock Closed, Bottom View is with Buttstock Extended.

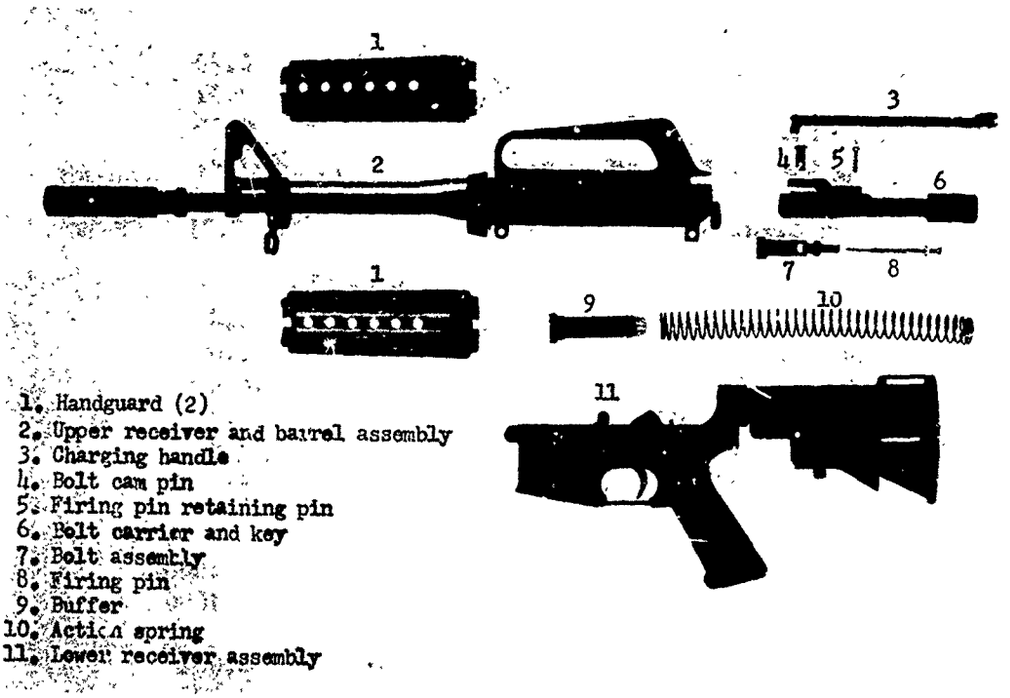


Figure 2.2-3: Field-Stripped XM177E2 Weapon.

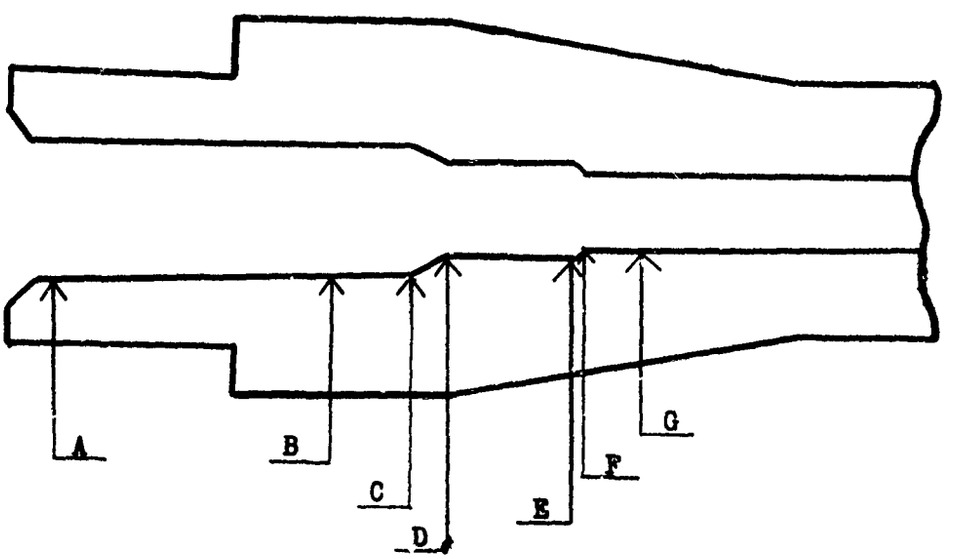


Figure 2.2-4: Sketch of Chamber for M16A1 Rifle and XM177E2 Submachine Gun. Letters Indicate Positions of Diameter Specifications as Shown on Standard Operation Instruction Sheet Used by the Manufacturer.

Table 2.2-I. Physical Characteristics of Submachine Gun, XM177E2

Weight, lb	
Weapon (No. 904541)[a]	6.20
Sling	0.31
Magazine, 20rd capacity[b]	0.19
20 rounds, M193 cartridges	0.51
Weapon with sling and loaded magazine	7.21
Dimensions, in.	
Barrel, bolt face to front of suppressor	15.4
Barrel, bolt face to barrel muzzle	11.6
Sight radius	14.4
Length, buttstock closed	29.7
Length, buttstock extended	33.0
Line of sight above bore	2.6
Buttstock comb above bore	0.7
Headspace	
Gun No. 904541, 904546	1.4646
Gun No. 904543, 904544, 904549	1.4656
Firing pin protrusion	
Gun No. 904546	0.032
Gun No. 904541, 904544	0.035
Gun No. 904549	0.036

[a]An XM177E1 model weighed 6.0 pounds.
[b]The weight of a fully-loaded, 30-round, aluminum magazine, standard with the engineering test weapon, was 1.02 pounds.

Table 2.2-II. Chrome-Plated Chamber Dimensions of XM177E2 Submachine Guns

	Dimension, in.						
	A	B	C	D	E	F	G
Diameter	0.3769	0.3594	0.3553	0.255	0.254	0.2245	0.210
Specification	0.3789	0.3614	0.3573	0.257	0.256	0.2265	0.220
Gun No.							
904541	0.3810	0.3608	0.3565	0.2595	0.2550	0.2283	0.2240
904543	.3840	.3613	.3572	.2606	.2558	.2295	.2238
904544	.3838	.3613	.3564	.2592	.2550	.2285	.2214
904546	.3866	.3602	.3563	.2597	.2549	.2283	.2214
904549	.3863	.3607	.3564	.2552	.2552	.2286	.2245

2.2.4.1 Receiver Hardness. The upper and lower receivers of the XM177E2 weapon were presumably shot-peened during manufacture, instead of sand-blasted, to reduce the possibility of corrosion and exfoliation during use under adverse conditions.

A metallurgical inspection to determine the surface hardness of the five XM177E2 models, three XM177E1 models, and one C-SMG model was conducted employing a superficial Rockwell hardness tester with a 1/16-inch-diameter ball penetrator and 15-kg load (15-T scale).

No measurable difference in hardness could be detected between the test weapons by use of the hardness tester; Rockwell hardness (15-T scale) varied from 89.0 to 91.5. It was concluded that only by destructive testing (examination of a sectioned receiver) could a determination of shot-peening versus sand-blasting be established.

2.2.4.2 X-Ray Results of Flash Suppressor Investigation. The flash suppressors of the XM177E2 weapons were X-rayed at the beginning of test and periodically thereafter. The X-ray results illustrated in Figures 2.2-5 through 2.2-11 show the progressive increase of fouling deposited in the internal baffles of the suppressions for various numbers of rounds fired.

Figure 2.2-5: Flash Suppressor of XM177E1, No. 902159 after Firing 180, 1200, 2700, and 5700 Rounds (TOP to BOTTOM).

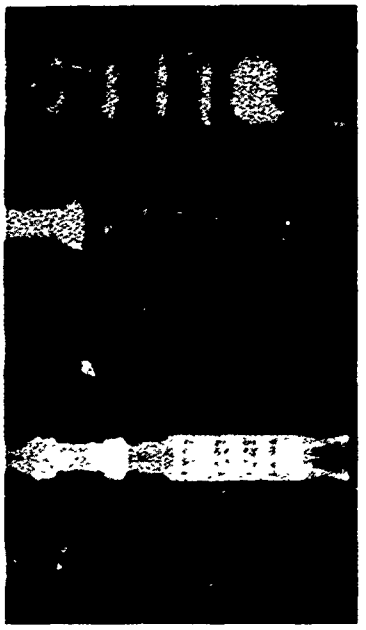


Figure 2.2-6: Flash Suppressor of XM177E1, No. 902279 before Firing and after Firing 1000, 2500, 4000, and 5500 Rounds (TOP to BOTTOM).

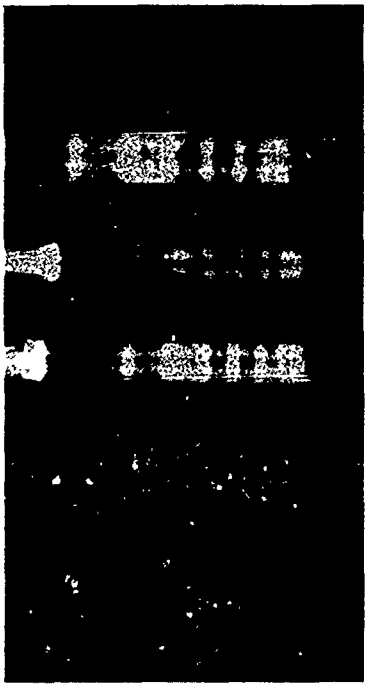


Figure 2.2-7: Flash Suppressor of XM177E2, No. 904541 before Firing and after Firing 2269, 3579, 4209, 6088, and 9088 Rounds (TOP to BOTTOM).

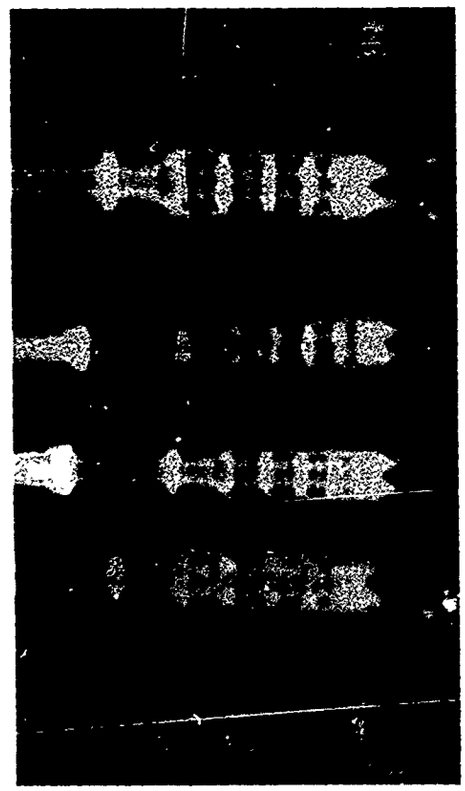


Figure 2.2-8: Flash Suppressor of XM177E2, No. 90453 before Firing and after Firing 2269, 3579, 4209, 5887, and 8887 Rounds (TOP to BOTTOM).

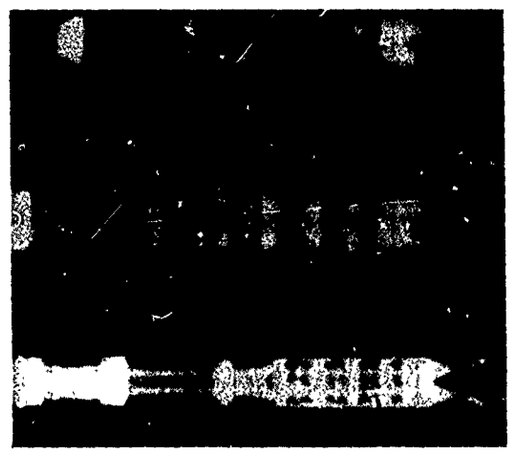


Figure 2.2-9: Flash Suppressor of XM177E2, No. 904544 before Firing and after Firing 1000 and 5167 Rounds (TOP to BOTTOM).

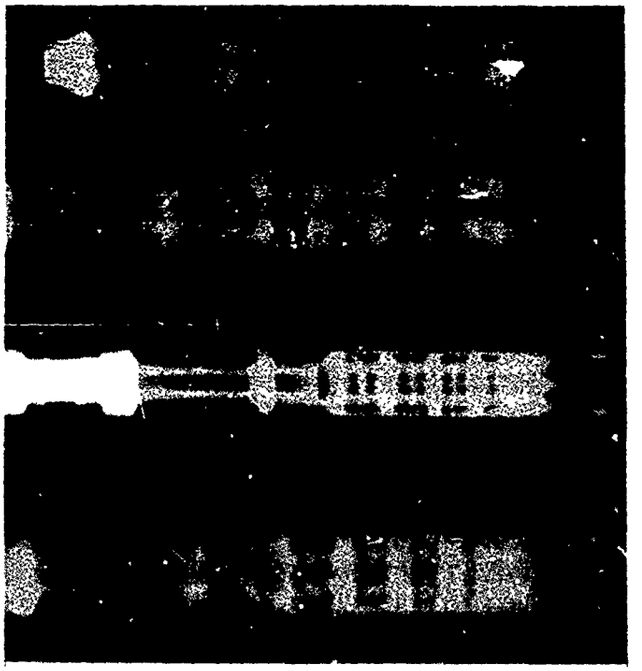


Figure 2.2-10: Flash Suppressor of XM177E2, No. 904546 before Firing and after Firing 1000, 5135, and 6515 Rounds (TOP to BOTTOM).

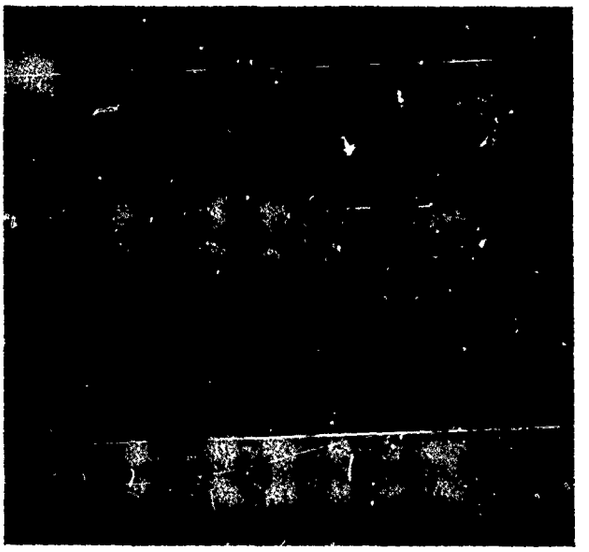


Figure 2.2-11: Flash Suppressor of XM177E2 No. 904549 before Firing and after Firing 1000 and 2064 Rounds (TOP to BOTTOM).

2.2.5 Analysis

The weight of the test weapon, 7.2 pounds, did not exceed the maximum permissible weight of 7.3 pounds and the maximum length criterion of 29.3 inches was judged not to be significantly exceeded by a measured length for the test weapons of 29.7 inches.

The criterion regarding chamber dimensions was originally prompted by concern that chrome-plating might result in undersize and out-of-tolerance chambers. However, the measurements in Table 2.2-II indicate that the chrome-plated chambers of the test weapons were oversize in some areas, although the reference data points on the standard operation instruction sheet were difficult to precisely locate on the chamber casts obtained. Considering that the major concern was to avoid undersize chambers and, due to the difficulty of obtaining precise comparison measurements, the apparent failure to fully meet the chamber dimension criterion is not considered a deficiency.

The effect of progressive fouling accumulation in the flash suppressor cavities is discussed in paragraph 1.4.2.

2.3 VELOCITY TEST

2.3.1 Objective

To determine the velocity of projectiles of various lots of M193 and M196 cartridges when fired from the test weapon.

2.3.2 Criteria

When fired in the test weapons and at a distance of 15 feet from the muzzle with cartridges temperature conditioned at +70°F:

a. The average velocity of M193 projectiles shall be at least 2500 feet per second with a standard deviation no greater than 40 feet per second (Reference 2, par. 2.9.3).

b. The average velocity of M196 projectiles shall be at least 2650 feet per second with a standard deviation no greater than 40 feet per second (Reference 2, par. 2.9.3).

2.3.3 Method

Sixty rounds of each of the four types of test ammunition were fired in each of three test weapons. The cartridges were conditioned before firing at -65, +70, and +155°F, 20 rounds at each temperature.

Dual sets of velocity screens were employed to measure time of flight at 78 feet from the weapon muzzle. A retardation factor of 1.4 fps per foot of travel is used to compute velocities at 15 feet from the muzzle.

2.3.4 Results

The velocity results are summarized in Table 2.3-I and the round-by-round velocity data are contained in Appendix I.

During the test, 250 rounds were fired semiautomatically in each of three test weapons (guns No. 904544, 904546, and 904549). One failure of the bolt to remain to the rear occurred with gun No. 904549, firing lot TW-18007, with ammunition conditioned at +70°F.

Table 2.3-I. Projectile Velocity Data at 15 Feet from the Muzzle for M193 and M196 Cartridges Fired in XM177E2 Submachine Guns

	Velocity, fps					
	+70°F		+160°F		-65°F	
Gun No.	Avg	Std Dev	Avg	Std Dev	Avg	Std Dev
Cartridge: M193, ball projectile, ball propellant, lot LC-12194.						
904544	2759	46	2833	19	2657	64
904546	2758	31	2832	21	2707	54
904549	2781	37	2860	33	2666	54
Avg	2766	38	2842	24	2677	57
Cartridge: M193, ball projectile, 8208M propellant, lot TW-18191.						
904544	2782	21	2860	25	2705	37
904546	2774	32	2854	13	2732	44
904549	2789	32	2864	22	2696	45
Avg	2782	28	2859	20	2711	42
Cartridge: M196, tracer projectile, ball propellant, lot LC-12081.						
904544	2760	32	2803	21	2682	65
904546	2762	29	2797	35	2680	62
904549	2762	24	2804	20	2693	41
Avg	2761	28	2801	25	2685	56

Table 2.3-I (Cont'd)

	Velocity, fps					
	+70°F		+160°F		-65°F	
Gun No.	Avg	Std Dev	Avg	Std Dev	Avg	Std Dev
Cartridge: M196, tracer projectile, 8208M propellant, lot TW-18007.						
904544	2776	32	2842	28	2751	35
904546	2780	25	2856	27	2753	58
904549	2784	29	2876	28	2719	46
Avg	2780	29	2858	28	2741	46

Notes: Average velocities for each gun are derived from 20 rounds obtained at 78 feet from the weapon muzzle and applying a retardation factor of +88 fps (1.4 fps per foot of travel added).
Standard deviations are those obtained at the 78-foot distance.

2.3.5 Analysis

All four lots of test cartridges met the velocity criteria when fired in three XM177E2 weapons. The cartridge lots loaded with 8208M propellant produced somewhat higher velocities under similar temperature conditions than did the lots loaded with ball propellant.

2.4 TIME OF FLIGHT

2.4.1 Objective

To determine the time-of-flight characteristics of the test projectiles.

2.4.2 Criteria

When fired from a test weapon:

a. The average velocity of M193 projectiles at 500 meters range shall be at least 950 fps with a maximum ordinate not to exceed 5.1 feet (Reference 2, par. 2.9.3).

b. The average velocity of M196 projectiles at 500 meters range shall be at least 1100 fps with a maximum ordinate not to exceed 3.7 feet (Reference 2, par. 2.9.3).

2.4.3 Method

A minimum of ten record rounds of each type of test ammunition were fired in a test weapon while employing the HAWK velocimeter to measure time of flight.

2.4.4 Results

Exterior ballistic results are summarized in Tables 2.4-I and 2.4-II.

2.4.5 Analysis

Both the M193 and M196 cartridges met the criteria delineated in paragraph 2.4.2.

Table 2.4-I. Exterior Ballistic Data for M193 Cartridges Fired from C-SMG and XM177E2 Submachine Guns[a]

Muzzle Velocity: C-SMG, 2558 fps, lot WCC-6089 (ball propellant)
XM177E2, 2787 fps, lot LC-12194 (ball propellant)
XM177E2, 2803 fps, lot TW-18191 (8208M propellant)

Range, meters	Elevation, mils			Time of Flight, sec			Max Ordinate, ft			Terminal Velocity, fps		
	Ball Prop.		8208M Prop.	Ball Prop.		8208M Prop.	Ball Prop.		8208M Prop.	Ball Prop.		8208M Prop.
	C-SMG	XM177E2	XM177E2	C-SMG	XM177E2	XM177E2	C-SMG	XM177E2	XM177E2	C-SMG	XM177E2[b]	XM177E2
0	0.0	0.0	0.0	0.00	0.00	0.00	0.0	0.0	0.0	2558	2787	2803
50	0.4	0.4	0.4	0.07	0.06	0.06	0.0	0.0	0.0	2347	2572	2590
100	1.0	0.8	0.8	0.14	0.13	0.13	0.1	0.1	0.1	2142	2361	2382
200	2.1	1.8	1.7	0.31	0.28	0.28	0.4	0.3	0.3	1758	1960	1985
300	3.7	3.1	3.0	0.52	0.47	0.46	1.1	0.9	0.9	1419	1603	1630
400	5.9	4.9	4.6	0.78	0.70	0.68	2.5	2.0	1.9	1138	1253	1316
500	8.9	7.3	6.9	1.09	1.00	0.96	5.1	4.1	3.8	967	980	1043
600	12.2	11.2	9.7	1.41	1.40	1.28	8.7	8.2	6.8	881	789	882
700	15.6		12.6	1.73		1.60	13.1		10.6	834		807
800	19.4		15.0	2.07		1.87	18.8		14.7	784		781
900	23.8			2.44			26.3			732		
1000	29.1			2.86			36.4			679		
1100	35.6			3.35			50.0			624		
1200	43.8			3.91			68.3			567		
1300	54.7			4.59			94.3			506		
1400	69.7			5.44			132.4			442		
1500												

[a] Data on C-SMG extracted from Reference 2.

[b] The rate of velocity loss in flight for these rounds as compared to that for the 8208M-propellant-loaded lot similarly fired indicates a probable lack of stability of the projectiles of this cartridge.

Table 2.4-II. Exterior Ballistic Data for M196 Cartridges Fired from C-SMG and XM177E2 Submachine Guns[a]

Muzzle Velocity: C-SMG, 2678 fps, lot RA-5031 (CR type propellant)
XM177E2, 2782 fps, lot LC-12081 (ball propellant)
XM177E2, 2801 fps, lot TW-18007 (8208M propellant)

Range, meters	Elevation, mils			Time of Flight, sec			Max Ordinate, ft			Terminal Velocity, fps		
	Ball Prop.		8208M Prop.	Ball Prop.		8208M Prop.	Ball Prop.		8208M Prop.	Ball Prop.		8208M Prop.
	C-SMG	XM177E2	XM177E2	C-SMG	XM177E2	XM177E2	C-SMG	XM177E2	XM177E2	C-SMG	XM177E2	XM177E2
0	0.0	0.0	0.0	0.00	0.00	0.00	0.0	0.0	0.0	2678	2782	2801
50	0.4	0.4	0.4	0.06	0.06	0.06	0.0	0.0	0.0	2491	2606	2623
100	0.8	0.8	0.8	0.13	0.13	0.13	0.1	0.1	0.1	2309	2431	2446
200	1.8	1.7	1.7	0.29	0.27	0.27	0.3	0.3	0.3	1961	2089	2103
300	3.1	2.8	2.8	0.48	0.44	0.44	0.9	0.8	0.8	1641	1767	1780
400	4.8	4.3	4.2	0.70	0.64	0.64	1.9	1.7	1.7	1359	1469	1481
500	7.0	6.2	6.1	0.96	0.89	0.89	3.7	3.2	3.2	1123	1201	1212
600		8.6	8.4		1.18	1.17		5.7	5.6		1026	1048
700		12.0			1.53			10.1			931	
800		17.8			2.01			18.0			785	
900		25.1			2.55			29.4			671	
1000		34.2			3.17			45.6			574	
1100												
1200												
1300												
1400												
1500												

[a] Data on C-SMG from Reference 2; ballistic data were not obtained beyond 500 meters due to apparent erratic projectile flight.

2.5 FLASH TEST

2.5.1 Objective

To evaluate the muzzle flash of the test weapon.

2.5.2 Criteria

Criteria are as follows:

a. Essential: When firing the test lots of ammunition, and by comparing photographic results, the muzzle flash shall not exceed the results reported in paragraph 2.4 of Reference 7.

b. Desirable: The muzzle flash characteristics shall be comparable to the muzzle flash of the XM16E1 rifle reported in Appendix IV of Reference 1.

2.5.3 Method

The method of test is described in Reference 1, paragraph 2.15.2, except that a different weapon with a barrel and muzzle device in "new" condition (fired more than 30 rounds and less than 300 rounds) was employed for each type of ammunition. Used 30-round magazines from the engineering test model were employed.

The test was repeated with "used" barrels and flash suppressors (fired approximately 4000 rounds).

2.5.4 Results

The muzzle flash photographs for each trial are contained in Appendix I.

Weapons No. 904543, 904544, 904546, and 904549 were fired in this test. Each gun was fired a total of 360 rounds using a different lot of ammunition in each gun. No malfunctions occurred during the "new" condition phase (less than 300 rounds on each gun prior to the flash test). Two feeding failures occurred during the "used" condition phase (more than 4000 rounds on each gun prior to the flash test).

2.5.5 Analysis

2.5.5.1 New Condition Phase. When firing either of the ball projectile lots, LC-12194 (ball propellant) and TW-18191 (8208M propellant), the essential portion of the criteria was met and, when firing the latter lot, the results approached the desirable criterion established by the M16A1 rifle.

The criteria were not met firing either of the tracer lots although the 8208M propellant tracer lot was superior to the ball propellant tracer lot in reducing muzzle flash in the XM177E2 submachine gun.

2.5.5.2 Used Condition Phase. With weapons in "used" condition the criteria were met only when lot TW18191 was fired. The muzzle flash with all other lots was unacceptable and much more severe than when the test weapons were in "new" condition.

2.6 SMOKE TEST

2.6.1 Objective

To evaluate the signature and target obscuration effects of smoke caused by firing.

2.6.2 Criteria

When firing the test lots of ammunition, and by comparing photographic results, the signature and target obscuration results of smoke shall be judged to be at least comparable to the results obtained with the control weapon.

2.6.3 Method

The method of test is described in Reference 2, paragraph 2.6.2, except that only ten rounds were fired in each trial. The test is conducted with one control and one test weapon firing each of the four types of ammunition.

2.6.4 Results

The photographic results of the target obscuration phase are contained in Appendix I. The smoke obscuration results with the XM177E2 test weapon and the XM177E1 control weapon were comparable with each lot of ammunition fired and there appeared to be no significant differences among the lots of ammunition.

Firings were also conducted to evaluate photographically the position disclosing effects of smoke during firing. Again, no significant difference could be detected between weapons or among lots of ammunition.

During the test a total of 360 rounds (90 rounds of each of the four test lots of ammunition) were fired; 180 rounds in XM177E2, No. 904549 and the same number of rounds in XM177E1, No. 902868. One failure to feed occurred while firing lot TW-18191 (ball projectile, 8208M propellant) in the XM177E1 weapon.

2.6.5 Analysis

The performance of the XM177E2 test weapon was comparable to that of the XM177E1 control weapon and the test criteria were judged to be satisfied.

2.7 ACCURACY AND DISPERSION

2.7.1 Objective

To determine the accuracy and dispersion characteristics of the test weapons when fired from a benchrest.

2.7.2 Criteria

The average standard deviation for 10-shot targets fired semi-automatically at 100 meters range for each of the test weapons shall not exceed, either horizontally or vertically, 3.4 inches for M193 cartridges and 10.7 inches for M196 cartridges (Reference 2, paragraphs 2.1.1.3 and 2.1.2.3). Note: A discussion of the suitability of the criteria is contained in paragraph 2.7.5.

2.7.3 Method

With each of three test weapons, three 10-round targets were obtained at each range (1000 inches, 50, 100, 200, and 400 meters) with each type of ammunition. Firing was done by master-class shooters from a benchrest under minimum wind conditions (0 to 5 mph).

2.7.4 Results

The dispersion results are summarized in Tables 2.7-I through 2.7-V and the individual target data are contained in Appendix I.

During the test, 619 rounds were fired semiautomatically in each of three test weapons (guns No. 904544, 904546, and 904549). One failure to fire occurred with lot LC-12081 which was an ammunition deficiency. The primer had been inserted on its side in the primer pocket of the cartridge. The primer functioned on impact from the firing pin but the propellant failed to ignite.

Table 2.7-I. Fired Dispersion Data at 1000-Inch Range for M193 and M196 Cartridges in XM177E2 Submachine Guns

Figures (given in inches) are averages of three 10-shot groups.

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M193, ball projectile, ball propellant, lot LC-12194.						
904544	2.0	0.6	2.3	0.7	2.6	0.8
904546	1.9	0.6	1.8	0.6	2.2	0.7
904549	1.0	0.3	1.1	0.3	1.3	0.4
Avg	1.7	0.5	1.7	0.5	2.0	0.6

Table 2.7-I (Cont'd)

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M193, ball projectile, 8208M propellant, lot TW-18191.						
904544	1.3	0.4	1.0	0.3	1.4	0.5
904546	1.7	0.6	1.5	0.5	2.0	0.7
904549	1.3	0.5	0.9	0.3	1.4	0.5
Avg	1.4	0.5	1.1	0.4	1.6	0.5
Cartridge: M196, tracer projectile, ball propellant, lot LC-12081.						
904544	3.6	1.2	3.4	0.9	4.3	1.4
904546	3.9	1.2	1.9	0.6	3.9	1.1
904549	4.7	1.4	3.0	0.9	5.2	1.2
Avg	4.1	1.3	2.8	0.8	4.5	1.2
Cartridge: M196, tracer projectile, 8208M propellant, lot TW-18007.						
904544	3.9	1.1	4.2	1.3	4.7	1.3
904546	3.6	1.1	3.4	1.1	4.2	1.3
904549	3.3	1.0	2.3	0.8	3.7	1.1
Avg	3.6	1.0	3.3	1.0	4.2	1.2

Table 2.7-II. Fired Dispersion Data at 50-Meter Range for M193 and M196 Cartridges in XM177E2 Submachine Guns

Figures (given in inches) are averages of three 10-shot groups.

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M193, ball projectile, ball propellant, lot LC-12194.						
904544	3.2	1.0	3.1	1.0	3.6	1.3
904546	3.9		3.4	1.0	4.4	1.3
904549	2.0	[illegible]	2.3	0.7	3.0	0.9
Avg	3.0	1.0	2.9	0.9	3.7	1.2
Cartridge: M193, ball projectile, 8208M propellant, lot TW-18191.						
904544	2.1	0.7	2.1	0.6	2.6	0.8
904546	2.9	0.8	2.5	0.7	3.4	0.9
904549	2.5	0.9	2.3	0.7	2.9	0.9
Avg	2.5	0.8	2.3	0.7	3.0	0.9

Table 2.7-II (Cont'd)

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M196, tracer projectile, ball propellant, lot LC-12081.						
904544	6.1	2.0	6.2	1.9	7.8	2.3
904546	10.9	3.2	3.6	1.2	11.1	2.7
904549	5.6	1.7	4.7	1.5	6.3	1.9
Avg	7.5	2.3	4.8	1.5	8.4	2.3
Cartridge: M196, tracer projectile, 8208M propellant, lot TW-18007.						
904544	4.8	1.5	5.4	1.7	5.9	1.9
904546	6.0	2.3	5.9	1.8	7.8	2.5
904549	6.0	1.9	5.6	1.7	7.7	2.1
Avg	5.6	1.9	5.6	1.7	7.1	2.2

Table 2.7-III. Fired Dispersion Data at 100-Meter Range for M193 and M196 Cartridges in XM177E2 Submachine Guns

Figures (given in inches) are averages of three 10-shot groups.

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M193, ball projectile, ball propellant, lot LC-12194.						
904544	5.4	1.7	6.2	1.9	6.9	2.1
904546	9.5	2.9	8.2	2.5	11.1	3.3
904549	5.4	1.8	3.5	1.1	5.5	1.8
Avg	6.8	2.1	6.0	1.9	7.8	2.4
Cartridge: M193, ball projectile, 8208M propellant, lot TW-18191.						
904544	3.9	1.3	6.1	1.7	6.7	1.8
904546	7.7	2.3	3.6	1.1	8.1	2.1
904549	4.2	1.4	3.6	1.2	5.0	1.6
Avg	5.3	1.7	4.4	1.4	6.6	1.8
Cartridge: M196, tracer projectile, ball propellant, lot LC-12081.						
904544	11.4	3.4	10.3	3.0	14.0	3.6
904546	15.3	4.9	15.3	4.6	17.8	5.6
904549	10.8	3.5	9.8	2.9	12.7	3.7
Avg	12.5	3.9	11.8	3.5	14.8	4.3

Table 2.7-III (Cont'd)

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M196, tracer projectile, 8208M propellant, lot TW-18007.						
904544	12.7	4.8	12.4	4.2	16.4	5.6
904546	14.6	4.6	15.6	4.8	19.4	5.6
904549	10.3	3.1	9.7	3.1	13.0	3.6
Avg	12.6	4.2	12.6	4.0	16.3	4.9

Table 2.7-IV. Fired Dispersion Data at 200-Meter Range for M193 and M196 Cartridges in XM177E2 Submachine Guns

Figures (given in inches) are averages of three 10-shot groups.

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M193, ball projectile, ball propellant, lot LC-12194.						
904544	11.4	3.8	9.9	2.9	11.9	4.1
904546	16.5	5.2	9.5	3.2	16.7	5.3
904549	7.9	2.5	9.0	3.0	10.5	3.4
Avg	11.9	3.8	9.4	3.0	13.0	4.3
Cartridge: M193, ball projectile, 8208M propellant, lot TW-18191.						
904544	8.3	2.9	9.7	3.1	11.9	3.7
904546	11.3	3.4	9.7	3.2	13.5	4.0
904549	12.8	3.9	6.4	2.2	13.7	3.8
Avg	10.8	3.4	8.6	2.8	13.0	3.8
Cartridge: M196, tracer projectile, ball propellant, lot LC-12081.						
904544	31.0	9.9	31.3	8.6	38.3	10.5
904546	37.3	10.8	41.4	11.9	54.4	12.3
904549	30.8	9.1	27.5	7.8	35.7	9.4
Avg	33.0	10.0	33.4	9.4	42.8	10.7
Cartridge: M196, tracer projectile, 8208M propellant, lot TW-18007.						
904544	24.1	8.2	30.1	8.8	34.0	10.2
904546	30.7	9.6	23.1	7.2	34.1	10.6
904549	30.0	8.8	28.6	8.2	37.5	9.0
Avg	28.3	8.9	27.2	8.1	35.2	9.9

Table 2.7-V. Fired Dispersion Data at 400-Meter Range for M193 and M196 Cartridges in XM177E2 Submachine Guns

Figures (given in inches) are averages of three 10-shot groups.

Gun No.	EV	VSD	EH	HSD	ES	MR
Cartridge: M193, ball projectile, ball propellant, lot LC-12194.						
904544	38.0	11.0	27.4	8.6	41.0	11.6
904546	39.6	14.1	33.4	10.8	45.1	16.1
904549	32.2	10.3	22.0	6.4	34.2	10.2
Avg	36.6	11.8	27.6	8.6	40.1	12.6
Cartridge: M193, ball projectile, 8208M propellant, lot TW-18191.						
904544	23.1	7.8	20.6	6.3	27.0	8.7
904546	32.5	10.6	28.5	8.1	35.9	11.1
904549	22.9	7.9	19.8	6.8	26.4	9.2
Avg	26.2	8.8	23.0	7.1	29.8	9.7
Cartridge: M196, tracer projectile, ball propellant, lot LC-12081.						
904544	61.7	18.3	48.2	15.5	65.2	19.7
904546	52.8	16.0	59.7	17.9	65.1	19.5
904549	38.2	11.5	37.2	11.4	44.2	14.7
Avg	50.9	15.3	48.4	14.9	58.2	18.0
Cartridge: M196, tracer projectile, 8208M propellant, lot TW-18007.						
904544	46.2	14.4	39.5	11.8	56.5	15.7
904546	56.5	14.9	43.0	12.4	58.0	19.4
904549	46.8	10.0	36.5	11.1	50.2	14.5
Avg	49.8	12.1	39.7	11.7	54.9	16.5

2.7.5 Analysis

The test plan criteria for M193 and M196 cartridges at 100 meters range, as stated in paragraph 2.7.2, were incorrectly extracted from the engineering test report (References 1 and 2) from firings done prone and without the aid of a sling. The correct benchrest average standard deviation for M193 cartridges should be 3.1 inches instead of 3.4 inches. The correct reference is Reference 1, Volume 2, Appendix I, page 122.

The engineering test report does not contain comparable benchrest data for M196 cartridges as all tracer firings were done prone and without the aid of a sling. However, the ballistic data inspection sheets contained in Appendix I of this report suggest that the dispersion of M196 cartridges should be approximately 2.5 times that of M193 cartridges. This is based on a maximum permitted mean radius of 2.0 inches at 200 yards for M193 cartridges and a 5.0-inch mean radius at 200 yards for M196 cartridges fired from a Mann barrel. Applying this factor to the 3.1-inch standard deviation criterion for M193 cartridges provides a suitable benchrest firing standard deviation criterion of 7.8 inches for M196 cartridges.

Applying the standard deviation criteria of 3.1 and 7.8 inches at 100 meters to M193 and M196 cartridges respectively, the test weapons did not exceed the maximum permissible criteria with any of the test lots of ammunition. The cartridge lots loaded with 8208M propellant provided smaller dispersion than did the lots loaded with ball propellant.

2.8 GRENADE LAUNCHER (XM148) TEST

2.8.1 Objective

To determine the feasibility and safety of firing the XM148 grenade launcher attached to the XM177E2 submachine gun.

2.8.2 Criteria

Not applicable.

2.8.3 Method

The test was directed as a supplement to the XM177E2 firings specified in the test plan. The supplemental directive is contained in Appendix II.

The details of test, as well as the results of test, were forwarded to Hq, USATECOM in letter form, a copy is contained in Appendix II.

2.8.4 Results

Reference Appendix II.

2.8.5 Analysis

Not applicable.

2.9 SUSTAINED FIRE

2.9.1 Objective

To determine the durability, reliability, and other performance characteristics of the test weapons.

2.9.2 Criteria

Criteria are as follows:

a. The malfunction rate of the test weapons shall not exceed 0.003 (Reference 1, par. 2.22.3). Note: Only malfunctions that cause a stoppage in firing, but regardless of how easily they may be cleared, are counted in the malfunction rate. Failures to feed, to fire, to extract, and eject are the most common. A broken or damaged part is also included in the malfunction rate if the part is a critical component in gun operation even if the breakage did not cause a firing stoppage.

b. No significant degradation shall be permitted for dispersion, velocity, projectile yaw, or cyclic rate of fire throughout test (Reference 1, par. 2.22.3).

2.9.3 Method

The method is as follows:

a. The weapons are fired at a rate of 15 rd/min for 30 minutes, completely cooled, and then fired 40 rd/min for 5 minutes. The foregoing schedules are fired semiautomatically and repeated automatically. Three 10-shot targets are recorded at a range of 100 meters, semiautomatically, from a bench-rest, before and after each of these firing tests. Velocities and projectile yaw are measured during the function-firing of the rounds in the next-to-last magazine in each semiautomatic and automatic phases (650 rounds per phase), and at least ten projectile velocities are determined during each of the benchrest trials.

b. The schedule outlined in a is repeated with the rates of fire doubled and the firing time halved.

c. The schedule is repeated again but with the rates of fire specified in b doubled and the firing time halved.

d. Cyclic rates of fire are recorded for weapons fired automatically.

e. All weapons are cleaned before and after the firing in c and after the firing in d.

Four weapons are employed in this test; each weapon to be fired exclusively with a single type of ammunition.

2.9.4 Results

Functioning data are summarized in Table 2.9-I. Detailed target data are contained in Appendix I.

Table 2.9-I. Summary of Functioning Data for Sustained Fire Test

Test Phase	Mode of Fire	Rate of Fire, rd/min	No. Rds Fired	Malfunct	Remarks
Gun No.: 904544. Cartridge: M193, lot LC-12194 (ball propellant).					
1	Acc	-	33		
2	SA	15	450	6-BOB a1-FBR	
3	SA	40	200	1-BOB a4-FBR	
4	Acc	-	33		
5	A	15	450	1-FJ a2-FBR	
6	A	40	200	a1-FBR a2-FJLR	
7	Acc	-	30		
8	SA	30	450	a1-FBR	
9	SA	80	200		
10					The accuracy exercise was inadvertently omitted.
11	A	30	450	a1-FBR a1-FJLR	
12	A	80	200		
13	Acc	-	30		
14	SA	60	450	a4-FBR	
15	SA	160	200	a2-FBR	
16	Acc	-	30		Some barrel erosion noted for several inches forward from the chamber; the chrome-plated chamber appeared to be undamaged.

[a]Malfunctions excluded from criteria evaluation.

Table 2.9-I (Cont'd)

Test Phase	Mode of Fire	Rate of Fire, rd/min	Nc. Rds Fired	Malfunct	Remarks
17	A	60	450	3-FJ [a]10-FBR	
17A	SA	-	40		Fired as functioning rounds.
18	A	160	200	1-BDP 2-FJ [a] 1-FBR	The ejector spring was damaged and was replaced.
19	Acc	-	30		The metal liners on the plastic hand-guards were loose.
Total			4126	43	

$$\text{Malfunction rate} = \frac{\text{Malfunctions causing a stoppage}}{\text{Number of rounds fired}} = \frac{14}{4126} = 0.0034$$

Gun No.: 904546.
Cartridge: M193, lot TW-18191 (8208M propellant).

1	Acc	-	33		
2	SA	15	450	1-BOB	
3	SA	40	200	3-BOB	
4	Acc	-	33		
5	A	15	450		
6	A	40	200		
7	Acc	-	30		
8	SA	30	450		
9	SA	80	200		
10					The accuracy exercise was inadvertently omitted.
11	A	30	450	1-FF 3-FFR	The malfunctions occurred on the first four rounds of this phase.
12	A	80	200		
13	Acc	-	30		
14	SA	60	450		
15	SA	160	200	1-BOB	

[a]Malfunctions excluded from criteria evaluation.

Table 2.9-I (Cont'd)

Test Phase	Mode of Fire	Rate of Fire, rd/min	No. Rds Fired	Malfunct	Remarks
16	Acc	-	30		While the chamber appeared undamaged, considerable erosion, more than noted with gun No. 904544, was evident in the area immediately forward of the chamber.
17	A	60	450		
18	A	160	200		
19	Acc	-	30		The metal liners on the hand-guards were loose.
Total			4086	9	

$$\text{Malfunction rate} = \frac{\text{Malfunctions causing a stoppage}}{\text{Number of rounds fired}} = \frac{9}{4086} = 0.002$$

Gun No.: 904543.
Cartridge: M196, lot TW-18007 (8208M propellant).

1	Acc	-	33		
2	SA	15	450		
3	SA	40	200		
4	Acc	-	31		
5	A	15	450		
6	A	40	200		
7	Acc	-	30		
8	SA	30	450	[a]5-F2R [a]1-F3R 1-BOB	
9	SA	80	200		The barrel and chamber were inspected, no damage or erosion was noted.
10	Acc	-	30		
11	A	30	450	3-BOB [a]1-FBR	All occurred on the 18th round in each of three magazines.
12	A	80	200	2-BOB	One occurred on 18th round; one on 16th.
13	Acc	-	30		

[a]Malfunctions excluded from criteria evaluation.

Table 2.9-I (Cont'd)

Test Phase	Mode of Fire	Rate of Fire, rd/min	No. Rds Fired	Malfunct	Remarks
14	SA	60	450	2-BOB	Both occurred on 18th round.
15	SA	160	200		
16	Acc	-	30		
17	A	60	450	[a]5-FBR	One liner on one hand-guard was loose.
18	A	160	200	1-BOB	Excessive carbon build-up, but not as severe as gun No. 904541, on flash suppressor slots.
19	Acc	-	30		Severe chipping and erosion of the barrel lands were found immediately forward of the chamber.
Total			4114	21	

$$\text{Malfunction rate} = \frac{\text{Malfunctions causing a stoppage}}{\text{Number of rounds fired}} = \frac{9}{4114} = 0.002$$

Gun No.: 904541.
Cartridge: M196, lot LC-12081 (ball propellant).

1	Acc	-	33		
2	SA	15	450	1-BOB	
2A			874		Fired to investigate problem of projectile yaw and projectile break up. No firing malfunctions occurred. Borescope inspection of the chamber, bore and flash suppressor failed to detect any deficiency or any fouling accumulation.
3	SA	40	200		
4	Acc	-	32		
5	A	15	450	1-BOB [a]2-FBR	

[a]Malfunctions excluded from criteria evaluation.

Table 2.9-I (Cont'd)

Test Phase	Mode of Fire	Rate of Fire, rd/min	No. Rds Fired	Malfunct	Remarks
6	A	40	200	1-BOB [a]2-FBR	
7	Acc	-	30		
8 to 10					These phases were omitted due to extra firing in phase 2A.
11	A	30	450	[a]3-FBR 1-BOB	Occurred on 18th round.
12	A	80	200		
13	Acc	-	30		
14	SA	60	450	[a]3-F2R [a]4-FBR	
15	SA	160	200		
16	Acc	-	30		
17	A	60	450	[a]6-FBR	Excessive carbon build-up on flash suppressor slots noted.
18	A	160	200	[a]1-FBR	
19	Acc	-	30	2-BDP	The polyurethane end cap on the buffer was chipped and cracked; it was not replaced. The extractor spring was broken and was replaced. Severe chipping and erosion of the barrel lands were noted.
Total			4309	27	

$$\text{Malfunction rate} = \frac{\text{Malfunctions causing a stoppage}}{\text{Number of rounds fired}} = \frac{6}{4309} = 0.001$$

[a]Malfunctions excluded from criteria evaluation.

Legend:

ACC = Accuracy targets, fired single shot or semiautomatic.
S = Semiautomatic.
A = Automatic.

2.9.4.1 Benchrest Accuracy. At the beginning of test, and then again following approximately each 650 rounds, three semiautomatically fired 10-shot targets were obtained on each occasion firing from a benchrest. Table 2.9-II summarizes these data. The guns were at normal ambient temperature prior to benchrest accuracy tests and the guns were cleaned following each benchrest exercise.

Table 2.9-II. Summary of Accuracy Test Phases during Sustained Fire Test

Data for each gun are the average in inches of three 10-shot targets at 100-meters range.

Test Phase No.	Gun No.	Ctg Lot	Target Data EV	VSD	EH	HSD	ES	MR
1	904544	LC-12194	7.6	2.2	5.1	1.7	7.9	2.3
	904546	TW-18191	5.4	1.7	7.2	2.1	7.5	2.4
	904543	TW-18007	9.6	3.1	9.2	2.8	11.9	3.5
	904541	LC-12081	9.6	3.1	11.0	3.2	13.1	3.9
4	904544	LC-12194	10.6	3.1	4.8	1.4	10.8	2.8
	904546	TW-18191	7.0	1.9	6.7	2.0	8.0	2.3
	904543	TW-18007	21.9	6.3	10.4	3.1	23.6	5.1
	904541	LC-12081	14.7	4.5	11.9	4.0	19.0	5.1
7	904544	LC-12194	7.5	2.6	4.9	1.7	8.2	2.8
	904546	TW-18191	4.9	1.5	4.0	1.2	5.5	1.6
	904543	TW-18007	11.7	3.9	14.6	4.6	15.7	5.4
	904541	LC-12081	30.5	9.7	26.8	9.1	34.4	11.8
10	904544	LC-12194	This test phase was omitted.					
	904546	TW-18191	This test phase was omitted.					
	904543	TW-18007	19.4	6.0	16.7	5.2	24.1	6.6
	904541	LC-12081	This test phase was omitted.					
13	904544	LC-12194	8.9	3.1	7.9	2.4	10.3	3.5
	904546	TW-18191	6.1	1.8	5.2	1.6	7.3	2.1
	[a]904543	TW-18007	-	-	-	-	-	-
	904541	LC-12081	32.9	12.4	30.1	9.2	39.9	13.6
16	904544	LC-12194	13.3	4.4	7.7	2.3	14.2	4.2
	904546	TW-18191	4.2	1.3	6.2	1.8	6.3	1.7
	[b]904543	TW-18007	-	-	-	-	-	-
	904541	LC-12081	25.3	7.8	25.0	7.6	33.3	8.7
19	904544	LC-12194	9.3	2.9	5.4	1.8	9.7	2.9
	904546	TW-18191	5.3	1.7	6.4	1.9	7.7	2.2
	[a]904543	TW-18007	-	-	-	-	-	-
	[c]904541	LC-12081	-	-	-	-	-	-

[a]Three of the 30 shots missed the 8- by 10-feet target.
[b]Seven of the 30 shots missed the 8- by 10-feet target.
[c]Four of the 30 shots missed the 8- by 10-feet target.

2.9.4.2 Cyclic Rate of Fire Data. During the automatically fired phases of the sustained fire test, cyclic rates of fire were measured for several of the final 20-round magazines in each phase. The data are summarized in Table 2.9-III.

Table 2.9-III. Cyclic Rate of Fire Data during Sustained Fire Test

Each rate is in rd/min for a single 20-round burst.

Test Phase No.	Gun No. 904544 Lot No. LC-12194		Gun No. 904546 Lot No. TW-18191		Gun No. 904543 Lot No. TW-18007		Gun No. 904541 Lot No. LC-12081	
5	953	967	900	905	867	858	Data not obtained	
	977	973	893	907	892	895	Data not obtained	
	990		897		900			
Avg	972		900		882			
6	920	907	893	900	860	883	896	908
	917	913	910	899	907	917	925	917
					908	900	930	
Avg	914		900		896		915	
11	897	890	892	882	913	908	850	860
	906	883	888	887	933	950	883	917
	893				967			
Avg	894		887		934		933	
12	863	867	850	867	883	917	833	867
	892	883	867	858	941	950	917	942
	903		862		958		928	
Avg	882		861		930		897	
17	Data not obtained		Data not obtained		917	925	941	933
					927	930	930	933
					925		917	
Avg					925		931	
18	883	900	833	826	850	833	850	875
			842	850	833	875	897	900
			882		883		908	
Avg	892		847		855		886	

2.9.4.3 Projectile Velocity Data. During the benchrest accuracy phases, with rifle barrels at normal ambient temperature, projectile velocities were measured at a distance of 78 feet from the muzzle. Again, during the final rounds in automatically fired phases, projectile velocities were measured at 22 feet from the muzzle with the weapon barrels heated by sustained fire. The velocity data are summarized in Table 2.9-IV.

Table 2.9-IV. Summary of Projectile Velocity Data during Sustained Fire Test

Average velocities are in fps at 22 feet from the weapon muzzle (hot barrel) and at 78 feet (cold barrel).

Test Phase No.	Gun No. 904544 Lot No. LC-12194 Barrel		Gun No. 904546 Lot No. TW-18191 Barrel		Gun No. 904543 Lot No. TW-18007 Barrel		Gun No. 904541 Lot No. LC-12081 Barrel	
	Hot	Cold	Hot	Cold	Hot	Cold	Hot	Cold
1	-	2721	-	2724	-	2721	-	2716
4	-	2730	-	2676	-	[a] -	-	[a] -
6	2741	-	2752	-	2726	-	2611	-
7	-	2647	-	2689	-	[a] -	-	[a] -
10	-	Omitted	-	Omitted	-	[a] -	-	Omitted
12	2621	-	2643	-	2703	-	2664	-
13	-	2643	-	2626	-	[a] -	-	[a] -
16	-	2642	-	2640	-	[a] -	-	[a] -
18	2700	-	2628	-	2662	-	2626	-
19	-	2624	-	2622	-	[a] -	-	[a] -

[a]Due to extreme dispersion, it was not possible to obtain velocity at the 78-foot distance without impacting and damaging the time-of-flight instrumentation.

2.9.4.4 Cook-Off Data. Immediately following the majority of the 200- and the 450-round sustained fire phases, a single round was chambered in the test weapon and a 5-minute cook-off period was observed. These data were obtained for additional information during the sustained fire exercise. The cook-off results are given in Table 2.9-V.

Table 2.9-V. Cook-Off Data during Sustained Fire Test

Test Phase No.	Mode of Fire	No. Rds Fired Immediately prior to Cook-Off	Rate of Fire, rd/min	Time to Cook-Off, sec			
				Gun No. 904544 Lot LC-12194	Gun No. 904546 Lot TW-18191	Gun No. 904541 Lot LC-12081	Gun No. 904543 Lot TW-18007
1				Accuracy Phase			
2	SA	450	15	Cook-off test omitted	Cook-off test omitted	Cook-off test omitted	No cook-off
3	SA	200	40	Cook-off test omitted	Cook-off test omitted	Cook-off test omitted	No cook-off
4				Accuracy Phase			
5	A	450	15	Cook-off test omitted	Cook-off test omitted	No cook-off	Cook-off test omitted
6	A	200	40	No cook-off		No cook-off	No cook-off
7				Accuracy Phase			
8	SA	450	30	No cook-off	Cook-off test omitted	Cook-off test omitted	Cook-off test omitted
9	SA	200	80	No cook-off	No cook-off	Cook-off test omitted	No cook-off
10				Accuracy Phase			
11	A	450	30	20	12	15	14
12	A	200	80	Cook-off test omitted	22	19	19
13				Accuracy Phase			
14	SA	450	60	20	13	15	Test interrupted
15	SA	200	160	28	19	25	18
16				Accuracy Phase			
17	A	450	60	7	6	9	7
18	A	200	160	23	13	22	22
19				Accuracy Phase			

2.9.4.5 Projectile Yaw Data. A continuously moving target was used at a distance of 1000 inches (25 meters) to record projectile yaw or projectile breakup during the 200- and 450-round firing phases. The 100-meter benchrest targets were also inspected for impact irregularities. The observations are summarized in Table 2.9-VI.

Table 2.9-VI. Projectile Yaw Data during Sustained Fire Test

Test Phase No.	No. Proj Evidencing Yaw	Yaw Occurred during Final No. Rds Fired	Amount of Yaw, Proj Impact Length, in.
Gun No.: 904544. Cartridge: M193, lot LC-12194 (ball propellant).			
3	4	36	0.26 to 0.27
6	1	-	0.38
14	8	30	0.28 to 0.36
15	9	40	0.26 to 0.35
17	7	50	0.26 to 0.30
18	18	40	0.28 to 0.35
Gun No.: 904546. Cartridge: M193, lot TW-18191 (8208M propellant).			
2	2	40	0.26
14	3	30	0.25
15	4	40	0.25
Gun No.: 904541. Cartridge: M196, lot LC-12081 (ball propellant).			
1	See Table 2.9-II.		
2	Extreme dispersion, severe yaw, high tracing failure.		
3	Same as above.		
4	It was not possible to confine the projectiles within the velocity screens; dispersion tabulated in Table 2.9-II.		
5	The results noted in phase No. 2 continued throughout test with many stripped jackets and jacket fragments noted. It was impractical to qualitatively measure the data.		
Gun No.: 904543. Cartridge: M196, lot TW-18007 (8208M propellant).			
1	See Table 2.9-II.		
2	Extreme dispersion observed, but less than with lot LC-12081.		

Table 2.9-VI (Cont'd)

Test Phase No.	No. Proj Evidencing Yaw	Yaw Occurred during Final No. Rds Fired	Amount of Yaw, Proj Impact Length, in.
3	Same as Phase No. 2; one stripped jacket noted.		
4	See Table 2.9-II.		
5	12	30	0.28 to 0.34
6	12	40	0.28 to 0.40
7	See Table 2.9-II.		
8	24	50	0.28 to 0.35
9	20	40	0.26 to 0.42
10	See Table 2.9-II.		
11	26	40	0.28 to 0.62
12	28	40	0.28 to 0.42
13	See Table 2.9-II.		
14	This phase was interrupted by a gun malfunction.		
15	22	40	0.28 to 0.50
16	See Table 2.9-II.		
17	26	44	0.28 to 0.56
	Six shots missed the yaw target.		
18	18	40	0.28 to 0.38
	Seven shots missed the yaw target.		
19	See Table 2.9-II.		

2.9.5 Analysis

2.9.5.1 Weapons Firing M193 Cartridges. The malfunction rate was exceeded with one test weapon firing M193 ball, lot LC-12194 (ball propellant). Some reduction occurred in projectile velocities and in average cyclic rates of fire as the test progressed. In addition, the incidence of projectile yaw steadily increased, particularly with the ball-propellant-loaded lot, although no similar degradation in bench-rest dispersion was noted. However, it was judged that the total performance degradation was slight, considering the severity of the test, and both weapons firing ball projectiles were considered to have met the basic performance levels stated in paragraph 2.9.2.

2.9.5.2 Weapons Firing M196 Cartridges. Although the malfunction rate was not exceeded with either of the test weapons, the projectile dispersion and incidence and degree of yaw were completely unacceptable. The degradation was more severe with the ball-propellant-loaded lot than with the 8208M-propellant-loaded lot.

During this test, and with the concurrence of the Project Manager, a limited amount of unscheduled firing was undertaken in an attempt to identify the incompatibility of the XM177E2 submachine gun and M196 tracer cartridges. A number of experimental firings were conducted and some high-speed radiograph X-rays were obtained of tracer bullets exiting from the weapon muzzle. Figure 2.9-1 illustrates some of the targets that were fired and Figure 2.9-2 illustrates projectiles from M196 tracer lot LC-12081 (ball-propellant-loaded) at the moment of launch from gun No. 90451.

The upper targets in Figure 2.9-1 were fired to determine if the suppressor original to gun No. 904541 was the cause of projectile yaw. The lower targets were fired to determine if gun No. 904541 was capable of firing other lots with more acceptable results. Lot TW-18007 is a tracer lot and lot TW-18191 is a ball projectile lot, both loaded with 8208M propellant.

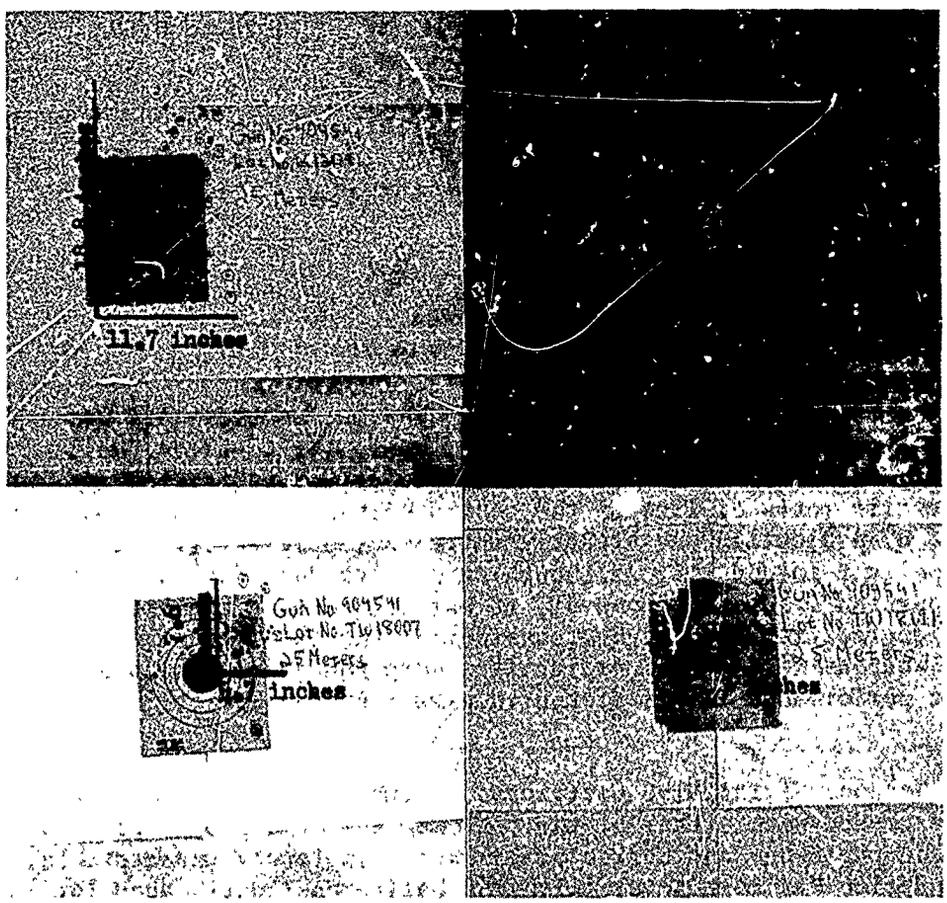


Figure 2.9-1: Typical 120-Round, 25-Meter Targets Fired with Gun No. 904541 and Various Lots of Ammunition. Circled Projectile Impacts Indicate Severe Yaw. Rate of Fire, 15 Rds/Min.

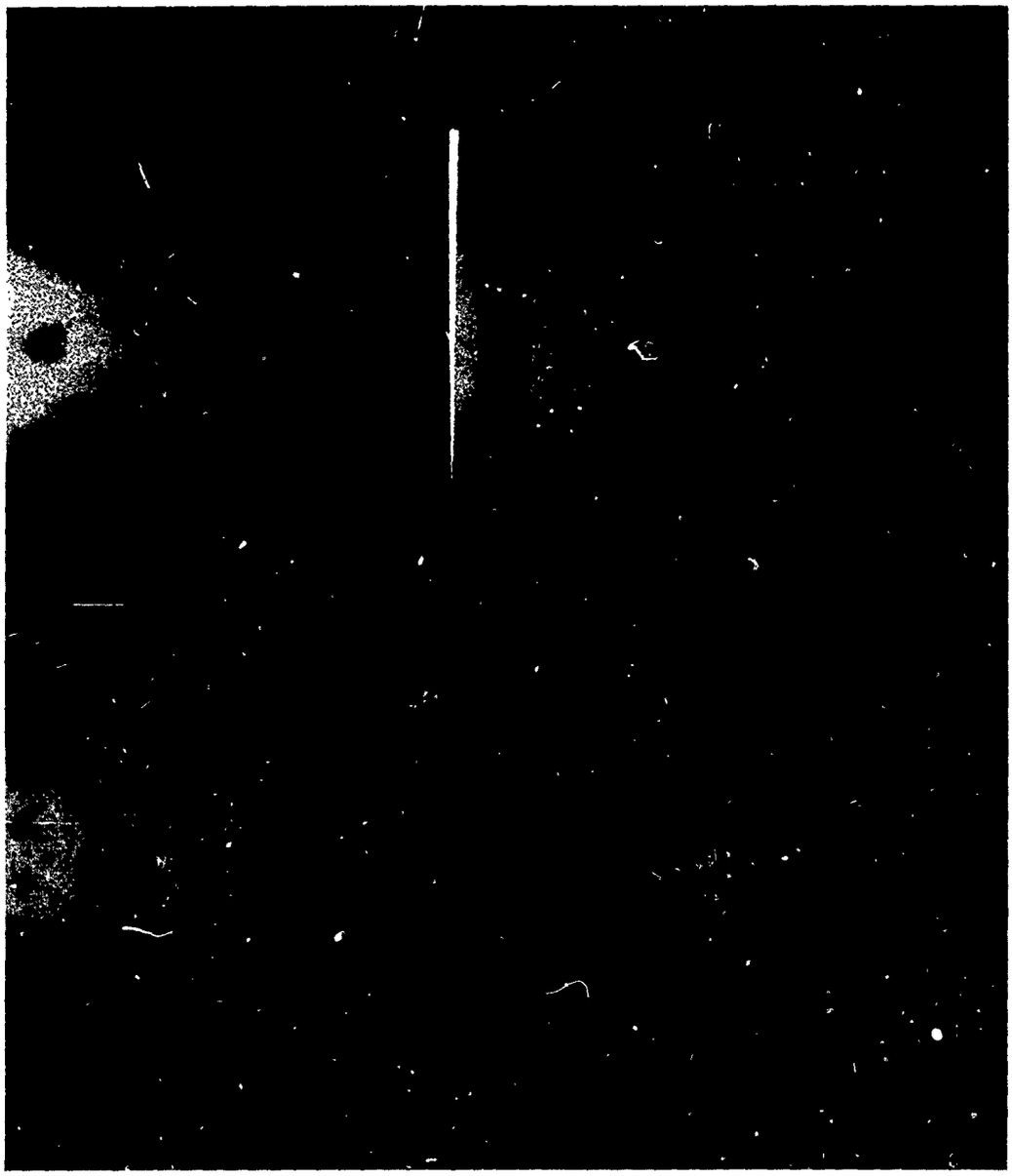


Figure 2.9-2: High-Speed Radiograph X-Rays Showing Tracer Projectiles from Cartridge, M196 Tracer, Lot LC-12081 Exiting from Flash Suppressor of Gun No. 904541.

The upper right X-ray shows a projectile yawing and apparently displaced from the bore line. Note that the jacket around the tracer cavity appears bulged or deformed. The upper left X-ray shows a projectile in what appears to be a position of extreme yaw while still in the suppressor. The lower X-ray shows a projectile just emerging from the suppressor with a very noticeably bulged or deformed jacket around the tracer cavity.

While these exploratory firings failed to identify the cause of the tracer incompatibility problem, it became increasingly evident that the test lot of ball-propellant-loaded tracers fired in the XM177E2 submachine gun was nearly useless as a tactical lot of ammunition and possibly even dangerous to fire because of bullet jacket break-up. Almost simultaneously with the XM177E2 firings, the tracer problem was encountered in a somewhat similar manner with M16A1 rifles (Reference 9) and, on 7 November 1967, information was received that USAMUCOM had suspended the lot from firing by other agencies except for emergency combat use.

While the M16A1/M196 problem may be solved most logically by redesign of the cartridge or respecification within the ammunition data package, the tracer incompatibility with the XM177E2 submachine gun may require weapon modification as well as a change in ammunition. This concern is due to the design of the combination sound suppressor - flash hider device on the XM177E2 weapon. The passageway through the suppressor intended for bullet travel is 0.25 inch in diameter for 2 inches of suppressor length. This permits propellant gases to bypass the projectile, possibly resulting in projectile yaw from side to side within the suppressor. Due to the thin jacket which must enclose the tracer cavity, the jacket may then become ruptured, bulged, or split if yawing and impacting the suppressor occurs. The presumably more durable solid core ball projectiles may be able to withstand the rupturing forces which cause the tracer projectile to fail. In addition, the ball projectiles are 0.15 inch shorter than the tracers.

While the preceding analysis is entirely conjectural, it is presented to emphasize that any solution to the current M196 ammunition/ M16A1 rifle problem will also require confirmation by firing in the XM177E2 submachine gun. Failure at that point may require a redesign of the XM177E2 muzzle device which in turn will require refiring many of the subtests in this report.

2.10 HIGH TEMPERATURE, HIGH HUMIDITY TEST

2.10.1 Objective

To evaluate the performance of the weapon when subjected to a high temperature, high humidity environment.

2.10.2 Criteria

The malfunction rate of the test weapons shall not exceed that of the control weapons.

2.10.3 Method

In the humidity test, two test weapons and two control weapons were exposed as indicated in Table 2.10-I for 10 days, with firings on the third, fifth, eighth, and tenth days. Each weapon was fired 1000 rounds; 250 rounds each time, in 125-round groups, with cooling between groups, and alternating between semiautomatic and automatic fire. This test is conducted without the benefit of cleaning or addition of lubrication between firings. Daily firing is conducted only after a minimum of 4 hours of continuous high temperature conditioning. One test weapon and one control weapon are each fired only with cartridges loaded with ball propellant, the remaining control and test weapons fired only with cartridges loaded with IMR8208M propellant. Additionally, magazines loaded with ball projectile cartridges and magazines loaded with tracer projectile cartridges are fired alternately in each weapon throughout the test.

Table 2.10-I. Storage-Firing Schedule for Humidity Test

No. Hrs		Temp, °F		Relative Humidity, %
4	increase to...	155.....	and.....	95
12	maintain at...	155 ± 3	and.....	90 to 95
4	decrease	155 to 70 ..	increase to..	96 to 98 (saturation)
4	maintain at..	70 ± 3	and.....	95 to 98

Total 24

2.10.4 Results

The results of the test are summarized in Table 2.10-II.

Table 2.10-II. Results of High Temperature, High Humidity Test

Legend:

Type A Cartridge: M196, tracer, lot LC-12081 (ball propellant).
Type B Cartridge: M196, tracer, lot TW-18007 (8208M propellant).
Type C Cartridge: M193, ball, lot LC-12194 (ball propellant).
Type D Cartridge: M193, ball, lot TW-18191 (8208M propellant).

Ammo Type	Number of Days Soaking in Temperature and Humidity Before Firing				Total Malfunct	Avg Cyclic Rate, rd/min
	3	5	8	10		
Weapon: XM177E1, No. 902159.						
A-C	2-FBR	2-FBR	1-FBR	SAT	5	
Cyclic Rate: rd/min.						
A	1000	993	973	928		973
C	1040	1049	1033	1008		1032
Weapon: XM177E1, No. 902279.						
B-D	SAT	SAT	1-FBR, 1-BOB	4-FBR	6	
Cyclic Rate, rd/min.						
B	999	954	938	957		962
D	973	957	955	961		961
Weapon: XM177E2, No. 904546.						
B-D	1-FF1	1-FF1, 1-FBR	2-FBR	SAT	5	
Cyclic Rate, rd/min.						
B	947	945	927	948		942
D	930	912	917	927		921

Table 2.10-II (Cont'd)

Ammo Type	Number of Days Soaking in Temperature and Humidity Before Firing				Total Malfunct	Avg Cyclic Rate, rd/min
	3	5	8	10		
Weapon: XM177E2, No. 904549.						
A-C	1-BOB, 1-FJ	SAT	2-FBR	1-FBR	5	
Cyclic Rate, rd/min.						
A	886	901	908	888		896
C	946	939	927	926		934

2.10.5 Analysis

The performance of E2 weapons was comparable to that of the E1 weapons. Two malfunctions which caused stoppages occurred on E2 weapons and one on the E1 weapons.

2.11 LOW TEMPERATURE, FOULING TEST

2.11.1 Objective

To evaluate the performance of the weapons when subjected to and fired in a low temperature environment expected to increase the severity of fouling.

2.11.2 Criteria

The malfunction rate of the test weapons shall not exceed that of the control weapon.

2.11.3 Method

Two test and two control weapons and sufficient rounds of ammunition were subjected to +20°F for a minimum of 12 hours prior to firing and between firing cycles. Each of the weapons was fired 1500 rounds, 300 rounds on each of five days, in 100-round groups at 4-hour intervals. Firing was conducted with respect to propellant-projectile combinations as in paragraph 2.10.3. Each weapon was disassembled, cleaned and lubricated with the prescribed oil prior to storage at +20°F. The effect of combustion residue build-up on weapon performance was evaluated and cyclic rates of fire were recorded during each firing day. At the conclusion of firing at +20°F, the weapons were cleaned and lubricated and the environmental chamber temperature lowered to

-65°F and the test repeated. The test was again repeated at -40°F. A witness screen was positioned at 25 meters from the muzzle to check yaw on the last three 100-round cycles.

2.11.4 Results

The results of the test are summarized in Tables 2.11-I, -II, and -III.

Table 2.11-I. Results of +20°F Test.

No. Rds Fired	Mode of Fire	Weapon XM177E1 No. 902159 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E1 No. 902279 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E2 No. 904541 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E2 No. 904543 Funct	Ammo Type	Cyclic Rate, rd/min
		No. Rds Previously Fired: 1200.			No. Rds Previously Fired: 1000.			No. Rds Previously Fired: 4588.			No. Rds Previously Fired: 4387.		
100	Semi	SAT			SAT			SAT			SAT		
100	Auto	SAT	A	811	SAT	B	824	SAT	B	791	1-DF	A	841
			C	879		D	829		D	775		C	893
100	Semi	SAT			1-FF, 1-FBR			SAT			SAT		
100	Auto	SAT	A	840	SAT	B	800	SAT	B	796	1-FF	A	853
			C	882		D	787		D	797		C	910
100	Semi	SAT			SAT			SAT			2-DF		
100	Auto	SAT	A	826	SAT	B	790	SAT	B	770	SAT	A	825
			C	894		D	796		D	790		C	907
100	Semi	SAT			SAT			SAT			1-DF		
100	Auto	1-FF1	A	830	SAT	B	794	SAT	B	765	SAT	A	-
			C	-		D	794		D	779		C	-
100	Semi	[a]1-FFR BDP			SAT			SAT			1-DF		
100	Auto	SAT	A	832	SAT	B	787	SAT	B	762	[b]2-FFR	A	863
			C	887		D	780		D	813		C	901
100	Semi	SAT			SAT			SAT			2-DF		
100	Auto	SAT	A	824	SAT	B	785	SAT	B	768	2-DF	A	887
			C	890		D	798		D	797		C	885

[a] The firing pin was bent. A new one was installed. The bolt was cleaned.
[b] The firing pin was seized as a result of heavy accumulation of carbon in the bolt. It was necessary to use a screwdriver to force the firing pin from the bolt. The weapon was not operable until the bolt was cleaned.

Table 2.11-I (Cont'd)

No. Rds Fired	Mode of Fire	Weapon XM177E1 No. 902159 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E1 No. 902279 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E2 No. 904541 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E2 No. 904543 Funct	Ammo Type	Cyclic Rate, rd/min
100	Semi	1-DF			SAT			1-FJ			1-DF		
100	Auto	SAT	A	834	SAT	B	774	SAT	B	760	2-DF	A	813
			C	905		D	780		D	803		C	919
100	Semi	1-DF			SAT			SAT			2-DF		
		Avg	A	828		B	793		B	773		A	847
			C	890		D	781		D	793		C	903
Malfunction rate per 100 rds		0.26			0.06			0.06			1.13		

Note: Ammunition Type A Cartridge: M196, tracer, lot LC-12081 (ball propellant).
Ammunition Type B Cartridge: M196, tracer, lot TW-18007 (8208M propellant).
Ammunition Type C Cartridge: M193, ball, lot LC-12194 (ball propellant).
Ammunition Type D Cartridge: M193, ball, lot TW-18191 (8208M propellant).

Table 2.11-II. Results of -65°F Test

No. Rds Fired	Mode of Fire	Weapon XM177E1 No. 902159 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E1 No. 902279 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E2 No. 904541 Funct	Ammo Type	Cyclic Rate, rd/min	Weapon XM177E2 No. 904543 Funct	Ammo Type	Cyclic Rate, rd/min
		No. Rds Previously Fired: 2700.			No. Rds Previously Fired: 2500.			No. Rds Previously Fired: 6088.			No. Rds Previously Fired: 5887.		
100	Semi	SAT			SAT			SAT			2-FJ		
100	Auto	SAT	A	724	SAT	B	733	2-BOB 1-FJ	B	746	4-FJ	A	813
			C	836		D	784		D	770		C	816
100	Semi	SAT			SAT			1-BOB 1-FJ 1-FJLR			5-FJ 2-FF		
100	Auto	1-FFR	A	752	SAT	B	780	1-BOB 1-FF	B	798	7-FJ 1-FJLR 1-BOB	A	-
			C	837		D	805		D	770		C	811
100	Semi	1-FFR			1-FF1			1-FF1 1-FJ			[c]21-FJ BDP		
								1-BOB 1-FF					
100	Auto	2-FFR	A	-	1-FFR	B	778	1-FF1 1-BOB	B	721	1-DF	A	740
			C	812		D	802		D	764		C	789
100	Semi	1-FF1			SAT			1-FF1 1-FF 1-F2R			SAT		
100	Auto	1-FFR 1-FF1 1-FJ	A	781	1-FFR	B	780	1-FF1 1-FF	B	762	1-DF	A	818
			C	846		D	802		D	783		C	790
100	Semi	1-FFR 1-FF1 [a]12-FJ BDP			1-FFR			1-FF			1-DF		
100	Auto	1-FFR [b]1-FJ	A	715	SAT	B	794	1-FFR 2-FJ	B	762	1-FF1 1-FFR 1-DF	A	813
			C	840		D	807		D	761		C	821
100	Semi	SAT			SAT			1-FF1 1-FF			SAT		
100	Auto	SAT	A	733	1-FF1	B	798	1-FF1 1-FJ	B	755	1-FF1 3-FFR	A	810
			C	834		D	806		D	780		C	821
100	Semi	1-FFR			1-FFR 1-FF1			1-FF1 1-FFR			1-FFR 1-DF		
100	Auto	1-FF1 8-FJ	A	758	1-FFR 1-FF1	B	798	1-FFR 1-FJ	B	746	1-DF 2-FFR	A	779
			C	831		D	802		D	756		C	826
100	Semi	1-FF1 [b]18-FJ			SAT			1-FF1			SAT		
		Avg	A	744		B	780		B	756		A	796
			C	834		D	801		D	769		C	811
Malfunction rate per 100 rds.		3.23			0.26			1.46			3.73		

[a] A new extractor spring was assembled after firing this 100-round cycle.
[b] Carbon accumulation on the ejector and in the ejector hole in the face of the bolt caused the ejector to seize in a partially compressed position. It was necessary to disassemble and clean the affected areas to restore function.
[c] A new extractor and extractor spring were assembled.

Table 2.11-III. Results of -40°F Test[a]

No. Rds Fired	Mode of Fire	Weapon XM177E1 No. 902159					Weapon XM177E1 No. 902279					Weapon XM177E2 No. 904541					Weapon XM177E2 No. 904543				
		Funct	Ammo Type	Cyclic Rate, rd/min	No. Rds (Out of 50) that Yawed	Bullet Yaw, deg	Funct	Ammo Type	Cyclic Rate, rd/min	No. Rds (Out of 50) that Yawed	Bullet Yaw, deg	Funct	Ammo Type	Cyclic Rate, rd/min	No. Rds (Out of 50) that Yawed	Bullet Yaw, deg	Funct	Ammo Type	Cyclic Rate, rd/min	No. Rds (Out of 50) that Yawed	Bullet Yaw, deg
		No. Rds Previously Fired: 4200.					No. Rds Previously Fired: 4000.					No. Rds Previously Fired: 7588.					No. Rds Previously Fired: 7387.				
100	Semi	SAT					1-FF					SAT					SAT				
100	Auto	SAT	A	776			SAT	B	790			SAT	B	773			SAT	A	846		
			C	854				D	771				D	781				C	878		
100	Semi	SAT					SAT					1-F2R					2-DF				
100	Auto	SAT	A	769			SAT	B	800			SAT	B	786			1-FBR 1-DF	A	853		
			C	820				D	761				D	788				C	891		
100	Semi	SAT					SAT					1-FJ 1-F2R					1-DF				
100	Auto	1-FBR	A	772			SAT	B	788			2-FJ	B	-			1-DF	A	832		
			C	839				D	784				D	-				C	881		
100	Semi	FBO 1-FF					SAT					SAT					FBO				
100	Auto	FBO	A	782			1-FF	B	799			1-FJ	B	779			2-DF	A	847		
			C	844				D	750				D	769				C	887		
100	Semi	SAT					SAT					1-F2R					1-DF				
100	Auto	1-DF	A	773			SAT	B	778			SAT	B	784			1-DF	A	844		
			C	836				D	765				D	796				C	873		
100	Semi	FBO					1-FF1					SAT					1-DF				
100	Auto	SAT	A	770			SAT	B	786			2-FJ	B	-			1-FBR	A	862		
			C	847				D	770				D	746				C	903		
100	Semi	SAT	A		42	68	SAT	B		2	10	2-FJ	B		8	13	4-DF	A		15	21
			C		27	25		D		2	14		D		0	-		C		50	52
100	Auto	SAT	A	768	42	31	SAT	B	797	2	17	2-FJ	B	791	9	17	SAT	A	855	17	19
			C	857	27	32		D	775	1	10		D	770	0	-		C	873	50	50
100	Semi	SAT	A		43	38	SAT	B		0	-	6-FJ	B		10	14	1-DF	A		5	14
			C		28	28		D		0	-		D		0	-		C		48	52
		Avg	A	773				B	791				B	783				A	848		
			C	842				D	768				D	775				C	884		
Malfunction rate per 100 rounds.		0.33					0.13					1.06					1.06				

[a]Bullet yaw data are given on the last three 100-round cycles.

2.11.5 Analysis

Combustion residue build-up was prevalent on both weapons firing ammunition loaded with ball propellant at +20°F. Functioning difficulties attributable to carbon build-up with the ball propellant lots occurred after approximately 800 rounds whereas, the weapons fired with lots loaded with 8208M propellant exhibited no malfunctions chargeable to fouling build-up during 1500 rounds similarly fired.

The critical area in the bolt where tolerances between the firing pin and bolt are affected by carbon build-up is principally the area from the cam pin extending forward to the foremost shoulder in the firing pin hole.

At -65°F, weapons firing ball-propellant-loaded ammunition gave 15 failures to fire compared with eight failures to fire in firing 8208M-propellant-loaded ammunition. The failures to fire are separated from other malfunctions since they are related to the effects of carbon build-up in the critical area of the bolt. One delrin charging-handle latch broke on the fifth day of firing at -65°F.

The effect of carbon accumulation in the mechanism was not different between the propellant types in the -40°F firing. Twenty-four malfunctions occurred on weapons firing ball-propellant-loaded ammunition and 22 occurred firing 8208M-propellant-loaded ammunition.

The malfunction rate of the test weapons exceeded that of the control weapons in each of the three temperatures tested and therefore failed to meet the criteria specified in paragraph 2.11.2.

2.12 ENVIRONMENTAL TESTS

2.12.1 Objective

To determine the performance of the test weapons when subjected to various adverse conditions.

2.12.2 Criteria

The malfunction rate of the test weapons shall not exceed that of the control weapons.

2.12.3 Method

Only M193 cartridges with ball propellant were fired. The weapons were tested as described in the following test procedures.

2.12.3.1 Dynamic Dust Test. The dynamic dust test was performed by subjecting each weapon to a dust blast in a specially constructed box with a blower. The box was 3 feet wide, 4 feet tall, and 4-1/2 feet long, with plexiglass sides. The plexiglass sides incorporated gauntlet-type gloves which allowed the gunner to fire the weapon from outside the box. Each weapon was mounted in a rest which was centrally located in the dust box. An attempt was then made to fire 40 rounds semiautomatically, 60 rounds in 3- to 5-round bursts, and 40 rounds in 20-round bursts (140 rounds total). The rate of fire was approximately 3-1/2 minutes to fire the 140-round complement. During firing, each rifle was subjected to a continuous blast of dust which was poured directly into the blower opening at an approximate rate of 2 pounds per minute. The dust used in test is commercially known as "140-mesh silica flour" and will pass 98 ± 2% through a 140-mesh screen (US standard sieve series).

2.12.3.2 Water Spray Test. The water spray test is an accelerated test to determine the effect of a heavy rainfall on the performance of the weapon. The test consists of a spray of water falling at a rate of approximately 0.4 inch per minute or 24 ± 3 inches per hour. The spray of water is directed over the entire weapon by means of a special shower head positioned about 3 feet above the weapon. The water and air temperatures are measured and recorded. The test weapon is lubricated with MIL-G-46003(MR) grease before the test but not between the test phases.

The basic sequence of operations for the water spray test was as shown in Table 2.12-I.

Table 2.12-I. Water Spray Schedule

Test Condition	Exposure Time (minutes)	Cumulative Exp. Time (minutes)	Rain (inches)	Cumulative Rain (inches)
Weapon Horizontal				
a. Bolt open	5	5	2.0	2.0
b. Loaded, bolt closed	5	10	2.0	4.0
c. 100 rounds semiauto.	4	14	1.6	5.6

Table 2.12-I (Cont'd)

Test Condition	Exposure Time (minutes)	Cumulative Exp. Time (minutes)	Rain (inches)	Cumulative Rain (inches)
d. Bolt open	5	19	2.0	7.6
e. Loaded, bolt closed	5	24	2.0	9.6
f. 100 rounds automatic	4	28	1.6	11.2
Weapon Muzzle Up*				
a. Bolt open	5	33	2.0	13.2
b. Loaded, bolt closed	5	38	2.0	15.2
c. 100 rounds semiauto.	4	42	1.6	16.8
d. Bolt open	5	47	2.0	18.8
e. Loaded, bolt closed	5	52	2.0	20.8
f. 100 rounds automatic	4	56	1.6	22.4
Weapon Muzzle Down*				
a. Bolt open	5	61	2.0	24.4
b. Loaded, bolt closed	5	66	2.0	26.4
c. 100 rounds semiauto.	4	70	1.6	28.0
d. Bolt open	5**	75	2.0**	30.0
e. Loaded, bolt closed	5**	80	2.0**	32.0
f. 100 rounds automatic	4**	84	1.6**	-

*Before attempting to fire, hold weapon with muzzle down, unlock bolt slightly, and attempt to remove water accumulated in the bore.

**Or as required to finish program with at least 32.0 inches cumulative rain total.

2.12.3.3 Salt Water Immersion Test. Two of each type E2, and E1 weapons were disassembled, cleaned, lubricated with MIL-L-46000A oil, and reassembled. The weapons were fully loaded and the safety was applied. The fully loaded weapons, and a sufficient number of rounds and magazines for 60 rounds of firing on each of five days, were submerged in a salt-water solution for 60 seconds. The solution is 20% salt, 80% water, by weight.

After removal from the salt water, the muzzle of each weapon was depressed and the bolt was retracted slightly to permit the salt water to drain from the bore. Thirty rounds were fired in each mode; the automatic mode was fired in bursts of approximately three rounds.

Four additional firings were conducted over a 10-day period, for a total of 300 rounds. The storage and firing schedule was in accordance with Table 2.12-II.

Table 2.12-II. Storage Schedule

No. of Hrs		Temp, °F		Relative Humidity, %
4	increase to...	105.....	and.....	95
12	maintain at...	105 ± 3	and.....	90 to 95
4	decrease....	105 to 70 ..	increase to.	100 (saturation)
4	maintain at...	70 ± 3.....	and.....	95 to 100
Total 24				

2.12.4 Results

The results are summarized in Tables 2.12-III through 2.12-V.

Table 2.12-III. Results of Dynamic Dust Test

Ammunition Type C: Cartridge, M193, ball, lot LC-12194 (ball propellant).

No. Rds Fired	Mode of Fire	Funct	Remarks
Weapon: XM177E1, No. 902159 (6300 rounds previously fired).			
20	A	SAT	Cyclic rate, 877/rpm.
20	1-B	SAT	
20	A	SAT	Cyclic rate, 786/rpm.
20	S	SAT	
20	1-B	SAT	
1	S	1-FF1 BAF 1-FX	The case extracted after closing and opening the bolt several times. Before stoppages were cleared, 3.5 minutes elapsed and 7 pounds of dust were used. Firing was resumed without dusting.
19	S	3-FF	The bolt lacked energy to strip the rounds from the magazine.
20	A	SAT	Cyclic rate, 851 rd/min.
Weapon: XM177E1, No. 902279 (6100 rounds previously fired).			
20	A	SAT	Cyclic rate, 813 rd/min.
20	1-B	SAT	
20	A	SAT	Cyclic rate, 784 rd/min.
20	S	SAT	
2	1-B	1-FF 1-FX	The rim of the case sheared and it was necessary to use a cleaning rod to remove the case. Before stoppages were cleared, 3.5 minutes elapsed and 7 pounds of dust were used. Firing was resumed without dusting.
18	1-B	1-FF, 1-FBR	
20	S	SAT	
20	A	SAT	Cyclic rate, 838 rd/min.

No. Rds Fired	Mode of Fire	Funct	Remarks
Weapon: XM177E2, No. 904544 (6410 rounds previously fired).			
20	A	SAT	Cyclic rate, 883 rd/min.
20	1-B	SAT	
20	A	SAT	No rate recorded.
20	S	SAT	
20	1-B	SAT	
20	S	SAT	
20	A	SAT	No rate recorded. Total time of firing was 3 minutes 20 seconds and 7 pounds of dust were used.
Weapon: XM177E2, No. 904549 (2664 rounds previously fired).			
20	A	SAT	Cyclic rate, 756 rd/min.
2	1-B	1-FF BAF 1-DF	Before stoppages were cleared, 3.5 minutes elapsed and 7 pounds of dust were used. Firing was resumed without dusting.
18	1-B	1-FF 16-FJ	On each occasion, short recoil caused failures to eject.
20	A	4-FJ	Same as previous.
20	S	SAT	
20	1-B	SAT	
20	S	SAT	
20	A	SAT	Cyclic rate, 715 rd/min.

Table 2.12-IV. Results of Water Spray Test

Ammunition Type C: Cartridge, M193, ball, lot LC-12194 (ball propellant).
Water Temperature: 40°F.
Air Temperature: 50°F.

Rds Fired	Mode of Fire	Funct	Remarks
Weapon: XM177E1, No. 902159 (5700 rounds previously fired).			
100	S	SAT	
100	A	SAT	
100	S	1-DF	18th round of magazine.
100	A	SAT	
100	S	SAT	
100	A	SAT	
Weapon: XM177E1, No. 902279 (5500 rounds previously fired).			
100	S	SAT	
100	A	1-FFR	Fired on second attempt.
100	S	SAT	
100	A	SAT	
100	S	SAT	
100	A	SAT	
Weapon: XM177E2, No. 904544 (5810 rounds previously fired).			
100	S	SAT	
100	A	3-FBR	
100	S	SAT	
100	A	SAT	
100	S	SAT	
100	A	SAT	
Weapon: XM177E2, No. 904549 (2064 rounds previously fired).			
100	S	SAT	
100	A	SAT	
100	S	SAT	
100	A	SAT	
100	S	SAT	
100	A	SAT	

Table 2.12-V. Results of Salt Water Immersion Test

Ammunition Type C: Cartridge, M193, ball, lot LC-12194 (ball propellant).

Initial Firing after Salt Water Dip		Third Day Firing		Fifth Day Firing[b]			Eighth Day Firing			Tenth Day Firing		
Funct	No. SWD Rds Fired[a]	Funct	No. SWD Rds Fired[a]	Funct	No. SWD Rds Fired[a]	No. Clean Rds Fired	Funct	No. SWD Rds Fired[a]	No. Clean Rds Fired	Funct	No. SWD Rds Fired[a]	No. Clean Rds Fired
Weapon: XM177E1, No. 902159 (6440 rounds previously fired).												
SAT	60	2-FX, 1-FF1	60	FBO, 1-FF1 11-FF, 3-FX	60	-	FBO, 1-FF1 1-FF, 3-FX	3	57	FBO, [c]5-FF	5	55
Weapon: XM177E1, No. 902279 (6246 rounds previously fired).												
SAT	60	FBO, 1-FX 1-FF1	60	2-FF1, [c]27-FF	60	-	FBO, 1-FF1 [c]8-FF	8	52	FBO, [c]5-FF 1-FFR		55
Weapon: XM177E2, No. 904544 (6550 rounds previously fired).												
SAT	60	1-FF	60	FBO, 23-FF 2-FX	40	20	FBO, 5-FF 2-FX 1-FFA	20	40	FBO, 14-FF 1-FFA	60	-
Weapon: XM177E2, No. 904549 (2804 rounds previously fired).												
SAT	60	1-FJ	60	1-FF1, 17-FF	60	-	7-FF	10	50	FBO, 7-FF 1-FJ, 2-FX	60	-

[a] Salt-water dipped.
[b] Ammunition was rested and corroded badly on fifth day and could not be stripped form clips in a normal manner.
[c] It was necessary to brush clean the chamber and bolt-locking lugs before the bolt could be closed with a round in the chamber.

2.14.4 Results

Insect repellent (FSN 6840-558-0918) caused the exposed area on the urethane end cap of the buffer to soften and become tacky; however, light application of the repellent, as by contact with the hands, failed to show any apparent effect following the 24-hour storage period. None of the other product improvements of the E2 weapon were affected by any of the fluids or greases.

2.14.5 Analysis

The buffer failed to meet the criteria specified in paragraph 2.14.2a with insect repellent (FSN 6840-558-0918).

2.15 SOUND PRESSURE LEVEL

2.15.1 Objective

To evaluate the sound pressure level of the test weapon.

2.15.2 Criteria

The sound level measurements shall not exceed the criteria established in Interim Pamphlet 70-74, TECP 700-700, 19 August 1965.

2.15.3 Method

The method of test is described in Interim Pamphlet 70-74, TECP 700-700, 19 August 1965. The test was conducted with each type of ammunition, first with a "new" barrel (fired more than 30 rounds but less than 1000 rounds) and repeated with an "old" barrel (fired approximately 9000 rounds).

Data were derived from firing ten rounds of each of the four test lots from an XM177E2 weapon using a "new" barrel and flash suppressor and from ten rounds using an "old" barrel and flash suppressor. Ten rounds were fired from an M16A1 control rifle, B&K condenser microphones were used to measure muzzle blast overpressure. Data were recorded by a multichannel galvanometer in a data van. Blast overpressures in psi were derived from the film record and converted to sound pressure level from the following relationship:

$$db = 20 \log_{10} (P \times 3.4475.10^{8})$$

db = sound pressure level in decibels (re: 0.0002 microbars)

P = measured pressure in psi.

2.13 MANN BARREL TEST

2.13.1 Objective

To determine the dispersion, chamber pressure, port pressure, and velocity levels of the test cartridges when fired in a Mann barrel.

2.13.2 Criteria

When fired in a 20-inch Mann barrel and with cartridges conditioned at +70°F:

a. The average of the mean radii of 10-shot targets shall not exceed 1.00 inch for M193 cartridges and 2.50 inches for M196 cartridges at 100 yards (Reference 3, par. 3.7; Reference 4, par. 3.8).

b. The corrected average velocities of M193 projectiles at a distance of 15 feet from the muzzle shall be 3250 ± 40 fps with a standard deviation no greater than 40 fps (Reference 3, par. 3.9).

c. The corrected average velocities of M196 projectiles at a distance of 15 feet from the muzzle shall be 3200 ± 40 fps with a standard deviation no greater than 40 fps (Reference 4, par. 3.11).

d. The average chamber pressure of M193 or M196 cartridges shall not exceed 52,000 psi and the average chamber pressure plus three standard deviations shall not exceed 58,000 psi (Reference 3, par. 3.10; Reference 4, par. 3.12).

e. The average port pressure of M193 and M196 cartridges shall be 15,000 ± 2000 psi (Reference 3, par. 3.11; Reference 4, par. 3.13).

2.13.3 Method

Fifty rounds of each of the four types of test ammunition were fired in a Mann barrel with the cartridges conditioned at +70°F for velocity measurements. In addition, dispersion targets were obtained at 100 yards simultaneously with the velocity firings. Twenty rounds of each lot were fired for chamber pressure and 20 rounds for port pressure measurements. Chamber pressure tests were then repeated with 20 rounds conditioned at -65°F and with 20 rounds conditioned at +160°F. Twenty rounds each of a reference lot of M193 cartridges were also fired for velocity, dispersion, chamber, and port pressure measurements during firing at each temperature.

2.13.4 Results

Table 2.13-I contains velocity and accuracy results of +70°F firings from an accuracy Mann barrel and Table 2.13-II gives results of universal receiver pressure barrel firings at three temperatures. Individual velocity, pressure, and target measurements are contained in Appendix I.

Table 2.13-I. Velocity and Accuracy Firing at +70°F

Velocity figures are averages of 50 rounds.

Vel, fps		Avg MR of Five 10-Shot Groups, in.
15 Ft from Muzzle	Std Dev	
Cartridge: 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).		
3201 (47 fps correction) 3248 (assessed value)	22	0.7
Cartridge: 5.56-mm, tracer, M196, lot LC-12081 (type A).		
3119 3166 (corrected)	26	1.7
Cartridge: 5.56-mm, tracer, M196, lot TW-18007 (type B).		
3147 3194 (corrected)	24	1.4
Cartridge: 5.56-mm, ball, M193, lot LC-12194 (type C).		
3204 3251 (corrected)	33	0.6
Cartridge: 5.56-mm, ball, M193, lot TW-18191 (type D).		
3159 3206 (corrected)	27	0.6

Table 2.13-II. Universal Receiver Pressure Barrel Firing

Figures are averages of 20 rounds.

Temp, °F	Chamber Press., psi	Std Dev	Port Press., psi	Std Dev	Corrected Press., psi Chamber	Port
Cartridge: 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).						
+ 70	42730	2887	13720	255	46100	14700
+160	47555	2705	15055	402		
- 65	43305	2284	14415	315		
Cartridge: 5.56-mm, tracer, M196, lot LC-12081 (type A).						
+ 70	43950	958	12400	304	47320	13380
+160	48060	1476	13600	355		
- 65	42980	2599	13155	328		
Cartridge: 5.56-mm, tracer, M196, lot TW-18007 (type B).						
+ 70	47125	1928	12535	432	50495	13515
+160	49565	1894	13890	273		
- 65	47125	2265	12230	525		
Cartridge: 5.56-mm, ball, M193, lot LC-12194 (type C).						
+ 70	43890	1646	13415	230	47260	14395
+160	44995	981	14835	366		
- 65	40880	1769	13530	208		
Cartridge: 5.56-mm, ball, M193, lot TW-18191 (type D).						
+ 70	49515	1447	11620	379	52885	12600
+160	52675	1457	14050	300		
- 65	46390	2503	11660	443		

Note: Copper cylinders (lot 4C-56) used in measuring chamber pressures had a mean length of 0.4000 inch (uncompressed) and a mean diameter of 0.2257 inch. The pistol copper cylinders, lot FA-4C-64, used in measuring port pressures had a mean length of 0.4000 inch (uncompressed) and a mean diameter of 0.1457 inch.

2.13.5 Analysis

All the cartridge lots in test met the accuracy mean radii criteria specified in paragraph 2.13.2a. The average corrected velocity of M193 ball cartridge lot TW-18191 was 3206 fps which was 4 fps below the minimum velocity level (3210 fps) specified in paragraph 2.13.2b.

The data for the reference lot of ammunition at +70°F, show a difference of +980 psi between test record values and assessed values for port pressure and +3370 psi for chamber pressure. With these corrected values applied to the +70°F results, three of the ammunition lots met the criteria (ref pars. 2.13d and e). The M193 with 8208M propellant, lot TW-18191, was 885 psi above the maximum chamber pressure permitted and 400 psi under minimum port pressure permitted.

2.14 NONSTANDARD CLEANERS

2.14.1 Objective

To determine if the delrin charging-handle latch, the buffer, and the nylon-coated buttstock are impervious to various fluids.

2.14.2 Criteria

Criteria are as follows:

a. Essential. The latch, buffer, and buttstock coating shall be impervious to lubricants MIL-L-644B, MIL-L-14107A, lubriplate 130-A and to dry cleaning solvent (SD), bore cleaner (CR), and insect repellent (FSN 6840-558-0918).

b. Desirable. The above items shall be impervious to carbon removing compound (P-C11A), gasoline, kerosene, and diesel fuel.

2.14.3 Method

At the conclusion of all other tests, portions of the weapon components specified above were individually immersed in or coated with each of the materials listed in paragraph 2.14.2 for 1 minute. Following a 24-hour normal storage, the items were then inspected.

2.14.4 Results

Insect repellent (FSN 6840-558-0918) caused the exposed area on the urethane end cap of the buffer to soften and become tacky; however, light application of the repellent, as by contact with the hands, failed to show any apparent effect following the 24-hour storage period. None of the other product improvements of the E2 weapon were affected by any of the fluids or greases.

2.14.5 Analysis

The buffer failed to meet the criteria specified in paragraph 2.14.2a with insect repellent (FSN 6840-558-0918).

2.15 SOUND PRESSURE LEVEL

2.15.1 Objective

To evaluate the sound pressure level of the test weapon.

2.15.2 Criteria

The sound level measurements shall not exceed the criteria established in Interim Pamphlet 70-74, TECP 700-700, 19 August 1965.

2.15.3 Method

The method of test is described in Interim Pamphlet 70-74, TECP 700-700, 19 August 1965. The test was conducted with each type of ammunition, first with a "new" barrel (fired more than 30 rounds but less than 1000 rounds) and repeated with an "old" barrel (fired approximately 9000 rounds).

Data were derived from firing ten rounds of each of the four test lots from an XM177E2 weapon using a "new" barrel and flash suppressor and from ten rounds using an "old" barrel and flash suppressor. Ten rounds were fired from an M16A1 control rifle, B&K condenser microphones were used to measure muzzle blast overpressure. Data were recorded by a multichannel galvanometer in a data van. Blast overpressures in psi were derived from the film record and converted to sound pressure level from the following relationship:

$$db = 20 \text{ Log}_{10} (P \times 3.4475.10^{8})$$

db = sound pressure level in decibels (re: 0.0002 microbars)

P = measured pressure in psi.

2.15.4 Results

Results are contained in Table 2.15-I.

Table 2.15-I. Summary of Average Data

Figures are average of ten rounds.

Barrel and Flash Suppressor	Ammo Type	Position No. 1 Max Press., db	Position No. 1 Duration Time[a], ms A	Position No. 1 Duration Time[a], ms B	Position No. 2 Max Press., db	Position No. 2 Duration Time[a], ms A	Position No. 2 Duration Time[a], ms B
Old (fired more than 9000 rounds)	A	160.1	0.32	4.69	161.9	0.34	0.94
	B	159.8	.36	4.56	162.8	.34	.90
	C	159.8	.36	4.53	163.1	.35	.89
	D	158.5	.49	4.66	163.1	.34	.82
New (fired more than 30 rounds but less than 1000)	A	156.5	0.52	5.35	159.8	0.34	0.90
	B	156.0	.53	5.40	159.2	.36	.86
	C	155.0	.58	5.52	159.8	.39	.95
	D	151.9	.52	5.39	160.1	.33	.91

Barrel and Flash Suppressor	Ammo Type	Position No. 3 Max Press., db	Position No. 3 Duration Time[a], ms A	Position No. 3 Duration Time[a], ms B	Position No. 2 Max Press., db	Position No. 2 Duration Time[a], ms A	Position No. 2 Duration Time[a], ms B
Control rifle, M16A1	RA-5089	158.8	0.28	2.87	161.7	0.32	0.79

[a]Duration time A indicates the time between initial rise in pressure and the return of overpressure to ambient pressure. Duration time B indicates the time between initial rise in pressure and the return of overpressure to a value of, and remain less than, 20 db below maximum overpressure.

Notes: A = Cartridge, M196, tracer, lot LC-12081 (ball propellant).
B = Cartridge, M196, tracer, lot TW-18007 (8208M propellant).
C = Cartridge, M193, ball, lot LC-12194 (ball propellant).
D = Cartridge, M193, ball, lot TW-18191 (8208M propellant).
RA = Cartridge, M193, ball, lot RA-5089 (ball propellant).

Notes continued on page 71.

Table 2.15-I (Cont'd)

Notes: Position No. 1: Gunner's ear.
27 inches from muzzle.
4 inches from center of bore.
63 inches above ground.

Position No. 2: 90° from line of fire.
78.7 inches from muzzle.
60 inches above ground.

Position No. 3: Gunner's ear.
31 inches from muzzle.
4 inches from center of bore.
63 inches above ground.

2.15.5 Analysis

At the gunner's ear position when firing with the new barrel and flash suppressor, all ammunition lots met the criteria specified in paragraph 2.15.2. When firing with the old barrel and flash suppressor, none of the four lots of ammunition met the criteria.

2.16 KINEMATIC TEST (DISPLACEMENT-TIME STUDY)

2.16.1 Objective

To obtain basic kinematic data for the test weapon as an aid in evaluating the significance of the product-improved buffer assembly and to measure cyclic performance characteristics of the weapon mechanism incorporating the product-improved barrel assembly.

To compare the performance of the weapon when firing various ammunition lots.

2.16.2 Criteria

Not applicable.

2.16.3 Method

The test weapon No. 902868, was originally received as an XM177E1 model and was converted to the configuration of the XM177E2 by installing a complete XM177E2 barrel and gas-tube assembly.

The gun was then modified so that traces of the motion of the bolt carrier and buffer could be recorded as a function of time.

Reflector viewing ports were cut at the right side of the upper receiver and along a portion of the buttstock extension tube. Small chrome-plated reflector rods were attached to the receiver and buttstock extension as reference points and concave reflecting surfaces were polished on the bolt carrier and on the buffer.

Various displacement-time records were then obtained during burst fire, employing a displacement-time drum camera with the test weapon installed in a variable-deflection mount. The mount permitted a recoil-counterrecoil displacement of approximately 0.175 inch for each shot.

In addition to physical inspection and measurements of the weapon, firing phases were conducted to evaluate four types of ammunition, to determine the effect of firing 21-, 20-, 19-, and 18-round bursts, and to compare cyclic performance with the gun in new condition versus firing with a barrel and gas-tube assembly previously fired 9000 rounds.

2.16.4 Results and Analysis

Due to the nature of the displacement-time studies, the results and analysis for each phase are combined and reported in single paragraphs for each test phase.

2.16.4.1 Applicable Phases of Recent Displacement-Time Studies for the M16A1 Rifle. As the XM177E2 submachine gun and the M16A1 rifle employ the same basic mechanism, differing only in the action spring and buffer, a number of displacement-time study phases with the XM177E2 were conducted concurrently during a displacement-time study of the M16A1 rifle and have been reported in Reference 10. (The shortened barrel and gas tube assembly of the XM177E2 are not considered here as part of the mechanism.)

While the referenced report should be consulted for detailed information, the results applicable to the XM177E2 submachine gun are summarized as follows:

a. The design of the XM177E2 mechanism successfully accommodates a wide range in cyclic rate of fire from approximately 600 to 975 rds per min.

b. The upper restraint in cyclic rate of fire is imposed by the design of the bolt-stop mechanism which cannot consistently respond at rates for final rounds in the magazine which exceed 975 rds per min.

c. The lower limit of approximately 600 rds per min is primarily a restraint characterized by short or incomplete recoil at low bolt-carrier energies. At these levels, successful firing becomes extremely marginal even under nonadverse conditions. However, as the lower limit was only estimated and not fully explored in the referenced test, this area of performance is more definitively discussed in par. 2.16.4.2 of this report.

The remaining paragraphs dicusss the results of the displacement-time studies which were conducted within the context of the product improvement test of the XM177E2 submachine gun.

2.16.4.2 Physical Characteristics. The physical characteristics of the buffer and action spring for the XM177E2 were measured and are compared to the same components for the M16A1 rifle in Table 2.16-I and illustrated in Figure 2.16-1. The XM177E2 buffer assembly is a product improved item which replaced the buffer assembly as tested in the engineering test (Reference 2) of the original model submachine gun, C-SMG. The product-improved buffer first appeared in XM177E1 models and appears to be identical in the limited production of both E1 and E2 weapons examined at APG.

Table 2.16-I. Physical Characteristics

Weights are in ounces, dimensions in inches.

	XM177E2	M16A1
Action spring:		
Weight	1.90	2.17
Free height	10.1	12.0
Assembled height	6.7	8.1
Compression height[a]	3.0	4.3
Wire diameter	0.072	0.072
Mean coil diameter	0.871	0.871
No. of coils	37-3/4	43-3/4
No. of working coils	36	41
Buffer assembly:		
Weight	2.98	5.20
Over-all length	3.3	5.9
No. of internal inertia weights[b]	3	5
No. of rubber inertia weight pads	3	5
Length of internal spacer	None	1.3
Working height of urethane end cap[c]	0.4	0.4
Cycling group weight[d]	15.09	17.49

[a]Measured at full rearward travel of the buffer without buffer cap compression.
[b]Inertia weights are identical in each buffer, weighing 278 grains each.
[c]The urethane end caps appear to be identical components in the buffer of each gun.
[d]Includes complete bolt carrier assembly (approximately 11.5 oz for each gun) plus buffer and 1/3 weight of action spring.

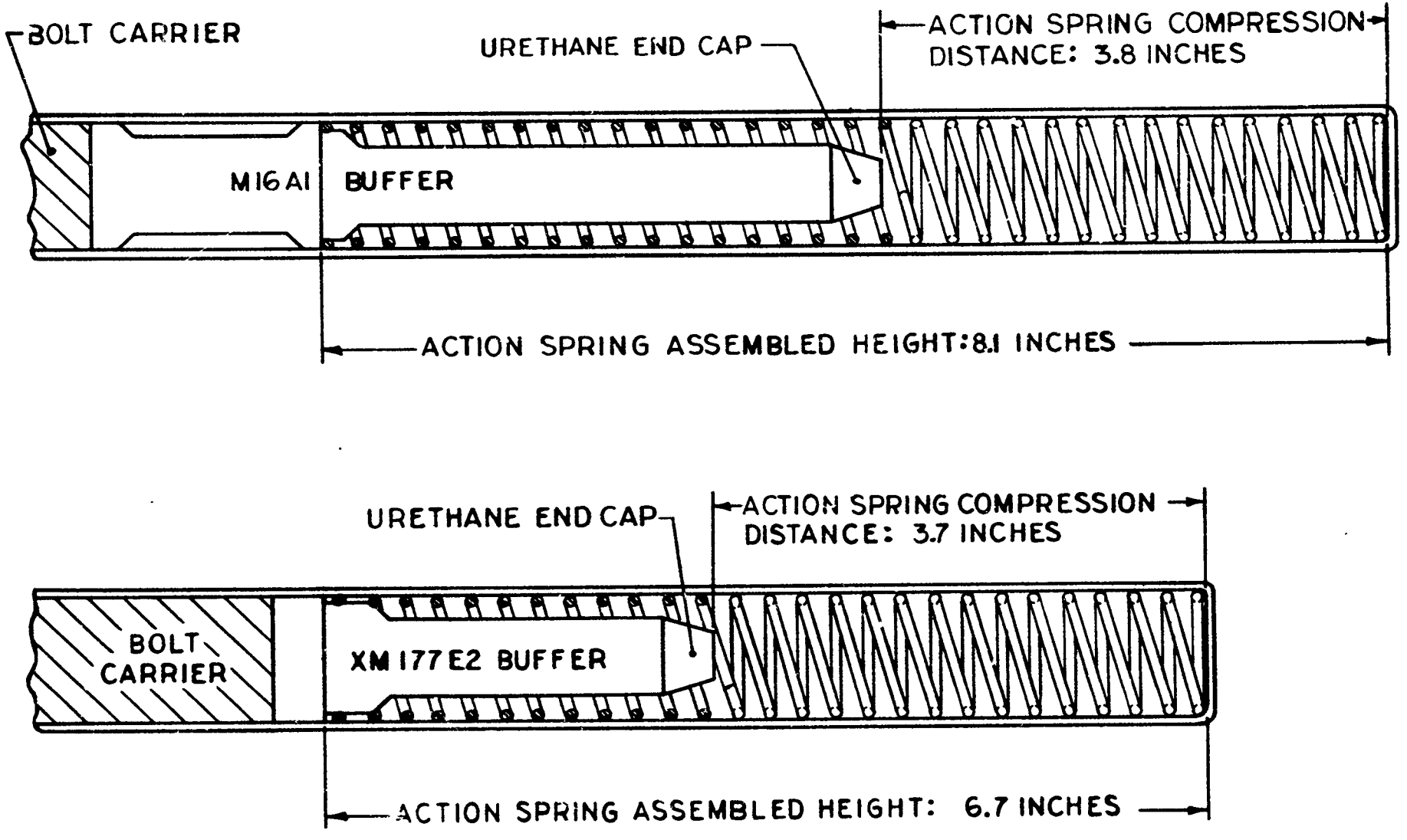


Figure 2.16-1: Engineering Sketch of the Buttstock Extension Tube, Buffer, and Action Spring for the M16A1 Rifle and XM177E2 Submachine Gun.

The similarity in design between the M16A1 and the XM177E2 offered the possibility that cyclic performance data for the M16A1 rifle, which has recently been obtained in great depth from large weapon and ammunition samples, could be used as criteria to evaluate cyclic performance of the XM177E2. However, as can be seen in Table 2.16-I and Figure 2.16-1, significant differences exist in the physical characteristics of the two recoil systems which could result in different bolt-velocity levels and cyclic rates of fire even though initial energy-input levels might be the same. As the cyclic performance data for the M16A1 rifle has largely been determined from bolt-velocity measurements (average cyclic rates of fire, displacement-time curves, etc.), the following study was made of action spring rates, action spring forces, and energy levels. The formulas used in the study are taken from Reference 11, where they are developed and discussed in detail.

a. Spring Load and Deflection Rates. The load-deflection rate of each spring was calculated as follows:

$$K = \frac{G\,d^4}{8\,D^3N}$$

where:

K = Load-deflection, lb/in.
G = Torsional modulus for steel (115×10^5 lb/in^2)
d = Spring wire diameter, in.
D = Mean coil diameter, in.
N = Number of working coils.

For the M16A1:

$$K = \frac{115\,(10^5)\,(.072^4)}{8\,(.871^3)\,(41)}$$

$$K = \frac{115\,(2.687)}{328\,(.661)}$$

$$K = 1.43 \text{ lb/in.}$$

For the XM177E2:

$$K = \frac{115\,(10^5)\,(.072^4)}{8\,(.871^3)\,(36)}$$

$$K = \frac{115\,(2.687)}{288\,(.661)}$$

$$K = 1.62 \text{ lb/in.}$$

The load-deflection rates for the action springs in one M16A1 rifle and five XM177E2 submachine guns were then measured with a universal test machine to obtain a comparison of actual rates with the above calculations. In all weapons, the initial measured rate was the same as the calculated average rate although some nonlinearity was observed as each spring approached full compression. This was attributed to instability during deflection which probably causes the spring to buckle slightly, resulting in increased friction against the action tube wall. It was also noted that the ends of the action springs for both weapons are not ground and square which is likely to induce instability as the spring is deflected.

b. Action Spring Forces. From the calculated values of K, the forces required to compress the spring were computed as follows:

$$F_1 = K\ (H_f - H_a)$$

$$F_2 = K\ (H_f - H_c)$$

$$F_a = \frac{F_1 + F_2}{2}$$

where:

F_1 = Initial spring force as assembled in the action tube, lb.
K = Load-deflection rate, lb/in.
H_f = Free height spring, in.
H_a = Assembled height of spring, in.
F_2 = Spring force with buffer just contacting end of action tube, lb.
H_c = Compression height of spring with buffer just contacting end of action tube, in.
F_a = Average spring force through full distance of carrier travel, lb.

For the M16A1:

$$F_1 = 1.43\ (12.0 - 8.1) = 5.6 \text{ lb.}$$

$$F_2 = 1.43\ (12.0 - 4.3) = 11.0 \text{ lb.}$$

$$F_a = \frac{5.6 + 11.0}{2} = 8.3$$

For the XM177E2:

$F_1 = 1.62\ (10.1 - 6.7) = 5.5$ lb.

$F_2 = 1.62\ (10.1 - 3.0) = 11.5$ lb.

$F_a = \frac{5.5 + 11.5}{2} = 8.5$ lb.

c. Energy Levels. With the average spring forces established for each weapon, a further calculation was made to estimate the initial cycling group energy which would result in a short recoil in each weapon. Short recoil is defined here as sufficient compression of the action spring to permit contact but not compression of the urethane buffer end cap with the rear of the action tube. Under nonadverse firing conditions, either weapon would be expected to cycle successfully at this initial energy-input level but lower energies would provide only marginal weapon functioning at best.

Remaining energy in the cycling group is expressed as:

1/2 Mcg V^2r which is equal to 1/2 Mcg $V_1^2 - \frac{1}{\varepsilon}(F_1x + \frac{1}{2} K x^2)$

where:

Mcg = Mass of the cycling group.
V_r = Velocity of the cycling group at any time, in./sec
V_1 = Initial velocity of the cycling group, in./sec
ε = Efficiency of the action spring.
F_1 = As defined previously, lb.
x = Recoil distance, in.
K = As defined previously, lb/in.

Under the definition of short recoil as stated above:

1/2 Mcg $V_f^2 = 0$ and 1/2 Mcg $V_1^2 = \frac{1}{\varepsilon}(F_1x + \frac{1}{2} K x^2)$ = initial energy, E_1.

Substituting values for both the M16A1 and XM177E2;

For the M16A1:

$E_1 = \frac{1}{\varepsilon}\left[(5.6)(3.8) + \frac{1}{2}(1.43)(3.8^2)\right]$

$E_1 = \frac{1}{\varepsilon}(21.28+10.32).$

$E_1 = \frac{31.60}{\varepsilon}$ in.-lb.

For the XM177E2:

$$E_1 = \frac{1}{\varepsilon}\left[(5.5)(3.7) + \frac{1}{2}(1.62)(3.7^2)\right]$$

$$E_1 = \frac{1}{\varepsilon}(20.35+11.09).$$

$$E_1 = \frac{31.44}{\varepsilon} \text{ in.-lb.}$$

As the spring efficience, ε, can be considered to be the same for both weapons, and is very nearly 1 in value during short recoil cycles, it can be seen that the design intent in modifying the M16A1 rifle to the XM177E2 configuration was to provide, through judicious selection of gas port size, the same level of cycling performance, whenever input energies are the same; e.g., a nearly identical short recoil will occur in both weapons given the same input energies from the gas tube. This presumes that losses due to friction would be approximately the same in both weapons which appears reasonable, considering the similarity of the two mechanisms.

However, it should be noted that if some energy level for the XM177E2, either explicit or implied, is to be measured on a time or bolt-carrier velocity basis, then performance "equal to" that of the M16A1 will be obtained at somewhat higher firing rates with the submachine gun version than with the rifle due to the lesser mass of the cycling group in the submachine gun. For example, the previously defined condition of short recoil would occur at approximately 645 rds per min with the XM177E2 and at 588 rds per min with the M16A1. These rates ignore friction losses and the energy required to feed a cartridge during counterrecoil. The initial velocities, cycle times, and firing rates are developed below for the specially defined case of short recoil:

As $E_1 = 1/2\ Mcg\ V_1^2$, initial velocity is obtained by solving for V_1.

For the M16A1:

$$31.60 = \frac{1}{2}\left[\frac{17.49/16}{32.2\ (12)}\right] V_1^2$$

$$V_1^2 = \frac{31.60\ (772.8)}{1.09}$$

$$V_1^2 = \frac{24420}{1.09} = 22404$$

$$V_1 = 150 \text{ in. per sec or } 12.5 \text{ ft per sec}$$

For the XM177E2:

$$31.44 = \frac{1}{2}\left[\frac{15.09/16}{322(12)}\right] V_1^2$$

$$V_1^2 = \frac{31.44\ (\ 772.8)}{.94}$$

$$V_1^2 = \frac{24297}{.94} = 25848$$

V_1 = 161 in. per sec or 13.4 ft per sec

Cycle time is computed as follows:

$$t_c = \left[\sqrt{\frac{\mathcal{E}\ M_{cg}}{K}} + \sqrt{\frac{M_{cg}}{\mathcal{E}K}}\right] \cos^{-1}\left(\frac{F_1}{F_2}\right)$$

where:

t_c = Total cycle time but not including dwell time, sec.
$\mathcal{E}$ = Spring efficiency; in short recoil 1.
M_{cg} = Mass of the cycling group.
K = Spring rate, lb/in.
F_1 = Initial spring force, lb.
F_2 = Final spring force without buffer compression, lb.

For the M16A1:

$$t_c = 2\left[\sqrt{\frac{1.09/386.4}{1.43}}\right] \cos^{-1}\left(\frac{5.6}{11.0}\right)$$

$$t_c = 2\sqrt{.00197} \quad \cos^{-1}\left(\frac{5.6}{11.0}\right)$$

$$t_c = 2\ (.044)\left(\frac{59.40}{57.30}\right)$$

t_c = .092 sec

For the XM177E2:

$$t_c = 2\left[\sqrt{\frac{.94/386.4}{1.62}}\right] \cos^{-1}\left(\frac{5.5}{11.5}\right)$$

$$t_c = 2\sqrt{.00150} \quad \cos^{-1} .478$$

$$t_c = 2 \left(.039\right)\left(\frac{61.45}{57.30}\right)$$

$$t_c = .083 \text{ sec.} \qquad \text{and} \quad f_r = \frac{60}{t_c + t_d}$$

where:

f_r = Firing rate, rds per min.
t_c = As above.
t_d = Dwell period; 0.010 second as determined in Reference 10.

For the M16A1:

$$f_r = \frac{60}{.092+.010} = \frac{60}{.102}$$

$$f_r = 588 \text{ rd per min.}$$

For the XM177E2:

$$f_r = \frac{60}{.083+.010} = \frac{60}{.093}$$

$$f_r = 645 \text{ rd per min}$$

2.16.4.3 Ammunition Lot Sensitivity Phase. Displacement-time records were obtained with each of the four lots of test ammunition. The round-by-round data sheets for each 20-round burst are contained in Appendix I, record Nos. 3, 6, 7, and 8. The individual cycle times for each round are also plotted in Figures 2.16-2 and 2.16-3.

The performance characteristics shown in the figures demonstrate nearly identical characteristics to data illustrated in Reference 10 where four similar lots were also fired in a displacement-time study of the M16A1 rifle. The referenced data were analyzed in detail covering three significant areas: initial round variation, cyclic variation as a function of buffer design, and cyclic variation as a function of ammunition type. A summary of the detailed analysis is presented in the following paragraphs and applies equally to either weapon:

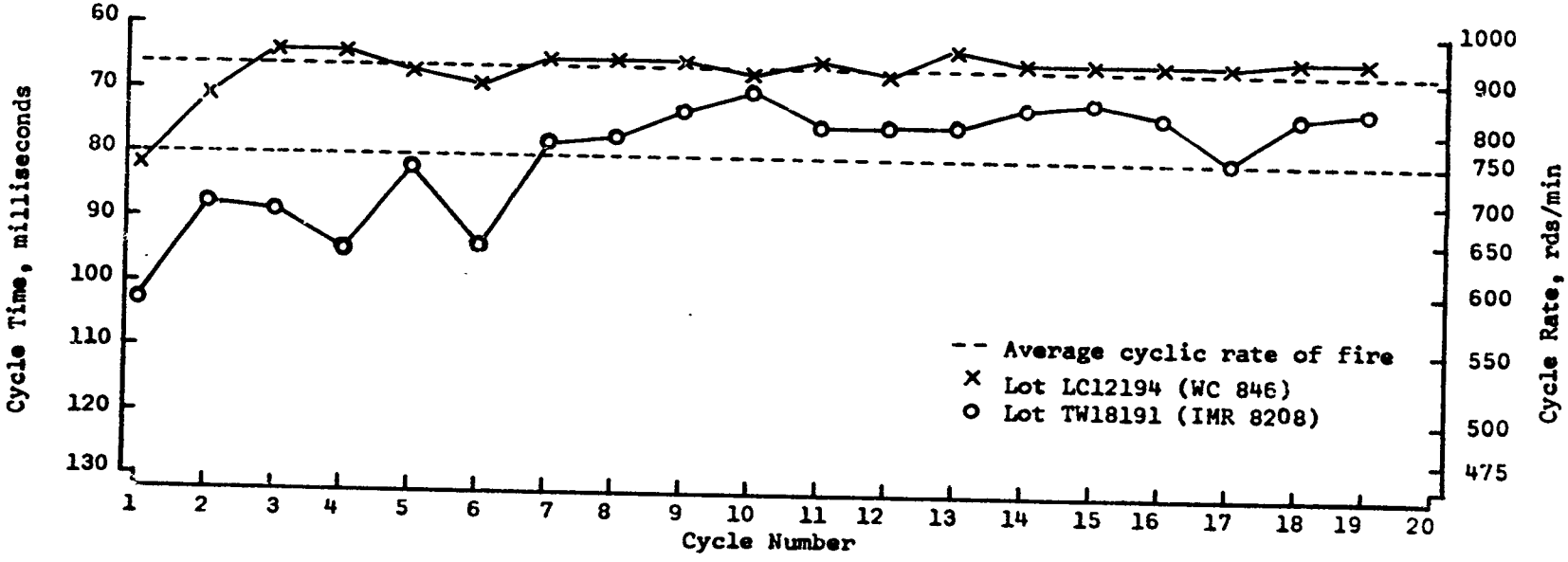


Figure 2.16-2: Cycle Times and Rates for Individual Rounds during Burst Fire with '1193 (Ball Projectile) Ammunition.

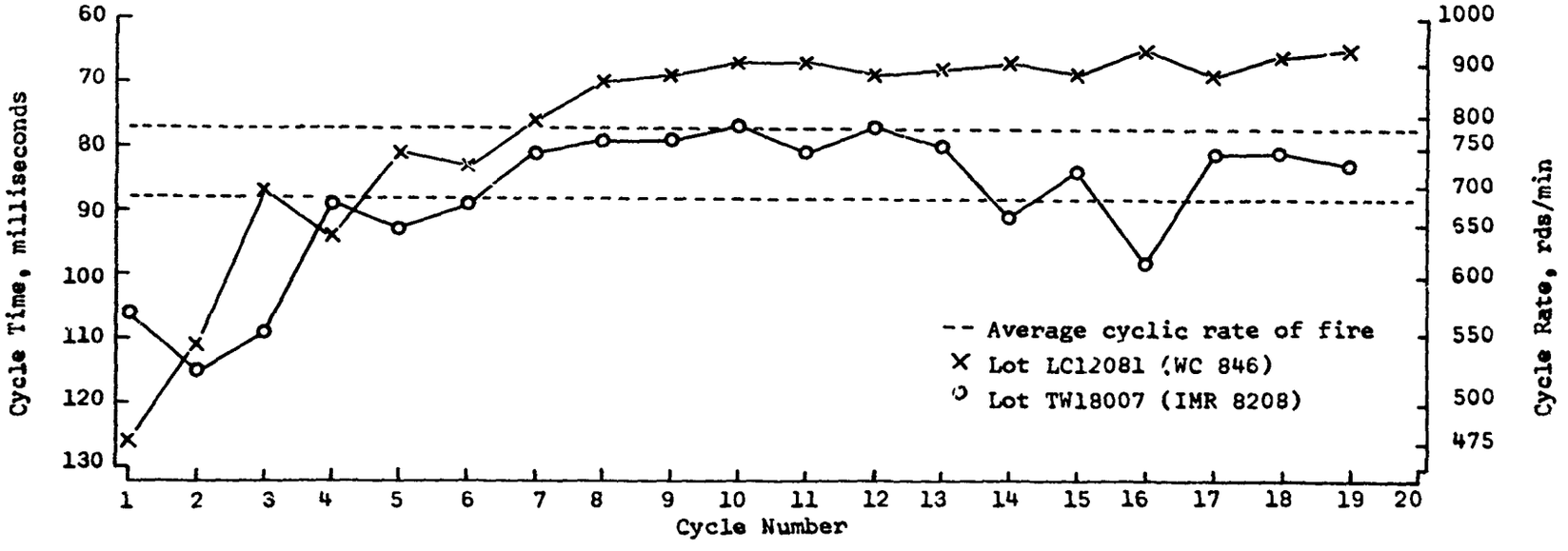


Figure 2.16-3: Cycle Times and Rates for Individual Rounds during Burst Fire with M196 (Tracer Projectile) Ammunition.

a. Initial Round Variation. As each burst was fired under nearly identical test conditions, the occurrence of the first round being a substantially lower than average cyclic round, although not always the lowest, seems well established. Inspection of the individual data sheets further confirms that the initial-round recoil time itself (as opposed to the complete cycle time) generally exceeds that of any of the remaining rounds in the burst. This phenomenon may be directly related to the temperature of the barrel and gas tube, which may substantially lower the working pressure available to the bolt carrier as a result of initial heat loss to the ambient temperature gas tube and barrel when the first round is fired. The predictable impact of this performance characteristic would be a disproportionately high malfunction rate associated with the first-round cycle of a burst, providing that an adverse tactical or test environment additionally imposed an energy-robbing burden on the mechanism. To date, insufficient data exist to confirm to what degree weapon stoppages are attributable to first round failures.

b. Cyclic Variation as a Function of Buffer Design. With few exceptions, the displacement-time records obtained with the XM177E2 indicated a progressively increasing rate of fire that only tended to level off by about the sixth to eighth round fired. Initially, this was attributed to an assumed progressive decrease in stripping force as the magazine empties during burst fire. This assumption was proved incorrect when records were obtained and the same phenomenon observed with magazines loaded in various amounts (from 20 to 5 rounds in Reference 10 and from 20 to 17 in this test, par. 2.16.4.5).

The theory was then examined that heating of the gas system to some unknown level by firing approximately six rounds was required before a maximum gas pressure was available at the carrier. This was a logical extension of the reasoning which explained the low initial rate of first-fired rounds. However, subsequent displacement-time records obtained with an M16A1 rifle and an original model buffer demonstrated that, under identical test conditions, no progressive rate climb was evident and that a "steady-state" rate was often reached after firing the first round. As this suggested that the rate increase, except for the first round, was largely associated with the so-called redesigned buffer for the M16A1 rifle, and the XM177E2 buffer is merely a shortened and lightened version of the rifle buffer, the physical characteristics of both the rifle and submachine gun buffers were then examined. The following is extracted from Reference 10;

"As buffing is accomplished through compression and decompression of the urethane end cap on the redesigned buffer, inquiries were made concerning the characteristics of this materiel from the subcontractor supplying the end caps.[1] The subcontractor advised that he did not have immediately available the data regarding the compression/decompression characteristics for small increments of time between impacts but that his opinion would be that if the cap were compressed as much as .08 inch it would be doubtful if it would decompress more than 25% in a 60-70 millisecond period and full decompression would require much longer. (Note: the amount of compression of the redesigned buffer was measured for selected rounds on nearly all XM177E2 displacement-time records and the maximum compression measured was approximately .10 inch.

In order to gain some further insight concerning the characteristics of the urethane cap a new M16A1 buffer was compressed .08 inch and an attempt was made to measure the decompression rate. While it was not possible to measure very short term initial decompression rates without a sophisticated and somewhat costly test technique it was observed that 2 to 3 seconds after release from compression, decompression was only 85% completed and that 100% decompression was not achieved even after five minutes.

From this information it became apparent that a fully decompressed urethane cap would have excellent buffing characteristics as a result of the first impact but would become progressively more "live" and less inert with each repeated impact."

c. Cyclic Variation as a Function of Ammunition Type. Although initial-round variation, and the progressive climb to "steady-state" rates attributed to the characteristics of the buffer cap, account for much of the cyclic variation shown in Figures 2.16-2 and 2.16-3, the most pronounced variation is encountered when types of ammunition other than ball projectile/WC846 propellant cartridges are fired. Gross variation in cyclic performance in conjunction with lower, and less desirable, energy levels was characteristic of the other three ammunition types in this test as well as in the data reported in Reference 10 for similar ammunition types.

[1]As nearly as can be determined, the urethane end caps on both the XM177E2 and M16A1 buffers are identical.

However, it should be emphasized that the displacement-time studies can only indicate the most reliable and least variable power source and that other characteristics of the various cartridge types must also be considered. For example, the firing subtests in this report are not conclusive in either endorsement or rejection of the ball projectile/WC846 propellant combination and the occurrence of mechanism fouling from firing WC846 propellant-loaded cartridges encountered in several subtests may be an unacceptable trade-off if the only gain is reduced cyclic variation.

2.16.4.4 Short Recoil Cycles. Short recoil cycles were experienced with three of the four lots tested in the ammunition-sensitivity phase with satisfactory cycling occurring only with lot LC12194, the ball projectile/WC846 propellant lot. As the displacement-time records indicated the exact rearmost positions of the bolt carrier during these short recoil cycles, a number of traces were selected which coincided with the definition of short recoil in par. 2.16.4.2; i.e., sufficient compression of the action spring to permit contact but not compression of the urethane end cap with the rear of the action tube. The displacement-time traces of these rounds are shown in Figures 2.16-4 through 2.16-6. One additional round, No. 4 on Record No. 7, is not illustrated but also coincided with the above definition of short recoil.

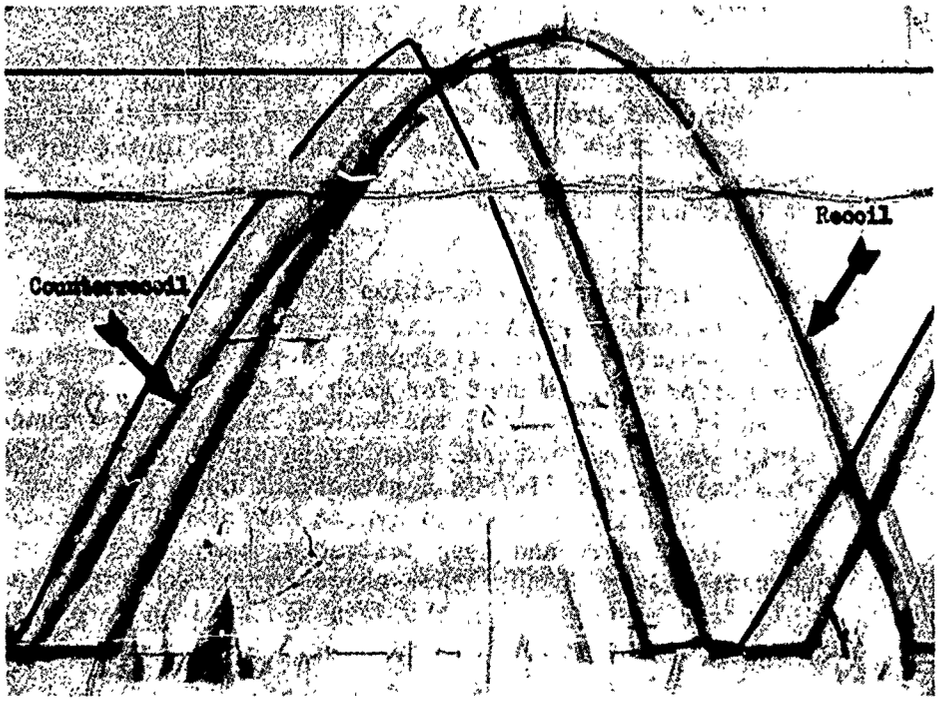


Figure 2.16-4: Displacement-Time Record During Burst Fire, Lot TW18007, Record No. 6. Traces of Rounds No. 8, 1 and 16, from Left to Right, Are Shown. Arrows Indicate Trace of Round No. 1, a Short Recoil Round.

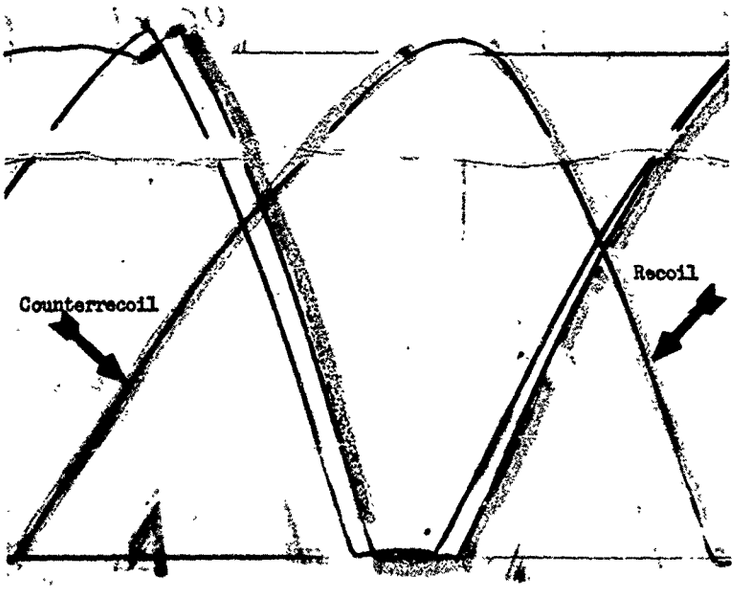


Figure 2.16-5: Displacement-Time Record During Burst Fire, Lot TW18007, Record No. 6. Traces of Rounds No. 12, 20 and 4, from Left to Right Are Shown. Arrows Indicate Trace of Round No. 4, a Short Recoil Round.

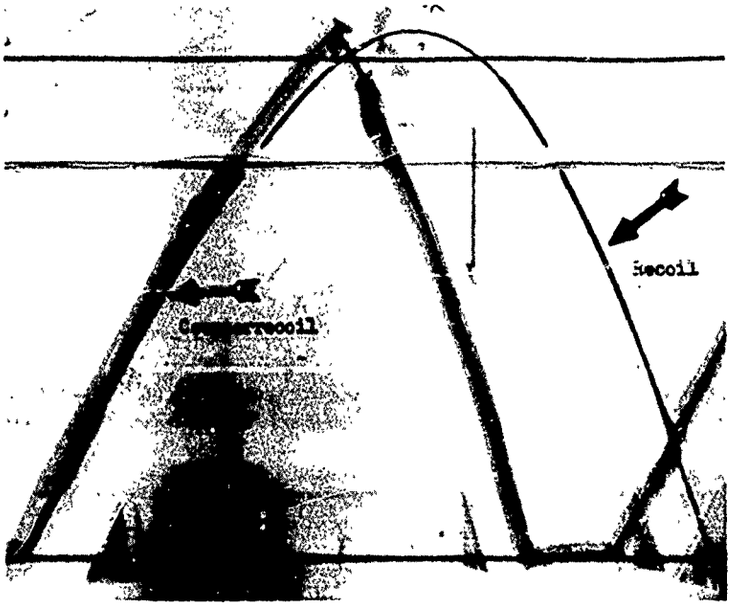


Figure 2.16-6: Displacement-Time Record During Burst Fire, Lot TW18007, Record No. 6. Traces of Rounds No. 14 and 6, from Left to Right Are Shown. Arrows Indicate Trace of Round No. 6, a Short Recoil Round.

The cyclic rates of fire of the four selected short-recoil rounds were as follows: 582, 632, 638, and 638 rds per min. The latter three rates agree well with the previously computed short recoil rate of 645 and indicate that losses due to friction in the XM177E2 are negligible. Examination of Figure 2.16-4, showing the 582 rds per min short recoil, indicates that an unusually "long" recoil time occurred, even though full rearward displacement of the buffer (but without buffer compression) was accomplished. This, combined with a somewhat difficult feeding operation during counterrecoil, apparently accounts for the lower than expected rate coinciding with the "short" recoil definition.

A further examination of the individual data sheets confirms that short recoil can generally be ascribed to any individual cycle which is less than 635 rds per min although this rate could also be associated with a normal and adequately powered full recoil if combined with a difficult counterrecoil feeding operation. In any event, rates below 635 rds per min provide only marginal cyclic operation with the XM177E2, whether due to insufficient initial energy, difficult feeding or higher than normal friction forces. If displacement-time records are obtained, the same criteria would apply when the recoil time exceeds 30 milliseconds or when the counterrecoil time exceeds 55 milliseconds.

Figures 2.16-7 and 2.16-8 illustrate an extremely severe instance of difficult feeding and two instances of extreme short recoil respectively. In one of the instances of short recoil, the bolt failed to move rearward sufficiently to feed the next round and the bolt carrier closed on an empty chamber stopping the gun.

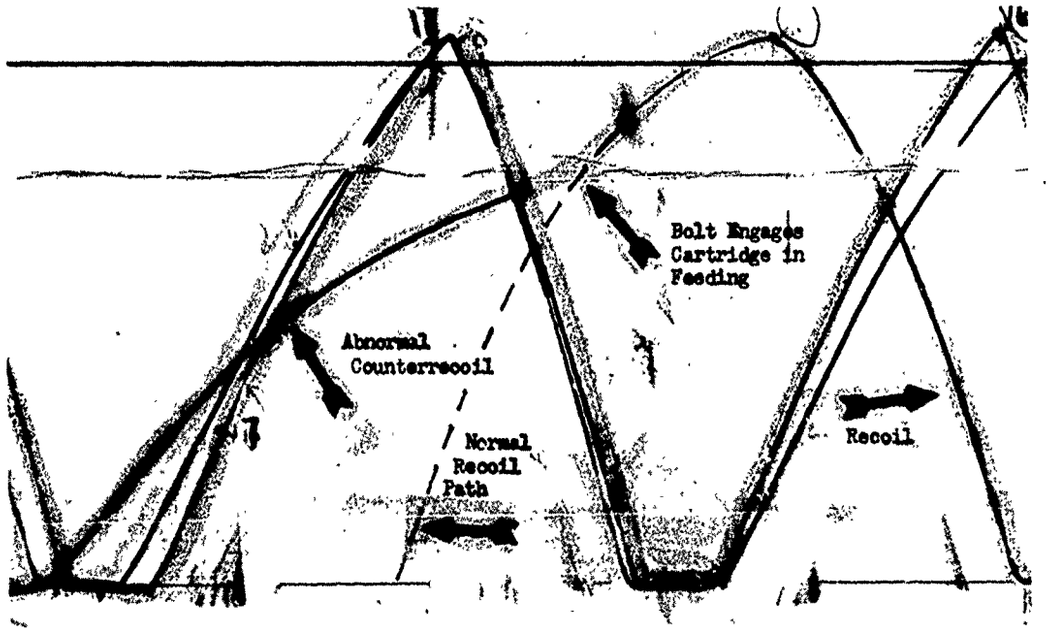


Figure 2.16-7: Displacement-Time Record During Burst Fire, Lot LC12081, Record No. 8. Traces of Rounds No. 8, 17, 1 and 16, from Left to Right Are Shown. Arrows Indicate Round No. 1, where A Cartridge Feeding Problem Was Overcome without a Gun Stoppage.

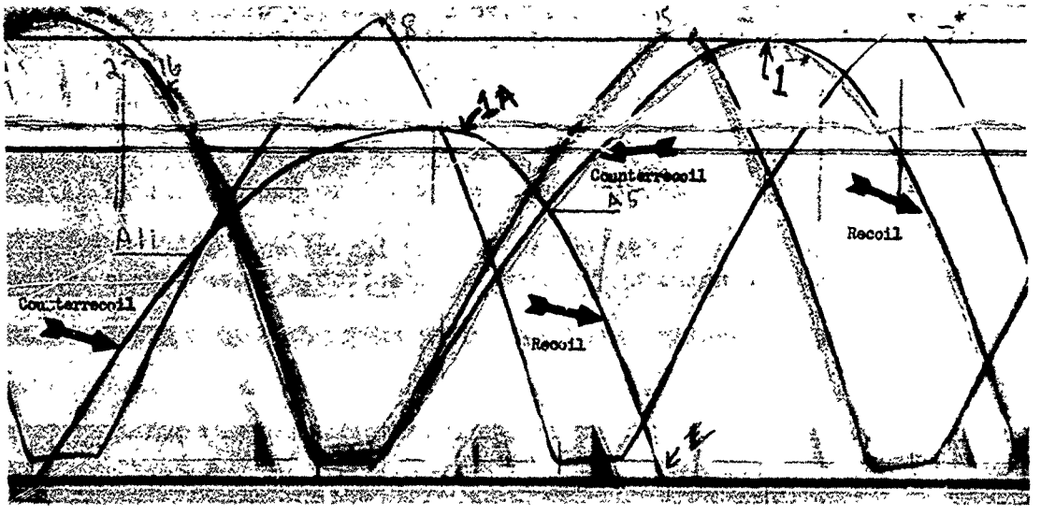


Figure 2.16-8: Displacement-Time Record During Burst Fire, Lot LC12081, Record No. 8. Traces of Rounds No. 2, 16, 8, 1A, 15, 1 and 7, from Left to Right, Are Shown. Arrows Indicate Round No. 1A, a Short Recoil Round Resulting in the Bolt Closing on an Empty Chamber and a Gun Stoppage, and Round No. 1 a Short Recoil Round which Did Not Result in a Gun Stoppage.

2.16.4.5 Magazine Complement Phase. Displacement-time records were obtained by firing lot LC12194 in the following burst lengths: 21, 20, 19, and 18 rounds. In each trial, one round was loaded in the weapon chamber and the magazine loaded with the remainder of the respective complement. The intent of the test was to determine if cyclic characteristics of the weapon, both in recoil and counterrecoil, would be measurably affected by firing from a less than fully loaded magazine.

The round-by-round data sheets are contained in Appendix I, record No. 1, 2, 3, 4, and 5. From an examination of the records, it can be seen that it requires approximately six to eight rounds of firing before a reasonable "steady-state" rate of fire is reached and that a less than fully-loaded magazine does not materially aid in overcoming initial low rates.

2.16.4.6 Characteristics of New Versus Used Barrels. The complete barrel and gas tube assembly from gun No. 904543 was assembled to the mechanism of the displacement-time gun, No. 902868. The barrel and gas tube assembly from No. 904543 had previously been fired approximately 9000 rds in other subtests of this report; 2450 rds with lot LC12081, 4200 rds with lot TW18007, and 2310 rds with lot LC12194.

Displacement-time record No. 9 was then obtained by firing one 20-round burst of lot LC12194. The cycle times are plotted in Figure 2.16-9 along with cycle times obtained with the same lot and with the original barrel on the test gun at a point in gun and barrel life of approximately 500 rds. The identical cyclic characteristics of both records indicate no degradation in the barrel and gas tube from the standpoint of continuing to serve as a suitable power source system over an extended life period.

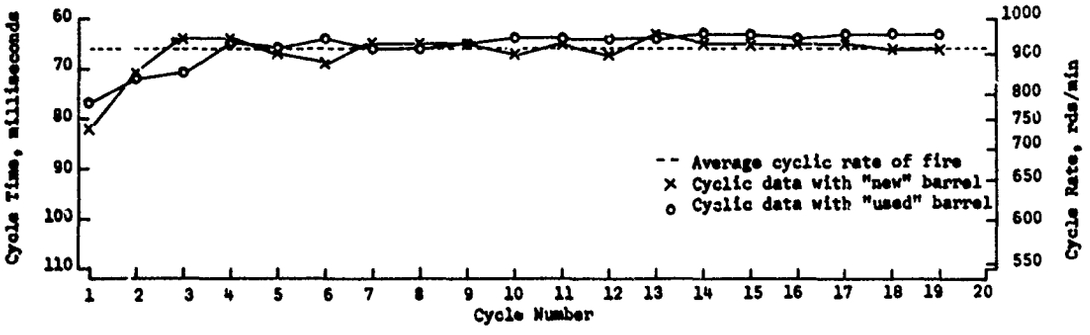


Figure 2.16-9. Cycle Times and Rates for Individual Rounds Firing Lot LC12194. One 20-round Burst Fired With a Barrel Assembly in New Condition (Less Than 500 Rounds); and One 20-round Burst Fired With a Barrel in Used Condition (more than 9000 Rounds)

Figure 2.16-9: Cycle Times and Rates for Individual Rounds Firing Lot LC12194. One 20-Round Burst Fired with a Barrel Assembly in New Condition (Less Than 500 Rounds); and One 20-Round Burst Fired with a Barrel In Used Condition (More Than 9000 Rounds).

2.16.4.7 Bolt-Carrier Rebound (Bolt "Bounce"). At high cyclic rates of fire, early production models of the M16A1 rifle had often malfunctioned as a result of rebound of the bolt carrier on closure, which interfered with the fall of the hammer and resulted in failures to fire during the automatic mode. A redesigned buffer was tested and reported in Reference 10 and demonstrated that bolt-carrier rebound had successfully been overcome by the redesign of the new buffer. As the XM177E2 submachine gun incorporates the same design of buffer, although shorter in length and lighter in weight, as does the current, or re-designed M16A1 model, individual high race cycles with the XM177E2 were examined to observe the degree of bolt-carrier rebound with the submachine gun.

As shown in Figure 2.16-10, bolt-carrier rebound is almost completely overcome, even at relatively high rates of fire in the XM177E2 submachine gun.

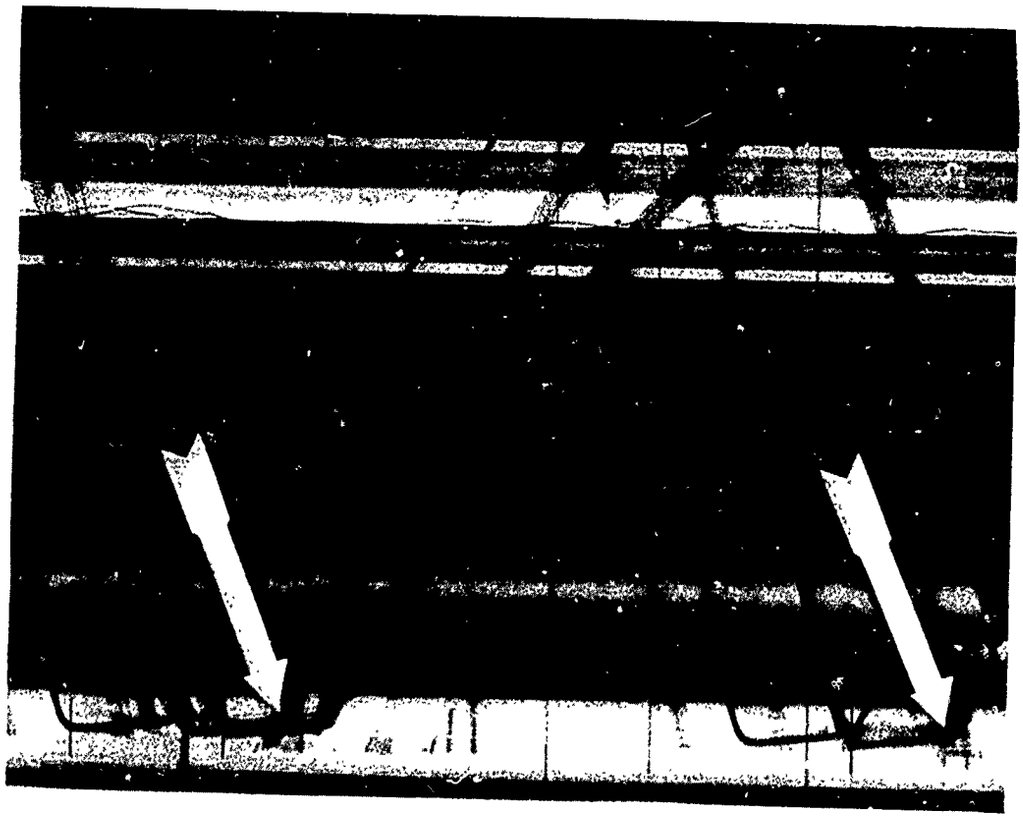


Figure 2.16-10: The Arrows Indicate Only a Very Negligible Amount of Bolt-Carrier Rebound on Closure. The Two Observations Are Made on Cycles of 952 Rds per Min for Each Round.

2.16.5 Summary of Results and Analysis

Results and analysis are summarized as follow:

a. Minimum cyclic rates of fire for any single round fired in the XM177E2 submachine gun should not be below 635 rds per min to insure proper gun functioning. This is estimated to be approximately 50 rds per min more than the minimum required for the M16A1 rifle. It must be emphasized that the above rate should be the minimum encountered under adverse conditions and that the minimum acceptance test rate must be higher than 635 rds per min to insure dependability in world-wide service use.

b. The M193 ball projectile cartridges loaded with WC846 propellant offered the least variation in cyclic performance at near optimum energy levels among the four cartridge types tested.

c. The urethane end cap on the buffer is not a suitable energy-absorbing material where repeated impacts occur within 60 to 70 milliseconds as in burst fire.

d. Reduced loading of the magazine does not aid in overcoming initial low cyclic rates.

e. Extended firing of the XM177E2 submachine gun, as much as 9000 rounds, does not degrade the effectiveness of the barrel and gas tube assembly as a power source system.

f. Bolt-carrier rebound with the XM177E2 is negligible and does not interfere with hammer fall or otherwise degrade cycling performance.

SECTION 3. APPENDICES

APPENDIX I - TEST DATA

Ammunition Acceptance Data Inspection Report

LAKE CITY ARMY AMMUNITION PLANT
INSPECTION REPORT - 5.56MM

PRESENTED	13 June 67
QTY PACKED	500,200
	1305-914-4719-(A068)
FUNCTIONAL LOT NOS.	
AMCMS CODE	4810.16.0217.2.A2.Fy66
SPEC. NO.	MIL-C-60111 REV. A/6
LCO	DATE 5/5/66
DWG. NO.	C10534193
REV	8 DATE 8/27/65

ITEM Ctg., Tracer, M196

LOT NO. LC 12081

ACCEPTED	X	1ST TEST	X
REJECTED		RETEST	
		WAIVER	

ACCEPTANCE DATE 19 June 67

CONTRACTOR:	Rem Arms Co. Inc.
CONTRACT NO.	DA-49-010-AMC-3(A)
PRIMER NO. 41	MIX FA 956
PRIMER LOT NOS.	10-136,137,139
TRACER MIX	R 284
IGNITER MIX	R 20C
PROPELLANT TYPE	WC 846
A.L. NO.	44663
CHG (GRS)	26.6 26.7
CASE-	STEEL [ ] BRASS [X]
HEADSTAMP (YR)	LC 67
BULLET JACKET	Gilding Metal

FIRING TESTS

	AMB	125°	+160°	-65°
CHAMBER PRESSURE (PSI)				
RDS FIRED	20	10	10	20
RECORD	47000	+5000	-1890	-3835
LIMIT - MAX	52,000	+5,000	+5,000	+5,000
AVG + 3 SD	52000			
LIMIT - MAX	58,000			
PORT PRESSURE (PSI)				
RDS FIRED	20	10	10	20
RECORD	13700	+5	-215	-180
LIMIT	15,000 ±2,000	±2,000	±2,000	±2,000
VELOCITY @ 15 FT (FS)				
RDS FIRED	20	10	10	20
RECORD	3175	+49	-15	-88
LIMIT	3280±40	-250	-250	-250
STD DEV	18.0			
LIMIT	40			

ACCURACY (MR - S)	RDS FIRED	RECORD	LIMIT
... @ 200 YDS	90	3.26	5.0
... (MS)	50	1.20	4.0

... & CASUALTY	RDS FIRED	RECORD	LIMIT
5.56MM, XM16E1	720	OK	

CASUALTIES
NONE

TRACE	NO. RDS.	RECORD	LIMIT
NO. TRACING @ 500 YDS	100	81	79
NO. BULLET BURSTS		0	0
NO. ERRATIC FLIGHTS		0	0
NO. MUZZLE FLASHES		0	0

WATERPROOF TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
50	1	3

DESCRIPTION OF DEFECTS
1 Ctg., W/2 or more mouth Bubbles @7½ PSI 30 Sec.

BULLET EXTRACTION TEST (LBS)

NO. TESTED	SPEC. MIN.	NO. FAILED	MAX.	MIN.	MEAN
25	35	0	114	65	94

MERCUROUS NITRATE TEST

NO. TESTED	NO. FAILED	SPEC LIMIT
50	0	3

BASE CLOSURE SEAL TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
25	0	3

VISUAL, GAGE & WEIGH INSPECTION

1ST SAMPLE DATE
2ND SAMPLE

	CRITICAL	MAJOR	MINOR
AQL %	.04	.25	1.50
% DEFECTIVE			
DEFECT NO. & DESCRIPTION			
TOTAL			

PACKING INSPECTION - CONTAINER CONTENT

MAJOR		MINOR	
% DEFECTIVE	AQL %	% DEFECTIVE	AQL %
	1.0		2.5

TOTAL AUTHORIZED RDS EXPENDED IN TESTS: 1,203

REMARKS:

Ammunition contained herein was originally withdrawn from Lot 12073 and Lot 12074 for additional ballistic evaluation. for trace performance.

PAGE 1 OF 1

QUALITY ASSURANCE REPRESENTATIVE

LCAAP Form 73 (TEST)
6 June 1966

Date Presented 8 June '67 Quantity Packed 535,560 Rds. FSN 1305-914-4519-A068 Functional Lot Nos. AMCMS Code 4810.16.0247.2.AL Spec. No MIL-C-60616(D) Rev. A/6 ECO Date Dwg. No. C10534193 Rev. 13 Date 8-27-65	**TWIN CITIES ARMY AMMUNITION PLANT INSPECTION REPORT – 5.56MM** ITEM CTGS. 5.56mm Tracer M196 Lot No. TW- 18007 Accepted [XXX] 1st Test [XXX] Rejected [ ] Retest [ ] Waiver [ ] Acceptance Date 13 June '67	Contractor: Federal Cartridge Corp. Contract No. DA-36-038 AMC 705(A) Primer No. [illegible] 185 Primer Lot Nos. 209AA 210AA, 211A Tracer Mix Igniter Mix Propellant Type IMR 8208 A.L. No. 44842 Chg. (Grs) 25.5 Case - Steel [ ] Brass [X] Headstamp (Yr) 1967 Bullet Jacket Guild's M'T'L

FIRING TESTS

CHAMBER PRESSURE (PSI)	AMB	125°	160°	-65°
RDS FIRED	20	10	10	20
RECORD	45,800	+1600	+1600	-100
LIMIT - MAX	52,000	+5,000	+5,000	+5,000
AVG +3 SD	51,100			
LIMIT - MAX	58,000			
PORT PRESSURE (PSI)				
RECORD	13,980	+30	+120	-960
LIMIT	15,000 ±2,000	±2,000	±2,000	±2,000
VELOCITY @ 15 FT. (FS)				
RDS FIRED	20	10	10	20
RECORD	3195	+27	-3	-124
LIMIT - BALL	3250 ± 40	-250	-250	-250
LIMIT - TRACER	3200 ± 40	-250	-250	-250
STD DEV	18.7			
LIMIT	40			

…RACY (…S)	RDS FIRED	RECORD	LIMIT
…RADII @ 200 YDS	90	2.43	5.0
…ON TIME (MS)	50	1.41	4.0

…TION & CASUALTY	RDS FIRED	RECORD	LIMIT
…E, 5.56MM, XM16E1	720		
CASUALTIES		NONE	

TRACE PERFORMANCE	NO. RDS.	RECORD	LIMIT
% TRACING @ 500 YDS.	100	98%	80%
NO. TOTAL BLINDS		1	
NO. SHORT TRACE		1	
NO. LATE TRACE			

WATERPROOF TEST

NO. TESTED	NO FAILED	SPEC. LIMIT
50	1	3

DESCRIPTION OF DEFECTS

1 slow leaker (neck)

BULLET EXTRACTION TEST (Lbs.)

No. Tested	SPEC. MIN.	NO. FAILED	MAX.	MIN.	MEAN
25	35	0	94	60	77

MERCUROUS NITRATE TEST

NO TESTED	NO. FAILED	SPEC LIMIT
50	0	0

BASE CLOSURE SEAL TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
25	0	3

VISUAL GAGE & WEIGH INSPECTION

1st SAMPLE 800 DATE 6-8-67
2nd SAMPLE

	CRITICAL	MAJOR	MINOR
AQL %	.04	.25	1.50
% DEFECTIVE			.10
DEFECT NO. & DESCRIPTION			
			1/23
			1/32
TOTAL			2

PACKING INSPECTION - CONTAINER CONTENT

SUB-LOT	MAJOR % DEFECTIVE	MAJOR AQL %	MINOR % DEFECTIVE	MINOR AQL %
		1.0		2.5
1ST	0		0	
2ND	0		0	

TOTAL AUTHORIZED RDS EXPENDED IN TESTS 1130

REMARKS:

CHIEF BALLISTICIAN TCAAP

CHIEF, GOVERNMENT QA DIVISION

C O FORM 5 REPLACES SMUTC FORM 116 WHICH IS OBSOLETE
… 67

RESENTED 5-23-67
Y PACKED 2,021,040
926-3930(A071)
LOT NOS.
10.16.0217.2.FA.FY
NO. MIL-C-9963D REV. A/2
DATE 5-5-66
NO. D10523632
REV D DATE 2-17-65

LAKE CITY ARMY AMMUNITION PLANT
INSPECTION REPORT - 5.56MM

ITEM Ctg., B.T., M193
LOT NO. LC 12194
ACCEPTED XX 1ST TEST XX
REJECTED RETEST
WAIVER
ACCEPTANCE DATE 31 May 1967

CONTRACTOR: REM ARMS CO. INC.
CONTRACT NO. DA-49-010-AMC-3(A)
PRIMER NO. 41 MIX FA956
PRIMER LOT NOS. 10-133, 10-134, 10-135, 10-136
TRACER MIX
IGNITER MIX
*PROPELLANT TYPE WC 846
A.L. NO. 44661, 44662
CHG (GRS) 27.9, 28.3
CASE- STEEL BRASS XX
HEADSTAMP (YR) LC 67
BULLET JACKET Gilding Metal

FIRING TESTS

	AMB	125°	160°	-65°
R PRESSURE (PSI)				
FIELD	20	10	10	20
PE	49000	+1630	-2610	-7115
- MAX	52,000	+5,000	+5,000	+5,000
SD	52300			
- MAX	58,000			
PORT PRESSURE (PSI)				
S FIRED	20	10	10	20
	15400	-35	-35	-590
	15,000 ±2,000	±2,000	±2,000	±2,000
Y @ 15 FT (FS)				
ED	20	10	10	20
	3244	+37	±0	-156
	3250±40	-250	-250	-250
Y	30.0			
	40			

CY (FPS)	RDS FIRED	RECORD	LIMIT
MEAN RADII @ 200 YDS	90	1.34	2.0
AIMING TIME (MS)	50	1.47	4.0

FUNCTION & CASUALTY	RDS FIRED	RECORD	LIMIT
RIFLE, 5.56MM, XM16E1	720	OK	
CASUALTIES			
None			

TRACE	NO. RDS.	RECORD	LIMIT
NO. TRACING @ 500 YDS			
NO. BULLET BURSTS			
NO. ERRATIC FLIGHTS			
NO. MUZZLE FLASHES			

WATERPROOF TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
50	1	3

DESCRIPTION OF DEFECTS
1 ctg. w/2 or more mouth bubbles @ 7 1/2 PSI for 30 sec.

BULLET EXTRACTION TEST (LBS)

NO. TESTED	SPEC. MIN.	NO. FAILED	MAX.	MIN.	MEAN
25	35	0	66	55	76

MERCUROUS NITRATE TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
50	0	1

BASE CLOSURE SEAL TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
		3

VISUAL, GAGE & WEIGH INSPECTION

DATE 5-22 & 23-67

	CRITICAL	MAJOR	MINOR
AQL%	.04	.25	1.50
% DEFECTIVE			
DEFECT NO. & DESCRIPTION			
SYSTEM EVALUATION			
Contractor Sample 2500	Major	0	
2500	Minor		1
Government Sample 63		0	
TOTAL			

PACKING INSPECTION - CONTAINER CONTENT

MAJOR		MINOR	
% DEFECTIVE	AQL %	% DEFECTIVE	AQL %
0	1.0	3.13	2.5

TOTAL AUTHORIZED RDS EXPENDED IN TESTS: 1105

REMARKS:

PAGE 1 OF 1

QUALITY ASSURANCE REPRESENTATIVE

LLC-1 FORM 73 (TEST)
6 JUNE 1966

Presented	9 June 1967
Qty Packed	2,423,920 Rds
	(305-926-3920-A066 *
...ional Lot Nos.	
AMCMS Code	4510.16.0217.2.C4 #
Spec. No.	MIL-C-9963-D Rev. Amend 2
ECO	Date
Dwg. No.	D10532632
Rev.	D Date 2-22-65

TWIN CITIES ARMY AMMUNITION PLANT
INSPECTION REPORT – 5.56MM

ITEM CTG, 5.56mm BALL M193

Lot No. TW-18191

Accepted	X	1st Test	X
Rejected		Retest	
		Waiver	

Acceptance Date 14 June 67

Contractor:	Federal Cartridge Corp.
Contract No.	DA-11-038AMC-10880
Primer No.	195
Primer Lot Nos.	312A-13 244-13
Tracer Mix	
Igniter Mix	
Propellant Type	IMR 8208
A.L. No.	44635
Chg. (Grs)	25.7
Case -	Steel ☐ Brass ☒
Headstamp (Yr)	1967
Bullet Jacket	Gilding Mtl.

FIRING TESTS

CHAMBER PRESSURE (PSI)	AMB	125°	160°	-65°
RDS FIRED	20	10	10	20
RECORD	49,600	-200	-1600	-6400
LIMIT - MAX	52,000	+ 5,000	+ 5,000	+ 5,000
AVG + 3 SD	53,500			
LIMIT - MAX	58,000			
PORT PRESSURE (PSI)				
RECORD	13,190	0	+130	-1160
LIMIT	15,000 ±2,000	±2,000	±2,000	±2,000
VELOCITY @ 15 FT. (FS)				
RDS FIRED	20	10	10	20
RECORD	3215	+79	-7	-155
LIMIT - BALL	3250 ± 40	-250	-250	-250
LIMIT - TRACER	3200 ± 40	-250	-250	-250
STD DEV	18.6			
LIMIT	40			

ACCURACY (INCHES)	RDS FIRED	RECORD	LIMIT
MEAN RADII @ 200 YDS	90	1.11	2.0
ACTION TIME (MS)	50	.98	4.0

FUNCTION & CASUALTY	RDS FIRED	RECORD	LIMIT
5.56MM, XM16E1	720		
CASUALTIES		NONE	

TRACE PERFORMANCE	NO. RDS.	RECORD	LIMIT
% TRACING @ 500 YDS.	100		95
NO. TOTAL BLINDS			
NO. SHORT TRACE			
NO. LATE TRACE			

WATERPROOF TEST

NO. TESTED	NO. FAILED	SPEC. LIMIT
50	0	3

DESCRIPTION OF DEFECTS

BULLET EXTRACTION TEST (Lbs.)

No. Tested	SPEC MIN.	NO. FAILED	MAX.	MIN	MEAN
25	35	0	106	52	86

MERCUROUS NITRATE TEST

NO TESTED	NO. FAILED	SPEC. LIMIT
50	0	0

BASE CLOSURE SEAL TEST

NO. TESTED	NO. FAILED	SPEC LIMIT
		3

VISUAL GAGE & WEIGH INSPECTION

1st SAMPLE 2400 DATE 6/9/67

2nd SAMPLE

	CRITICAL	MAJOR	MINOR
AQL %	.04	.25	1.50
% DEFECTIVE		.08	.20
DEFECT NO. & DESCRIPTION			
		2/44	2/16
			1/15
TOTAL		2	3

PACKING INSPECTION - CONTAINER CONTENT

SUB-LOT	MAJOR % DEFECTIVE	MAJOR AQL %	MINOR % DEFECTIVE	MINOR AQL %
		1.0		2.5
1ST	0		0	
2ND	0		0	

TOTAL AUTHORIZED RDS EXPENDED IN TESTS: 1030

REMARKS:

THIS CARTON PACKED LOT CHARGED AGAINST PROJ: F6-7-A0120-01-F0-FN, (10 RD. CLIP). AUTHORITY PER SMUAP FORM 1018.

CHIEF BALLISTICIAN TCAAP — CHIEF, GOVERNMENT QA DIVISION

SMUTC Q FORM 5 25 APR. 67 — REPLACES SMUTC FORM 116 WHICH IS OBSOLETE

Chamber and Part Pressure Data

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 21 November 1967.
Previous Rounds: 111.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3191	3092	46300
2	3189	3095	47300
3	3255	3148	53500
4	3194	3086	46000
5	3128	3030	47800
6	3209	3116	46700
7	3160	3068	45900
8	3189	3097	48200
9	3203	3112	47200
10	3168	3069	44800
11	3176	3085	45700
12	3183	3086	46900
13	3259	3163	54600
14	3206	3107	45900
15	3155	3071	44200
16	3174	3077	47500
17	3212	3113	51200
18	3189	3101	46800
19	3164	3070	45500
20	3220	3123	49100
Average	3191	3095	47555
Standard Deviation	31	30	2705

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 21 November 1967.
Previous Rounds: 131.
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot LC-12081.
Ammunition Temperature: +160°F.
Barrel No.: 26
Universal Receiver No.: 1.

1	3153	3060	48000
2	3108	3024	46700
3	3160	3065	49300
4	3160	3067	49200
5	3171	3068	50400
6	3137	3040	48100
7	3118	3012	46600
8	3108	3021	47900
9	3111	3016	49000
10	3094	3002	47900
11	3136	3037	48000
12	3092	2992	45900
13	3161	3062	50000
14	3039	2961	46800
15	3102	3002	46900
16	3104	3027	47400
17	3142	3040	48500
18	3096	3000	46000
19	3116	3014	47200
20	3156	3061	51400
Average	3123	3029	48060
Standard Deviation	33	30	1476

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 21 November 1967.
Previous Rounds: 152.
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007.
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3184	3088	52500
2	3197	3110	49600
3	3144	3049	47700
4	3194	3107	50200
5	3208	3116	49300
6	3158	3098	50300
7	3163	3068	48700
8	3138	3071	45600
9	3206	3101	51900
10	3168	3075	51900
11	3197	3095	50300
12	3197	3109	49800
13	3192	3094	50400
14	3150	3086	48700
15	3146	3045	46500
16	3180	3069	50900
17	3169	3070	47100
18	3153	3047	48400
19	3195	3085	52200
20	3131	3039	49300
Average	3174	3081	49565
Standard Deviation	24	23	1894

Round No.	Instrumental Velocity at 15 Ft	78 Ft	Chamber Pressure, psi

Date: 21 November 1967.
Previous Rounds: 172.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-12194.
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3214	3118	44900
2	3224	3127	46600
3	3183	3089	44900
4	3185	3101	44500
5	3208	3114	44000
6	3199	3109	44400
7	3203	3106	46100
8	3184	3099	43200
9	3212	3117	43800
10	3208	3118	45900
11	3213	3119	45600
12	3175	3090	43300
13	3196	3106	45600
14	3215	3129	45000
15	3195	3110	44000
16	3198	3107	44900
17	3234	3145	45400
18	3224	3134	45900
19	3215	3127	46000
20	3249	3155	45900
Average	3207	3116	44995
Standard Deviation	18	17	981

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 21 November 1967.
Previous Rounds: 192.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot TW-18191.
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3177	3092	54200
2	3181	3093	51900
3	3204	3116	51300
4	3209	3109	53100
5	3210	3124	54900
6	3244	3154	55500
7	3214	3120	53100
8	3147	3059	51600
9	3224	3118	54300
10	3190	3097	51400
11	3177	3082	50700
12	3188	3093	51200
13	3208	3115	53200
14	3195	3095	53600
15	3190	3099	52300
16	3197	3108	53700
17	3176	3084	52400
18	3190	3099	51600
19	3231	3137	53400
20	3178	3084	50100
Average	3196	3104	52675
Standard Deviation	22	21	1457

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi

Date: 22 November 1967.
Previous Rounds: 217.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3202	3113	14900
2	3187	3099	15300
3	3184	3092	15400
4	3180	3096	15400
5	3251	3143	15300
6	3209	3120	15200
7	3121	2924	16400
8	3165	3073	15000
9	3208	3120	15000
10	3199	3116	14800
11	3179	3077	15000
12	3137	3046	14600
13	3188	3100	15000
14	3215	3119	14800
15	3181	3090	14700
16	3184	3093	14800
17	3198	3100	15000
18	3163	3077	14500
19	3213	3113	15000
20	3210	3109	15000
Average	3189	3091	15055
Standard Deviation	29	45	402

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi

Date: 22 November 1967.
Previous Rounds: 237.
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot LC-12081.
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3209	3114	14000
2	3163	3065	13900
3	3155	3059	14300
4	3139	3062	14200
5	3155	3049	13400
6	3104	3013	13800
7	3190	3087	13300
8	3147	3050	13500
9	3124	3025	14200
10	3146	3055	13500
11	3095	2997	13000
12	3126	3067	13400
13	3123	3015	13600
14	3066	3021	13200
15	3166	3109	13400
16	3158	3076	13500
17	3120	3064	13400
18	3174	3080	13600
19	3157	3063	13500
20	3157	3058	13300
Average	3144	3056	13600
Standard Deviation	33	31	355

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 22 November 1967.			
Previous Rounds: 257.			
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007.			
Ammunition Temperature: +160°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3216	3154	13900
2	3255	3152	14000
3	3239	3141	13900
4	3214	3112	13500
5	3227	3143	13300
6	3263	3167	13400
7	3219	3132	13800
8	3258	3153	13800
9	3248	3162	13800
10	3224	3132	13900
11	3204	3118	13900
12	3232	3140	14000
13	3240	3143	14300
14	3233	3137	13900
15	3258	3158	14200
16	3179	3111	14000
17	3169	3086	13800
18	3203	3121	14300
19	3201	3133	13800
20	3206	3148	14300
Average	3224	3137	13890
Standard Deviation	26	20	273

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi

Date: 22 November 1967.
Previous Rounds: 277.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-12194.
Ammunition Temperature: +160°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3218	3129	14300
2	3188	3098	14100
3	3196	3107	14900
4	3191	3095	14600
5	3197	3109	14800
6	3222	3127	15100
7	3235	3145	14800
8	3194	3105	14700
9	3206	3107	15100
10	3211	3124	15000
11	3214	3127	14700
12	3203	3111	14900
13	3171	-	14000
14	3259	3171	15400
15	3204	3114	15000
16	3235	3148	15000
17	3202	3112	15000
18	3247	3160	15200
19	3226	3140	15300
20	3232	3141	14800
Average	3213	3125	14835
Standard Deviation	22	21	366

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 22 November 1967.			
Previous Rounds: 297.			
Ammunition: Cartridge, 5.56-mm, ball, M193, lot TW-18191.			
Ammunition Temperature: +160°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3163	3074	13600
2	3233	3148	13900
3	3252	3158	14100
4	3259	3168	13600
5	3285	3190	13800
6	3250	3149	13800
7	3274	3179	14100
8	3255	3164	13600
9	3274	3180	14000
10	3267	3180	14300
11	3261	3176	14200
12	3233	3139	13900
13	3245	3150	14200
14	3259	3176	14200
15	3244	3150	14100
16	3219	3131	14200
17	3227	3139	14100
18	3250	3162	14200
19	3249	3164	14200
20	3266	3180	14900
Average	3248	3158	14050
Standard Deviation	26	26	300

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 28 November 1967.
Previous Rounds: 442.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).
Ammunition Temperature: -65°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3103	3012	46300
2	3064	2975	42100
3	3077	2994	44300
4	3057	2972	46000
5	3018	2932	38800
6	3050	2965	42600
7	3057	2967	43400
8	3102	3016	47700
9	3092	3004	45200
10	2983	2889	41000
11	3034	2952	43300
12	3048	2960	42100
13	3009	2926	39000
14	3051	2947	41200
15	3073	2979	44500
16	3028	2937	42400
17	3090	3000	44200
18	3046	2963	43000
19	3021	2927	43800
20	3092	3007	45200
Average	3055	2966	43305
Standard Deviation	33	34	2284

Round No.	Instrumental Velocity at 15 Ft	78 Ft	Chamber Pressure, psi

Date: 28 November 1967.
Previous Rounds: 462.
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot LC-12081.
Ammunition Temperature: -65°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3022	2925	40800
2	2983	2888	40400
3	2981	2877	41000
4	3037	2942	46100
5	2992	2936	44100
6	3013	2910	43400
7	2954	2860	39600
8	2957	2864	39500
9	3018	2919	44500
10	3009	2925	47400
11	2999	2900	40200
12	3023	2930	42100
13	3074	2975	48900
14	3031	2947	44900
15	3051	2956	41400
16	3065	2980	44500
17	3030	2936	41800
18	3015	2919	42100
19	3044	2949	44400
20	3032	2940	42500
Average	3016	2924	42980
Standard Deviation	32	33	2599

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi
Date: 28 November 1967.			
Previous Rounds: 482.			
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007.			
Ammunition Temperature: -65°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3031	2943	48000
2	3009	2894	47900
3	3035	2925	47200
4	3106	3006	50200
5	3032	2959	48100
6	3009	2923	43700
7	3006	2921	45000
8	3008	2942	48100
9	3025	2921	48300
10	3048	2945	48900
11	2975	2868	43000
12	2944	2840	43100
13	3061	2965	49900
14	3030	2940	47900
15	3039	2983	49600
16	2968	2868	45600
17	3102	3008	49600
18	3020	2922	47800
19	3033	2943	45900
20	2988	2926	44700
Average	3023	2932	47125
Standard Deviation	39	43	2265

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 28 November 1967.
Previous Rounds: 502.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-12194.
Ammunition Temperature: -65°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3118	3030	40900
2	3139	3043	43400
3	3093	2994	41900
4	3159	3064	44300
5	3044	2956	39100
6	3091	3002	40900
7	3088	2999	40300
8	3106	3015	41700
9	3116	3031	43000
10	3107	3017	40600
11	3022	2931	38100
12	3026	2936	37600
13	3126	3041	41600
14	3075	2985	40800
15	3023	2933	38400
16	3106	3022	39500
17	3106	3021	41700
18	3108	3018	41400
19	3100	2993	42500
20	3067	2982	39900
Average	3091	3001	40880
Standard Deviation	38	38	1769

Round No.	Instrumental Velocity at 15 Ft	78 Ft	Chamber Pressure, psi

Date: 28 November 1967.
Previous Rounds: 523.
Ammunition: Cartridge, 5.56-mm, ball, '1193, lot TW-18191.
Ammunition Temperature: -65°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3102	3011	38600
2	3010	2924	47900
3	3016	2927	46600
4	3029	2942	50000
5	3038	2944	47400
6	2966	2875	45000
7	2963	2866	45900
8	2993	2925	48300
9	3001	2917	45900
10	2961	2879	45400
11	3030	2944	44200
12	2994	2902	45500
13	2961	2875	45800
14	3006	2919	46300
15	3026	2943	50100
16	3024	2930	47800
17	2994	2908	43900
18	3002	2913	48300
19	3009	2921	48200
20	3000	2914	46700
Average	3006	2919	46390
Standard Deviation	33	32	2503

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 30 November 1967.			
Previous Rounds: 633.			
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).			
Ammunition Temperature: -65°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3116	3021	14900
2	3057	2975	14800
3	3065	2964	14400
4	3094	2999	13600
5	3014	2924	14100
6	3086	3004	14100
7	3029	2941	14000
8	3031	2948	14400
9	3099	3009	14400
10	3052	2958	14500
11	3174	3081	14200
12	3097	3012	14400
13	3087	3002	14400
14	3082	2992	14700
15	3163	3075	14600
16	3047	2954	14700
17	3098	3009	14500
18	3111	3024	14700
19	3053	2969	14200
20	3130	3037	14700
Average	3084	2995	14415
Standard Deviation	42	42	315

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 30 November 1967.			
Previous Rounds: 653.			
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot LC-12081.			
Ammunition Temperature: -65°F.			
Barrel No. 26.			
Universal Receiver No.: 1.			
1	3187	3084	14000
2	3032	2934	12800
3	3088	2989	13300
4	3078	2992	13000
5	3092	2995	13300
6	3092	2992	12800
7	3082	2998	13300
8	3064	2983	13400
9	3008	2914	13400
10	3072	2975	13300
11	3046	2951	12900
12	3093	2990	13200
13	3063	2968	13400
14	3020	2932	12600
15	3091	3003	13300
16	3023	2913	13200
17	3077	2991	13300
18	3022	2931	13100
19	3070	2979	12900
20	3040	2954	12600
Average	3067	2973	13155
Standard Deviation	40	39	328

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 30 November 1967.			
Previous Rounds: 673.			
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007.			
Ammunition Temperature: -65°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3107	3000	12800
2	3142	3044	13100
3	3150	-	13100
4	3092	2987	12800
5	3121	3027	12800
6	3107	3010	12800
7	3172	3085	12500
8	3149	3053	12500
9	3121	3019	12500
10	3057	2956	11600
11	3081	2990	12100
12	3069	3011	12100
13	3124	3038	11500
14	3052	2947	11300
15	3073	2979	11900
16	3116	3018	11800
17	3139	3045	11800
18	3124	3031	12000
19	3100	3001	11900
20	3071	2968	11700
Average	3108	3011	12230
Standard Deviation	34	35	552

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 30 November 1967.			
Previous Rounds: 693.			
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-12194.			
Ammunition Temperature: -65°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3059	2958	13800
2	3068	2976	13700
3	2969	2874	13400
4	3062	2973	13800
5	3099	3010	13600
6	3082	2983	13400
7	3095	3006	13700
8	3084	2994	13100
9	3018	2934	13600
10	3024	2925	13400
11	3061	2969	13400
12	3085	2992	13600
13	3116	3020	13700
14	3096	3001	13900
15	3089	3000	13500
16	3108	3022	13600
17	3093	3006	13300
18	3121	3031	13500
19	3033	2941	13400
20	3064	2980	13200
Average	3071	2980	13530
Standard Deviation	37	38	208

Date: 30 November 1967.
Previous Rounds: 713.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot TW-18191.
Ammunition Temperature: -65°F.
Barrel No.: 26.
Universal Receiver No.: 1.

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
1			
2	3049	2965	
3	3095	3011	12600
4	3073	2984	12200
5	3062	2974	12300
6	3134	3049	12100
7	3081	2992	11500
8	3060	2968	11000
9	3062	2968	11700
10	3013	3114	11400
11	3086	2996	11300
12	3089	2990	11400
13	3110	3027	11700
14	3081	2993	11000
15	3087	3001	11900
16	3059	2972	12100
17	3084	2964	11600
18	3070	2980	11000
19	3073	2987	11400
20	3105	3014	11600
	3092	3003	11600
			11800
Average	3077	2998	11660
Standard Deviation	26	35	443

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi

Date: 1 December 1967.
Previous Rounds: 738.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).
Ammunition Temperature: -65°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3061	2955	13300
2	3061	2986	13200
3	3115	3028	12600
4	3124	3035	12700
5	3113	3023	13200
6	3104	3005	12600
7	3127	3023	12600
8	3039	2947	12900
9	3058	2974	12600
10	3189	3097	12400
11	3085	2998	12400
12	3085	2998	12700
13	3055	2962	12800
14	3116	3026	12500
15	3123	3026	13100
16	3065	2967	12700
17	3059	2971	13000
18	3027	2936	13000
19	3074	2986	12700
20	3000	2934	12500
Average	3084	2994	12775
Standard Deviation	43	40	275

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date 2 December 1967.
Previous Rounds: 863.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).
Ammunition Temperature: +70°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3216	3125	45200
2	3157	3071	43500
3	3126	3038	43000
4	3110	3018	41000
5	3213	3128	48900
6	3153	3062	42400
7	3109	3018	39900
8	3108	3022	41000
9	3077	2979	39700
10	3126	3035	42700
11	3131	3030	42600
12	3097	3013	38800
13	3192	3096	46900
14	3090	2998	40000
15	3093	3002	40000
16	3189	3102	45900
17	3089	3002	39600
18	3156	3070	43600
19	3193	3100	47400
20	3164	3079	42500
Average	3139	3049	42730
Standard Deviation	44	45	2887

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 2 December 1967.
Previous Rounds: 883.
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot LC-12081.
Ammunition Temperature: +70°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3090	3029	43300
2	3133	3045	44200
3	3138	3033	45300
4	3120	3027	43900
5	3119	3014	44000
6	3111	3009	43500
7	3088	2985	43400
8	3112	3007	45500
9	3135	3034	45000
10	3073	2979	42900
11	3125	3048	44500
12	3091	2992	44000
13	3076	2977	42300
14	3074	3004	43300
15	3124	3036	45500
16	3059	2972	42300
17	3085	2995	43300
18	3120	3013	44900
19	3114	3014	43700
20	3092	2988	44200
Average	3104	3010	43950
Standard Deviation	24	23	958

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi
Date: 2 December 1967.			
Previous Rounds: 903.			
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007.			
Ammunition Temperature: +70°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3130	3033	50700
2	3146	3053	48900
3	3100	2991	47400
4	3135	3062	48300
5	3084	3012	43800
6	3095	2990	46900
7	3097	2996	46800
8	3128	3025	47700
9	3096	3005	45900
10	3105	3040	46700
11	3066	2956	43600
12	3146	3054	50300
13	3091	3004	45800
14	3076	2975	45400
15	3138	3044	49800
16	3121	3022	46900
17	3098	2995	46100
18	3093	3022	48400
19	3055	2953	45500
20	3132	3033	47600
Average	3107	3013	47125
Standard Deviation	27	31	1928

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 2 December 1967.
Previous Rounds: 923.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-12194.
Ammunition Temperature: +70°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3192	3103	44200
2	3207	3111	45000
3	3132	3041	42400
4	3206	3110	46500
5	3211	3119	45400
6	3188	3098	44400
7	3145	3054	43400
8	3135	3044	43500
9	3164	3073	42800
10	3144	3052	43600
11	3241	3142	48000
12	3188	3099	45300
13	3108	3022	41600
14	3118	3029	42000
15	3153	3058	42500
16	3131	3041	41900
17	3165	3072	43400
18	3178	3084	45400
19	3157	3065	43300
20	3135	3038	43200
Average	3165	3073	43890
Standard Deviation	35	34	1646

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Chamber Pressure, psi

Date: 2 December 1967.
Previous Rounds: 943.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot TW-18191.
Ammunition Temperature: +70°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3067	2972	47900
2	3135	3037	52000
3	3078	2984	47900
4	3108	3014	49000
5	3098	3007	47300
6	3120	3023	49800
7	3102	3009	49500
8	3107	3021	48600
9	3123	3032	48400
10	3117	3027	49200
11	3133	3037	50700
12	3093	2994	49200
13	3097	2999	49100
14	3119	3022	49900
15	3132	3037	50900
16	3150	3056	52400
17	3131	3037	51700
18	3076	2979	47500
19	3120	3018	49700
20	3148	3053	49600
Average	3113	3018	49515
Standard Deviation	23	23	1447

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 4 December 1967.			
Previous Rounds: 1028.			
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-Y-5.56-501 (reference).			
Ammunition Temperature: +70°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3215	3125	13700
2	3208	3115	14000
3	3225	3136	13700
4	3176	3092	13700
5	3165	3082	13500
6	3154	3066	13900
7	3169	3079	13400
8	3178	3083	13700
9	3201	3107	13500
10	3208	3124	13600
11	3219	3134	13800
12	3195	3111	13400
13	3212	3131	13800
14	3151	3061	13500
15	3208	3117	13500
16	3227	3142	13500
17	3175	3080	14000
18	3189	3096	14200
19	3194	3101	14300
20	3220	3128	13700
Average	3194	3105	13720
Standard Deviation	24	25	255

Round No.	Instrumental Velocity at 15 Ft	78 Ft	Port Pressure, psi

Date: 4 December 1967.
Previous Rounds: 1048.
Ammunition: Cartridge, 5.56-mm, tracer, M196, Lot LC-12081.
Ammunition Temperature: +70°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3201	3095	12700
2	3137	3031	12700
3	3172	3075	12400
4	3187	3085	12100
5	3185	3087	12500
6	3172	3108	12400
7	3157	3059	12300
8	3120	3018	12600
9	3165	3077	12700
10	3142	3045	12600
11	3125	3023	12900
12	3121	3029	12700
13	3151	3061	11900
14	3166	3105	12000
15	3201	3104	12000
16	3202	3104	11900
17	3193	3085	12300
18	3131	3014	12400
19	3140	3042	12200
20	3130	3047	12700
Average	3160	3065	12400
Standard Deviation	28	32	304

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 4 December 1967.			
Previous Rounds: 1068.			
Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007.			
Ammunition Temperature: +70°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3172	3087	12600
2	3181	3085	13000
3	3192	3128	13100
4	3233	3132	12800
5	3181	3095	12900
6	3181	3082	13400
7	3180	3082	12100
8	3174	3081	12700
9	3175	3071	12100
10	3184	3089	12700
11	3165	3067	12600
12	3164	3069	12600
13	3163	3070	12300
14	3164	3066	12700
15	3163	3054	11600
16	3196	3101	12500
17	3169	3086	12200
18	3159	3066	11900
19	3131	3029	12700
20	3146	3075	12200
Average	3174	3081	12535
Standard Deviation	20	23	432

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi
Date: 4 December 1967.			
Previous Rounds: 1089.			
Ammunition: Cartridge, 5.56-mm, ball, M193, lot LC-12194.			
Ammunition Temperature: +70°F.			
Barrel No.: 26.			
Universal Receiver No.: 1.			
1	3244	3151	13900
2	3156	3071	13300
3	3213	3125	12900
4	3162	3085	13400
5	3211	3121	13600
6	3168	3081	13200
7	3156	3064	13500
8	3262	3173	13500
9	3177	3086	13500
10	3234	3137	13500
11	3253	3163	13300
12	3177	3086	13700
13	3205	3108	13900
14	3173	3077	13400
15	3186	3092	13300
16	3178	3083	13500
17	3219	3133	13500
18	3204	3106	13200
19	3211	3121	13500
20	3236	3143	13600
Average	3201	3110	13415
Standard Deviation	33	32	230

Round No.	Instrumental Velocity at 15 Ft	Instrumental Velocity at 78 Ft	Port Pressure, psi

Date: 4 December 1967.
Previous Rounds: 1109.
Ammunition: Cartridge, 5.56-mm, ball, M193, lot TW-18191.
Ammunition Temperature: +70°F.
Barrel No.: 26.
Universal Receiver No.: 1.

1	3172	3083	11900
2	3185	3090	11800
3	3153	3056	11600
4	3161	3065	12400
5	3125	3041	11900
6	3124	3023	12100
7	3166	3076	12100
8	3177	3087	11300
9	3198	3103	11700
10	3161	3072	11200
11	3161	3067	11800
12	3130	3037	11400
13	3198	3108	11100
14	3220	3133	11600
15	3195	3107	11800
16	3132	3042	10900
17	3172	3081	11600
18	3149	3061	11300
19	3195	3109	11200
20	3158	3070	11700
Average	3167	3076	11620
Standard Deviation	27	28	379

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

NUMBER	MODEL	MANUFACTURER	CASTING NUMBER
014657	C-SMG		X

5.56 MM BARREL	FIRING STATUS (Check One)	NUMBER OF ROUNDS	PROOF OFFICER
DATE OF GAUGING 27 JUNE 67	✓ BEFORE / AFTER		

Bore Measurements

MEASUREMENTS INDICATED IN 1/10000 OF AN INCH.

DISTANCE FROM FACE OF FLASH SUPPRESSOR	LANDS. BASIC DIA. .2190" VERT.	LANDS. BASIC DIA. .2190" HORZ.	GROOVES. BASIC DIA. .2235" VERT.	GROOVES. BASIC DIA. .2235" HORZ.
3.00	+.0007	+.0007	+.0006	+.0006
4	5	6	6	5
5	3	6	4	4
6	3	6	4	4
7	3	4	4	4
8	4	4	4	4
9	4	5	4	4
9.80	4	4	4	4
10.05	4	4	4	4
10.25	+.0005	+.0005	+.0004	+.0004

BORESCOPE (Chamber not chrome plated)

Very light longitudinal scratches in chamber. Light chatter marks on slope of chamber at 4 o'clock position. Very light carbon residue in centering slope. Light to moderate circumferential [illegible] [illegible] and origin of rifling. Edges of lands chipped at commencement of rifling. Light to heavy circumferential [illegible] throughout bore, with light metal deposits on lands & [illegible] [illegible] with erosion on forward edges. One land at 2 o'clock at muzzle end has light chip on [illegible].

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

NUMBER	MANUFACTURER	MODEL	CASTING NUMBER
902159 [redacted]		XM177E1	

5.56 MM BARREL

DATE OF GAUGING: 27 JUNE 67

FIRING STATUS (Check One): BEFORE ✓ / AFTER

NUMBER OF ROUNDS:

PROOF OFFICER:

MEASUREMENTS INDICATED IN 1/10000 OF AN INCH.

DISTANCE FROM FACE OF FLASH SUPRESSOR	LANDS Basic Dia .2190" VERT.	LANDS Basic Dia .2190" HORZ.	GROOVES Basic Dia. .2235" VERT.	GROOVES Basic Dia. .2235" HORZ.
3.85	+.0009	+.0008	+.0008	+.0009
4	7	8	8	5
5	7	6	10	10
6	7	8	11	11
7	7	7	11	11
8	7	6	12	12
9	7	7	11	11
10	5	7	8	8
11	5	4	5	5
11.35	6	2	6	5
11.60	6	5	6	6
11.80	+.0006	+.0005	+.0005	+.0003

BORESCOPE (Chamber not chrome plated)

Chamber has light to moderate longitudinal scratches and gouges. Sides of chamber roughly machined. Centering slope has heavy circular tool marks with light deposits. Light longitudinal scratches with light deposits in forcing cone area. Origin of rifling slightly battered, with light scratches and grooves [illegible]. Throughout bore, with light deposits. [illegible] light [illegible] ledge encircling it. Burrs on ports in flash suppressor.

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

CASTING NUMBER	MANUFACTURER	MODEL	NUMBER	
		XM177E1	902 279 [redacted]	5.56 M/M BARREL

PROOF OFFICER:

NUMBER OF ROUNDS:

FIRING STATUS (Check One): BEFORE ✓ AFTER

DATE OF GAUGING: 27 JUNE 67

MEASUREMENTS INDICATED IN 1/10,000 OF AN INCH

	Distance from face of flash suppressor	Lands Basic Dia. .2190" Vert.	Lands Horz.	Grooves Basic Dia. .2235" Vert.	Grooves Horz.
	3.86	+.0005	+.0005	+.0001	+.0002
	4	7	7	3	3
	5	6	8	4	3
	6	6	6	4	3
	7	7	5	4	4
	8	6	3	3	3
	9	1	.0000	-.0005	-.0001
	10	GAUGE	WOULD	6	5
	11	NOT	ENTER	5	4
RFT.	11.36	THIS	AREA.	5	3
	11.60			5	3
2.60	11.80	+.0001	+.0004	-.0003	-.0002

BORESCOPE (chamber not chrome plated)

Chamber has light to moderate longitudinal scratches [illegible] slope and at height of [illegible]. Has circumferential tool marks with light to moderate longitudinal scratches. Light deposits at [illegible] edge of [illegible] slope. Circumferential tool marks in forcing cone area. Light longitudinal scratches at origin of rifling with light [illegible] deposits extending throughout bore. Wire edge [illegible] gas port. Wire edge on portion at flash suppressor.

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

CASTING NUMBER	
MANUFACTURER	
MODEL	XM177E1
NUMBER	902868 [redacted]
PROOF OFFICER	
NUMBER OF ROUNDS	
FIRING STATUS (Check One)	✓ BEFORE / AFTER
	5.56 mm BARREL
DATE OF GAUGING	27 JUNE 67

MEASUREMENTS INDICATED IN 1/10000 OF AN INCH

DISTANCE FROM FACE OF FLASH SUPRESSOR	LANDS Basic Dia. .2190" VERT.	LANDS HORZ.	GROOVES Basic Dia. .2235" VERT.	GROOVES HORZ.
3.85	+.0005	+.0006	+.0003	+.0003
4	2	6	3	3
5	-.0002	2	3	4
6	.0000	2	3	4
7	+.0005	1	4	4
8	6	1	5	4
9	5	1	5	4
10	3	4	5	4
11	-.0003	-.0001	2	1
11.35	+.0002	+.0002	2	4
11.60	1	2	2	3
11.80	+.0002	+.0002	+.0002	+.0002

BORESCOPE (chamber not chrome plated)

Very light circumferential tool marks in straight of chamber. One light longitudinal scratch in straight of chamber at 6 o'clock. Light tool strokes in center, slope and forcing cone area light to medium. Light circumferential tool marks intermittently throughout bore, with light metallic deposits. Gas port has light wire edge. Wire edge on slots at flash suppressor.

ORDBO Form 2045-(R), Reinstated 9 Jul 59 (Part 1)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

CASTING NUMBER	MANUFACTURER	PROOF OFFICER

MODEL	NUMBER	FIRING STATUS (Check One)		NUMBER OF ROUNDS
		BEFORE	AFTER	
XM177E2	904541 [redacted]			

5.56 MM	BARREL	DATE OF GAUGING 27 JUNE 67

DISTANCE FROM FACE OF FLASH SUPPRESSOR	MEASUREMENTS INDICATED IN 1/10000 OF AN INCH. LANDS. BASIC DIA .2190" VERT.	HOR.	GROOVES BASIC DIA .2235" VERT.	HOR.
3.85	+.0004	+.0002	.0000	+.0002
4	1	4	-.0001	.0000
5	5	5	+.0002	+.0002
6	4	5	2	1
7	5	4	4	4
8	5	4	1	3
9	5	5	2	3
10	5	5	2	3
11	4	5	2	3
12	5	5	3	3
12.80	5	5	3	3
13.05	5	5	2	3
13.25	+.0005	+.0005	+.0002	+.0003

Borescoped (Chamber [redacted] Chrome plated)
Circumferential tool marks beginning in
Centering Cylinder and extending throughout
bore. Edges of lands chipped at commencement
of rifling. Light deposits of metal
throughout bore. More pronounced
on lands. Forward edge of gas port
lightly eroded.
Lands appear to be battered at
commencement of rifling.

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

	NUMBER	MODEL	MANUFACTURER	CASTING NUMBER
5.56 m/m BARREL	904543[redacted]	XM177E2		X

DATE OF GAUGING	FIRING STATUS (Check One)	NUMBER OF ROUNDS	PROOF OFFICER
27 JUNE 67	✓ BEFORE / AFTER		

MEASUREMENTS INDICATED IN 1/10000 OF AN INCH

DISTANCE FROM FACE OF FLASH SUPPRESSOR	LANDS. BASIC DIA. .2190" VERT.	LANDS. BASIC DIA. .2190" HORZ.	GROOVES. BASIC DIA. .2235" VERT.	GROOVES. BASIC DIA. .2235" HORZ.
3.85	+.0012	+.0011	+.0008	+.0006
4	9	10	3	3
5	8	9	4	3
6	5	10	4	3
7	8	8	4	3
8	7	8	3	3
9	9	8	4	4
10	8	10	3	3
11	9	6	4	2
12	-.0007	-.0004	.0000	1
12.80	4	+.0004	-.0002	-.0003
13.05	.0000	2	2	2
13.25	.0000	+.0001	-.0003	-.0003

BORESCOPE (Chamber chrome plated)

Circumferential tool marks [illegible] with light chattering [illegible] in forcing cone area. Light to moderately circumferential tool marks throughout bore. Gas port has very [illegible] edged with metallic deposits [illegible] rear edge were [illegible] intersect port. Wear edges on ports of flash suppressor. Chamber has been chrome plated.

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

5.56 Mm BARREL

NUMBER	MODEL	MANUFACTURER	CASTING NUMBER
904544 [redacted]	XM177E2		X

DATE OF GAUGING	FIRING STATUS (Check One)	NUMBER OF ROUNDS	PROOF OFFICER
27 JUNE 67	✓ BEFORE / AFTER		

MEASUREMENTS INDICATED IN 1/10000 OF AN INCH

DISTANCE FROM FACE OF FLASH SUPPRESSOR	LANDS. BASIC DIA. .2190" VERT.	LANDS. BASIC DIA. .2190" HORZ.	GROOVES BASIC DIA. .2235" VERT.	GROOVES BASIC DIA. .2235" HORZ.
3.80	+.0007	+.0006	+.0003	+.0004
4	8	8	5	5
5	9	9	6	7
6	9	7	6	5
7	9	8	6	6
8	9	9	6	6
9	9	9	5	6
10	10	8	6	7
11	10	9	6	6
12	9	9	7	6
12.80	8	9	7	6
13.05	9	9	6	6
13.25	+.0009	+.0009	+.0005	+.0004

BORESCOPE (Chamber chrome plated)

Slope of chamber roughly machined, circumferential tool marks. [illegible] in [illegible] slope and [illegible] throughout bore. Edges of lands chipped at commencement of rifling. Lands appear to be flattened in this area. Heavy light deposit throughout bore. Light [illegible] gas cut with light chip or [illegible] on forward edge. [illegible] edge on ports at flash suppressor with light to heavy chipping. Chamber [illegible] before chrome plated.

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

CASTING NUMBER	MANUFACTURER	MODEL	NUMBER			
X		XM177E2	904546	5.56 MM BARREL		

PROOF OFFICER:

NUMBER OF ROUNDS:

FIRING STATUS (Check One): ✓ BEFORE / AFTER

DATE OF GAUGING: 17 JUNE 67

MEASUREMENTS INDICATED IN [illegible] OF AN INCH

DISTANCE FROM FACE OF FLASH SUPPRESSOR	LANDS. BASIC DIA. .2190" VERT.	LANDS. BASIC DIA. .2190" HORZ.	GROOVES. BASIC DIA. .2235" VERT.	GROOVES. BASIC DIA. .2235" HORZ.
3.85	+.0010	+.0011	+.0004	+.0004
4	8	8	4	4
5	8	7	8	9
6	8	7	8	9
7	7	8	10	9
8	8	9	10	9
9	6	6	9	9
10	8	7	9	9
11	7	7	8	9
12	7	6	8	8
12.80	7	6	8	7
13.05	6	7	8	7
13.25	+.0006	+.0007	+.0006	+.0006

BORESCOPE (Chamber chrome plated)

Light to heavy circumferential [illegible] cracks beginning [illegible] scope and extending [illegible]. Edges of lands lightly chipped at commencement of rifling and appear to be slightly flattened. [illegible] edge [illegible] gas [illegible] with light build up [illegible] forward [illegible] of flash suppressor, with light to heavy chipping. Chamber has been chrome plated.

ORDBG Form 2045-(R), Reinstated 9 Jul 59 (Part 1)

MULTIPLE STARGAGE MEASUREMENT & INSPECTION DATA FORM

	5.56 M/m
	BARREL
NUMBER	9041549
MODEL	XM177E2
MANUFACTURER	
CASTING NUMBER	
DATE OF GAUGING	27 JUNE 67
FIRING STATUS (Check One)	BEFORE ✓ / AFTER
NUMBER OF ROUNDS	
PROOF OFFICER	

MEASUREMENTS INDICATED IN 1/10000 OF AN INCH

DISTANCE FROM FACE OF FLASH SUPPRESSOR	LANDS. BASIC DIA. .2190" VERT.	LANDS. HORZ.	GROOVES. BASIC DIA. .2235" VERT.	GROOVES. HORZ.
3.85	.0000	.0000	.0000	+.0001
4	+.0003	0	+.0002	3
5	4	+.0003	5	5
6	4	2	5	5
7	5	2	5	5
8	6	2	3	4
9	5	2	4	4
10	4	2	4	3
11	4	2	4	3
12	-.0008	-.0010	-.0001	.0000
12.80	9	3	1	-.0001
13.05	4	3	.0000	.0000
13.25	-.0003	-.0003	.0000	+.0001

BORESCOPE (Chamber chrome plated)

Slope and straight of chamber [illegible]. Light to heavy [illegible] beginning [illegible] and [illegible] throughout [illegible]. Light [illegible] moderate [illegible] beginning at origin of rifling and [illegible] forward [illegible]. [illegible] light build up [illegible] edge. [illegible] 1.5" from muzzle forward [illegible] light to moderate longitudinal scratches, [illegible] edge [illegible] ports at flash suppressor [illegible] moderate chipping around edges. Chamber [illegible] been chrome plated.

Velocity Data

Date Fired: 11 August 1967.
Ammunition Temperature: +70°F.
Test Ammunition: 5.56-mm, M196, tracer, lot LC-12081.

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549
	2687	2749	2658
	2713	2681	2698
	2690	2717	2682
	2630	2667	2662
	2660	2672	2706
	2695	2706	2707
	2709	2668	2622
	2657	2700	2667
	2662	2664	2681
	2660	2690	2687
	2691	2658	2640
	2626	2650	2661
	2661	2680	2711
	2657	2658	2678
	2596	2644	2682
	2701	2634	2685
	2678	2629	2647
	2729	2657	2639
	2660	2674	2681
	2682	2675	2678
Average	2672	2674	2674
Maximum	2729	2749	2711
Minimum	2596	2629	2622
Extreme Variation	133	120	89
Standard Deviation	32	29	24

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 10 August 1967.
Ammunition Temperature: -65°F.
Test Ammunition: 5.56-mm, M193 ball, lot TW-18191.

	2632	2615	2533
	2626	2661	2603
	2610	2559	2524
	2603	2606	2607
	2575	2606	2588
	2636	2616	2591
	2559	2695	2532
	2643	2650	2577
	2710	2644	2650
	2564	2589	2579
	2633	2595	2584
	2597	2641	2618
	2558	2693	2650
	2584	2722	2633
	2636	2670	2670
	2619	2684	2633
	2616	2600	2665
	2626	2671	2606
	2661	2668	2661
	2644	2693	2647
Average	2617	2644	2608
Maximum	2710	2722	2670
Minimum	2558	2559	2524
Extreme Variation	152	163	146
Standard Deviation	37	44	45

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 11 August 1967.
Ammunition Temperature: +70°F.
Test Ammunition: 5.56-mm, M196 tracer, lot TW-18007.

	2704	2688	2701
	2709	2674	2713
	2665	2734	2716
	2704	2688	2701
	2677	2729	2716
	2634	2717	2709
	2677	2695	2665
	2743	2657	2714
	2716	2670	2732
	2735	2675	2711
	2706	2672	2646
	2697	2697	2717
	2661	2714	2710
	2660	2735	2674
	2655	2709	2707
	2743	2661	2720
	2685	2704	2675
	2646	2661	2625
	2687	2670	2657
	2657	2693	2707
Average	2688	2692	2696
Maximum	2743	2735	2732
Minimum	2634	2657	2625
Extreme Variation	109	78	107
Standard Deviation	32	25	29

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 11 August 1967.
Ammunition Temperature: +70°F.
Test Ammunition: 5.56-mm, M193 ball, lot LC-12194.

	2567	2662	2627
	2677	2725	2719
	2662	2665	2713
	2667	2626	2762
	2648	2704	2665
	2569	2682	2725
	2664	2657	2678
	2665	2657	2695
	2687	2721	2637
	2698	2632	2728
	2685	2707	2703
	2680	2633	2717
	2650	2674	2662
	2746	2661	2625
	2681	2621	2675
	2653	2664	2670
	2698	2661	2684
	2740	2664	2737
	2734	2714	2717
	2655	2670	
Average	2671	2670	2697
Maximum	2746	2725	2762
Minimum	2567	2621	2625
Extreme Variation	179	104	137
Standard Deviation	46	31	37

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 11 August 1967.
Ammunition Temperature: +70°F.
Test Ammunition: 5.56-mm, M193 ball, lot TW-18191.

	2700	2700	2750
	2660	2680	2749
	2703	2654	2682
	2704	2706	2709
	2711	2698	2700
	2667	2668	2688
	2737	2660	2706
	2688	2697	2657
	2693	2661	2643
	2728	2664	2671
	2710	2773	2713
	2672	2703	2741
	2665	2670	2720
	2713	2706	2710
	2680	2641	2688
	2678	2713	2707
	2694	2644	2728
	2688	2703	2725
	2671	2667	2698
	2711	2722	2636
Average	2694	2686	2701
Maximum	2737	2773	2750
Minimum	2660	2641	2636
Extreme Variation	77	132	114
Standard Deviation	21	32	32

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 9 August 1967.
Ammunition Temperature: +160°F.
Test Ammunition: 5.56-mm, M196 tracer, lot LC-12081.

	2725	2737	2719
	2707	2653	2707
	2722	2743	2674
	2719	2732	2740
	2720	2731	2728
	2710	2726	2716
	2722	2738	2716
	2741	2746	2700
	2726	2695	2735
	2693	2693	2732
	2685	2732	2674
	2709	2647	2714
	2729	2688	2747
	2722	2667	2717
	2700	2693	2719
	2688	2758	2746
	2769	2725	2707
	2726	2700	2716
	2717	2646	2710
	2680	2740	2704
Average	2715	2709	2716
Maximum	2769	2758	2747
Minimum	2680	2646	2674
Extreme Variation	89	112	73
Standard Deviation	21	35	20

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 9 August 1967.
Ammunition Temperature: +160°F.
Test Ammunition: 5.56-mm, M196 tracer, lot TW-18007.

	2697	2750	2779
	2737	2743	2775
	2823	2759	2778
	2743	2756	2787
	2750	2752	2806
	2747	2759	2809
	2746	2759	2786
	2729	2776	2811
	2772	2770	2831
	2756	2716	2795
	2807	2741	2770
	2761	2809	2769
	2744	2772	2784
	2734	2806	2752
	2792	2812	2728
	2756	2776	2772
	2725	2809	2756
	2747	2793	2844
	2755	2734	2800
	2756	2775	2828
Average	2754	2768	2788
Maximum	2823	2812	2844
Minimum	2697	2716	2728
Extreme Variation	126	96	116
Standard Deviation	28	27	28

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 10 August 1967.
Ammunition Temperature: +160°F.
Test Ammunition: 5.56-mm, M193 ball, lot LC-12194.

	2767	2731	2726
	2710	2762	2812
	2741	2740	2755
	2749	2752	2800
	2738	2716	2775
	2759	2719	2814
	2749	2775	2740
	2737	2775	2752
	2759	2738	2796
	2728	2744	2761
	2716	2694	2687
	2765	2746	2795
	2744	2725	2792
	2741	2740	2752
	2740	2758	2798
	2747	2753	2798
	2720	2765	2773
	2792	2729	2796
	2746	2770	2732
	2744	2752	2789
Average	2745	2744	2772
Maximum	2792	2775	2814
Minimum	2710	2694	2687
Extreme Variation	82	81	127
Standard Deviation	19	21	33

Date Fired: 10 August 1967.
Ammunition Temperature: +160°F.
Test Ammunition: 5.56-mm, M193 ball, lot TW-18191.

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549
	2706	2747	2762
	2761	2775	2764
	2759	2746	2800
	2743	2775	2770
	2746	2764	2752
	2770	2761	2764
	2719	2775	2765
	2732	2764	2801
	2687	2759	2747
	2755	2753	2779
	2787	2761	2822
	2769	2767	2784
	2770	2795	2792
	2781	2784	2792
	2781	2752	2815
	2752	2773	2772
	2759	2779	2752
	2750	2758	2758
	2744	2776	2781
	2756	2752	2749
Average	2751	2766	2776
Maximum	2787	2795	2822
Minimum	2687	2746	2747
Extreme Variation	100	49	75
Standard Deviation	25	13	22

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 10 August 1967.
Ammunition Temperature: -65°F.
Test Ammunition: 5.56-mm, M196 tracer, lot LC-12081.

	2518	2527	2580
	2572	2597	2612
	2641	2640	2630
	2589	2648	2572
	2606	2622	2611
	2626	2537	2655
	2623	2632	2641
	2665	2648	2600
	2678	2607	2606
	2701	2629	2637
	2428	2572	2504
	2584	2415	2632
	2490	2516	2524
	2622	2583	2550
	2619	2565	2606
	2592	2575	2619
	2532	2555	2647
	2637	2653	2595
	2563	2680	2644
	2601	2644	2637
Average	2594	2592	2605
Maximum	2701	2680	2655
Minimum	2428	2415	2504
Extreme Variation	273	265	151
Standard Deviation	65	62	41

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 10 August 1967.
Ammunition Temperature: -65°F.
Test Ammunition: 5.56-mm, M196 tracer, lot TW-18007.

	2650	2639	2600
	2665	2697	2552
	2587	2616	2561
	2650	2697	2662
	2681	2725	2677
	2629	2688	2627
	2651	2770	2665
	2694	2658	2647
	2710	2639	2647
	2729	2770	2670
	2685	2661	2603
	2597	2651	2554
	2641	2584	2647
	2654	2615	2684
	2651	2577	2634
	2694	2572	2675
	2684	2740	2687
	2677	2662	2640
	2674	2701	2550
	2648	2647	2639
Average	2663	2665	2631
Maximum	2729	2770	2687
Minimum	2587	2572	2550
Extreme Variation	142	198	137
Standard Deviation	35	58	46

	Instrumental Velocity at 78 Feet, fps		
	Gun No. 904544	Gun No. 904546	Gun No. 904549

Date Fired: 10 August 1967.
Ammunition Temperature: -65°F.
Test Ammunition: 5.56-mm, M193 ball, lot LC-12194.

	2504	2648	2637
	2519	2625	2546
	2386	2555	2577
	2580	2606	2603
	2603	2647	2579
	2610	2619	2547
	2597	2568	2599
	2632	36	2629
	2661	2672	2539
	2665	2480	2503
	2583	2693	2553
	2591	2627	2458
	2513	2579	2528
	2622	2537	2591
	2585	2654	2585
	2547	2596	2554
	2514	2660	2665
	2575	2630	2675
	2564	2701	2618
	2533	2654	
Average	2569	2619	2578
Maximum	2665	2701	2675
Minimum	2386	2480	2458
Extreme Variation	279	221	217
Standard Deviation	64	54	54

Mann Barrel Target and Velocity Data

Mann-barrel target measurements and velocity data for ammunition types A, B, C, D, and reference lots. Velocities are listed for the round number as fired; however, the round numbers do not necessarily agree with the target coordinate measurements since these were obtained from the group of shots.

Ammunition: Cartridge, 5.56-mm, ball, M193, lot TW-18191 (type D).
Ammunition Temperature: +70°F.
Weapon: Remington model 700 with accuracy Mann barrel No. 34169.
Previous Round Count: 13.
Date Fired: 17 November 1967.

Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert	Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert
1	3193	3108	+5.3	+1.3	26	3130	3040	+4.6	+2.1
2	3108	3020	+6.0	+1.6	27	3152	3061	+4.4	+2.1
3	3187	3103	+5.5	+1.9	28	3172	3085	+5.3	+2.5
4	3155	3071	+5.4	+1.9	29	3102	3018	+6.0	+3.0
5	3175	3089	+5.0	+2.1	30	3151	3065	+4.3	+3.0
6	3176	3089	+5.1	+2.4	31	3104	3019	+5.6	+2.0
7	3206	3120	+5.2	+2.6	32	3138	3054	+4.3	+2.2
8	3172	3082	+4.5	+2.6	33	3184	3094	+4.0	+2.4
9	3147	3062	+4.6	+2.9	34	3158	3073	+4.5	+2.5
10	3144	3062	+5.5	+3.3	35	3117	3028	+5.1	+2.7
11	3120	3030	+5.1	+1.2	36	3166	3077	+5.2	+2.8
12	3154	3068	+5.0	+1.6	37	3179	3090	+4.4	+2.9
13	3189	3101	+4.2	+1.6	38	3154	3069	+4.0	+3.1
14	3127	3036	+3.7	+2.0	39	3160	3073	+4.9	+3.2
15	3224	3138	+5.2	+2.1	40	3202	3107	+5.2	+3.4
16	3164	3078	+4.9	+2.1	41	3183	3095	+4.3	+1.7
17	3176	3085	+5.1	+2.4	42	3169	3082	+4.0	+1.8
18	3230	3143	+5.3	+2.6	43	3125	3037	+4.6	+2.0
19	3180	3095	+3.9	+2.7	44	3135	3053	+4.7	+2.1
20	3157	3070	+5.0	+3.6	45	3173	3085	+4.8	+2.1
21	3164	3076	+4.6	+1.4	46	3144	3046	+3.2	+2.3
22	3137	3053	+5.0	+2.0	47	3154	3060	+4.1	+2.6
23	3142	3055	+5.3	+2.1	48	3158	3073	+4.2	+2.6
24	3178	3095	+5.1	+2.1	49	3152	3070	+4.1	+2.7
25	3114	3031	+4.9	+2.2	50	3154	3069	+5.1	+3.1

Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert	Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert

Ammunition: Cartridge,5.56-mm, ball, M193,lot LC-12194 (type C).
Ammunition Temperature: +70°F.
Weapon: Remington model 700 with accuracy Mann barrel No. 34169.
Previous Round Count: 64.

1	3213	3123	+4.2	+1.5	26	3199	3113	+5.1	+2.3
2	3237	3150	+4.4	+1.6	27	3179	3097	+4.7	+2.3
3	3162	3078	+4.9	+1.9	28	3195	3112	+4.5	+2.4
4	3146	3061	+4.3	+2.0	29	3160	3073	+4.7	+2.5
5	3234	3143	+4.5	+2.1	30	3208	3110	+5.0	+2.6
6	3187	3103	+4.5	+2.1	31	3216	3128	+3.5	+1.7
7	3135	3045	+4.4	+2.4	32	3205	3117	+4.9	+2.1
8	3230	3142	+4.1	+2.6	33	3148	3061	+5.7	+2.2
9	3207	3123	+4.8	+2.7	34	3203	3117	+4.0	+2.3
10	3225	3137	+4.4	+3.2	35	3223	3133	+4.1	+2.4
11	3219	3135	+4.2	+1.5	36	3251	3164	+4.1	+2.6
12	3173	3079	+3.1	+1.7	37	3211	3124	+4.7	+2.5
13	3216	3128	+4.5	+1.9	38	3182	3093	+5.1	+2.5
14	3231	3142	+5.2	+1.9	39	3207	3120	+5.6	+2.5
15	3217	3124	+5.0	+2.1	40	3224	3136	+5.3	+2.8
16	3242	3149	+4.6	+2.1	41	3233	3148	+5.6	+1.5
17	3188	3101	+3.7	+2.2	42	3264	3179	+3.5	+1.5
18	3213	3124	+4.8	+2.4	43	3203	3105	+5.2	+1.7
19	3175	3087	+4.1	+2.5	44	3189	3095	+4.6	+1.7
20	3187	3096	+4.9	+3.4	45	3234	3141	+4.5	+2.0
21	3302	3213	+4.5	+1.4	46	3183	3100	+4.9	+2.4
22	3135	3053	+6.2	+1.6	47	3181	3095	+4.9	+2.6
23	3150	3066	+5.0	+1.9	48	3218	3125	+4.6	+2.6
24	3221	3131	+4.8	+1.9	49	3238	3150	+5.2	+3.4
25	3202		+4.9	+2.0	50	3175	3091	+4.3	+4.0

Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert	Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert

Ammunition: Cartridge, 5.56-mm, tracer, M196, lot TW-18007 (type B).
Ammunition Temperature: +70°F.
Weapon: Remington model 700 with accuracy Mann barrel No. 34169.
Previous Round Count: 114.

1	3133	3046	+6.2	+1.6	26	3157	3062	+5.5	+2.3
2	3205	3118	+5.5	+1.9	27	3136	3040	+4.9	+2.6
3	3176	3087	+5.8	+2.0	28	3116	3057	+5.2	+2.7
4	3138	3071	+6.1	+2.3	29	3169	3070	+3.0	+4.2
5	3168	3071	+5.6	+2.6	30	3161	3077	+3.4	+5.2
6	3192	3109	+6.3	+3.1	31	3137	3053	+3.5	-2.1
7	3167	3076	+7.0	+3.5	32	3123	3023	+6.5	-0.7
8	3108	3014	+6.2	+3.3	33	3113	3016	+5.9	-0.4
9	3179	3083	+3.9	+3.4	34	3117	3060	+4.5	+0.8
10	3137	3055	+5.8	+3.7	35	3148	3079	+5.9	+0.9
11	3130	3056	+4.9	+1.0	36	3161	3055	+5.5	+1.5
12	3121	3039	+5.4	+1.2	37	3141	3078	+4.4	+2.9
13	3129	3040	+5.6	+1.3	38	3133	3041	+3.9	+3.1
14	3123	3023	+5.6	+1.5	39	3168	3069	+4.6	+3.6
15	3163	3081	+7.2	+1.7	40	3135	3039	+9.7	+3.8
16	3187	3100	+4.9	+1.8	41	3154	3054	+5.3	+1.0
17	3108	3045	+6.0	+2.1	42	3161	3098	+6.5	+1.1
18	3133	3031	+5.0	+2.2	43	3170	3085	+4.7	+1.7
19	3155	3073	+5.0	+3.1	44	3131	3049	+4.2	+1.6
20	3132	3040	+5.9	+3.8	45	3196	3100	+4.3	+1.8
21	3173	3075	+4.8	+0.6	46	3144	3077	+5.9	+2.2
22	3140	3054	+3.6	+1.0	47	3171	3084	+7.3	+2.6
23	3150	3069	+6.7	+1.3	48	3126	3041	+5.0	+2.6
24	3121	3028	+4.7	+1.8	49	3148	3064	+5.1	+2.9
25	3076	3016	+3.6	+1.8	50	3158	3069	+3.2	+4.3

Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert	Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert

Ammunition: Cartridge,5.56-mm, ball, M193,lot LC-Y-5.56-501 (reference).
Ammunition Temperature: +70°F.
Weapon: Remington model 700 with accuracy Mann barrel No. 34169.
Previous Round Count: 164.

1	3228	3135	+5.1	+1.8	26	3190	3108	+6.2	+2.0
2	3206	3124	+5.2	+2.0	27	3176	3085	+5.0	+2.1
3	3184	3096	+5.3	+2.4	28	3191	3096	+5.2	+2.1
4	3193	3103	+5.9	+2.4	29	3188	3107	+4.5	+2.4
5	3209	3113	+5.7	+2.5	30	3179	3097	+6.1	+2.5
6	3129	3036	+6.5	+2.6	31	3230	3147	+4.6	+1.2
7	3192	3108	+5.8	+2.7	32	3252	3162	+5.1	+1.4
8	3159	3075	+5.0	+3.1	33	3175	3088	+4.8	+1.5
9	3223	3133	+4.6	+3.2	34	3208	3123	+4.9	+1.7
10	3146	3062	+5.5	+3.6	35	3220	3129	+5.4	+1.9
11	3219	3133	+4.5	+1.0	36	3222	3135	+5.3	+2.3
12	3164	3082	+3.7	+1.3	37	3231	3145	+5.4	+2.4
13	3167	3087	+4.9	+1.3	38	3192	3100	+5.3	+2.6
14	3221	3136	+4.9	+1.4	39	3196	3115	+3.8	+2.2
15	3183	3101	+4.6	+2.0	40	3231	3133	+3.5	+2.4
16	3196	3115	+4.7	+2.2	41	3191	3103	+4.6	+1.5
17	3194	3105	+5.0	+2.3	42	3197	3113	+4.1	+1.6
18	3203	3119	+5.5	+2.3	43	3229	3144	+3.6	+1.9
19	3213	3124	+4.9	+2.4	44	3209	3123	+3.3	+2.0
20	3212	3126	+4.9	+2.8	45	3212	3124	+4.1	+2.1
21	3209	3124	+4.6	+0.6	46	3244	3161	+4.8	+2.0
22	3189	3092	+4.0	+1.1	47	3257	3169	+3.8	+2.2
23	3199	3113	+5.6	+1.1	48	3204	3116	+3.8	+2.6
24	3192	3109	+4.7	+1.9	49	3194	3110	+4.8	+2.6
25	3165	3074	+4.0	+2.0	50	3238	3152	+4.6	+2.8

Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert	Rd No.	Instrumental Velocity at 15 Ft	78 Ft	TM from AIP, in. Hor	Vert

Ammunition: Cartridge, 5.56-mm, tracer, M196, lot LC-12081 (type A).
Ammunition Temperature: +70°F.
Weapon: Remington model 700 with accuracy Mann barrel No. 34169.
Previous Round Count: 214.

1	3177	3082	+4.4	-0.7	26	3108	3023	+3.6	+2.0
2	3093	3007	+5.4	+0.5	27	3084	3031	+5.2	+2.1
3	3138	3056	+3.4	+1.6	28	3135	3039	+5.2	+2.2
4	3135	3038	+5.2	+2.5	29	3114	3019	+6.0	+2.8
5	3103	3001	+6.6	+2.8	30	3124	3027	+6.6	+3.9
6	3140	3040	+4.9	+2.7	31	3162	3064	+5.6	-1.2
7	3155	3068	+3.0	+3.0	32	3039	2945	+5.1	+0.9
8	3138	3038	+5.4	+3.6	33	3136	3046	+4.5	+2.1
9	3099	2998	+7.7	+3.9	34	3112	3015	+4.2	+2.2
10	3130	3050	+6.6	+4.1	35	3113	3065	+5.9	+2.3
11	3139	3043	+5.1	-0.2	36	3154	3070	+4.7	+2.8
12	3111	3021	+6.0	+0.1	37	3158	3074	+4.2	+2.9
13	3127	3045	+8.5	+0.1	38	3140	3047	+5.9	+3.4
14	3091	3014	+2.2	+0.8	39	3149	3073	+4.0	+4.3
15	3082	2989	+4.5	+1.1	40	3092	3002	+5.3	+4.4
16	3107	3043	+6.5	+2.0	41	3147	3061	+6.9	-0.6
17	3115	3022	+4.8	+2.5	42	3129	3030	+5.3	+0.7
18	3127	3023	+5.8	+2.7	43	3076	3012	+3.3	+1.1
19	3110	3009	+4.2	+2.9	44	3103	3015	+4.0	+1.6
20	3092	3032	+5.1	+5.4	45	3100	3007	+3.9	+2.1
21	3098	3049	+5.9	-0.9	46	3132	3048	+5.7	+3.1
22	3114	3033	+5.6	+0.4	47	3067	2970	+4.1	+3.5
23	3101	3014	+4.9	+0.6	48	3128	3034	+2.5	+3.7
24	3130	3083	+6.1	+0.9	49	3109	3016	+5.5	+4.2
25	3173	3080	+5.7	+1.1	50	3101	3005	+6.8	+4.3

TM = Target measurements.
AIP = Arbitrary index point.

Target Data Identification

Target No.	Lot No.	Range
1.00 thru 9.00	LC-12081	1000 inches
10.00 thru 18.00	TW-18007	1000 inches
19.00 thru 27.00	LC-12194	1000 inches
28.00 thru 36.00	TW-18191	1000 inches
37.00 thru 45.00	LC-12081	50 meters
46.00 thru 54.00	TW-18007	50 meters
55.00 thru 63.00	LC-12194	50 meters
64.00 thru 72.00	TW-18191	50 meters
73.00 thru 81.00	LC-12081	100 meters
82.00 thru 90.00	TW-18007	100 meters
91.00 thru 99.00	LC-12194	100 meters
100.00 thru 108.00	TW-18191	100 meters
109.00 thru 117.00	LC-12081	200 meters
118.00 thru 126.00	TW-18007	200 meters
127.00 thru 135.00	LC-12194	200 meters
136.00 thru 144.00	TW-18191	200 meters
145.00 thru 153.00	LC-12081	400 meters
154.00 thru 162.00	TW-18007	400 meters
163.00 thru 171.00	LC-12194	400 meters
172.00 thru 180.00	TW-18191	400 meters

Note: For each set of nine targets, the first three were fired with gun No. 904544, the second three with gun No. 904546, and the third with gun No. 904549.

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
1.00	2.2	.5	.6	3.3	.7	.9	3.6	.9	.5	-1.2
2.00	2.7	.8	1.0	3.2	.7	.9	3.3	1.2	.7	-1.9
3.00	5.8	1.8	2.1	3.6	.6	.9	5.9	2.1	1.3	-2.0
mean	3.6	1.0	1.2	3.4	.7	.9	4.3	1.4	.8	-1.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
4.00	4.5	1.1	1.4	1.6	.5	.6	4.5	1.2	-1.1	-1.5
5.00	4.0	1.0	1.3	1.6	.4	.5	4.0	1.2	-1.9	-1.7
6.00	3.2	.7	1.0	2.4	.6	.7	3.3	1.0	-1.3	-1.4
mean	3.9	.9	1.2	1.9	.5	.6	3.9	1.1	-1.4	-1.5

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
7.00	8.6	1.4	2.5	5.7	1.1	1.6	9.8	1.9	.1	-1.6
8.00	2.6	.7	.9	1.9	.6	.7	2.8	1.0	-.2	-.4
9.00	3.0	.7	.9	1.5	.4	.5	3.0	.8	.0	-.0
mean	4.7	.9	1.4	3.0	.7	.9	5.2	1.2	-.0	-.7
aver.	4.1	1.0	1.3	2.8	.6	.8	4.5	1.2	-.2	-1.3

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
10.00	3.9	.6	1.1	4.1	.9	1.2	5.3	1.2	.4	-1.4
11.00	3.5	.7	1.0	3.7	1.0	1.2	4.0	1.4	1.3	-1.6
12.00	4.2	.7	1.2	4.7	1.1	1.4	4.8	1.4	1.4	-1.7
mean	3.9	.7	1.1	4.2	1.0	1.3	4.7	1.3	1.0	-1.6

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
13.00	3.4	.8	1.0	2.8	.7	.9	4.0	1.1	-.7	-1.6
14.00	3.6	1.0	1.2	4.8	1.2	1.5	4.8	1.7	-.1	-2.1
15.00	3.8	.6	1.0	2.5	.8	.9	3.8	1.2	-.2	-2.5
mean	3.6	.8	1.1	3.4	.9	1.1	4.2	1.3	-.3	-2.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
16.00	4.6	1.0	1.3	2.5	.6	.7	4.7	1.2	-.3	-1.3
17.00	3.7	.9	1.1	2.1	.7	.8	3.8	1.1	-.3	-1.9
18.00	1.6	.4	.5	2.3	.6	.7	2.5	.8	.1	-1.5
mean	3.3	.8	1.0	2.3	.6	.8	3.7	1.1	-.2	-1.5
aver.	3.6	.7	1.0	3.3	.8	1.0	4.2	1.2	.2	-1.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
19.00	2.1	.6	.7	1.4	.4	.5	2.3	.8	.5	-1.0
20.00	2.4	.6	.7	3.1	.6	.9	3.3	1.0	.5	-1.0
21.00	1.6	.3	.4	2.3	.6	.7	2.3	.7	.1	-1.1
mean	2.0	.5	.6	2.3	.5	.7	2.6	.8	.4	-1.0

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
22.00	1.8	.4	.5	1.8	.5	.6	2.0	.7	-.1	-.8
23.00	1.7	.3	.4	2.1	.5	.6	2.2	.6	-.3	-1.2
24.00	2.2	.7	.8	1.4	.4	.5	2.3	.9	-.2	-1.4
mean	1.9	.5	.6	1.8	.5	.6	2.2	.7	-.2	-1.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
25.00	.8	.2	.3	.8	.2	.3	1.0	.3	-.0	-1.3
26.00	1.0	.2	.3	.9	.2	.3	1.2	.4	.1	-1.6
27.00	1.3	.4	.4	1.5	.3	.4	1.7	.5	.3	-1.2
mean	1.0	.3	.3	1.1	.3	.3	1.3	.4	.1	-1.4
aver.	1.7	.4	.5	1.7	.4	.5	2.0	.6	.1	-1.2

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
28.00	1.4	.4	.5	1.0	.2	.3	1.4	.5	.4	-.4
29.00	.9	.3	.4	1.0	.2	.3	1.2	.4	.6	-.5
30.00	1.7	.4	.5	.9	.3	.3	1.7	.5	.4	-.7
mean	1.3	.4	.4	1.0	.2	.3	1.4	.5	.5	-.5

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
31.00	2.1	.6	.7	1.3	.3	.4	2.1	.7	-.6	-.6
32.00	1.2	.3	.4	1.7	.4	.5	1.7	.6	-.3	-.2
33.00	1.7	.5	.6	1.5	.4	.5	2.1	.7	-.3	-.2
mean	1.7	.4	.6	1.5	.4	.5	2.0	.7	-.4	-.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
34.00	1.4	.4	.5	.9	.2	.3	1.5	.5	-.0	-1.5
35.00	1.2	.3	.4	1.1	.3	.4	1.2	.5	-.0	-1.2
36.00	1.4	.5	.6	.8	.2	.2	1.4	.6	.1	-1.2
mean	1.3	.4	.5	.9	.2	.3	1.4	.5	.0	-1.3
aver.	1.4	.4	.5	1.1	.3	.4	1.6	.5	.0	-.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
37.00	4.4	1.2	1.4	7.3	1.9	2.4	7.5	2.5	2.6	-.2
38.00	6.9	1.6	2.1	5.4	.9	1.4	7.0	2.0	.4	.5
39.00	7.0	2.0	2.6	6.0	1.4	1.9	8.8	2.5	.9	-.4
mean	6.1	1.6	2.0	6.2	1.4	1.9	7.8	2.3	1.3	-.0

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
40.00	10.5	2.2	2.9	2.4	.6	.8	10.5	2.4	-1.8	.5
41.00	10.8	2.8	3.7	2.6	.7	.9	10.9	3.0	-3.9	-.1
42.00	11.5	2.1	3.1	5.7	1.4	1.8	11.8	2.8	-2.2	-.1
mean	10.9	2.3	3.2	3.6	.9	1.2	11.1	2.7	-2.6	.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
43.00	3.4	.9	1.2	3.2	.8	1.0	4.3	1.3	.3	.0
44.00	9.1	1.7	2.6	5.6	1.4	1.8	9.1	2.5	-.7	4.3
45.00	4.3	.9	1.3	5.4	1.3	1.7	5.5	1.8	-.9	2.3
mean	5.6	1.2	1.7	4.7	1.1	1.5	6.3	1.9	-.4	2.2
aver.	7.5	1.7	2.3	4.8	1.2	1.5	8.4	2.3	-.6	.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
46.00	5.2	1.2	1.6	5.2	1.3	1.7	5.2	2.0	2.8	-.9
47.00	5.6	1.2	1.6	5.3	1.1	1.5	5.9	1.8	2.3	1.0
48.00	3.7	1.1	1.4	5.6	1.4	1.7	6.4	1.9	3.2	-2.6
mean	4.8	1.1	1.5	5.4	1.3	1.7	5.9	1.9	2.8	-.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
49.00	6.2	1.7	2.1	4.5	1.4	1.6	7.5	2.3	-1.9	-1.8
50.00	6.3	2.3	2.6	6.1	1.4	1.8	8.6	2.8	-.9	-2.4
51.00	5.5	1.8	2.1	7.2	1.2	2.0	7.2	2.4	.7	-1.6
mean	6.0	2.0	2.3	5.9	1.3	1.8	7.8	2.5	-.7	-1.9

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
52.00	8.6	1.8	2.5	6.3	1.5	1.9	10.7	2.3	-.2	-.8
53.00	5.9	1.6	2.0	5.5	1.3	1.6	6.4	2.2	-2.0	-1.3
54.00	3.6	1.1	1.4	5.0	1.2	1.6	5.1	1.7	.6	-2.0
mean	6.0	1.5	1.9	5.6	1.3	1.7	7.7	2.1	-.5	-1.4
aver.	5.6	1.5	1.9	5.6	1.3	1.7	7.1	2.2	.5	-1.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
55.00	3.0	.9	1.1	3.7	.9	1.2	3.7	1.4	.4	.9
56.00	3.3	.8	1.0	2.4	.7	.8	3.3	1.2	.8	.2
57.00	3.3	.7	.9	3.1	.9	1.1	3.8	1.2	.1	-.4
mean	3.2	.8	1.0	3.1	.8	1.0	3.6	1.3	.4	.2

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
58.00	2.5	.5	.7	3.6	.8	1.1	3.6	1.1	-.9	-.2
59.00	4.7	1.3	1.6	3.2	.7	.9	4.7	1.6	-.5	-1.3
60.00	4.4	.9	1.3	3.5	.8	1.1	4.8	1.3	.5	-1.2
mean	3.9	.9	1.2	3.4	.8	1.0	4.4	1.3	-.3	-.9

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
61.00	1.8	.4	.6	3.0	.8	.9	3.1	1.0	-.0	-.6
62.00	3.2	.8	1.0	1.3	.3	.4	3.3	.9	-.3	-.7
63.00	1.1	.3	.4	2.7	.7	.8	2.8	.8	.5	-.4
mean	2.0	.5	.7	2.3	.6	.7	3.0	.9	.1	-.6
aver.	3.0	.7	1.0	2.9	.7	.9	3.7	1.2	.1	-.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
64.00	1.8	.6	.7	2.2	.4	.6	2.2	.8	.7	1.3
65.00	2.3	.5	.7	2.3	.7	.8	3.0	.9	.6	1.2
66.00	2.3	.6	.8	1.7	.4	.5	2.4	.8	1.1	1.3
mean	2.1	.6	.7	2.1	.5	.6	2.6	.8	.8	1.3

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
67.00	2.3	.5	.7	1.7	.4	.5	2.3	.7	-.4	.6
68.00	2.4	.5	.7	3.3	.7	.9	3.9	.9	-1.2	1.0
69.00	3.9	.8	1.2	2.5	.6	.8	4.0	1.1	-.0	.7
mean	2.9	.6	.8	2.5	.6	.7	3.4	.9	-.5	.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
70.00	2.5	.7	.8	2.8	.4	.8	3.0	.9	.1	-.3
71.00	2.4	.8	.9	1.0	.3	.4	2.5	.9	-.5	-.6
72.00	2.6	.6	.8	3.2	.5	.8	3.2	.9	.1	-1.0
mean	2.5	.7	.9	2.3	.4	.7	2.9	.9	-.1	-.6
aver.	2.5	.6	.8	2.3	.5	.7	3.0	.9	.0	.5

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
73.00	8.2	1.9	2.5	15.6	2.7	4.5	15.8	3.8	2.2	2.3
74.00	13.1	2.5	3.7	9.5	1.8	2.6	13.2	3.5	2.8	4.3
75.00	12.9	2.9	4.0	5.8	1.4	1.8	12.9	3.5	1.0	4.0
mean	11.4	2.5	3.4	10.3	2.0	3.0	14.0	3.6	2.0	3.5

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
76.00	14.3	4.1	4.8	11.6	2.4	3.3	14.7	5.2	-5.0	.4
77.00	14.3	3.3	4.5	21.0	3.9	6.0	21.0	5.9	-2.9	2.1
78.00	17.4	3.5	5.2	13.3	3.8	4.4	17.9	5.8	-4.0	4.5
mean	15.3	3.7	4.9	15.3	3.3	4.6	17.8	5.6	-4.0	2.3

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
79.00	10.8	2.7	3.6	5.4	1.7	2.0	10.8	3.5	-1.1	1.4
80.00	10.2	3.0	3.4	7.8	1.7	2.3	10.6	3.7	-.4	5.6
81.00	11.5	2.2	3.3	16.2	2.8	4.2	16.6	4.0	1.7	3.4
mean	10.8	2.6	3.5	9.8	2.1	2.9	12.7	3.7	.1	3.4
aver.	12.5	2.9	3.9	11.8	2.5	3.5	14.8	4.3	-.6	3.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
82.00	9.7	2.6	3.2	12.4	2.7	3.8	15.0	4.2	5.5	-3.4
83.00	14.4	4.4	5.3	9.0	3.3	3.8	16.8	5.9	4.4	-.8
84.00	14.0	5.1	5.9	15.8	3.9	5.0	17.5	6.8	3.5	-1.6
mean	12.7	4.0	4.8	12.4	3.3	4.2	16.4	5.6	4.5	-1.9

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
85.00	15.2	3.6	4.7	17.0	3.9	4.9	18.2	5.8	-.3	-1.8
86.00	15.6	4.1	5.0	9.6	2.6	3.2	16.7	5.2	-1.0	-2.1
87.00	13.1	3.2	4.2	20.3	4.3	6.2	23.3	5.8	.9	-4.2
mean	14.6	3.7	4.6	15.6	3.6	4.8	19.4	5.6	-.2	-2.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
88.00	10.2	2.4	3.1	6.2	1.6	2.0	10.3	3.2	-2.4	4.0
89.00	10.6	2.1	3.1	14.6	2.8	4.1	15.7	3.8	-3.2	1.6
90.00	10.2	2.7	3.2	8.3	2.5	3.1	13.1	3.9	-1.9	-2.6
mean	10.3	2.4	3.1	9.7	2.3	3.1	13.0	3.6	-2.5	1.0
aver.	12.6	3.4	4.2	12.6	3.1	4.0	16.3	4.9	.6	-1.2

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
91.00	4.0	.8	1.2	4.2	1.1	1.4	4.7	1.5	1.0	3.0
92.00	5.2	1.5	1.8	7.8	1.5	2.2	8.1	2.4	1.0	2.3
93.00	7.0	1.7	2.1	6.7	1.6	2.0	8.0	2.4	.2	3.0
mean	5.4	1.3	1.7	6.2	1.4	1.9	6.9	2.1	.7	2.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
94.00	9.4	2.0	2.8	8.8	2.2	2.7	11.3	3.3	-.4	4.0
95.00	13.3	3.2	4.0	8.3	1.9	2.5	13.5	4.0	-.0	2.8
96.00	5.8	1.6	2.0	7.6	1.9	2.5	8.5	2.6	1.8	1.1
mean	9.5	2.3	2.9	8.2	2.0	2.5	11.1	3.3	.5	2.6

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
97.00	5.5	1.4	1.8	3.8	1.0	1.3	5.7	1.8	-.6	-.1
98.00	4.3	1.5	1.7	2.7	.7	.9	4.4	1.7	.2	.8
99.00	6.5	1.4	1.8	4.1	1.0	1.2	6.5	1.8	.8	1.7
mean	5.4	1.4	1.8	3.5	.9	1.1	5.5	1.8	.1	.8
aver.	6.8	1.7	2.1	6.0	1.4	1.9	7.8	2.4	.4	2.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
100.00	3.6	1.0	1.2	6.4	1.3	1.8	6.5	1.8	.2	2.6
101.00	4.6	1.0	1.4	6.0	1.4	1.8	6.7	1.9	.5	3.7
102.00	3.5	1.1	1.3	5.9	1.1	1.6	6.8	1.7	1.3	2.3
mean	3.9	1.0	1.3	6.1	1.3	1.7	6.7	1.8	.7	2.9

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
103.00	11.7	2.4	3.3	3.9	.7	1.1	11.7	2.7	-.9	2.4
104.00	5.3	1.5	1.9	3.4	1.1	1.3	5.6	2.0	-2.4	5.6
105.00	6.1	1.3	1.7	3.4	.9	1.1	7.0	1.7	-1.6	4.1
mean	7.7	1.7	2.3	3.6	.9	1.1	8.1	2.1	-1.6	4.0

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
106.00	4.6	1.2	1.5	3.4	1.0	1.2	4.7	1.7	-.2	.1
107.00	3.4	.7	1.0	2.2	.6	.7	3.5	1.1	-.5	-.4
108.00	4.6	1.5	1.7	5.2	1.3	1.6	6.9	2.0	.5	-1.2
mean	4.2	1.1	1.4	3.6	1.0	1.2	5.0	1.6	-.1	-.5
aver.	5.3	1.3	1.7	4.4	1.0	1.4	6.6	1.8	-.3	2.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
109.00	28.0	7.5	9.0	39.7	6.5	10.4	39.7	11.3	9.7	-3.4
110.00	22.6	5.3	7.3	18.7	4.2	5.7	28.6	7.0	6.7	-3.7
111.00	42.5	10.7	13.5	35.5	6.6	9.8	46.6	13.1	8.0	1.5
mean	31.0	7.8	9.9	31.3	5.7	8.6	38.3	10.5	8.1	-1.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
112.00	24.3	5.3	7.2	52.4	9.2	15.2	55.0	11.7	-12.5	-3.2
113.00	34.9	6.5	10.3	46.1	7.8	12.8	53.4	11.6	-12.8	-.5
114.00	52.8	10.9	14.8	25.6	6.0	7.8	54.7	13.6	-8.1	-1.8
mean	37.3	7.6	10.8	41.4	7.7	11.9	54.4	12.3	-11.1	-1.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
115.00	22.3	5.3	6.9	22.3	4.7	6.3	23.2	7.9	-3.0	2.3
116.00	21.4	5.9	7.0	25.0	5.0	7.4	26.8	8.7	1.3	2.7
117.00	48.6	8.3	13.5	35.3	6.9	9.5	57.1	11.5	3.8	3.4
mean	30.8	6.5	9.1	27.5	5.5	7.8	35.7	9.4	.7	2.8
aver.	33.0	7.3	10.0	33.4	6.3	9.4	42.8	10.7	-.8	-.3

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
118.00	20.3	6.6	8.0	38.1	7.2	10.6	43.2	10.6	6.9	-1.1
119.00	21.3	5.8	7.1	23.9	6.5	7.9	28.0	8.9	9.0	.4
120.00	30.8	7.7	9.6	28.2	6.1	8.0	30.9	11.0	4.2	-9.4
mean	24.1	6.7	8.2	30.1	6.6	8.8	34.0	10.2	6.7	-3.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
121.00	36.8	9.0	11.1	17.2	5.0	5.9	37.0	11.0	-7.6	-10.0
122.00	36.4	9.8	11.4	28.1	5.2	7.6	37.8	12.1	2.3	-11.4
123.00	19.0	5.2	6.4	23.9	6.5	8.1	27.6	8.8	-.1	-9.2
mean	30.7	8.0	9.6	23.1	5.5	7.2	34.1	10.6	-1.8	-10.2

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
124.00	46.8	7.9	12.3	46.1	7.2	12.4	57.8	12.0	1.9	-.7
125.00	23.5	6.6	8.4	16.9	4.1	5.4	28.9	8.0	-2.2	-1.1
126.00	19.7	4.2	5.8	22.7	5.2	6.8	25.8	7.1	-4.1	-4.4
mean	30.0	6.3	8.8	28.6	5.5	8.2	37.5	9.0	-1.5	-2.1
aver.	28.3	7.0	8.9	27.2	5.9	8.1	35.2	9.9	1.1	-5.2

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
127.00	10.3	2.6	3.3	9.1	2.1	2.7	10.3	3.8	5.4	-.8
128.00	11.7	3.8	4.3	10.7	2.1	3.0	11.7	4.7	-.4	-.8
129.00	12.1	2.6	3.7	9.8	2.5	3.1	13.7	3.9	-1.1	-.6
mean	11.4	3.0	3.8	9.9	2.2	2.9	11.9	4.1	1.3	-.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
130.00	16.0	3.8	5.1	5.8	1.5	1.8	16.0	4.4	-6.6	-.5
131.00	17.5	3.8	5.1	13.9	3.6	4.5	17.8	6.0	-6.1	-6.7
132.00	16.0	4.3	5.4	8.7	2.8	3.2	16.3	5.5	.6	-7.6
mean	16.5	4.0	5.2	9.5	2.6	3.2	16.7	5.3	-4.0	-4.9

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
133.00	7.0	2.0	2.4	8.4	2.6	3.1	10.3	3.5	2.2	-2.7
134.00	7.7	1.4	2.1	10.5	2.3	3.1	10.5	3.0	-.4	-4.1
135.00	9.0	2.0	2.8	8.1	2.4	2.8	10.6	3.5	2.4	-.8
mean	7.9	1.8	2.5	9.0	2.4	3.0	10.5	3.4	1.7	-2.5
aver.	11.9	2.9	3.8	9.4	2.4	3.0	13.0	4.3	-.4	-2.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
136.00	10.7	2.9	3.7	8.2	1.9	2.5	11.9	3.9	3.0	1.9
137.00	7.8	2.2	2.9	9.8	2.4	3.2	12.4	3.5	2.1	3.9
138.00	6.3	1.7	2.0	11.0	3.0	3.7	11.5	3.6	3.4	5.1
mean	8.3	2.3	2.9	9.7	2.5	3.1	11.9	3.7	2.8	3.6

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
139.00	16.3	3.8	4.8	7.5	2.2	2.7	17.0	4.8	-6.0	4.7
140.00	10.6	2.3	3.0	10.3	2.3	3.7	12.1	4.1	-6.3	3.1
141.00	7.1	1.7	2.3	11.2	2.1	3.1	11.4	3.1	-5.9	6.8
mean	11.3	2.6	3.4	9.7	2.4	3.2	13.5	4.0	-6.0	4.9

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
142.00	11.8	2.9	3.8	4.3	1.0	1.3	11.9	3.3	.7	-4.9
143.00	13.0	3.1	4.0	8.8	2.3	3.0	14.5	4.3	3.2	-4.5
144.00	13.6	2.9	4.0	6.1	2.1	2.4	14.7	3.7	1.1	-6.4
mean	12.8	3.0	3.9	6.4	1.8	2.2	13.7	3.8	1.7	-5.2
aver.	10.8	2.6	3.4	8.6	2.2	2.8	13.0	3.8	-.5	1.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
145.00	70.1	12.3	18.5	52.0	13.4	16.3	70.7	20.0	10.8	-23.6
146.00	71.0	15.6	21.1	44.9	11.5	14.6	71.3	20.3	5.1	-12.3
147.00	43.9	12.8	15.4	47.6	11.8	15.6	53.5	18.8	-1.8	-7.3
mean	61.7	13.5	18.3	48.2	12.2	15.5	65.2	19.7	4.7	-14.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
148.00	45.8	11.3	14.6	62.9	11.9	17.7	67.0	18.5	-20.8	-9.4
149.00	53.3	9.7	14.2	53.2	12.5	16.8	57.6	17.3	-25.8	-9.2
150.00	59.4	14.7	19.1	63.1	14.1	19.1	70.7	22.7	-20.8	-18.5
mean	52.8	11.9	16.0	59.7	12.8	17.9	65.1	19.5	-22.5	-12.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
151.00	26.9	5.3	7.5	36.6	8.5	10.8	36.6	11.7	8.9	-.1
152.00	42.4	7.7	11.1	45.8	12.5	15.7	50.4	16.5	19.3	-.1
153.00	45.4	14.1	15.9	29.1	5.3	7.7	45.7	15.9	9.9	4.6
mean	38.2	9.0	11.5	37.2	8.8	11.4	44.2	14.7	12.7	1.4
aver.	50.9	11.5	15.3	48.4	11.3	14.9	58.2	18.0	-1.7	-8.5

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
154.00	31.1	8.4	10.3	40.1	8.1	12.0	47.7	12.9	4.6	-23.3
155.00	64.2	15.0	19.1	35.6	8.4	10.9	67.9	18.9	1.9	-16.9
156.00	43.3	10.4	13.9	42.9	8.7	12.3	54.1	15.1	4.9	-16.3
mean	46.2	11.3	14.4	39.5	8.4	11.8	56.5	15.7	3.8	-18.8

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
157.00	61.0	17.1	21.5	44.3	9.8	13.3	61.6	21.6	-21.6	-21.6
158.00	51.4	16.6	19.3	31.0	8.5	10.7	54.8	20.1	-17.3	-24.1
159.00	57.2	11.1	15.7	53.7	7.3	13.1	57.6	16.3	-10.4	-18.9
mean	56.5	14.9	18.8	43.0	8.5	12.4	58.0	19.4	-16.4	-21.5

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
160.00	53.1	11.6	15.5	54.0	12.5	16.3	62.9	18.5	8.8	-9.3
161.00	51.9	10.8	14.7	35.1	9.4	11.5	51.9	15.2	7.5	-9.9
162.00	35.3	7.6	10.7	20.5	4.0	5.5	35.8	9.9	-2.5	-23.0
mean	46.8	10.0	13.6	36.5	8.6	11.1	50.2	14.5	4.6	-14.1
aver.	49.8	12.1	15.6	39.7	8.5	11.7	54.9	16.5	-2.7	-18.1

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
163.00	33.8	8.1	10.5	33.3	7.7	10.2	40.7	12.4	-.2	-25.8
164.00	43.7	9.0	12.3	28.4	6.8	9.1	44.0	12.2	-6.7	-25.2
165.00	36.6	7.8	10.3	20.5	5.4	6.5	38.5	10.3	-11.2	-26.3
mean	38.0	8.3	11.0	27.4	6.6	8.6	41.0	11.6	-6.1	-25.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
166.00	34.3	10.2	11.9	28.6	7.7	9.9	36.3	14.4	-6.1	-20.2
167.00	45.7	13.2	15.6	24.1	4.6	6.7	45.9	14.6	-4.4	-34.0
168.00	38.8	12.4	14.8	47.5	12.1	16.0	53.1	19.4	-3.0	-41.6
mean	39.6	11.9	14.1	33.4	8.1	10.8	45.1	16.1	-4.5	-32.0

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
169.00	37.9	10.6	12.9	26.1	5.0	7.2	38.1	12.9	3.7	-35.5
170.00	20.2	5.6	6.6	18.9	4.7	6.1	23.4	7.9	9.8	-28.2
171.00	38.4	7.8	11.4	20.9	4.3	6.0	41.1	9.7	5.4	-20.6
mean	32.2	8.0	10.3	22.0	4.7	6.4	34.2	10.2	6.3	-28.1
aver.	36.6	9.4	11.8	27.6	6.5	8.6	40.1	12.6	-1..	-28.6

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
172.00	24.8	7.7	9.1	18.3	3.7	5.4	29.2	9.0	-6.4	-16.2
173.00	19.7	5.1	6.4	25.0	5.0	7.2	26.4	8.1	-1.8	-16.4
174.00	24.8	6.1	7.9	18.6	5.5	6.4	25.4	9.1	-3.8	-14.5
mean	23.1	6.3	7.8	20.6	4.7	6.3	27.0	8.7	-4.0	-15.7

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
175.00	36.4	9.6	12.7	25.6	4.8	6.9	39.3	11.1	-9.1	-17.5
176.00	32.5	7.7	10.2	24.5	4.8	7.0	32.7	10.6	-5.5	-19.5
177.00	28.6	7.3	9.0	35.4	7.8	10.4	35.6	11.6	-8.7	-12.3
mean	32.5	8.2	10.6	28.5	5.8	8.1	35.9	11.1	-7.8	-16.4

tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
178.00	15.9	6.4	7.0	15.4	5.1	6.1	21.3	8.3	2.3	-34.0
179.00	28.3	6.5	8.2	18.8	4.3	5.5	28.8	8.4	1.9	-31.8
180.00	24.5	6.8	8.4	25.2	7.7	8.9	29.2	11.0	1.2	-38.4
mean	22.9	6.6	7.9	19.8	5.7	6.8	26.4	9.2	1.8	-34.7
aver.	26.2	7.0	8.8	23.0	5.4	7.1	29.8	9.7	-3.3	-22.3

Bench Rest Target Data, Sustained Fire Test

Gun No. 904541, Lot No. LC 12081

test phase no.	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
1	181.00	12.5	3.7	4.3	7.5	1.7	2.2	12.7	4.3	1.3	6.6
	182.00	7.9	1.7	2.3	16.1	3.3	4.6	16.5	4.0	3.6	12.5
	183.00	8.4	1.9	2.5	9.4	2.0	2.9	10.1	3.3	9.1	12.9
	mean	9.6	2.4	3.1	11.0	2.3	3.2	13.1	3.9	4.7	10.7
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
4	184.00	25.7	5.3	7.1	9.2	2.5	3.0	26.9	6.0	10.6	7.4
	185.00	9.3	2.2	2.9	12.9	3.5	4.4	13.9	4.5	7.8	12.9
	186.00	9.0	2.7	3.3	13.5	3.7	4.5	16.1	4.8	9.3	16.1
	mean	14.7	3.4	4.5	11.9	3.2	4.0	19.0	5.1	9.2	12.1
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
7	187.00	51.4	11.3	17.7	50.5	14.9	17.8	59.2	22.6	6.2	-6.9
	188.00	13.7	3.2	4.1	13.0	4.2	4.8	16.2	5.7	24.1	27.7
	189.00	26.5	5.3	7.3	17.0	3.5	4.8	27.8	7.1	19.8	33.1
	mean	30.5	7.6	9.7	26.8	7.5	9.1	34.4	11.8	16.7	18.0
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
13	193.00	50.8	19.3	21.5	59.6	12.9	18.3	65.5	24.5	-9.5	3.7
	194.00	15.9	4.6	5.4	18.7	4.4	5.9	21.3	7.2	4.2	27.3
	195.00	31.9	8.6	10.4	12.1	2.6	3.4	32.9	9.2	11.0	32.8
	mean	32.9	10.8	12.4	30.1	6.6	9.2	39.9	13.6	1.9	21.3
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
16	196.00	28.0	8.1	9.7	40.0	8.5	11.8	47.5	12.3	-10.0	-9.0
	197.00	22.8	4.7	6.4	10.6	2.6	3.6	22.9	6.0	1.4	-5.2
	198.00	25.0	4.4	7.1	24.5	5.5	7.4	29.5	7.7	8.4	-.4
	mean	25.3	5.8	7.8	25.0	5.5	7.6	33.3	8.7	-.0	-4.8

test phase no.	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
19	199.00	25.1	7.1	9.1	82.1	22.2	29.5	85.0	23.7	-16.5	-2.5
	200.00	19.7	4.9	6.2	14.3	3.4	4.5	20.8	6.6	-9.7	-2.2
	201.00	44.7	9.4	13.1	34.1	7.3	9.8	47.3	13.4	-4.1	-11.5
	mean	29.8	7.1	9.5	43.5	11.0	14.6	51.0	14.6	-10.1	-5.4

Gun No. 904543, Lot No. TW 18007

	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
1	202.00	10.1	2.3	3.1	7.7	2.2	2.7	12.3	3.4	2.7	6.0
	203.00	8.3	1.8	2.4	11.0	1.8	2.8	11.0	3.1	3.7	1.9
	204.00	10.3	3.2	3.7	8.8	2.1	2.8	12.4	4.0	4.2	-1.2
	mean	9.6	2.4	3.1	9.2	2.1	2.8	11.9	3.5	3.6	2.2
4	205.00	31.4	5.0	8.8	14.7	3.4	4.5	34.1	6.4	5.0	-.0
	206.00	18.0	3.9	5.2	11.4	2.4	3.2	20.1	5.0	3.8	1.0
	207.00	16.2	3.7	4.9	5.2	1.1	1.6	16.8	4.1	3.4	1.1
	mean	21.9	4.2	6.3	10.4	2.3	3.1	23.6	5.1	4.1	.7
7	208.00	15.0	4.0	4.8	13.8	3.2	4.0	16.1	5.4	9.4	4.3
	209.00	7.9	2.2	2.7	13.9	3.7	4.6	14.5	4.6	12.1	.6
	210.00	12.1	3.9	4.4	16.1	4.1	5.2	16.4	6.2	8.1	.2
	mean	11.7	3.3	3.9	14.6	3.7	4.6	15.7	5.4	9.9	1.7
10	211.00	25.1	5.4	7.5	9.0	2.2	2.9	25.1	6.3	6.8	.4
	212.00	21.2	4.6	6.3	22.3	5.0	6.6	28.1	7.1	9.1	-.5
	213.00	11.9	3.4	4.2	18.7	4.6	6.0	18.9	6.5	6.3	.8
	mean	19.4	4.5	6.0	16.7	3.9	5.2	24.1	6.6	7.4	.2

test phase no.	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
	214.00	27.3	6.7	9.1	14.7	4.2	5.2	28.1	8.3	8.0	-5.3
13	215.00	16.7	4.7	5.8	10.4	3.5	4.2	17.5	6.2	9.0	-3.1
	216.00	50.4	10.6	15.7	10.5	2.3	3.3	50.8	11.4	9.8	-5.5
	mean	31.5	7.4	10.2	11.9	3.3	4.2	32.1	8.6	8.9	-4.6
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
	217.00	19.1	5.9	7.1	11.7	3.9	4.8	19.5	7.4	4.0	-2.2
16	218.00	21.2	5.0	6.9	16.1	4.1	5.2	21.6	7.3	6.1	-4.3
	219.00	20.0	4.8	6.6	41.5	9.6	14.9	44.7	11.4	11.4	-2.4
	mean	20.1	5.2	6.9	23.1	5.8	8.3	28.6	8.7	7.2	-3.0
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
	220.00	52.2	9.3	14.0	20.3	3.0	5.0	53.8	10.4	8.3	1.1
19	221.00	31.7	6.5	9.8	13.6	4.0	4.8	31.8	8.3	9.6	3.5
	222.00	25.0	7.4	8.7	29.5	5.5	8.8	33.3	10.1	9.5	-4.3
	mean	36.3	7.7	10.8	21.1	4.1	6.2	39.6	9.6	9.1	.1

Gun No. 904544, Lot No. LC 12194

	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
	223.00	10.4	2.1	3.0	5.4	1.2	1.7	11.0	2.6	-.7	3.0
1	224.00	6.1	1.6	1.9	4.5	1.2	1.5	6.2	2.2	.1	2.3
	225.00	6.3	1.3	1.8	5.5	1.4	1.8	6.3	2.2	-.9	1.6
	mean	7.6	1.7	2.2	5.1	1.3	1.7	7.9	2.3	-.5	2.3
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
	226.00	9.6	2.0	2.7	5.0	1.3	1.6	9.9	2.6	-3.7	6.8
4	227.00	12.2	2.5	3.4	4.9	1.0	1.4	12.2	2.9	-2.2	3.5
	228.00	9.9	2.4	3.1	4.6	.9	1.3	10.1	2.7	-4.7	5.3
	mean	10.6	2.3	3.1	4.8	1.1	1.4	10.8	2.8	-3.5	5.2

test phase no.	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
7	229.00	8.7	2.1	2.8	5.7	1.4	1.8	9.2	2.9	-6.9	3.8
	230.00	6.7	1.9	2.4	5.1	1.5	1.8	8.1	2.6	-5.3	4.7
	231.00	7.2	2.4	2.8	4.0	1.2	1.3	7.4	2.8	-4.5	2.7
	mean	7.5	2.1	2.6	4.9	1.4	1.7	8.2	2.8	-5.6	3.7
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
13	235.00	10.0	2.8	3.5	9.6	2.5	3.1	12.3	4.1	-.9	-4.0
	236.00	6.9	1.8	2.2	8.6	1.9	2.6	8.9	2.9	-2.3	-4.5
	237.00	9.7	3.0	3.5	5.5	1.2	1.6	9.7	3.5	-4.4	-.4
	mean	8.9	2.5	3.1	7.9	1.9	2.4	10.3	3.5	-2.5	-3.0
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
16	238.00	11.9	3.8	4.4	6.5	1.5	2.0	12.6	4.3	-3.5	-8.9
	239.00	16.8	4.6	5.9	11.4	2.6	3.5	18.8	5.8	-3.9	-8.3
	240.00	11.3	2.1	3.0	5.1	1.0	1.4	11.3	2.5	-5.2	-9.1
	mean	13.3	3.5	4.4	7.7	1.7	2.3	14.2	4.2	-4.2	-8.8
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
19	241.00	13.5	3.0	3.9	8.0	1.9	2.5	14.1	3.8	.1	-1.8
	242.00	6.8	1.9	2.4	4.3	1.4	1.6	7.3	2.6	-4.9	-1.4
	243.00	7.5	1.9	2.3	4.0	1.0	1.3	7.6	2.2	-.7	1.2
	mean	9.3	2.3	2.9	5.4	1.5	1.8	9.7	2.9	-1.8	-.7
	Gun No. 904546, Lot TW 18191										
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
1	244.00	4.9	1.3	1.7	5.7	1.2	1.6	6.2	2.0	-1.7	5.6
	245.00	6.6	1.8	2.1	7.5	1.5	2.1	7.7	2.6	-2.5	4.5
	246.00	4.8	.9	1.4	8.5	2.0	2.5	8.5	2.5	-2.0	2.5
	mean	5.4	1.3	1.7	7.2	1.6	2.1	7.5	2.4	-2.1	4.2

test phase no.	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
4	247.00	6.0	1.3	1.8	6.8	1.6	2.1	7.4	2.2	-3.8	4.0
	248.00	11.2	2.0	2.9	8.5	1.5	2.3	11.2	3.0	-2.5	3.4
	249.00	3.8	.9	1.1	4.7	1.3	1.6	5.4	1.7	-3.7	4.8
	mean	7.0	1.4	1.9	6.7	1.5	2.0	8.0	2.3	-3.3	4.1
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
7	250.00	5.9	1.4	1.7	4.9	1.1	1.5	5.9	1.9	-2.3	4.1
	251.00	3.0	.8	1.0	2.9	.9	1.1	3.8	1.3	-3.4	4.9
	252.00	5.7	1.4	1.7	4.3	.9	1.2	6.7	1.7	-3.5	3.6
	mean	4.9	1.2	1.5	4.0	1.0	1.2	5.5	1.6	-3.1	4.2
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
13	256.00	4.6	1.2	1.6	6.1	1.2	1.8	6.1	2.1	-4.0	6.1
	257.00	9.3	1.8	2.4	3.6	.7	1.0	9.3	2.0	-4.7	3.8
	258.00	4.3	1.2	1.4	5.9	1.5	1.9	6.3	2.1	-4.4	4.7
	mean	6.1	1.4	1.8	5.2	1.2	1.6	7.3	2.1	-4.4	4.8
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
16	259.00	4.5	1.0	1.3	5.9	1.3	1.7	6.0	1.8	-6.2	2.6
	260.00	2.8	.7	.9	6.1	1.2	1.6	6.1	1.5	-6.5	2.3
	261.00	5.2	1.2	1.6	6.5	1.3	1.9	6.6	1.9	-5.2	.3
	mean	4.2	.9	1.3	6.2	1.3	1.8	6.3	1.7	-6.0	1.8
	tgt no.	ev	mvd	vsd	eh	mhd	hsd	es	mr	ci h	ci v
19	262.00	4.4	1.0	1.3	8.3	1.5	2.2	8.5	2.0	-5.0	3.4
	263.00	7.4	1.8	2.3	4.7	1.0	1.3	8.2	2.1	-5.1	1.0
	264.00	4.1	1.3	1.5	6.2	1.9	2.3	6.2	2.5	-6.1	1.1
	mean	5.3	1.3	1.7	6.4	1.5	1.9	7.7	2.2	-5.4	1.8

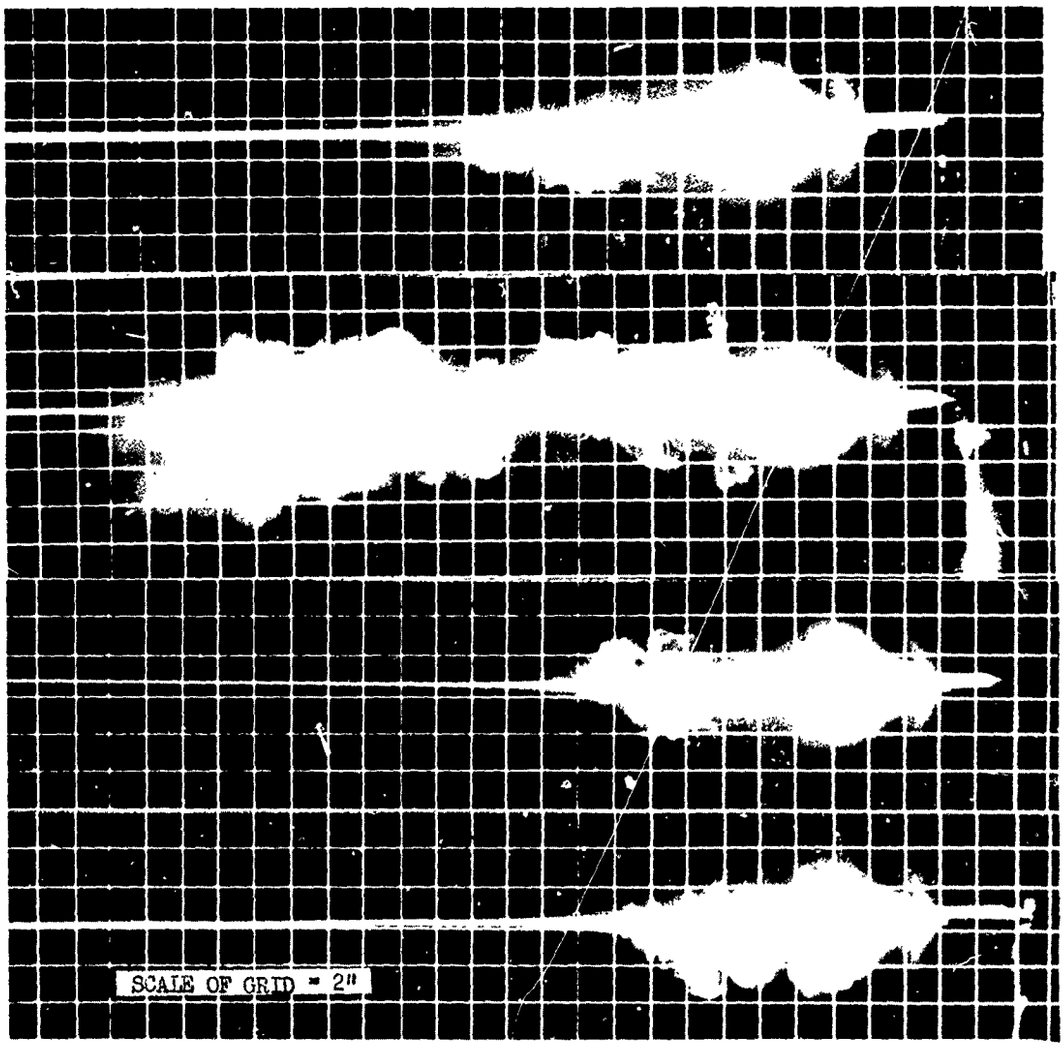


Figure I-1: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot LC-12081 (Tracer Projectile, Ball Propellant) in a New Condition (Less than 300 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semiautomatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

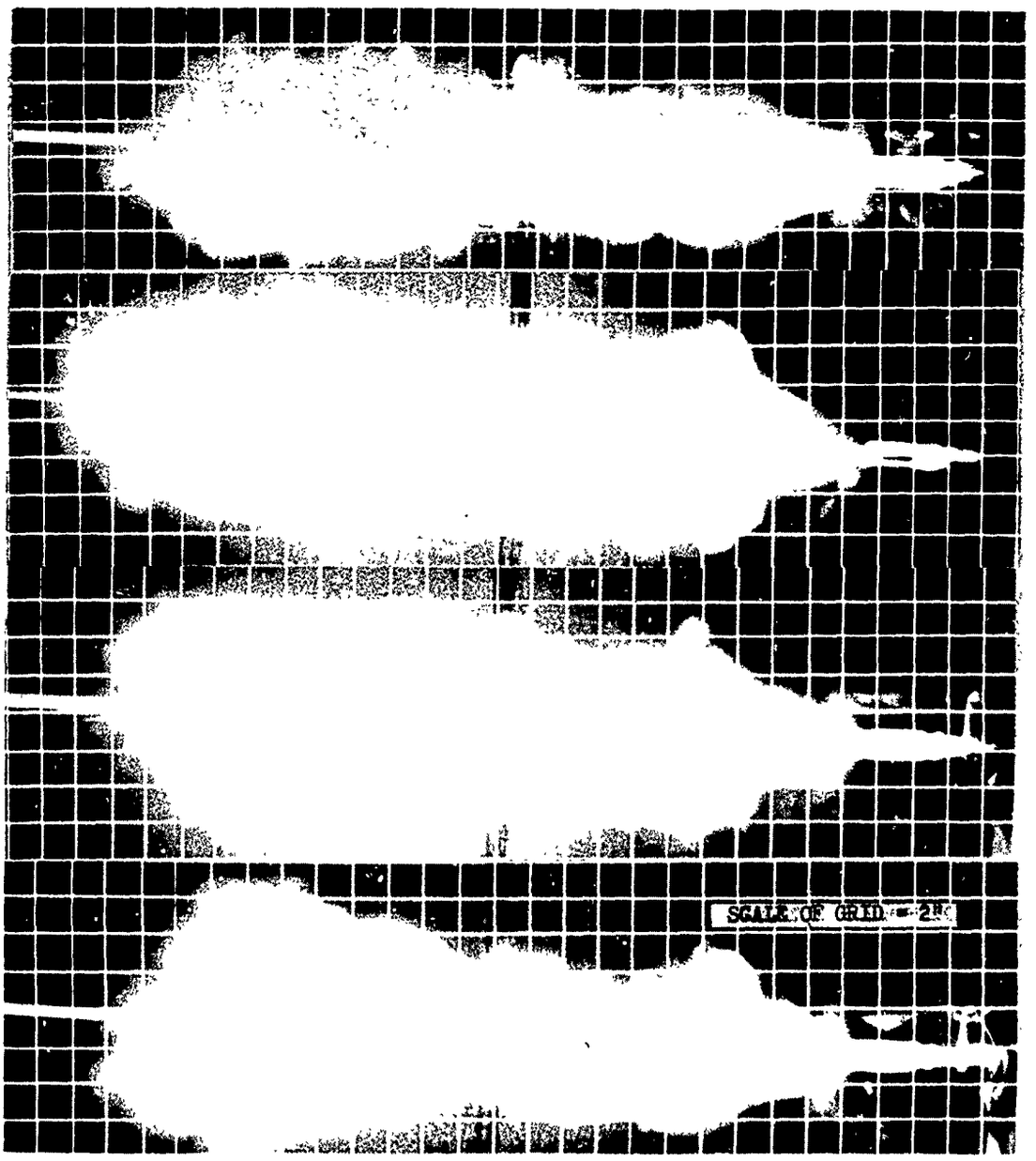


Figure I-2: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot LC-12081 (Tracer Projectile, Ball Propellant) in a Used Condition (Fired More than 4300 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semi-automatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

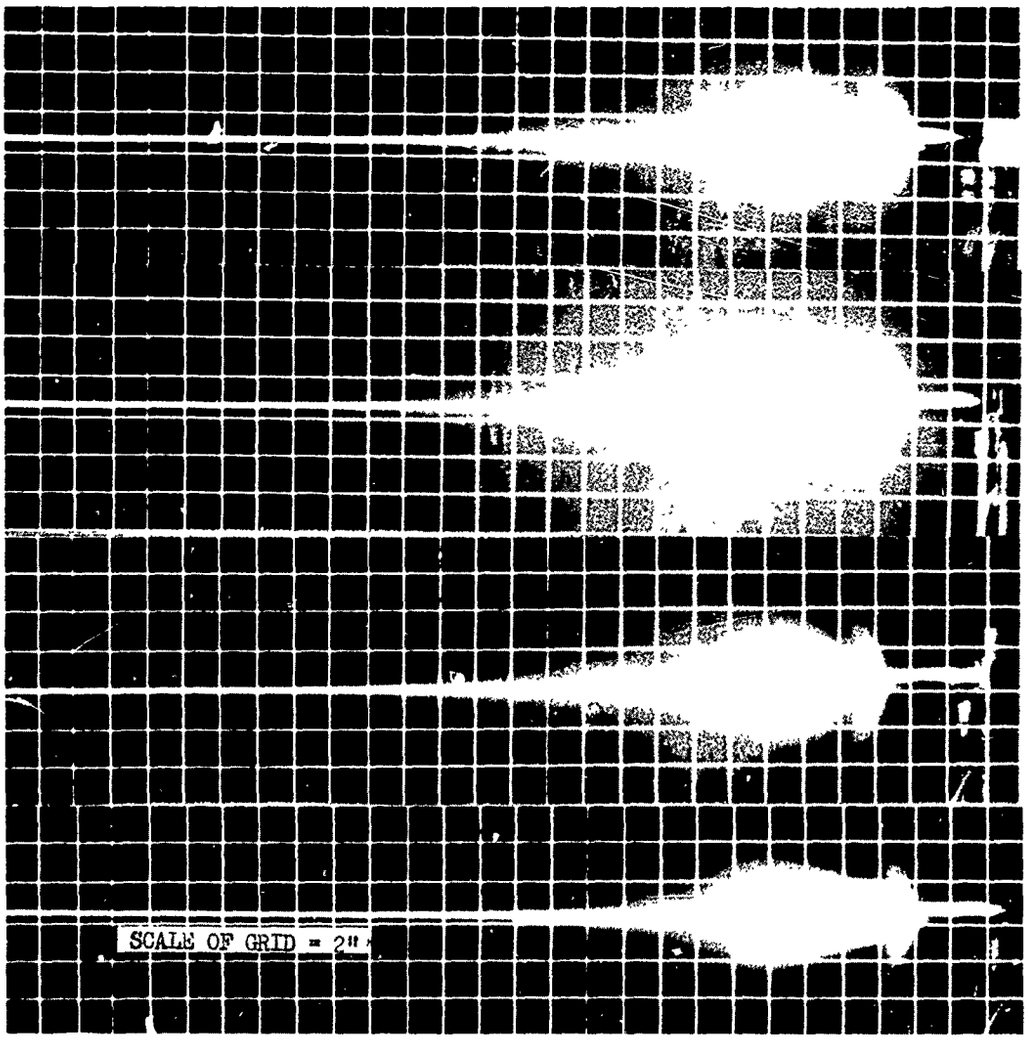


Figure I-3: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot TW-18007 (Tracer Projectile, 8208M Propellant) in a New Condition (Less than 300 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semiautomatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

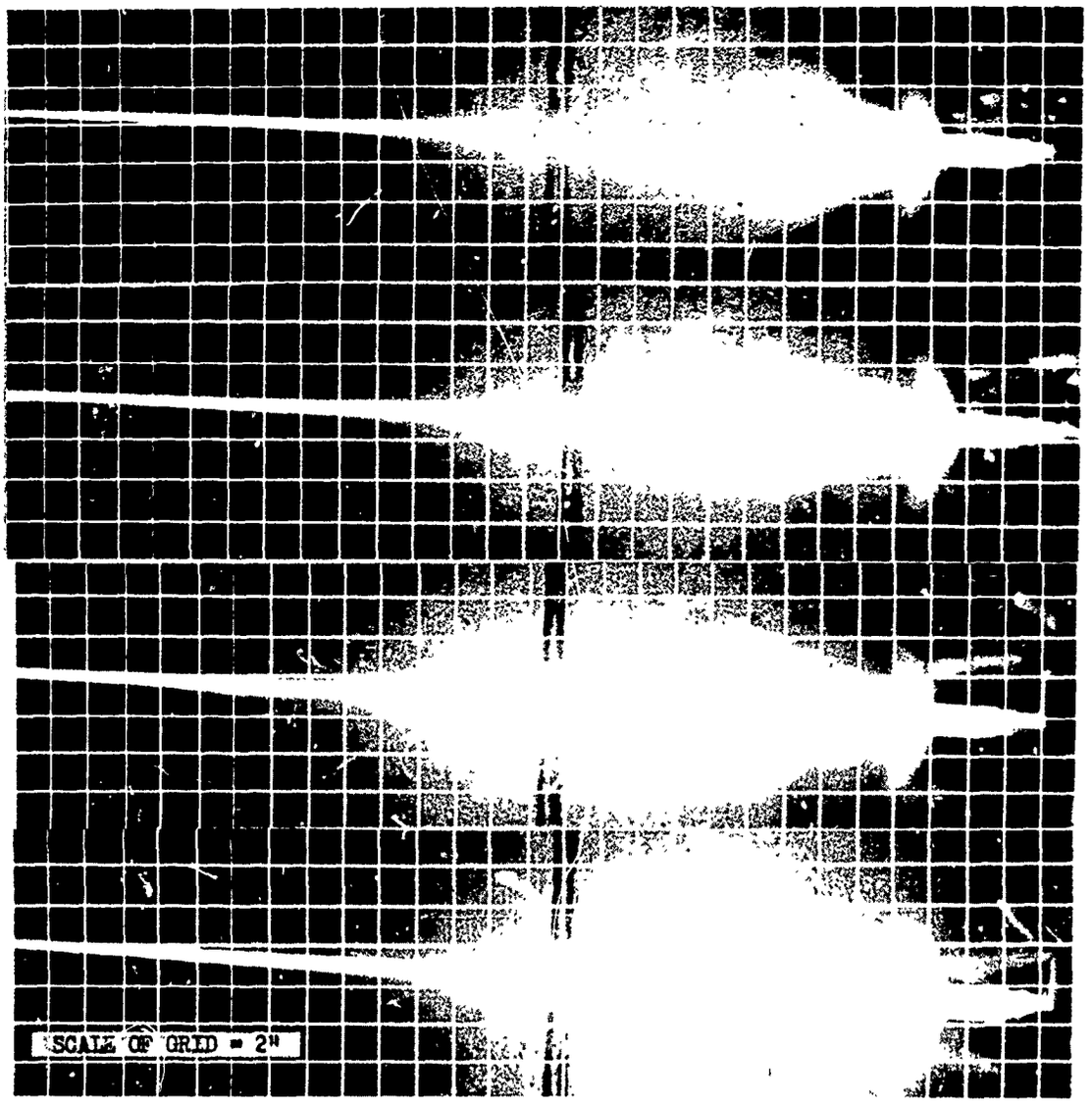


Figure I-4: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot TW-18007 (Tracer Projectile, 8208M Propellant) in a Used Condition (Fired More than 4200 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semiautomatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

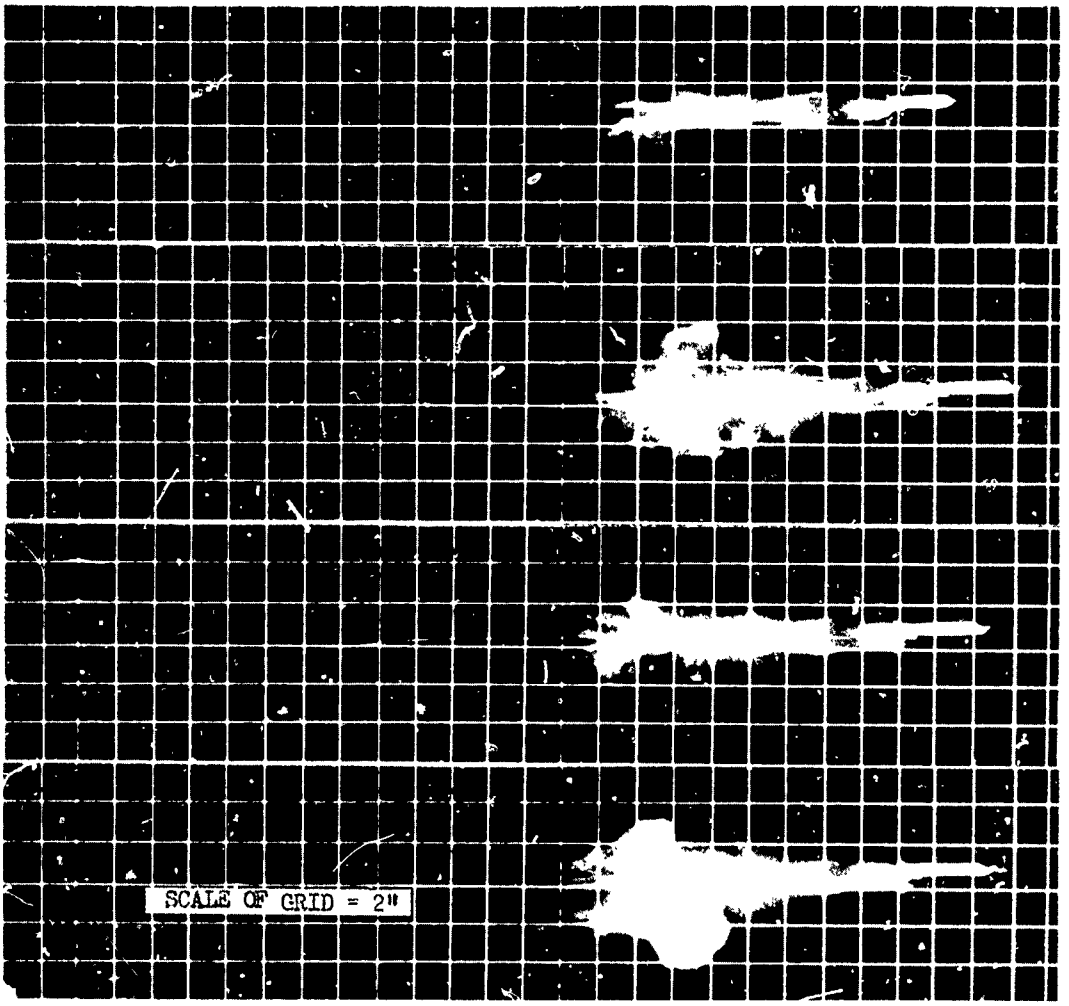


Figure I-5: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot LC-12194 (Ball Projectile, Ball Propellant) in a New Condition (Less than 300 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semiautomatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

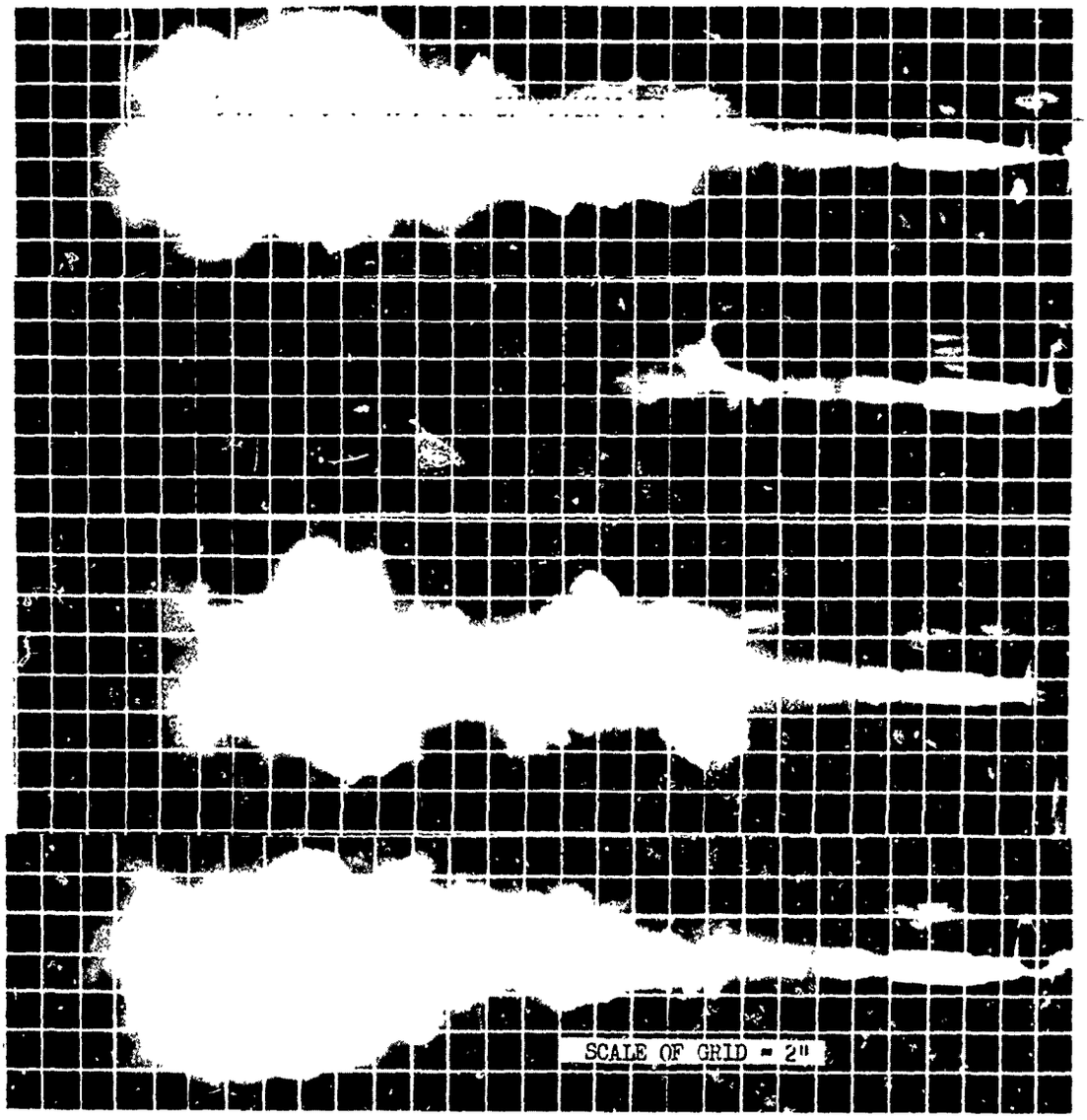


Figure I-6: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot LC-12194 (Ball Projectile, Ball Propellant) in a Used Condition (Fired More than 5100 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semiautomatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

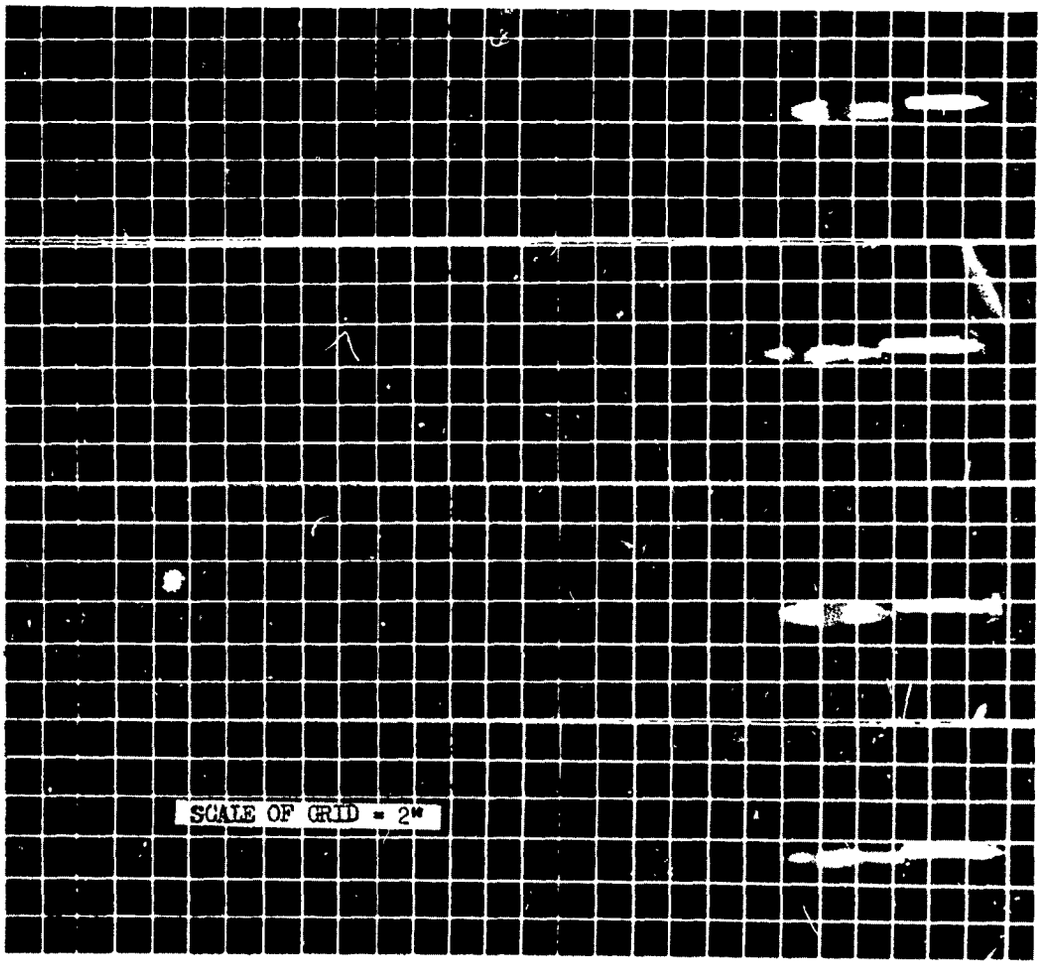


Figure I-7: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot TW-18191 (Ball Projectile, 8208M Propellant) in a New Condition (Less than 300 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semiautomatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

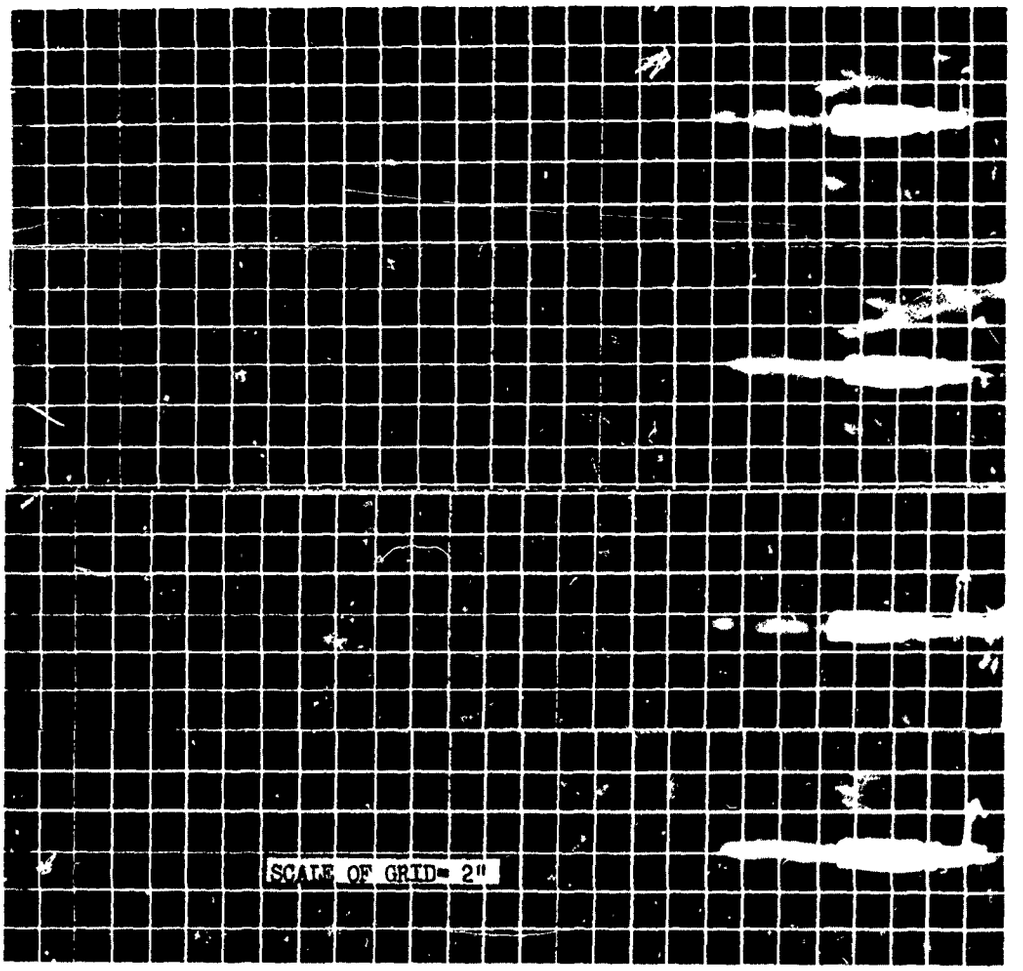


Figure I-8: Cumulative Muzzle Flash Photographs Obtained while Firing 30 Rounds of Lot TW-18191 (Ball Projectile, 8208M Propellant) in a Used Condition (Fired More than 5100 Rounds) XM177E2 Submachine Gun. TOP TO BOTTOM: Fired Semiautomatically from Cold Barrel; Semi-automatically from Preheated Barrel (Heated First by Firing 60 Rounds); Automatically from Cold Barrel; Automatically from Preheated Barrel.

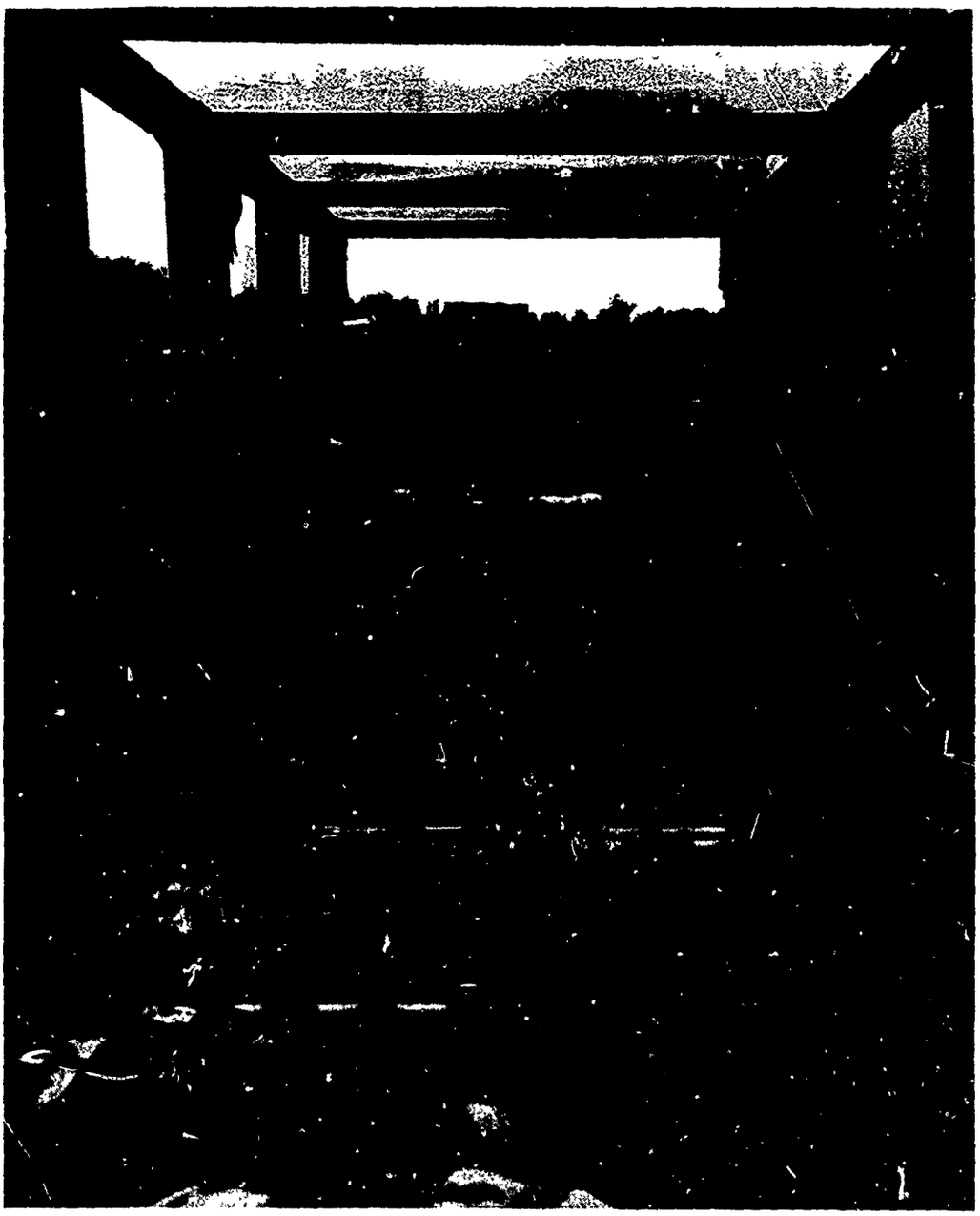


Figure I-9: Reference Photographs, Nonfiring, for Target Obscuration Test of XM177E2 and XM177E1 Submachine Guns. Checkerboard Target and E-Type Silhouettes Are at 50-Meter Range.

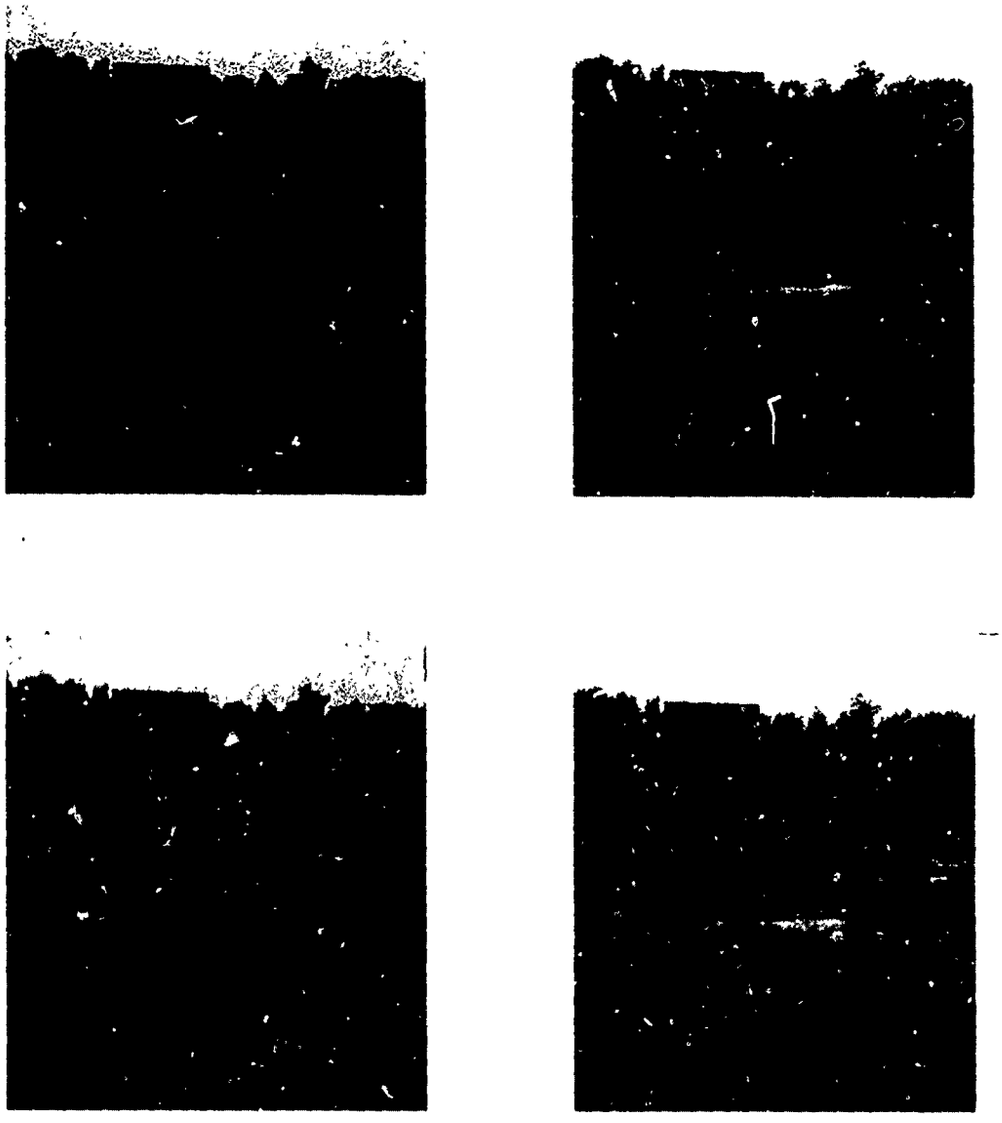


Figure I-10: Target Obscuration Effect of Smoke while Firing Semiautomatically, Ten Rounds Each of Four Lots of Ammunition in XM177E2 Submachine Gun. UPPER LEFT: Lot LC-12081 (Tracer Projectile, Ball Propellant). UPPER RIGHT: Lot TW-18007 (Tracer Projectile, 8208M Propellant). LOWER LEFT: Lot LC-12194 (Ball Projectile, Ball Propellant). LOWER RIGHT: Lot TW-18191 (Ball Projectile, 8208M Propellant).

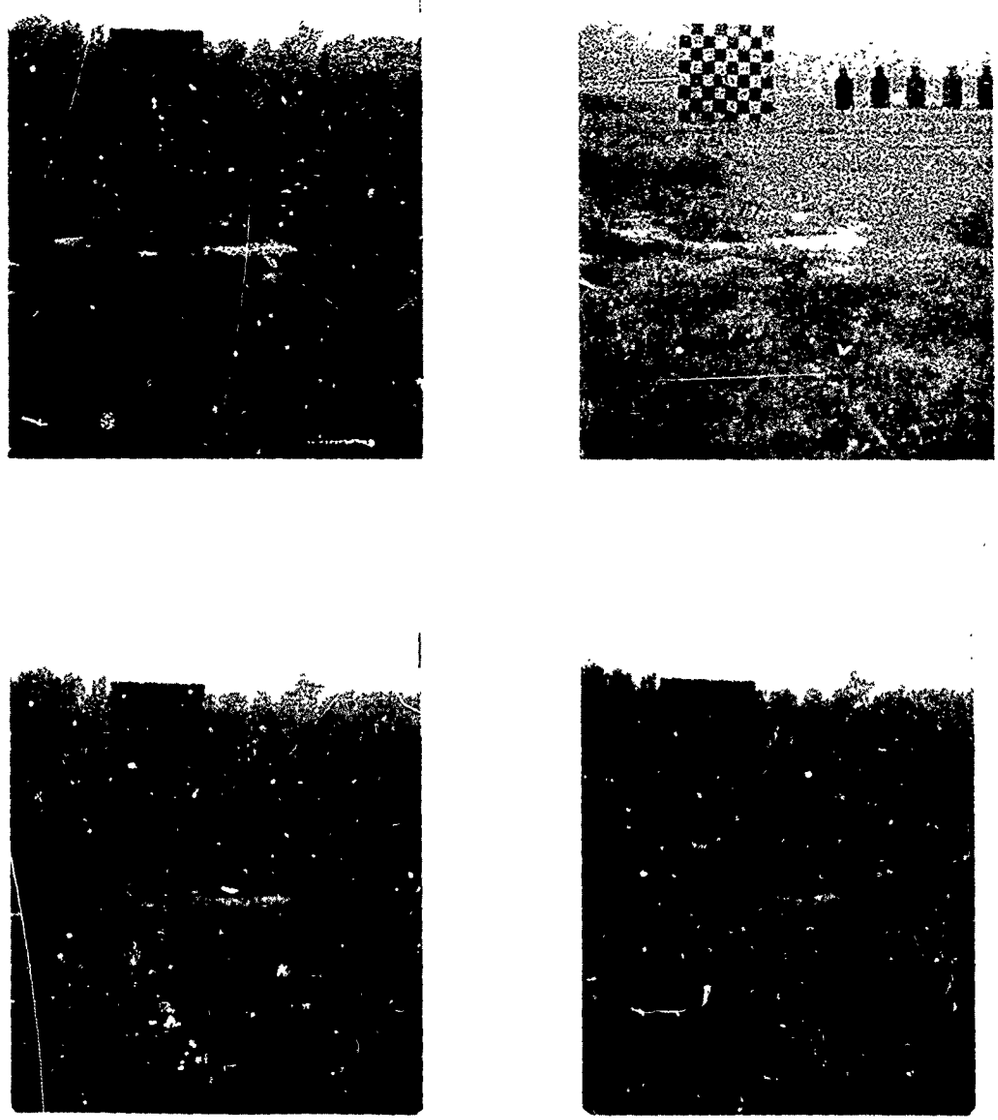


Figure I-11: Target Obscuration Effect of Smoke while Firing Automatically, Ten Rounds Each of Four Lots of Ammunition in XM177E2 Submachine Gun. UPPER LEFT: Lot LC-12081 (Tracer Projectile, Ball Propellant). UPPER RIGHT: Lot TW-18007 (Tracer Projectile, 8208M Propellant). LOWER LEFT: Lot LC-12194 (Ball Projectile, Ball Propellant). LOWER RIGHT: Lot TW-18191 (Ball Projectile, 8208M Propellant).

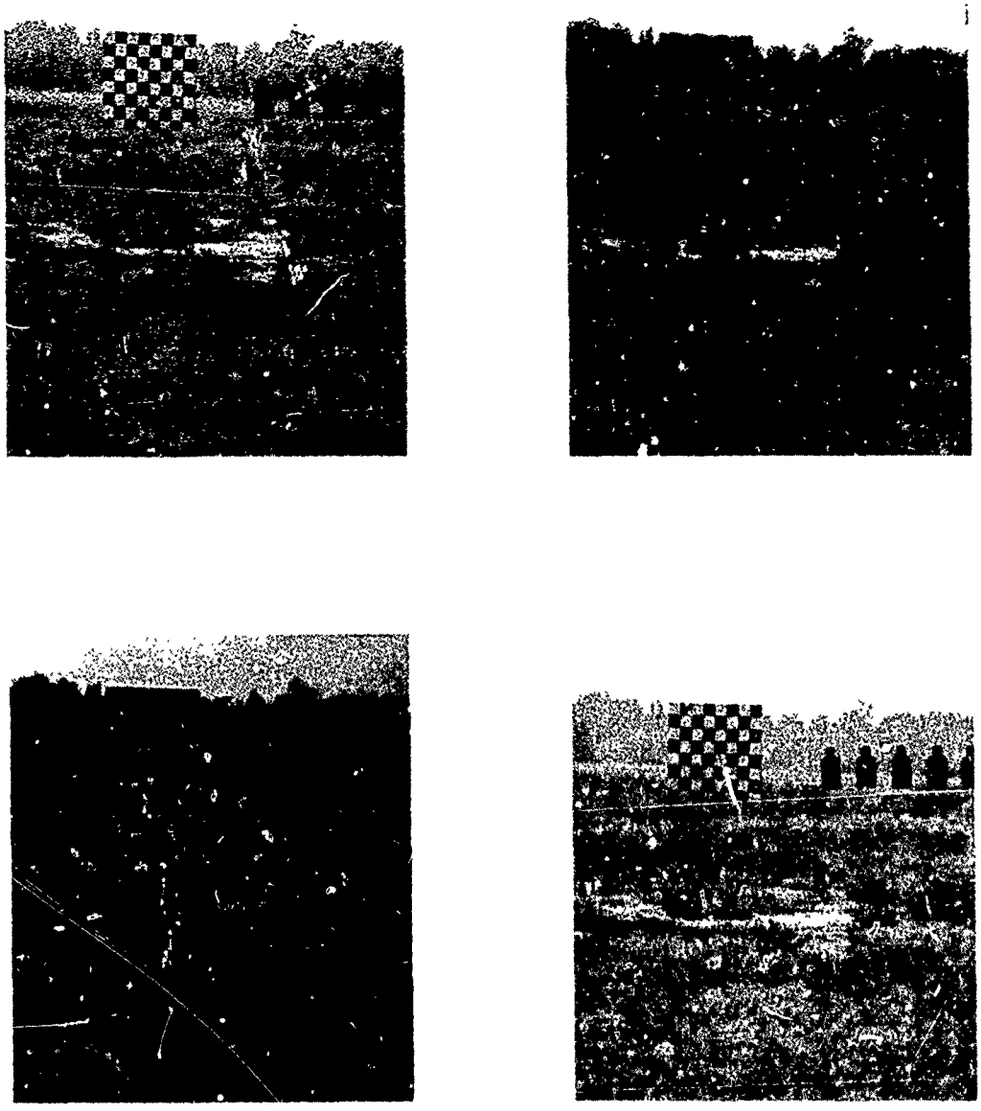


Figure I-12: Target Obscuration Effect of Smoke while Firing Semiautomatically, Ten Rounds Each of Four Lots of Ammunition in XM177E1 Submachine Gun. UPPER LEFT: Lot LC-12081 (Tracer Projectile, Ball Propellant). UPPER RIGHT: Lot TW-18007 (Tracer Projectile, 8208M Propellant). LOWER LEFT: Lot LC-12194 (Ball Projectile, Ball Propellant). LOWER RIGHT: Lot TW-18191 (Ball Projectile, 8208M Propellant).

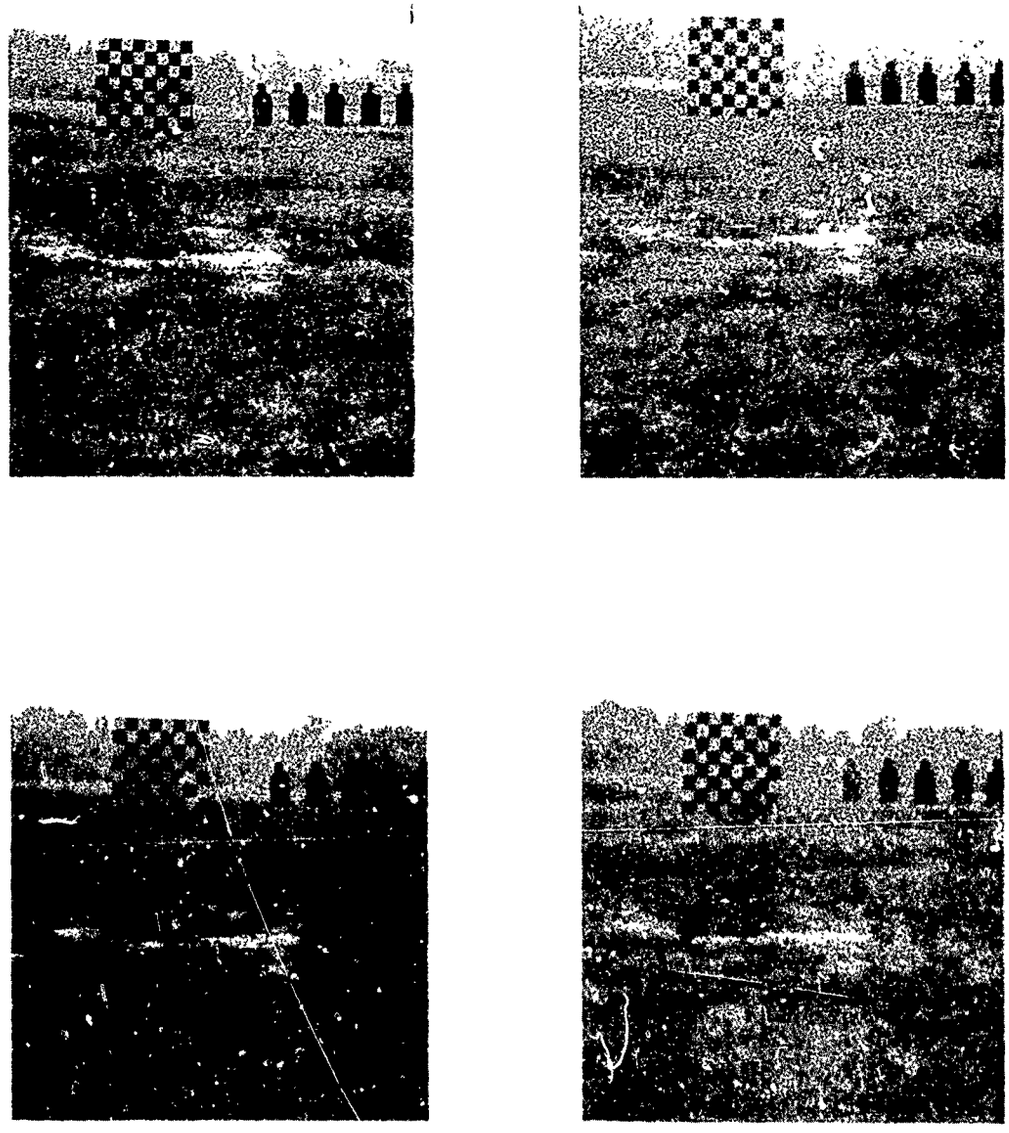


Figure I-13: Target Obscuration Effect of Smoke while Firing Automatically, Ten Rounds Each of Four Lots of Ammunition in XM177E1 Submachine Gun. UPPER LEFT: Lot LC-12081 (Tracer Projectile, Ball Propellant). UPPER RIGHT: Lot TW-18007 (Tracer Projectile, 8208M Propellant). LOWER LEFT: Lot LC-12194 (Ball Projectile, Ball Propellant). LOWER RIGHT: Lot TW-18191 (Ball Projectile, 2808M Propellant).

Displacement-Time Data

Date: 5 February 1968 Record No.: 1

Weapon
Model: XM177E2.
Caliber: 5.56-mm.
Serial No.: 902868.

Ammunition
Projectile Type: M193 (ball).
Propellant Type: WC846.
Lot No.: LC12194.

Test Condition: A 21-round burst was fired by loading one round in the chamber and 20 rounds in the magazine.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	23	47	9.5	80	750	NR
2	21	41	-	72	833	-
3	21	39	-	70	857	-
4	21	37	-	69	870	-
5	20	37	-	67	896	-
6	20	36	10.0	66	909	0.09
7	20	37	-	67	896	-
8	20	36	-	66	909	-
9	20	36	-	66	909	-
10	20	36	-	66	909	-
11	20	36	10.0	66	909	NR
12	20	36	-	65	923	-
13	20	35	-	65	923	-
14	20	35	-	65	923	-
15	20	35	-	65	923	-
16	20	36	9.6	65	923	.09
17	20	36	-	65	923	-
18	20	35	-	65	923	-
19	20	35	10.0	65	923	.11
20	20	33	10.3	64	938	.11
21	20	-	-	-	-	.11

Total Cycle Time, ms: 1339. Average Cyclic Rate of Fire, rds/min: 896.

[a] Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b] Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c] Individual total cycle time converted to a rate of fire in rds/min.
[d] Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Record No.: 3

Test Condition: A 20-round burst was fired.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	25	48	9.0	82	732	0.04
2	24	47	-	71	845	-
3	22	42	-	64	938	-
4	23	41	-	64	938	-
5	21	37	-	67	896	-
6	22	38	9.7	69	870	.06
7	20	35	-	65	923	-
8	20	35	-	65	923	-
9	20	35	-	65	923	-
10	20	37	-	67	896	-
11	20	35	9.9	65	923	.09
12	20	37	-	67	896	-
13	20	34	-	63	952	-
14	20	35	-	65	923	-
15	20	35	-	65	923	-
16	20	35	10.2	65	923	.10
17	20	35	-	65	923	-
18	20	35	-	64	938	-
19	20	34	10.1	64	938	NR
20	20	-	-	-	-	.09

Total Cycle Time, ms: 1262. Average Cyclic Rate of Fire, rds/min: 903.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Record No.: 4

Test Condition: A 19-round burst was fired.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	23	47	8.9	79	759	0.06
2	22	45	-	77	779	-
3	22	40	-	72	833	-
4	22	39	-	70	857	-
5	22	38	-	69	870	-
6	21	37	9.6	68	882	.09
7	20	35	-	65	923	-
8	20	36	-	65	923	-
9	19	35	-	64	938	-
10	19	36	-	65	923	-
11	19	36	9.4	65	923	.10
12	20	35	-	65	923	-
13	20	35	-	65	923	-
14	20	34	-	64	938	-
15	20	35	-	65	923	-
16	20	34	9.8	64	938	.09
17	20	35	-	64	938	-
18	20	33	9.8	63	952	.09
19	20	-	-	-	-	.09
20	-	-	-	-	-	-

Total Cycle Time, ms: 1209. Average Cyclic Rate of Fire, rds/min: 893.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Record No.: 5

Test Condition: An 18-round burst was fired.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	24	48	9.2	81	741	0.06
2	23	46	-	79	759	-
3	22	39	-	71	845	-
4	21	39	-	69	870	-
5	22	40	-	72	833	-
6	20	36	10.0	66	909	.08
7	20	36	-	66	909	-
8	20	37	-	66	909	-
9	19	35	-	65	923	-
10	20	35	-	65	923	-
11	20	35	9.8	65	923	.09
12	20	35	-	65	923	-
13	20	34	-	63	952	-
14	20	35	-	64	938	-
15	20	35	-	64	938	-
16	20	35	9.9	65	923	.10
17	19	34	10.4	63	952	.10
18	19	-	-	-	-	.09
19	-	-	-	-	-	-
20	-	-	-	-	-	-

Total Cycle Time, ms: 1149. Average Cyclic Rate of Fire, rds/min: 888.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Date: 13 February 1968. Record No.: 6

Propellant Type: IMR8208.
Lot No.: TW18191.

Test Condition: A 20-round burst was fired.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	38	56	8.8	103	582	0.00
2	26	53	8.8	88	682	.05
3	28	52	9.0	89	674	.06
4	31	56	-	95	632	.00
5	26	46	-	82	732	-
6	36	49	9.1	94	638	.00
7	25	44	-	78	769	-
8	25	42	-	77	779	-
9	26	39	-	73	822	-
10	23	39	-	70	857	-
11	24	41	9.6	75	800	.07
12	25	41	-	75	800	-
13	25	41	-	75	800	-
14	25	38	-	72	833	-
15	24	38	-	71	845	-
16	24	40	9.2	73	822	.07
17	26	45	-	80	750	-
18	25	39	-	73	822	-
19	24	39	9.4	72	833	.07
20	24	-	-	-	-	-

Total Cycle Time, ms: 1515. Average Cyclic Rate of Fire, rds/min: 752.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Record No.: 7

Projectile Type: M196 (tracer).
Propellant Type: WC846.
Lot No.: LC12081.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	30	88	7.8	126	476	0.05
2	37	65	-	111	540	.16
3	27	52	-	87	690	.05
4	31	55	-	94	638	.00
5	28	44	-	81	741	.06
6	27	48	8.4	83	723	.06
7	25	40	-	76	789	-
8	22	40	-	70	857	-
9	21	38	-	69	870	-
10	21	36	-	67	896	-
11	21	37	9.3	67	896	.08
12	22	38	-	69	870	-
13	22	37	-	68	882	-
14	21	37	-	67	896	-
15	21	38	-	69	870	-
16	20	35	9.7	65	923	.06
17	23	37	-	69	870	-
18	20	37	-	66	909	-
19	21	34	9.6	65	923	.09
20	20	-	-	-	-	.09

Total Cycle Time, ms: 1469. Average Cyclic Rate of Fire, rds/min: 776.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Record No.: 8

Propellant Type: IMR8208.
Lot No.: TW18007.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	39	58	8.8	106	566	-0.21
2	40	66	-	115	522	-
3	39	62	-	109	550	-
4	28	51	-	89	674	-
5	30	53	-	93	645	-
6	31	49	9.4	89	674	.06
7	28	43	-	81	741	.08
8	26	43	-	79	759	.06
9	26	42	-	79	759	-
10	25	42	-	77	779	-
11	27	45	8.9	81	741	.07
12	26	42	-	77	779	.06
13	26	44	-	80	750	-
14	30	51	-	91	659	-
15	28	46	-	84	714	-
16	36	53	8.9	98	612	-
17	26	45	-	81	741	-
18	28	44	-	81	741	-
19	29	45	9.1	83	723	.06
20	28	-	-	-	-	.07

Total Cycle Time, ms: 1673. Average Cyclic Rate of Fire, rds/min: 681.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

Date: 15 February 1968. Record No.: 9

Projectile Type: M193 (ball).
Propellant Type: WC846.
Lot No.: LC12194.

Test Condition: The complete barrel and gas tube assembly from gun No. 904543; previously fired 2450 rounds, lot LC12081; 4200 rounds, TW18007; 2310 rounds, LC12194; was installed on the mechanism of gun No. 902868 and a 20-round burst fired.

Cycle No.[a]	Time, ms				Cyclic Rate of Fire[c], rds/min	Buffer Compression[d], in.
	Recoil	Counter Recoil	Dwell[b]	Total Cycle		
1	22	46	8.9	77	779	0.04
2	21	42	-	72	833	-
3	20	41	-	71	845	-
4	19	36	-	65	923	-
5	20	36	-	66	909	-
6	19	35	9.9	64	938	.08
7	19	37	-	66	909	-
8	19	37	-	66	909	-
9	20	35	-	65	923	-
10	19	36	-	64	938	-
11	20	35	9.9	64	938	.09
12	20	35	-	64	938	-
13	19	35	-	64	938	-
14	19	34	-	63	952	-
15	19	34	-	63	952	-
16	19	35	9.8	64	938	.08
17	19	34	-	63	952	-
18	19	34	-	63	952	-
19	19	34	9.7	63	952	.09
20	19	-	-	-	-	.09

Total Cycle Time, ms: 1247. Average Cyclic Rate of Fire, rds/min: 914.

[a]Each cycle begins at the point of initial rearward movement of the bolt carrier and ends at the final moment of bolt carrier dwell.
[b]Measured from point of initial bolt carrier contact with the barrel extension, at conclusion of counter recoil, to initial rearward movement of the carrier as next round fires; only selected rounds are measured.
[c]Individual total cycle time converted to a rate of fire in rds/min.
[d]Minus values, if listed, indicate buffer failed to impact rear of extension tube; only selected rounds are measured.

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

S - 15 May 67
S - 5 Jun 67

AMSTE-BC

21 APR 1967

SUBJECT: Test Directive for Product Improvement (PI) Test of the Submachine Gun, Cal. 5.56mm, XM177E1, USATECOM Project No. 8-7-0220-01, 02

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-CO-P
President, USA Infantry Board, ATTN: STEBC-SA

1. References:

a. Report, AMSTE-BC, 28 Jan 66, subject: Analysis of Results of SAWS Engineering and Service Tests, USATECOM Project No. 8-5-0400-03 through 06.

b. Partial Report, DPS-1851, Dec 65, subject: Engineering Test of Small Arms Weapons Systems (SAWS), USATECOM Project No. 8-5-0400-03, Volume I and Final Report DPS-1970, Mar 66, Volume II.

c. Final Report, USAIB-3110, Dec 65, subject: Service Test of SAWS, USATECOM Project No. 8-5-0400-04.

d. Final Report (DPS-2215) on Engineer Design Test of Modified Flash Suppressor for 5.56mm CAR-15 Submachine Gun, USATECOM Project No. 8-6-0200-06.

e. Message, AMCPM-RS, 141920Z Mar 67, subject: Type Classification XM177E1 Submachine Gun (CAR-15 SMG).

f. Message, AMSTE-BC 6056, 22 Mar 67, subject: Type Classification of Submachine Gun (CAR-15).

g. Letter, AMCPM-RS, 5 Apr 67, subject: Effectiveness Evaluation of XM177/XM177E1 SMG, inclosure 1.

h. Letter, AMCPM-RS, 31 Mar 67, subject: Minutes of M16/M16A1 Rifle Technical Coordinating Committee Meeting on 2 Mar 67, inclosure 2.

SUBJECT: Test Directive for Product Improvement (PI) Test of the Submachine Gun, Cal. 5.56mm, XM177E1, USATECOM Project No. 8-7-0220-01, 02

2. Description of Materiel: The CAR-15 Submachine Gun is a lightweight, gas-operated, front locking rotary bolt weapon capable of firing either the semi or full automatic mode. A thumb-actuated safety is provided with three positions: safe, semiautomatic, and full automatic. The weapon is capable of being fed from a 20 or 30-round detachable box magazine and fires from a closed bolt position; bolt remains open after last round is fired. The weapon is equipped with an adjustable peep and post sight system. The weapon features a telescoping buttstock. The sling is the only accessory. Since the "SAWS" test, several product improvements have been made. These are buffer, *chrome plated chamber to minimize corrosion and promote extraction, $1\frac{1}{2}$" increased barrel length (for mounting XM148 Grenade Launcher), *delrin on charging handle latch to minimize wear on upper receiver, *new handguard slip ring to assure physical integrity, *cadium-plated slip ring spring to minimize corrosion, *shot peened upper and lower receivers to minimize corrosion, nylon-coated buttstock and release lever, and XM148 Grenade Launcher spacer. (The asterisk denotes those improvements pertinent to the M16A1 Rifle). When available, the material used and reasons for the improvements will be forwarded under separate cover. This information should be available during week of 24 April.

3. Background:

a. During the "SAWS" tests (reference 1a, b, c), approximately 140,000 rounds of ammunition were fired with the CAR-15 Submachine Gun. As reported, excessive flash was observed when firing ammunition loaded with ball propellant. Subsequent firings with ammunition loaded with extruded grain propellant significantly reduced the flash.

b. At the request of the Project Manager, Rifles, engineer design tests of a modified flash suppressor was conducted by this command which also included limited firings of a new buffer design. The suppressor was found to be durable and a reduction of flash was observed as compared to the model tested during "SAWS".

c. Reference 1e requested comment and/or concurrence on type classification of the XM177E1 Submachine Gun (CAR-15 SMG). Based on results of the "SAWS" tests this command concurred in type classification of the CAR-15 Submachine Gun.

4. Test Objectives:

a. To evaluate the physical and technical characteristics.

b. To evaluate weapon performance when using both IMR (extruded grain) and ball propellants.

c. To evaluate suitability of the product improvements.

d. To evaluate test results regarding suitability of the product improvements for application to the M16A1 Rifle as shown in paragraph 2.

5. Responsibilities:

a. Commanding Officer, Aberdeen Proving Ground is responsible for preparation of test plan, execution and final reporting by which the test objectives of paragraphs 4a, b and d may be evaluated. Also, support of tests required by the Ballistics Research Laboratories.

b. President, USA Infantry Board is responsible for preparation of test plan, execution and final reporting by which the test objectives of paragraph 4 may be evaluated.

6. Coordination: Draft test plans will be coordinated with the following:

Coordination Agency	Test Plan (APG)	Test Plan (USAIB)
CG USAMC (AMCPM-RS)	X	X
CG USAWECOM (AMSWE-RDS)	X	X
Comdt USA Infantry School	X	X
CO USA Infantry Agency	X	X
CO APG (STEAP-DS)		X
Pres USAIB	X	

7. Special Instructions:

a. DA Project No. - Unknown.

b. AMCMS Code No. - Unknown.

c. For a comprehensive and objective test of subject weapon it is deemed necessary to evaluate weapon performance by utilizing both types of propellants on both ball and tracer projectiles. Additionally, 30-round magazines will be evaluated.

d. Five weapons will be available for test at APG in April. Three control weapons without improvements will also be available. Five additional weapons have been requested for tests at USA Infantry Board but availability is unknown at this time.

e. Tests will include but not necessarily be limited to the following:

(1) For Aberdeen Proving Ground:

(a) Examination to include photographs of major component parts.

(b) Accuracy - 1000 inches; 50, 100, 200 and 400 meters (ball and tracer ammunition).

(c) Extreme Temperature - measure cyclic rates.

(d) Environmental to include dynamic dust test.

(e) Smoke and flash (ball and extruded grain propellant with ball and tracer ammunition).

(f) Sustained fire.

(g) Reliability and durability - measure cyclic rates; use 20 and 30-round magazines.

(h) Time of flight and velocity using velocimeter.

(2) For USA Infantry Board:

(a) Physical examination.

(b) Accuracy - 50 meters, 100, 200 and 400 meters with ball and tracer ammunition.

(c) Quick fire.

(d) Day and night defense.

(e) Day and night assault.

(f) Flash and smoke - ball and extruded grain propellant with ball and tracer cartridges under various light conditions.

(g) Maintenance.

(h) Human factors.

SUBJECT: Test Directive for Product Improvement (PI) Test of Submachine Gun, Cal. 5.56mm, XM177E1, USATECOM Project No. 8-7-0220-01, 02

Since basic weapon was tested in the SAWS Program, only limited testing in paragraphs (2)(c), (d) and (e), above, should be planned unless results are such that extensive tests are necessary for complete evaluation.

(3) For Aberdeen Proving Ground (Ballistics Research Laboratories) Tests:

(a) As indicated by reference 1g, BRL has overall responsibility for an effectiveness evaluation to include dispersion and projectile yaw. Special target paper will be supplied by BRL. Maximum coordination is directed so that single tests may be designed to satisfy requirements of both BRL and APG.

(b) General test outline for BRL is as follows:

1. Dispersion and yaw firings at approximately 3, 7, 10 and 15 meters at ambient temperature with five weapons. Fire 20-round samples from each weapon. If multiple firings at close range makes target measurements inaccurate, select alternate aim points on same target. Mark each aim point.

2. Within the climatic chamber, using a weapon to be supplied by BRL, fire at temperatures of minus 65°F, 25°F, 0°F, plus 125°F and 155°F to provide yaw, velocity and dispersion data as required by BRL.

3. Fire for accuracy and yaw from a bench rest at ambient temperature at ranges of 1000 inches; 50, 100, 200 and 400 meters from each of the five weapons delivered to APG.

(c) All measurements of targets fired in support of BRL are the responsibility of BRL.

(d) The above outline of tests is subject to change as dictated by test results.

f. Materiel and cost requirements should be provided this headquarters as soon as possible but not later than 15 May 67. Sufficient funds to support the BRL tests will be included in the APG cost estimate but listed separately.

g. USATECOM Project Numbers are as follows:

APG - 8-7-0220-01 (includes support for BRL)
USAIB - 8-7-0220-02

h. USATECOM Priority 2 is assigned.

AMSTE-BC 21 APR 1967

SUBJECT: Test Directive for Prouduct Improvement (PI) Test of Submachine Gun, Cal. 5.56mm, XM177E1, USATECOM Project No. 8-7-0220-01, 02

8. Test Plans and Reports:

a. Test plans from APG are required by 5 Jun 67. The USAIB will be notified of a firm date for submission of test plans subject to availability of test weapons.

b. A brief outline of the BRL tests will be included in the APG test plan. Also, within each subtest indicate the data pertinent to the BRL area of interest.

c. Test plans will be specifically designed to address the significance of the indicated improvements.

d. A firing record will be published for the BRL data and included in the appendix of final APG report.

e. Formal test plans and reports are required.

9. Security: Test plans and reports will be unclassified.

10. Safety: Since the product improvements do not affect the basic weapon design, the XM177E1 is considered safe to shoulder fire.

FOR THE COMMANDER:

AUSTIN SHIPLETT, Jr.
Colonel
Dir, Inf Mat Test

✓ 4 Incl
1-2 as
3. STE Form 1027 (APG only)
4. Distribution List

Copies furnished:(w/o incls)
CG USAMC ATTN: AMCPM-RS
CO BRL ATTN: AMXBR-WD

AMCPM-RS (15 Aug 67) 1st Ind
SUBJECT: Approval of Test Plans for Product Improvement Test of Sub-machine Gun, caliber 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01, 02

OFFICE OF THE PROJECT MANAGER, RIFLES, U. S. Army Materiel Command, Rock Island, Illinois 61201 25 AUG 1967

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

1. This office concurs in plan of tests with the following exceptions:

a. USATECOM Project No. 8-7-0220-01.

(1) Paragraph 2.3.2b - delete 2650 and add 2500.

(2) Paragraph 2.12.2a - add MIL-L-46000A.

(3) Appendix V, Distribution List - add CG, USAWECOM, ATTN: AMCPM-RS, 5 copies each of interim and final reports and CG, USAMC, ATTN: AMCPMSO-RS, 2 copies each of interim and final reports.

b. USATECOM Project No. 8-7-0220-01.

(1) Delete references to 30rd magazine, which will not be available for the test.

(2) Appendix V, Distribution List - add CG, USAWECOM, ATTN: AMCPM-RS, 5 copies each of interim and final reports and CG, USAMC, ATTN: AMCPMSO-RS, 2 copies each of interim and final reports.

2. Request that test firing of the XM148 Grenade Launcher mounted on the XM177E2 SMG be included in both USAIB and D&PS test plans. The test should determine if it is technically feasible and safe to fire the grenade launcher attached to the SMG.

3. Arrangements have been made to furnish four XM148 Grenade Launchers and 200 rounds of practice 40mm ammunition to the USAIB. Request that D&PS advise, by telephone, of their requirements for test equipment and ammunition.

FOR THE PROJECT MANAGER:

wd all incl

WM C. DAVIS, JR.
Ch, Tech Mgt Division

S - 29 Sep 1967

AMSTE-BC (15 Aug 67) 2nd Ind
SUBJECT: Approval of Test Plans for Product Improvement Test of Submachine Gun, Caliber 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01, 02

DA, Headquarters, US Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 21005 11 SEP 1967

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-DS-TI, Aberdeen Proving Ground, Maryland 21005
President, US Army Infantry Board, ATTN: STEBC-SA, Fort Benning, Georgia 31905

1. This headquarters concurs in the comments of 1st Indorsement. For clarification, assume that the USATECOM project number in paragraph 1b of 1st Indorsement should read 8-7-0220-02.

2. It is requested that Commanding Officer, Aberdeen Proving Ground determine that firing of the XM148 Grenade Launcher attached to the XM177E2 Submachine Gun (SMG) is technically feasible and safe to shoulder fire. Recommendation for safety release is required by 29 September 1967. If additional funds are required, direct communication with the Project Manager, Rifles is suggested.

3. The US Army Infantry Board will confirm the safety of firing the XM148 Grenade Launcher attached to the SMG in accordance with USATECOM Regulation 385-7.

4. It is requested that this headquarters be provided with 40 copies of the final reports instead of 30 by which to accommodate the additional distribution.

5. Change notices should be prepared and distributed to all recipients of test plans without further approval of this command.

FOR THE COMMANDER:

Robert B. Tully

ROBERT B. TULLY
LTC GS
Dir, Inf Mat Test Dir

Copy furnished:
CG USAMC ATTN: AMCPM-RS

AMCPM-RS (15 Aug 67) 1st Ind
SUBJECT: Approval of Test Plans for Product Improvement Test of Sub-machine Gun, caliber 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01, 02

OFFICE OF THE PROJECT MANAGER, RIFLES, U. S. Army Materiel Command, Rock Island, Illinois 61201 25 AUG 1967

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3. Arrangements have been made to furnish four XM148 Grenade Launchers and 200 rounds of practice 40mm ammunition to the USAIB. Request that D&PS advise, by telephone, of their requirements for test equipment and ammunition.

FOR THE PROJECT MANAGER:

wd all incl

WM C. DAVIS, JR.
Ch, Tech Mgt Division

S - 29 Sep 1967

AMSTE-BC (15 Aug 67) 2nd Ind
SUBJECT: Approval of Test Plans for Product Improvement Test of Submachine Gun, Caliber 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01, 02

DA, Headquarters, US Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 21005 11 SEP 1967

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-DS-TI, Aberdeen Proving Ground, Maryland 21005
President, US Army Infantry Board, ATTN: STEBC-SA, Fort Benning, Georgia 31905

1. This headquarters concurs in the comments of 1st Indorsement. For clarification, assume that the USATECOM project number in paragraph 1b of 1st Indorsement should read 8-7-0220-02.

2. It is requested that Commanding Officer, Aberdeen Proving Ground determine that firing of the XM148 Grenade Launcher attached to the XM177E2 Submachine Gun (SMG) is technically feasible and safe to shoulder fire. Recommendation for safety release is required by 29 September 1967. If additional funds are required, direct communication with the Project Manager, Rifles is suggested.

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4. It is requested that this headquarters be provided with 40 copies of the final reports instead of 30 by which to accommodate the additional distribution.

5. Change notices should be prepared and distributed to all recipients of test plans without further approval of this command.

FOR THE COMMANDER:

Robert B Tully

ROBERT B. TULLY
LTC GS
Dir, Inf Mat Test Dir

Copy furnished:
CG USAMC ATTN: AMCPM-RS

COPY/am

MrWilson/ps/578-1500/3242

2 OCT 1967

STEAP-DS-TI

SUBJECT: Safety Evaluation and Feasibility Study of Attachment and Firing of Grenade Launcher, XM148 on Submachine Gun, XM177E2, USATECOM Proj No. 8-7-0220-01

TO: Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-BC

1. References:

a. Test Plan for Product Improvement Test of Submachine Gun, XM177E2.

b. AMSTE-BC letter, 15 Aug 67, w/1st & 2nd Ind, Subject: Approval of Test Plans for Product Improvement Test of Submachine Gun, Caliber 5.56mm, XM177E2, USATECOM Project No. 8-7-0220-01, 02.

2. AMSTE-BC requested that tests be conducted to determine if firing of the XM148 grenade launcher attached to the XM177E2 submachine gun is technically feasible and safe for shoulder firing.

3. Launcher No. 11848 was attached to submachine gun No. 904549 and 55 rounds of 40-mm practice ammunition (M407A1) were fired. Firing was conducted first with the weapon buttstock extended and the weapon rigidly mounted in a test stand (5 rounds) and then fired from hand-held and shoulder positions with the shooter standing, kneeling and prone (15 rounds each). A final five rounds were fired from the hip position with the buttstock in an extended position.

4. Due to the configuration of the weapon, and the the high angle sighting requirements, the buttstock of the weapon was held under the right arm, rather than at the shoulder, for long range firings. Three angles of fire were employed in each firing position, attempting to impact rounds at 100, 200 and 400 meters. Several of the rounds were fired with the buttstock extended but intentionally unlocked.

COPY/am

STEAP-DS-TI
SUBJECT: Safety Evaluation and Feasibility Study of Attachment and Firing of Grenade Launcher, XM148 on Submachine Gun, XM177E2, USATECOM Project No. 8-7-0220-01

5. The tests confirmed the technical feasibility of firing the XM148 grenade launcher while attached to the XM177E2 submachine gun and such firings can be considered safe from hand-held and shoulder positions providing the following precautions are observed.

a. Due to the configuration of the launcher sight, and its proximity to the shooter's face, only experienced firers, fully capable of controlling the weapon in recoil, should be permitted to fire the subject weapon combination. The possibility of injury from the launcher sight during recoil is greatest when the weapon is supported under the arm. However, the recoil hazard from any firing position appears no more acute than when firing the XM148 launcher attached to the M16A1 rifle.

b. No firings should be attempted from the shoulder or underarm position with the buttstock in a forward position.

c. The security of the buttstock latch must be established before firing each round. Inadvertent or unexpected release of the latch during firing will almost certainly permit some portion of the launcher or submachine gun to strike the shooter's face. The physical integrity of the buttstock latch, either in design or material, is not known and cannot be estimated from the limited firings. Eye protection must be considered essential.

d. Until a more comprehensive firing evaluation has been conducted it is recommended that the launcher not be fired with the submachine gun loaded nor vice versa.

FOR THE COMMANDER:

/s/ W. A. Gross, Jr.
for /t/ J. A. TOLEN
Deputy Director for
Engineering Testing
Development and Proof Services

COPY/am

JOINT MESSAGEFORM

SECURITY CLASSIFICATION: UNCLASSIFIED

TYPE MSG	BOOK	MULTI	SINGLE
		M	

PRECEDENCE

ACTION: ROUTINE

INFO: ROUTINE

RESERVED FOR COMMUNICATION CENTER

COMMUNICATIONS CENTER

1967 DEC 8 14 43

ABERDEEN PROVING GROUND
MARYLAND

DTG

FROM: COAPG MD

SPECIAL INSTRUCTIONS

TO: CGUSAWECOM ROCK ISLAND ILL

INFO: CGUSATECOM APG
CGUSAMUCOM DOVER NJ
COUSABRL APG

UNCL 14193 FOR AMCPM-RS, MR. DAVIS: AMSTE-BC, MR. CRIDER; AMSMU-RE, MR. SPAULDING; AMXBR-ED, MR. PIDDINGTON FROM STEAP-DS-TI SGD WILSON AND BROWN

SUBJ: FIRING OF M196 CARTRIDGES IN XM177E2 SUBMACHINE GUN, USATECOM PROJ NO. 8-7-0020-01

1. SUSTAINED FIRE TEST OF FOUR WEAPONS EACH FIRING A DIFFERENT LOT OF AMMUNITION HAS BEEN COMPLETED. REVIEW OF THE DATA INDICATES THAT ALL CRITERIA WERE MET WITH THE TWO GUNS FIRING M193 CARTRIDGES BUT CRITERIA WERE NOT MET WITH THE TWO GUNS FIRING M196 CARTRIDGES DUE TO EXCESSIVE YAW AND DISPERSION. ONE LOT OF M196 CARTRIDGES WAS LOADED WITH 8208M AND ONE LOT WITH WC846 PROPELLANT.

2. THERE IS SERIOUS CONCERN THAT THE INCOMPATIBILITY OF M196 TRACERS AND XM177E2 GUNS CANNOT BE SOLVED BY CHANGES IN AMMUNITION ONLY. TOTAL COMPATIBILITY MAY REQUIRE REDESIGN OF THE XM177E2

DATE	TIME
8	14002
MONTH: DEC	YEAR: 1967
PAGE NO. 1	NO. OF PAGES 2

DRAFTER — TYPED NAME AND TITLE: /t/ S. A. DOILNEY, Chief, Small Arms & Acft Wpns Branch — PHONE: 4489

RELEASER — SIGNATURE:

TYPED (or stamped) NAME AND TITLE: /t/ CLAUDE E BROWN, Ch, Inf & Acft Wpns Di

SECURITY CLASSIFICATION: UNCL

REGRADING INSTRUCTIONS: NA

DD FORM 1 NOV 63 173

REPLACES EDITION OF 1 MAY 55 WHICH WILL BE USED.

COPY/am

ABBREVIATED JOINT MESSAGEFORM and/or CONTINUATION SHEET		SECURITY CLASSIFICATION: UNCL	
PRECEDENCE: ACTION ROUTINE; INFO ROUTINE	RELEASED BY: C. E. BROWN	DRAFTED BY: A. WILSON	PHONE: 4489

MUZZLE DEVICE. WHILE THE NEED FOR MUZZLE DEVICE REDESIGN IS ONLY CONJECTURAL AT THIS TIME, SUCH REDESIGN WOULD PROBABLY REQUIRE CONFIRMATION BY RETEST OF MOST OF THE SUBTESTS IN CURRENT PRODUCT IMPROVEMENT TEST OF XM177E2.

3. NO SIMILAR INCOMPATIBILITY OF 8208M-LOADED M196 CARTRIDGES HAS BEEN OBSERVED IN M16A1 RIFLE FIRINGS.

4. THE PRECEDING INFORMATION WAS DISCUSSED WITH REPRESENTATIVES FROM FRANKFORD ARSENAL DURING A VISIT TO APG ON 29 NOVEMBER 1967.

CONTROL NO.	TOR/TOD	PAGE NO.	NO. OF PAGES	MESSAGE IDENTIFICATION	INITIALS
		2	2		ps

REGRADING INSTRUCTIONS	SECURITY CLASSIFICATION
NA	UNCL

DD FORM 1 NOV 68 173-1 REPLACES EDITION OF 1 MAY 68 WHICH WILL BE USED.

APPENDIX III - REFERENCES

1. Wilson, A., "Partial Report of Engineering Test of Small Arms Weapons Systems (SAWS)." Aberdeen Proving Ground. Report No. DPS-1851, December 1965. (Distribution Controlled by AMCPM-PM50-RS.)

2. Wilson, A., "Final Report of Engineering Test of Small Arms Weapons Systems (SAWS)." Aberdeen Proving Ground. Report No. DPS-1970, April 1966. (Distribution Controlled by AMCPM-PM50-RS.)

3. MIL-C-99630, Military Specification for Cartridge, 5.56-MM, Ball, M193.

4. MIL-C-60111, Military Specification for Cartridge, 5.56-MM, Tracer, M196.

5. USABRL 610, Displacement Time Recorder.

6. Test Plan on Military Potential Test of Weapon Lubricants, January 1967.

7. Staley, L., "Final Report on Engineer Design Test of Modified Flash Suppressor for CAR-15 Submachine Gun." Aberdeen Proving Ground. Report No. DPS-2215, January 1967. (Distribution Controlled by AMCPM-RS. AD 804 406L.)

8. AMSWE-SMM-SA letter, 2 June 1967, Subject: Lubrication and Preservatives for M16A1 Rifle.

9. Hankins, A., "Final Report on Special Study of High Temperature Bore Fouling of 5.56-MM, M196 Tracer Cartridge in M16A1 Rifle." Aberdeen Proving Ground. Report No. DPS-2264, March 1968. (Distribution Controlled by AMCPM-RS.)

10. Addendum to Final Report on Product Improvement Test of Redesigned Buffer for M16A1 Rifle. USATECOM Project No. 8-7-0230-04. Report No. DPS-2662.

11. Handbood on Design of Automatic Weapons, draft copy, Duke University, 1968.

AD _____ Accession No. _____

Development and Proof Services, Aberdeen Proving Ground, Maryland
Final Report on USATECOM Project No. 8-7-0220-01, Product Improvement Test of Submachine Gun, 5.56-MM, XM177E2, June 1968
AMCMS Code No. 4420.25.0132.2.39, Report No. DPS-2754
Authors George Hendricks and Allan Wilson
Secondary distribution controlled by Project Manager, Rifles, ATTN: AMCPM-RS
218 pages, 49 illustrations

Unclassified Report

The product improved components of the test weapons were: chrome-plated chambers, buffer, 1-1/2 inch increased barrel length, delrin charging-handle latch, hand-guard slip ring, cadmium-plated slip ring spring, shot-peened upper and lower receivers, nlyon coated buttstock and release lever, and grenade launcher spacer (for attaching an XM148 grenade launcher). With the exception of the delrin charging handle latch, which proved susceptible to breakage at -65°F, durability of all the product improvements was satisfactory throughout the test. It was recommended that further development of the XM177E2 submachine gun buffer and noise - flash suppressor be accomplished, that the delrin charging handle latch be considered unacceptable, and that the remaining product improvements under test be considered suitable for use on the XM177E2 submachine gun and, as appropriate, the M16A1 rifle.

AD _____ Accession No. _____

Development and Proof Services, Aberdeen Proving Ground, Maryland
Final Report on USATECOM Project No. 8-7-0220-01, Product Improvement Test of Submachine Gun, 5.56-MM, XM177E2, June 1968
AMCMS Code No. 4420.25.0132.2.39, Report No. DPS-2754
Authors George Hendricks and Allan Wilson
Secondary distribution controlled by Project Manager, Rifles, ATTN: AMCPM-RS
218 pages, 49 illustrations

Unclassified Report

The product improved components of the test weapons were: chrome-plated chambers, buffer, 1-1/2 inch increased barrel length, delrin charging-handle latch, hand-guard slip ring, cadmium-plated slip ring spring, shot-peened upper and lower receivers, nylon coated buttstock and release lever, and grenade launcher spacer (for attaching an XM148 grenade launcher). With the exception of the delrin charging handle latch, which proved susceptible to breakage at -65°F, durability of all the product improvements was satisfactory throughout the test. It was recommended that further development of the XM177E2 submachine gun buffer and noise - flash suppressor be accomplished, that the delrin charging handle latch be considered unacceptable, and that the remaining product improvements under test be considered suitable for use on the XM177E2 submachine gun and, as appropriate, the M16A1 rifle.

Unclassified
Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY *(Corporate author)* Development and Proof Services Aberdeen Proving Ground, Maryland 21005	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b GROUP

3. REPORT TITLE
PRODUCT IMPROVEMENT TEST OF SUBMACHINE GUN, 5.56-MM, XM177E2

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Final Report 1 August 1967 to 15 April 1968

5 AUTHOR(S) *(Last name, first name, initial)*
Hendricks, George
Wilson, Allan

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b NO OF REFS
June 1968	218	9

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
Not applicable b. PROJECT NO. USATECOM Project No. 8-7-0220-01 c. d.	DPS-2754 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*

10. AVAILABILITY/LIMITATION NOTICES
This document may be further distributed by any holder only with specific prior approval of Project Manager, Rifles, ATTN: AMCPM-RS.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
None	Project Manager, Rifles

13 ABSTRACT

At the request of US Army Weapons Command, a product improvement test of the 5.56-mm submachine gun, XM177E2, was conducted at Aberdeen Proving Ground, Maryland between 1 August 1967 and 15 April 1968. The product improved components of the test weapons were: crome-plated chambers, buffer, 1-1/2 inch increased barrel length, delrin charging-handle latch, hand-guard slip ring, cadmium-plated slip ring spring, shot-peened upper and lower receivers, nylon coated buttstock and release lever, and grenade launcher spacer (for attaching an XM148 grenade launcher). With the exception of the delrin charging handle latch, which proved susceptible to breakage at -65°F, durability of all the product improvements was satisfactory throughout the test. The chrome-plated chambers demonstrated improvement over nonplated chambers in reducing failures to extract and the hand-guard slip ring offers advantages over the previous design in ease of assembly and disassembly of hand-guards. Kinematics studies showed that the energy-absorbing characteristics of the urethane end cap on the buffer are subject to change under repetitive impacts, causing undesirably large variations in cyclic rate within a burst. Progressive build-up of fouling in the flash - sound suppressor during firing tends to increase muzzle flash and sound level and apparently has an adverse effect on bullet stability and flight. It was recommended that further development of the XM177E2 submachine gun buffer and noise - flash suppressor be accomplished, that the delrin charging handle latch be considered unacceptable, and that the remaining product improvements under test be considered suitable for use on the XM177E2 submachine gun and, as appropriate, the M16A1 rifle.

DD FORM 1 JAN 64 1473

Unclassified
Security Classification

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
PI of XM177E2, 5.56-mm, SMG.						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

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2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

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6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

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8b, 8c, & 8d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

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10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

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(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

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If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

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There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

Unclassified

Security Classification