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MILITARY POTENTIAL TEST OF TWO AND THREE ROUND BURST CONTROL DEVICES WITH AND WITHOUT COMPENSATOR FOR M16A1 RIFLE

FINAL REPORT

By

MAJOR ROBERT L. WEBSTER, JR.

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UNITED STATES ARMY INFANTRY BOARD
Fort Benning, Georgia 31905

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SUBJECT: Final Report of Military Potential Test of Two and Three Round Burst Control Devices with and without Compensator for M16A1 Rifle, TECOM Project No 8-WE-604-016-001

Commander
US Army Small Arms Systems Agency
ATTN: AMXAA-CD
Aberdeen Proving Ground, Maryland 21005

Subject document is forwarded for your approval.

FOR THE PRESIDENT:

D. H. COLLINS
1LT, QM
Adjutant

1 Incl
as (15 cys)

CF:
Cdr, TECOM, ATTN: AMSTE-BC (1 cy)

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ABSTRACT

The Military Potential Test of Two and Three Round Burst Control Devices with and without Compensator for the M16A1 Rifle was conducted by the US Army Infantry Board at Fort Benning, Georgia, during the period 13 April - 31 July 1972, under prevailing intermediate climatic conditions.

The purpose of the test was to determine the military potential of the M16A1 rifle equipped with a two or three round burst control device, with and without a compensator.

Testing was conducted using soldiers representative of those who would normally employ the test items. Firing tests included both the semiautomatic and automatic modes of fire. Subtests conducted were: Preoperational Inspection and Physical Characteristics; Safety; Training; Accuracy and Dispersion; Field Firing; both Quick Fire and Defensive Fire; Low Light Level Fire; Durability, Reliability, and Maintainability; and Human Factors.

No deficiencies were found. There was one shortcoming. This was the lack of durability of the decalcomania for the burst control device selector lever.

It was concluded that: (1) the compensated burst control devices have military potential; the results were inconclusive as to which compensated burst control device was best. (2) The uncompensated burst control devices have no military potential with the M16A1 rifle. (3) The data contained in the report should contribute to a future decision concerning the removal of the full automatic option from the M16A1 and substituting a burst control device. (4) The data provided should contribute to a future decision concerning whether burst control devices will curtail indiscriminate use of automatic fire. (5) The test results indicated that the standard M16A1 rifle with a compensator has military potential. (6) Further study and testing are required to determine the optimum design of the selector arrangement with the burst control device and to evaluate the effects of carbon buildup in the compensator.

It was recommended that the M16A1 rifle equipped with the burst control device and compensator be further tested and that a standard M16A1 rifle equipped with a compensator only be tested.

FOREWORD

The United States Army Small Arms Systems Agency provided the outline of the plan of test and the statistical design. Based on the above, the United States Army Infantry Board was responsible for test planning, test execution, and test reporting.

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SECTION 1. SUMMARY

1.1 BACKGROUND

1.1.1 Numerous tests have been conducted involving compensators and/or controlled burst fire mechanisms for the M16A1 rifle (M16A1). Most of those tests were limited in scope and were designed to compare the M16A1 with other rifle systems under development. User agencies have recently expressed interest in burst control devices as a means of improving the hit capability of the M16A1.

1.1.2 Recent information obtained from personnel returning from the field, along with studies and reports gathered by US Army Combat Developments Command Infantry Agency indicated that:

a. The M16A1, when used in the automatic mode of fire, has created problems in the area of fire discipline, small unit sustainability, and training. These problems were increased by the issuance of the 30 round magazine.

b. Full automatic fire delivered by the M16A1 is inefficient.

c. Automatic fire in 3 round bursts provides the optimum mode of fire under conditions of reduced visibility.

1.1.3 The US Army Small Arms Systems Agency (USASASA) believes that combat effectiveness of the M16A1 might be increased by using a 2 or 3 round burst control device with compensator. Previous limited testing in this area showed that without compensation, there is no significant advantage to 2 or 3 round bursts. Hence, USASASA proposed, and received US Army Combat Developments Command and US Marine Corps concurrence, that compensation be included in a test program aimed at increasing the effectiveness of the M16A1.

1.1.4 On 16 December 1971 USASASA requested that the US Army Test and Evaluation Command (TECOM) conduct a military potential test (MPT) of the 2 and 3 round burst control device, with and without compensator, for the M16A1 rifle. On 21 January 1972 TECOM directed the US Army Infantry Board (USAIB) to conduct the test.

1.1.5 At the request of the test sponsor, the number of weapons configurations to be fired by the seven test soldiers in Subtest No 4, Accuracy and Dispersion, was changed from six to seven. Consequently, the firing order shown in the test plan is not valid. Also, at the request of the test sponsor, the number of test soldiers used in Subtests No 5 and 6 was increased from 14 to 49 for each of these two subtests. Consequently, the firing orders shown in the test plan are not valid.

1.2 DESCRIPTION OF MATERIEL

1.2.1 Burst Control Kit Parts (fig 2, app I)

1.2.1.1 The 2 or 3 round burst control devices (BCD) consist of the components listed in Table 1-1. They replace the standard M16A1 components listed in the table. The only difference between the 2 round burst control device and the 3 round burst control device is the cam. One cam allows two rounds of automatic fire and the other allows three rounds of automatic fire.

Standard Parts to be Removed		Kit Parts to be Installed	
Part No	Nomenclature	Part No	Nomenclature
61590	Sear, Automatic	GX-4940	Sear, Automatic
62317	Hammer and Hammer Pin Assembly	GX-5065	Hammer
		GX-4930 or GX-4999	Cam (Two-shot) or Cam (Three-shot)
61697	Spring, Hammer	GX-5067	Spring, Hammer
		GX-4931	Spring, Cam
61955	Trigger	GX-5070	Trigger
62344	Disconnect	GX-5068	Disconnect (burst)
		Unknown	Disconnect Assembly Pin
		GX-5071	Disconnect (semiauto)
61925	Spring Disconnect (1 required)	61925	Spring Disconnect (2 required)
		GX-5069	Spring, Aux Disconnect
61959	Selector, Fire Control	GX-5066	Lever, Safety Selector
		GX-6039	Decalcomania

Table 1-1

PARTS LIST FOR 2 AND 3 ROUND BURST CONTROL DEVICE FOR M16A1

1.2.1.2 The BCD provides an additional fire control mode for the weapon. When a weapon is so equipped and the fire control selector is set on the BURST position, each pull of the trigger will cause automatic fire of two or three rounds depending on whether the 2 shot or the 3 shot cam is installed (fig 3, app I). This functioning will continue until another fire control mode is selected or until the magazine is empty. However, the first pull of the trigger after selection of the burst mode may not result in the full burst, depending upon the position of the hammer cam. The next trigger pull will fire the full burst if enough cartridges remain in the magazine and the trigger is held down until the full burst has fired. When the BCD is installed, there are four positions for the selector lever: SAFE, SEMI, AUTO, and BURST (fig 2 and 8, app I). The BURST position is located directly below the AUTO position with the selector pointing downward. A decalcomania is supplied which is affixed to the receiver to indicate the positions of the lever with burst control added. Before installation of the selector lever, the decalcomania is placed over the present selector lever markings.

1.2.2 Compensator

1.2.2.1 The compensator is a slotted device that is attached to the muzzle of the M16A1 in place of the flash suppressor (fig 4, 5, 6, and 7, app I). The escaping propellent gases are bled off through the slots of the compensator exerting a compensating pressure against the normal rise or jump of the muzzle when the weapon is fired.

1.2.2.2 The development objective of the compensator evaluated in this test was to provide a device that would decrease the pattern size of 2 or 3 round bursts and be comparable in size, shape, weight, noise level, flash suppression, and semiautomatic accuracy to the standard flash suppressor. The compensator has two positions: one for a right-handed shooter and one for a left-handed shooter (fig 7, app I). The desired position is set with a special tool (wrench).

1.3 TEST OBJECTIVES

1.3.1 To determine the military potential of the M16A1 equipped with a BCD (2 and 3 rounds) with and without a compensator.

1.3.2 To provide data which may contribute to a future decision concerning the removal of the full automatic option from the M16A1 and substituting a BCD.

1.3.3 To provide data which may contribute to a future decision concerning whether a BCD will curtail indiscriminate use of automatic fire, ultimately resulting in reduced ammunition expenditures.

1.4 SCOPE

1.4.1 This military potential test was conducted at Fort Benning, Georgia, under the prevailing intermediate climatic conditions. Testing was conducted from 13 April 1972 through 31 July 1972. A total of 106 test soldiers, representative of the user population was used. One group of seven test soldiers fired accuracy and dispersion exercises on a 25-meter known distance range. One group of 50 test soldiers fired exercises on the USAIB quick-fire facility and from these 50, 47 fired from the night firing positions of the defense facility. Another group of 49 test soldiers fired exercises on the defense facility during daylight.

1.4.2 This test addressed the hit probability of four test and three control weapon configurations. Configurations hereinafter collectively referred to as the test items or test configurations, and control items or control configurations were:

a. M16A1 with 2 round burst control device - test

b. M16A1 with 3 round burst control device - test

c. M16A1 with 2 round burst control device with compensator - test

d. M16A1 with 3 round burst control device with compensator - test

e. M16A1 fired in the semiautomatic mode - control

f. M16A1 fired in the automatic mode using trigger manipulated techniques to obtain a 2 or 3 round burst - control

g. M16A1 fired in the automatic mode using trigger manipulation techniques to obtain a 4 to 6+ round burst - control

1.4.3 The control item, firing a 4 to 6+ round burst by trigger manipulation, was included at the request of the test sponsor. Current doctrine, as taught by the US Army Infantry School, however, states that automatic fire with the M16A1 rifle will be in 3 round bursts and larger bursts will not be employed. The data resulting from the firing of the 4 to 6+ configuration by test soldiers have been eliminated from the analysis in the quick fire and defensive fire phases of Subtest No 5, and Low Light Level Fire, Subtest No 6, because the test soldiers only fired an average of 2.58 rounds per burst in quick fire and 3.40 rounds per burst in the defensive and 2.58 rounds per burst in low light level. During the accuracy and dispersion subtests the test soldiers were under the direct control of the test officer at all times and 4 to 6+ rounds per burst were achieved. During the quick fire and defensive fire subtests direct control was not possible. It is believed that the following factors caused the soldiers not to fire 4 to 6+ rounds per burst:

a. Previous training taught them that a 2 to 3 round burst was the most effective.

b. In a long burst the weapon moves off of the target after approximately 2 or 3 rounds. The test soldiers, trying to score hits, would either consciously or unconsciously, release the trigger as soon as they saw that the muzzle and/or bullet strikes were not on target.

1.4.4 The safety release stated that the test items were released for shoulder fire and that normal precautions when firing small arms would be observed. In addition, sustained fire exercises that exceeded the cook-off point of approximately 140 rounds per minute were not to be conducted. These conditions were adhered to and safety testing was an integral part of all subtests. Durability, reliability, maintenance, and human factors were assessed as a routine condition of the test. Data relevant to these areas of interest were collected throughout testing and are presented in this report. The accuracy of the lots of ammunition used during testing was determined by fixture firing, using accuracy barrels available at the US Army Marksmanship Training Unit (USAMTU) at Fort Benning. The average extreme spread of each weapon configuration was determined by using seven representative test soldiers to fire each of the seven weapons configurations. The seven test soldiers were randomly assigned using a 7 X 7 Latin Square design. This design was selected by the test sponsor. Exercises were conducted from both the prone supported and standing positions. The daylight hit probability of each weapon configuration was determined through a series of tactical firing exercises in both the quick-fire and defensive environment. Low level light hit probability was determined as a result of night firing exercises. The statistical design was provided by the test sponsor and was based on the number of rounds fired by each weapon configuration. There were seven weapons for each test configuration and seven weapons for each control configuration. There were seven test soldiers per configuration for the quick-fire exercise, except for semiautomatic; eight soldiers fired semiautomatic. The low level light exercise used 47 of these 50; 8 fired 2BCDC, 5 fired semi, 6 fired 2BCD, and 7 fired all others. In the defense firing exercise a different group of 49 test soldiers was used. Seven soldiers were assigned to each configuration except for the 2 round and 3 round compensated burst control devices. Eight men fired the 2BCDC and six fired the 3BCDC. The sample size of test and control items was sufficent to obtain the data required. An analysis of variance and the Duncan Multiple Range Test were applied to the results obtained in all firing subtests to determine significant differences between weapon configurations. Throughout testing, records were maintained which reflected the ammunition expenditure per configuration.

1.4.5 Since no approved requirement document existed for the test items, the criterion of a demonstrated increase in hit probability of 15 percent at 90-percent confidence as stated by the test sponsor was used. All other criteria were developed by USAIB.

1.5 SUMMARY OF RESULTS

1.5.1 The 2 and 3 round burst control devices, with and without compensators, were tested against 17 different requirements; 13 were met and 4 were not met (app II).

1.5.2 No unsafe conditions or safety hazards associated with the employment of the test and control items were noted during the test. A potential safety hazard exists with the burst control device selector lever. It has no mechanical stop and can be rotated 360 degrees in either direction. This allows the operator, when putting the weapon on SAFE, to inadvertently rotate the lever through SAFE and into a firing mode (para 2.2.4.2).

1.5.3 There were no deficiencies and one shortcoming found on the test items (app III).

1.5.4 The test and control items were complete, serviceable, and operable (para 2.1.4.1).

1.5.5 The manufacturer's instructions on installation of the test items were adequate for installing the test items at company level (para 2.1.5.5).

1.5.6 No differences in signature effects could be discerned between the test and control items (para 2.1.4.8).

1.5.7 A minor problem associated with training was the test soldiers' tendency to release the trigger of the BCD weapons before the full burst was fired, particularly with the 3 round burst control devices (para 2.3.4.3).

1.5.8 The burst control devices, with and without compensators, did not demonstrate average extreme spreads equal to or smaller than the control items when fired in the prone supported and standing positions. In the standing position the test items, with the exception of the uncompensated 3 round and 2 round burst control devices, demonstrated average extreme spreads that were less than the 2 to 3 trigger manipulated control items, but greater than the semiautomatic control item (para 2.4.5.1 and 2.4.5.5).

1.5.9 The test items did not demonstrate an increase in hit probability of at least 15 percent at a 90-percent confidence level when compared to the control items in the quick-fire environment (para 2.5.5.3 and 2.5.5.10).

1.5.10 The test items did not demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence level when compared to the control items in the defensive-fire environment (para 2.5.10.1 and 2.5.10.10).

1.5.11 The test items did not demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence level when compared to the control items during low level light firing (para 2.6.5.1 and 2.6.5.2).

1.5.12 The installation and use of the test items did not adversely affect durability, reliability, or maintenance of the M16A1. The decal furnished with the kit lacked durability. This is a shortcoming (para 2.7.5.3 and 2.7.5.4).

1.5.13 A carbon buildup was observed in the compensator. However, this buildup was not visible when the compensator was mounted on the rifle and did not affect firing accuracy or functioning (para 2.7.5.4).

1.5.14 The test items were suitably designed from a human factors standpoint. While no difficulty was experienced with selector settings, test soldier comments indicate that the existing relative positions of the selector settings and the lack of mechanical stops on the selector may not be optimum (para 2.8.4.8).

1.6 CONCLUSIONS. The United States Army Infantry Board concludes that:

a. The compensated burst control devices have military potential. The results were inconclusive as to which compensated burst control device was best.

b. The uncompensated burst control devices have no military potential with the M16A1 rifle.

c. The data contained in the body of this report should contribute to a future decision concerning the removal of the full automatic option from the M16A1 and substituting a burst control device.

d. The data contained in the body of this report should provide data contributing to a future decision concerning whether a burst control device will curtail indiscriminate use of automatic fire.

e. The test results indicate that the standard M16A1 rifle with compensator has military potential.

f. Further study and testing are required to determine the optimum design of the selector arrangement on the burst control device.

g. An insufficient number of rounds was fired in this test to evaluate the effects of carbon buildup in the compensator.

1.7 RECOMMENDATIONS. The United States Army Infantry Board recommends that:

a. The compensated burst control devices be further tested.

b. The standard M16A1 rifle with a compensator be tested.

SECTION 2. DETAILS OF TEST

2.1 SUBTEST NO 1, PREOPERATIONAL INSPECTION AND PHYSICAL CHARACTERISTICS

2.1.1 Objective

2.1.1.1 To insure that all of the weapons, BCD's, and compensators were complete and in the proper condition for testing.

2.1.1.2 To determine the physical characteristics of the BCD's and compensators.

2.1.1.3 To confirm the functional operation of the test and control items in all available modes of fire.

2.1.1.4 To evaluate the adequacy of instructional material provided on the BCD's and compensators.

2.1.1.5 To determine the average extreme spread of the lot of ammunition to be used during testing.

2.1.2 Criteria

2.1.2.1 All test and control items must be in the proper condition for testing. (item 1, app II)

2.1.2.2 The test and control items must function properly. (item 2, app II)

2.1.2.3 The average extreme spread of the lot of ammuntion used during testing shall not exceed the accuracy standards for acceptance testing. (item 3, app II)

2.1.2.4 The signature effects (flash, smoke, dust, and sound) of the test items with compensator shall not exceed those of the control items. (item 4, app II)

2.1.3 Method

2.1.3.1 The weapons, BCD's, and compensators were visually inspected for completeness, defects, and/or damage.

2.1.3.2 A sample of 2 and 3 round BCD's was displayed by component part and photographed.

2.1.3.3 A sample of the compensator was photographed by component part and by mounting on the weapon.

2.1.3.4 Each test weapon, control weapon, BCD, and compensator was weighed and measured.

2.1.3.5 BCD's and compensators were installed by a small arms repairman on 28 weapons, as follows:

a. Three round BCD's on seven weapons.

b. Three round BCD's and compensators on seven weapons.

c. Two round BCD's on seven weapons.

d. Two round BCD's and compensators on seven weapons.

2.1.3.6 All test and control items, to include seven 20-round magazines per weapon, were marked for identification.

2.1.3.7 All rifles were test fired. The operation of the safety mechanism was checked periodically between each mode of fire. The firing mode selector lever was changed periodically between trigger pulls.

2.1.3.8 All instructional material provided with the test and control items was reviewed by test supervisory personnel for adequacy and completeness.

2.1.3.9 One hundred rounds of ammunition were fired from each of the two lots of ammunition provided for test, using fixture firing facilities and accuracy barrels. Ten round shot groups were fired at 200 yards.

2.1.3.10 During the conduct of this subtest supervisory personnel observed the signature effects of both the compensated test items and the control items. Comparison photographs, day and night, were made to compare the flash, smoke, and dust of both the compensated test items and the control items. An impact noise analyzer was used to measure the noise level of six compensated and six uncompensated weapons.

2.1.4 Results

2.1.4.1 The weapons (60 M16A1's), BCD's, and compensators were in the proper condition for testing.

2.1.4.2 Photographs of the test items are shown in Figures through 8, Appendix I.

2.1.4.3 Weight and measurement data on the test and control items are shown in Tables 2-1 and 2-2.

Test Item	Weight (pounds) Average	Length (inches) Average
2 round BCD's	.2190	-
3 round BCD's	.2198	-
Compensators	.1642	2.125

All 14 two round BCD's were weighed.
All 14 three round BCD's were weighed.
All 14 compensators were weighed and measured.

Table 2-1

WEIGHT AND MEASUREMENT DATA
ON BCD'S AND COMPENSATORS DISMOUNTED

Weapon Configuration	Weight (pounds) Average	Length (inches) Average
Standard	7.0234	38.750
2BCD	7.0781	38.750
2BCDC	7.1406	39.125
3BCD	7.1094	38.750
3BCDC	7.1562	39.125

Standard - M16A1 rifle without BCD
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2BCDC - 2 round burst control device, with compensator
3BCDC - 3 round burst control device, with compensator

Note: Installation of BCD's has no effect on length of weapons, compensator changes length.

Table 2-2

WEIGHT AND MEASUREMENT DATA
ON TEST AND CONTROL WEAPONS

2.1.4.4 The BCD's and compensators were installed on the weapons without any difficulty. A special wrench and alignment tool provided by the developer was used to install the compensators. Examination of the armorer's tool kit showed that the installations could have been made with existing tools.

2.1.4.5 All test and control weapons functioned properly. During functional firing 60 M16A1's were fired. One hundred rounds were fired through each weapon. There were no malfunctions on 28 BCD-equipped rifles that could be attributed to the BCD or compensator. Malfunctions that did occur are discussed in Subtest No 7, Durability, Reliability, and Maintainability. The safety functioned properly on all weapons fired. During firing of the BCD-equipped weapons it was noted that the 2 and 3 shot cycle can be interrupted by releasing the trigger before both or all three shots have been fired. The next trigger pull fires the remainder of the burst, if the trigger is held down until the remainder of the burst has fired.

2.1.4.6 Instructional material on the installation and operation of the BCD's and compensators was determined to be adequate.

2.1.4.7 The average mean radii for each of the two lots of ammunition used in testing was 1.59 and 1.58 inches, respectively.

2.1.4.8 The signature effects of the compensated test items were not identifiably different from the signature effects of the standard flash suppressor during daylight observation or comparison of photographs taken at night. The impact noise analyzer did not measure differences in noise levels between the compensated weapons and the uncompensated weapons. Test personnel were unable to detect any differences in noise levels during firing exercises.

2.1.5 Analysis

2.1.5.1 The test and control items are physically in the proper condition for testing.

2.1.5.2 The weight and length increases resulting from use of the test items are not considered practically significant.

2.1.5.3 The BCD's and compensators can be installed at company level. The compensator can be installed with the existing tools found in the company armorer's took kit, rather than using the special wrench and alignment tool provided by the developer.

2.1.5.4 The design of the compensator requires a wrench to change the orientation from left to right, or vice versa. Although not a result of this test, this Board feels that the design should permit the individual soldier in the field to change the orientation without tools.

2.1.5.5 The test and control weapons all functioned properly. The fact that the firer can interrupt the 2 or 3 round burst cycle by releasing the trigger before all rounds in the burst have fired is a problem that can be minimized by training, i.e., train the firer to hold the trigger down until the burst is completed.

2.1.5.6 The instructional material provides adequate instruction on the installation and operation of the BCD's and compensators.

2.1.5.7 The ammunition provided for testing meets the government acceptance accuracy criteria.

2.1.5.8 The day and night signature effects (flash, smoke, and sound) of the compensated weapons meet the criterion.

2.2 SUBTEST NO 2, SAFETY

2.2.1 Objective

To determine whether the burst control devices and compensators are safe for their intended use.

2.2.2 Criterion

The burst control devices and compensators must be safe for their intended use when operated in all available modes of fire. (item 5, app II)

2.2.3 Method

2.2.3.1 The safety release was reviewed for any precautions or limitations to be observed during testing and to determine whether it placed undue restrictions on the use of the test items. Conditions specified in the safety release were adhered to during testing. The safety release stated that the test items were safe for shoulder firing and that normal precautions for firing small arms would be observed. The release also stated that sustained fire exercises exceeding the cook-off point of 140 rounds per minute would not be conducted.

2.2.3.2 Throughout the conduct of all subtests, particular attention was given to detecting any unsafe characteristics of the test items.

2.2.3.3 Throughout testing attempts were made to fire the weapons while they were in the SAFE position.

2.2.3.4 Prior to each firing exercise the security and orientation of the compensator were checked.

2.2.4 Results

2.2.4.1 These conditions placed no undue restrictions on the use of the test items.

2.2.4.2 There were no unsafe conditions detected on any of the test or control items. A potential hazard caused by no mechanical stops on the burst control device selector lever is discussed in paragraph 2.8.4.8, Subtest No 8, Human Factors.

2.2.4.3 Throughout testing all attempts to fire the test and control items while the weapons were on SAFE were unsuccessful.

2.2.4.4 During testing no compensators became loose or changed orientation.

2.2.4.5 No unsafe conditions were noted during the test which indicated that unsafe acts result from a right-handed individual firing a weapon with a compensator oriented for a left-handed shooter, and vice versa.

2.2.5 Analysis

The burst control devices and compensators meet the safety criterion.

2.3 SUBTEST NO 3, TRAINING

2.3.1 Objectives

2.3.1.1 To insure that test soldiers are sufficiently trained and oriented to use the test and control items properly.

2.3.1.2 To familiarize each soldier with the seven weapon configurations being tested and each mode of fire available.

2.3.1.3 To insure that each test soldier had zeroed the weapons he would use throughout testing.

2.3.2 Criteria

2.3.2.1 All test soldiers shall be sufficiently trained to use both the test and control items properly. (item 6, app II)

2.3.2.2 All test soldiers shall be familiar with each weapon configuration being tested and each mode of fire to be used during testing. (item 7, app II)

2.3.2.3 All test soldiers will have established their individual zero for the weapons they will fire during testing. (item 8, app II)

2.3.3 Method

2.3.3.1 There was one group of seven test soldiers for the accuracy and dispersion subtest; one group of 50 test soldiers for the quick-fire subtest; 47 of these 50 for the low level light subtest; another group of 49 test soldiers for the defensive fire subtest. Each group of test soldiers was given an orientation and demonstration on range procedures, range safety, conduct of fire, and zeroing in accordance with the USAIB Range Operation and Safety SOP and Chapter 3, FM 23-9, March 1970. This was followed by an orientation, demonstration, and practical exercise on the characteristics and operation of the test and control items. A review of marksmanship fundamentals was conducted in accordance with Chapter 1, Sections I and II, of FM 23-71, with Changes 1-3, December 1966, and TC 23-71-1, May 1967.

2.3.3.2 During the practical exercise portions of paragraph 2.3.3.1, each test soldier fired at least 50 rounds of ammunition, per assigned weapon. Both aimed fire and the pointing techniques were reviewed and practiced by each test soldier. The semiautomatic mode was used by each test soldier to zero each of his assigned test and/or control weapons. Each test soldier's zero was recorded and used during subsequent testing.

2.3.3.3 Zeroing was conducted at a range of 25 meters.

2.3.4 Results

2.3.4.1 The test soldiers were familiar with the range procedures and safety procedures prior to conducting firing exercises.

2.3.4.2 All test soldiers established their individual weapon zero prior to conducting firing exercises.

2.3.4.3 All test soldiers executed practice firing with their assigned weapons. Test soldiers conducted practice fire in the mode of fire that they would use during subsequent firing exercises. There were no major problems in training. Initially, the test soldiers firing BCD weapons had a tendency to release the trigger before the full burst was fired. This was more noticeable in the 3 round BCD weapons than the 2 round BCD weapons. After considerable emphasis on keeping the trigger depressed until a complete burst was fired, the test soldiers demonstrated that they could fire full bursts with the BCD weapons. For further discussion of burst size, see Subtest No 7, Durability, Reliability, and Maintainability.

2.3.5 Analysis

All training criteria are met.

2.4 SUBTEST NO 4, ACCURACY AND DISPERSION

2.4.1 Objective

To determine and compare the dispersion characteristics (average extreme spread) of each weapon configuration.

2.4.2 Criterion

The average extreme spread of the test items shall be equal to or less than that of the control items when fired by representative test soldiers in the prone supported and standing positions. (item 9, app II)

2.4.3 Method

2.4.3.1 Seven representative test soldiers each zeroed seven weapons, one of each configuration. Zeroing was conducted in accordance with the provisions of Appendix D, FM 23-71, December 1966, with changes 1-3.

2.4.3.2 Seven rifle targets, type A, were mounted on seven 8 foot by 8 foot panels 25 meters from the firing line. Each test soldier fired three 9 or 10 round shot groups at each target from the prone supported position. The targets were checked to account for all rounds fired in each shot group. The extreme spread, extreme horizontal and extreme vertical spreads were measured and recorded for each trigger pull in automatic fire. The spreads on semiautomatic fire were recorded for each 10 round shot group.

2.4.3.3 The exercise described in paragraph 2.4.3.2 was repeated with the soldier using the standing (off-hand) firing position.

2.4.3.4 The firing data obtained from this subtest were subjected to an analysis of variance at the 10-percent level of significance to determine whether there were any significant differences between the configurations. The data were then subjected to a Duncan Multiple Range Test to isolate the differences by configuation.

2.4.4 Results

2.4.4.1 The results of the extreme spread, extreme vertical spread, and extreme horizontal spread measurements were expressed as averages of all weapons by configurations and firing positions (table 2-3).

Weapon Configuration	Average Spreads (inches)					
	Prone		Standing		Extreme Spread	
	Horizontal	Vertical	Horizontal	Vertical	Prone	Standing
Semi	1.94	2.50	4.91	5.80	2.92	7.42
2BCDC	5.72	7.31	9.38	6.31	10.44	12.50
2BCD	5.98	7.88	10.41	16.44	10.48	22.28
2 to 3TM	7.94	8.11	11.58	19.10	12.38	24.41
3BCDC	7.01	10.08	12.62	11.17	12.62	17.57
3BCD	9.12	11.52	15.02	21.84	14.55	30.45
4 to 6+TM	10.41	13.31	18.12	26.91	17.02	34.29

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-3

AVERAGE SPREADS OF ALL WEAPONS BY CONFIGURATION
AT 25 METERS

2.4.5 Analysis

2.4.5.1 The analysis of variance and Duncan Multiple Range Test applied to the results of firing from the standing position are shown in Table 2-4. This analysis shows that in the standing position the semiautomatic weapon configuration is significantly better than all test and control items with the exception of the 2BCDC. There is no significant difference between the 2BCDC and semiautomatic. The 2BCDC is significantly better than the trigger manipulated configurations and the uncompensated burst control device weapons, but there is no significant difference between the 2BCDC and 3BCDC. The 3BCDC is significantly better than the trigger manipulated control items and the 3BCD. There is no significant difference between the 3BCDC and 2BCD. The 2BCD and 2 to 3 TM are both significantly better than only 3BCD and 4 to 6+TM.

Weapon Configuration	Significantly Better Than	No Significant Difference	Significantly Worse Than
Semi	3BCDC 2BCD 2 to 3 TM 3BCD 4 to 6+TM	2BCDC	None
2BCDC	2BCD 2 to 3TM 3BCD 4 to 6+TM	3BCDC Semi	None
3BCDC	2 to 3TM 3BCD 4 to 6+TM	2BCD 2BCDC	Semi
2BCD	3BCD 4 to 6+TM	2 to 3TM 3BCDC	Semi 2BCDC
2 to 3TM	3BCD 4 to 6+TM	2BCD	Semi 2BCDC 3BCDC
3BCD	None	4 to 6+TM	Semi 2BCDC 2BCD 3BCDC 2 to 3TM
4 to 6+TM	None	3BCD	Semi 2BCDC 3BCDC 2BCD 2 to 3TM

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC- 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-4

STATISTICALLY SIGNIFICANT DIFFERENCES
IN EXTREME SPREADS FIRED FROM THE
STANDING POSITION AT 25 METERS

2.4.5.2 The analysis of variance test and Duncan Multiple Range Test applied to the results of firing from the prone supported position are shown in Table 2-5. This analysis shows that in prone fire the semi-automatic is significantly better than all other test and control items. The 2BCDC and 2BCD configurations are only better than the 4 to 6+TM configurations.

Configuration	Significantly Better Than	No Significant Difference	Significantly Worse Than
Semi	2BCDC 3BCDC 2BCD 3BCD 2 to 3TM 4 to 6+TM	None	None
2BCDC	4 to 6+TM	3BCDC 2BCD 3BCD 2 to 3TM	Semi
2BCD	4 to 6+TM	2BCDC 3BCDC 3BCD 2 to 3TM	Semi
2 to 3TM	None	2BCDC 3BCDC 2BCD 3BCD 4 to 6+TM	Semi
3BCDC	None	2BCDC 2BCD 3BCD 2 to 3TM 4 to 6+TM	Semi
3BCD	None	2BCDC 3BCDC 2BCD 2 to 3TM 4 to 6+TM	Semi
4 to 6+TM	None	3BCDC 3BCD 2 to 3TM	Semi 2BCDC 2BCD

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-5

STATISTICALLY SIGNIFICANT DIFFERENCES IN
EXTREME SPREADS FIRED FROM THE PRONE POSITION
AT 25 METERS

2.4.5.3 Table 2-5 shows that the test items do not meet the criterion in that they do not demonstrate an average extreme spread equal to or less than the control items.

2.5 SUBTEST NO 5, FIELD FIRING

PHASE I - QUICK FIRE

2.5.1 Objective

To determine and compare the relative effectiveness of each weapon configuration when fired in a quick-fire environment.

2.5.2 Criterion

The test items shall demonstrate an increase in hit probability of at least 15 percent at a 90-percent confidence when compared to the control items in the quick-fire environment. (item 10, app II)

2.5.3 Method

2.5.3.1 Prior to execution of this phase of testing the 50 test soldiers (group 1) were given a 1-hour orientation and demonstration on range procedures, range safety, and conduct of the exercise in accordance with the USAIB Range Operation and Safety SOP.

2.5.3.2 Each weapon used in this subtest was zeroed by the individual test soldier during Subtest No 3, paragraph 2.3.3.2.

2.5.3.3 Prior to the test soldiers' firing, a data link confirmation exercise was fired by one man (test supervisory personnel) as a controlled sample to insure the validity of electrically collected data.

2.5.3.4 This subtest was conducted on the USAIB instrumented quick-fire facility. Each test soldier negotiated the course one time with the weapon configuration assigned to him. There were seven test soldiers for each configuration, except semiautomatic; there were eight test soldiers for semiautomatic, for a total of 50 test soldiers. During the execution of the course each test soldier was allocated 100 rounds of ammunition with which to engage 23 targets. The pointing technique of fire was used. Each soldier was presented 19 single targets and two arrays of two targets each. In the two target arrays, targets were presented one at a time. This required the test soldier to shift fire from the first target in each array to the second target in each array.

Targets were at ranges varying from 20 to 80 meters and were the E-type silhouette targets modified to allow for electrical scoring. The targets were exposed as follows:

a. 20-meter range - 3 seconds

b. 40-meter range - 4 seconds

c. 60-meter range - 5 seconds

d. 80-meter range - 6 seconds

2.5.3.5 The hit probability for each weapon configuration was subjected to an analysis of variance test to determine whether significant differences existed between the weapons configurations. The results of this analysis of variance were subjected to a Duncan Multiple Range Test in order to isolate the significantly different hit probabilities by weapon configuration.

2.5.3.6 The following measures of effectiveness were recorded for each test soldier by weapon configuration:

a. Percentage of hits per rounds fired - The total number of rounds that hit targets versus the total number of rounds fired.

b. Number of targets hit - The number of individual targets that were hit at least once.

c. Number of target hits - The number of bullet holes in all of the targets.

d. Hits per trigger pull - The number of trigger pulls that hit a target versus the total number of trigger pulls.

e. Rounds fired per trigger pull - The average number of rounds fired per trigger pull for each configuration.

f. Total number of rounds fired - The total number of rounds fired by all weapons of the same configuration.

g. Time to fire (each target) - The average time measured from target appearance to the first round fired at that target.

h. Time to first hit (each target) - The average time measured from target appearance to the first hit on that target.

i. Average time to shift fire - There are two target arrays in the quick-fire course that provide for measuring time to shift fire. In

both arrays, the first target appears for 3 seconds, then falls, or is hit and falls. Immediately after the first target falls the second target appears in a different location, but in close proximity to the first to eliminate target detection time. The time to shift fire is measured from the appearance of the second target to the time that the first round is fired at the second target. Times to shift fire are expressed as the average time to shift fire for both arrays by weapon configuration.

j. Percentage of targets hit versus rounds fired - The total number of individual targets which were hit at least once versus the total number of rounds fired.

2.5.3.7 The firing data obtained from this subtest were compared based on rounds fired and bursts fired.

2.5.3.8 The actual burst sizes of the burst control device weapons were compared to the designed burst size.

2.5.3.9 The ammunition expended versus the individual targets hit was compared by weapon configuration.

2.5.4 Results

2.5.4.1 The measures of effectiveness were summarized, by weapon configuration, and are shown in Table 2-6.

Weapon Configuration	Percentage of Hits Per Rounds Fired	Number of Targets Hit	Number of Target Hits	Hits Per* Trigger Pull	Rounds Fired Per Trigger Pull	Total Number of Rounds Fired	Average Time to Fire (seconds)	Average Time to First Hit (seconds)	Average Time** to Shift Fire (seconds)	Percentage of Targets Hit Versus Rounds Fired
Semi	32.75	101	150	32.75	1.00	458	2.71	3.25	1.93	22.05
2BCDC	27.00	80	125	43.31	1.82	463	2.94	3.15	2.46	17.27
3BCDC	21.91	78	110	44.39	2.45	502	2.61	3.10	2.56	15.54
2BCD	17.56	64	82	30.31	1.84	467	2.55	3.44	2.25	13.70
2 to 3TM	17.15	60	71	32.50	2.07	414	2.95	3.27	3.01	14.49
3BCD	15.06	65	75	31.67	2.25	498	2.98	3.46	2.81	13.05
4 to 6+TM	09.26	38	44	22.28	2.58	475	2.77	3.47	2.43	8.00

* Based on number of trigger pulls that hit a target versus total trigger pulls.
** Two target arrays on the quick-fire range used for measuring time to shift fire.

Note: Eight test soldiers fired semiautomatic; seven fired all others.

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-6

QUICK FIRE MEASURES OF EFFECTIVENESS

2.5.4.2 The hit percentages based on rounds fired as a function of range are shown in Table 2-7.

Weapon Configuration	Hit Percentages Based on Rounds Fired by Range (meters)				Overall Hit Percentages
	20	40	60	80	
Semi	55.81	31.31	27.71	16.33	32.75
2BCDC	45.86	23.68	21.69	11.56	27.00
3BCDC	37.72	19.15	14.10	11.04	21.91
2BCD	34.38	13.98	07.78	11.54	17.56
2 to 3TM	31.75	15.07	11.69	07.97	17.15
3BCD	28.91	13.04	10.19	08.82	15.06
4 to 6+TM	17.89	13.79	03.36	03.83	09.26

Note: Eight soldiers fired semiautomatic, seven fired all others.

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-7

QUICK FIRE HIT PERCENTAGES BY ROUNDS

2.5.4.3 The performance of the test and control items was compared based on the number of bursts fired for information only and is expressed in terms of not normalized hit percentages as shown in Tables 2-8 and 2-9. Table 2-8 considers only the proper sized bursts fired where the 2 round burst control devices and 3 round burst control devices are concerned. Table 2-9 considers all bursts fired by the 2BCD and 3BCD configurations, regardless of burst size.

Weapon Configuration	Hit Percentages Based on Full Bursts by Range (meters)				Overall Hit Percentages
	20	40	60	80	
3BCDC	74.42	48.15	50.00	33.33	51.85
2BCDC	72.60	51.61	41.67	20.59	47.12
3BCD	67.86	33.33	28.57	30.23	39.17
2BCD	66.13	23.81	20.59	25.00	36.17
Semi	55.81	31.31	27.71	16.33	32.75
2 to 3TM	57.63	32.35	21.95	16.67	32.50
4 to 6+TM	39.58	34.29	09.09	10.29	22.28

Note: Hit percentages based on number of full bursts that hit a target versus the number of bursts fired.

Eight soldiers fired semiautomatic, seven fired all others.

Full burst - 3 rounds fired with 3BCD, 3BCDC, and 2 rounds fired on 2BCD, 2BCDC, each burst
Semi - Semiautomatic
2BCDC- 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-8

QUICK FIRE HIT PERCENTAGES BY FULL BURSTS

Weapon Configuration	Hit Percentages Based on All Bursts by Range (meters)				Overall Hit Percentages
	20	40	60	80	
3BCDC	70.15	43.24	28.57	27.27	44.39
2BCDC	70.59	39.53	36.17	20.25	43.31
Semi	55.81	31.31	27.71	16.33	32.75
2 to 3TM	57.63	32.35	21.95	16.67	32.50
3BCD	57.14	27.91	23.91	19.74	31.67
2BCD	66.67	21.57	12.50	21.43	30.71
4 to 6+TM	39.58	34.29	09.09	10.29	22.28

Note: Hit percentages based on the number of bursts that hit a target versus number of bursts fired.

Eight soldiers fired semiautomatic, seven fired all others.

All bursts - Considers all bursts fired by 2BCD, 2BCDC, and 3BCD, 3BCDC, regardless of burst size.
Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-9

QUICK FIRE HIT PERCENTAGES BY ALL BURSTS

2.5.4.4 Test soldiers did not always fire full 2 or 3 round bursts when using the burst control devices. There are four situations that cause less than full-sized bursts to be fired:

a. The test soldiers can interrupt the firing cycle by releasing the trigger before the full burst has fired.

b. The magazine does not have sufficient rounds remaining to permit a full burst to fire.

c. The first time that the weapon is loaded and fired, there is no way to predict the position of the firing cam. It may be positioned to fire a partial burst or a full burst.

d. A malfunction can interrupt the firing cycle.

Table 2-10 compares the number of full-sized bursts to the number of odd-sized bursts. See Subtest No 7, Durability, Reliability, and Maintainability, for additional data on burst size.

			Odd-sized Bursts				
Weapon Configuration	Total Bursts	Total Full Bursts	Total 2 round Bursts	Percent 2 round Bursts	Total 1 round Bursts	Percent 1 round Bursts	Percent All Odd-sized Bursts
2BCDC	255	208	-	-	47	18.4	18.4
2BCD	254	210	-	-	44	17.3	17.3
3BCDC	205	135	27	13.1	43	20.9	34.1
3BCD	221	120	37	16.7	64	28.9	45.7

Note: This table includes odd-sized bursts from all causes.

Full burst - A full 2 round burst for a 2 round BCD, BCDC, and a full 3 round burst for a 3BCD, BCDC.
Odd-sized burst - Burst size less than 2 rounds for 2BCD and less than 3 rounds for 3BCD.
2BCDC - 2 round burst control device with compensator.
2BCD - 2 round burst control device
3BCDC - 3 round burst control device with compensator
3BCD - 3 round burst control device

Table 2-10

QUICK FIRE
BURST SIZE DATA ON 2 AND 3 ROUND BURST CONTROL DEVICES

2.5.4.5 A comparison of the number of targets hit versus ammunition expended is shown in Table 2-11.

Weapon Configuration	Range (meters) 20 Rounds	20 TH/TE	40 Rounds	40 TH/TE	60 Rounds	60 TH/TE	80 Rounds	80 TH/TE	Total Rounds	Total TH/TE
Semi	129	40/54	99	26/28	83	11/15	147	24/41	458	73.18
2BCDC	157	39/50	76	19/26	83	7/16	147	15/36	463	62.50
3BCDC	167	38/48	94	19/21	78	4/11	163	17/31	502	70.27
2BCD	128	29/44	93	12/22	90	5/16	156	18/36	467	54.23
2 to 3TM	126	32/48	73	12/18	77	6/11	138	10/29	414	56.60
3BCD	128	28/47	92	17/23	108	6/17	170	14/37	498	52.50
4 to 6+TM	123	17/43	87	13/19	82	1/12	183	7/37	475	34.23

Note: Based on each target hit being counted as one hit regardless of how many rounds hit the target.

Eight test soldiers fired semiautomatic, seven fired all others.

TH - Targets hit
TE - Targets engaged
Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-11

QUICK FIRE
TARGETS HIT AT LEAST ONCE

2.5.5 Analysis

2.5.5.1 The analysis of variance based on number of rounds fired by each weapon configuration detected significant differences in hit probabilities among the weapons configurations. The Duncan Multiple Range Test isolated these differences, by weapon configuration, as shown in Table 2-12. The weapons configurations in this table are shown in rank order.

Weapon Configuration	Significantly Higher Hit Probability Than	No Significant Difference	Significantly Lower Hit Probability Than
Semi	4 to 6+TM 3BCD 2BCD 2 to 3TM 3BCDC	2BCDC	None
2BCDC	4 to 6+TM 3BCD	Semi 3BCDC 2BCD 2 to 3TM	None
3BCDC	4 to 6+TM	2BCDC 2BCD 3BCD 2 to 3TM	Semi
2 to 3TM	4 to 6+TM	2BCDC 2BCD 3BCD 2BCD	Semi
2BCD	4 to 6+TM	2BCDC 3BCDC 3BCD 2 to 3TM	Semi
3BCD	4 to 6+TM	2BCD 3BCDC 2 to 3TM	Semi 2BCDC
4 to 6+TM	None	None	All others

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-12

QUICK FIRE
STATISTICALLY SIGNIFICANT DIFFERENCES IN HIT PROBABILITY
BASED ON ROUNDS FIRED

2.5.5.2 The data on the 4 to 6+TM configuration is shown for information only as discussed in paragraph 1.4.3 of the scope; 4 to 6+TM data have been eliminated from the analysis.

2.5.5.3 The semiautomatic demonstrates a significant increase in hit probability over all test and control items with the exception of the 2BCDC. There is no significant difference between semiautomatic and 2BCDC.

2.5.5.4 An examination of Table 2-6 shows that the semiautomatic configuration hit 101 individual targets, but scored 150 target hits. This was caused by the test soldier hitting some individual targets more than once. The firers were instructed to fire at each target as long as it was visible. An alert firer had ample opportunity to fire several rounds at each target. The total number of hits per rounds fired for the semiautomatic in Table 2-6 is based on all hits on all targets because each round fired on semiautomatic represents one trigger pull. Therefore, in calculating the hit probability of the semiautomatic configuration, hits per rounds fired and hits per trigger pull are identical.

2.5.5.5 In Table 2-6 the total hits per rounds fired shown for the burst control device configurations and trigger manipulated configurations were based on all hits on all targets versus rounds fired. The hits per trigger pull are based on the number of bursts or trigger pulls that hit a target versus the number of bursts fired.

2.5.5.6 As shown in Table 2-6, the compensated burst control devices consistently achieves the highest hit percentages except for semiautomatic in the analysis by rounds fired. The compensator appears to have been a critical factor in the hit percentages of the burst control device configurations equipped with compensators. The overall hit percentages shown in Tables 2-7, 2-8, and 2-9 indicate that the compensated configurations are better than the uncompensated. The uncompensated configurations, with the exception of the semiautomatic (and the 4 to 6+TM configuration) are relatively close together in hit percentage. The data seem to indicate that the compensator is essential to the relatively high hit percentages achieved by the burst control device weapons. This test was not designed to detect a statistically significant difference of 15 percent at a 90-percent confidence level as a function of range or by bursts.

2.5.5.7 An examination of the data shown in Table 2-6 shows that some of the USASASA measures of effectiveness did not appear to be discriminating factors. There was no significant difference between configurations for the times to fire, between the times to first hit, and between the times to shift fire. The total amounts of ammunition expended by each weapon configuration also showed little variation between weapons configurations.

2.5.5.8 It is clear that analysis can be conducted based on the number of rounds fired, the number of proper-sized bursts fired, and the number

of all sized bursts fired. A comparison based on rounds fired will bias in favor of the semiautomatic configuration. A comparison based on bursts fired will bias in favor of the burst control device configuration and the trigger manipulated automatic fire configuration. In Table 2-11 a comparison of test and control items, based on targets hit, i.e., mission accomplishment, was conducted. All firers had an equal opportunity to hit each target presented. All firers were allocated the same amount of ammunition. If each individual target that was hit is considered as an enemy casualty, then the configuration that had the highest hit percentage of individual targets achieved the greatest degree of mission accomplishment. Table 2-11 shows that the semiautomatic configuration had the highest overall hit percentage. Based only on this comparison, the semiautomatic is the best configuration. By the same basis of comparison, the burst control devices with compensators are better over all than the uncompensated burst control device configurations and better than the 2 to 3 trigger manipulated configuration. As shown in Table 2-11, it is important to note that the 2 and 3 burst control devices with compensators achieved a slightly higher hit percentage than all other configurations at 20 meters. Twenty meters was the closest range engaged by test soldiers. These targets were also the ones which were exposed for the shortest amount of time (3 seconds).

2.5.5.9 All the test items fail to meet the criterion in that they did not demonstrate an increase of 15 percent in hit probability when compared to the semiautomatic mode of fire.

2.5.5.10 In analyzing all the data obtained in this subtest, the following indications emerge:

a. The compensated burst control devices were better than the uncompensated burst control devices. Consequently, the uncompensated burst control devices do not have military potential.

b. The compensated burst control devices are better than the existing trigger manipulated automatic fire. There is military potential for the compensated burst control devices.

PHASE II - DEFENSIVE FIRE

2.5.6 Objective

To determine and compare the relative effectiveness of each weapon configutation when fired in a defensive-fire environment.

2.5.7 Criterion

The test items shall demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence when compared to the control items in the defensive firing environment. (item 11, app II)

2.5.8 Method

2.5.8.1 Prior to this phase of testing, a new group of 49 test soldiers (group 2) was given a 1-hour orientation and demonstration on range procedures, range safety, and conduct of the exercise in accordance with USAIB Range Operation and Safety SOP.

2.5.8.2 Each weapon in this subtest was zeroed by the individual test soldier during Subtest No 3, paragraph 2.3.3.2.

2.5.8.3 Prior to the test soldiers firing, the data link was confirmed by range operation personnel to insure validity of electrically collected data.

2.5.8.4 This subtest was conducted on the USAIB instrumented defense facility. Each test soldier fired the course one time using aimed fire with his assigned weapon configuration from the foxhole unsupported position. There were seven test soldiers per configuration, except for 2BCDC and 3BCDC. Eight fired 2BCDC, six fired 3BCDC, and seven fired all others, for a total of 49 test soldiers. During execution of the course each test soldier was allocated 200 rounds of ammunition. A 12-minute scenario of E-type targets, modified for electrical scoring, was presented at ranges from 390 meters decreasing to 50 meters, simulating an enemy attack. There were three to five targets at each range. The targets were in tactical disposition and ranges were unknown to the firers. Each target in the array was exposed individually at least four times in a random presentation. Target exposure times ranged from 3 to 12 seconds. Firers engaged targets as they appeared using the mode of fire dictated by their assigned weapon configuration. Target engagements continued throughout the scenario or until the 200 rounds of ammuntion allocated had been expended. There was only one presentation of the scenario. Five test soldiers fired at the same time.

2.5.8.5 The firing data obtained from this subtest were subjected to an analysis of variance test to determine whether any significant differences in hit probability existed between the weapons configurations. This analysis was based on the number of rounds fired.

2.5.8.6 The following data were recorded for each test soldier by weapon configuration, type target, and range to the target (definitions of terms a through i are included in Subtest No 5, Phase I, Quick Fire):

a. Total number of hits per rounds fired

b. Number of targets hit

c. Number of target hits

d. Hits per trigger pull

e. Rounds fired per trigger pull

f. Total number of rounds fired

g. Time to fire

h. Time to first hit

i. Average time to shift fire

j. Number of hits on a group of targets - All of the hits on all target arrays presenting more than one individual target.

k. Percentage of targets hit versus rounds fired - The total number of individual targets which were hit at least once versus the total number of rounds fired.

2.5.8.7 The firing data obtained from this subtest were compared based on rounds fired and bursts fired. The data on bursts is provided for information only. Ammunition expenditure was evaluated as a factor bearing on the data.

2.5.8.8 The actual burst sizes of the burst control device weapons were compared.

2.5.8.9 The ammunition expended versus individual targets hit was compared by weapon configuration.

2.5.9 Results

2.5.9.1 The USASASA measures of effectiveness were summarized, by weapon configuration, in Table 2-13.

Weapon Configuration	Percentage of Hits Per Rounds Fired	Number of Individual Targets Hit	Number of Target Hits	Hits Per Trigger Pull*	Rounds Fired Per Trigger Pull	Total Number of Rounds Fired	Average Time to Fire (Seconds)	Average Time to First Hit (Seconds)	Time to Shift Fire (Seconds)	Hits on a Group of Targets **	Percentage of Targets Hit Versus Rounds Fired
Semi	07.17	61	72	07.17	1.00	1004	4.40	5.57	5.62	42	6.07
2BCDC	05.68	55	66	10.59	1.86	1161	4.63	4.85	5.62	48	4.73
3BCDC	05.63	46	52	13.90	2.58	923	5.15	5.95	6.03	36	4.98
4 to 6+TM	04.56	42	55	15.06	3.40	1207	5.13	6.98	6.17	44	3.47
2BCD	04.50	45	46	08.47	1.89	1021	4.90	5.81	6.08	32	4.40
2 to 3TM	03.26	41	41	07.70	2.42	1259	4.86	5.76	5.48	34	3.25
3BCD	02.71	29	31	07.38	2.52	1102	5.10	6.44	6.29	28	2.63

*Hit percentage based on the number of trigger pulls that hit a target versus total number of trigger pulls.

**The number of hits on a group of targets is based on all of the hits on all target arrays presenting more than one individual target.

Note: Eight fired 2BCDC, six fired 3BCDC, and seven fired all others.

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
4 to 6+TM - 4 to 6+ round burst, trigger manipulated
2 to 3TM - 2 to 3 round burst, trigger manipulated
3BCD - 3 round burst control device

Table 2-13

DEFENSIVE FIRE MEASURES OF EFFECTIVENESS

2.5.9.2 The number of hits on a group of targets, by range, is shown in Table 2-14.

Weapon Configuration	Hits on a Group of Targets By Range (meters)												Total Hits on Groups of Targets
	390	340	360	295	290	300	250	220	180	130	110	50	
4 to 6+TM	6	10	8	2	0	2	2	3	1	7	1	2	44
Semi	4	3	4	0	3	0	0	4	5	14	2	3	42
2BCDC	0	2	1	2	3	0	3	6	3	12	10	6	48
3BCDC	0	2	3	1	0	4	1	6	3	8	4	4	36
2 to 3TM	0	1	2	3	3	3	2	5	3	9	2	1	34
2BCD	2	3	3	0	1	1	1	2	1	14	4	0	32
3BCD	0	4	4	0	1	3	1	4	2	7	1	1	28

The number of hits on a group of targets as based on the number of rounds that hit a group.
Note: Eight fired 2BCDC, six fired 3BCDC, and seven fired all others.

4 to 6+TM - 4 to 6+ round burst, trigger manipulated
Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2 to 3TM - 2 to 3 round burst, trigger manipulated
2BCD - 2 round burst control device
3BCD - 3 round burst control device

Table 2-14

DEFENSIVE FIRE
NUMBER OF HITS ON A GROUP OF TARGETS

2.5.9.3 The hit percentages based on rounds fired as a function of range are shown in Table 2-15. As a factor bearing on this data, premature ammunition expenditure was recorded (table 2-16).

Weapon Configuration	Hit Percentages Based on Rounds Fired and By Range (meters)												Overall Hit Percentages
	390	340	360	295	290	300	250	220	180	130	110	50	
Semi	04.21	04.08	04.82	05.00	05.05	03.45	03.26	11.76	09.62	25.33	05.13	04.60	07.17
2BCDC	00.00	03.25	01.23	05.00	02.97	02.27	03.92	08.80	11.69	11.21	14.29	07.14	05.68
3BCDC	00.00	03.06	03.09	01.52	01.52	04.82	02.44	10.31	08.11	11.65	07.55	16.67	05.63
2BCD	01.43	04.26	03.80	02.86	00.97	01.16	02.06	03.19	07.14	18.28	11.43	02.17	04.50
4 to 6+TM	05.04	12.10	01.75	04.08	00.00	01.67	02.22	05.13	02.35	12.12	09.52	06.12	04.56
2 to 3TM	00.00	01.06	01.45	02.91	03.36	02.13	02.33	07.50	06.25	15.38	09.52	02.70	03.25
3BCD	00.00	03.12	03.50	00.00	00.78	02.80	00.00	06.33	04.55	18.00	03.57	03.03	02.71

Note: Hit percentages based on rounds that hit a target versus rounds fired.
Eight fired 2BCDC, six fired 3BCDC, and seven fired all others

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-15

DEFENSE HIT PERCENTAGES BY ROUNDS

Individual Weapons	Target Locations at Which Weapon Was Out of Ammunition (Meters) 50	75	100	125	150	175	200	225	250	275	300
1 each, 2BCDC	50										
1 each, 3BCDC			110								
1 each, 3BCDC	50										
1 each, 2BCD	50										
1 each, 3BCD				130							
1 each, 3BCD				130							
1 each, 3BCD						180					
1 each, 2 to 3TM							220				
1 each, 2 to 3TM			110								
1 each, 2 to 3TM			110								
1 each, 2 to 3TM			110								
1 each, 4 to 6+TM			110								
1 each, 4 to 6+TM			110								

Note: There were no occurrences of premature ammunition expenditure for the semiautomatic configuration.

2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-16

DEFENSIVE FIRE INDIVIDUAL
PREMATURE EXPENDITURE OF AMMUNITION DATA

2.5.9.4 The performance of the test and control items was compared based on the number of bursts fired for information only. This information expressed in terms of hit percentages, is shown in Tables 2-17 and 2-18. Table 2-17 considers only the proper sized bursts fired where the 2BCD and 3BCD are concerned. Table 2-18 considers all bursts fired by the 2BCD and 3BCD configurations, regardless of burst size.

Weapon Configuration	Hit Percentages Based on Full Bursts By Range (Meters)												Overall Hit Percentages
	390	340	360	295	290	300	250	220	180	130	110	50	
3BCDC	00.00	14.29	10.91	04.76	00.00	13.64	04.55	26.67	21.74	37.50	18.75	37.50	16.60
4 to 6+TM	09.52	38.00	06.67	12.12	00.00	05.88	07.69	16.00	07.41	38.10	25.00	18.75	15.06
2BCDC	00.00	03.57	02.56	10.71	06.38	02.44	08.51	17.54	25.00	24.53	30.00	14.63	10.35
2BCD	03.03	06.82	05.56	05.88	02.08	02.50	04.44	06.67	12.82	38.10	17.65	04.35	09.76
3BCD	00.00	08.82	09.09	00.00	02.78	07.14	00.00	23.81	18.18	50.00	14.29	10.00	08.62
2 to 3TM	00.00	02.47	03.45	06.82	07.94	05.00	05.56	17.65	14.81	27.59	22.22	07.14	07.70
Semi	04.21	04.08	04.82	05.00	05.05	03.45	03.26	11.76	09.62	25.33	05.13	04.60	07.17

Note: Hit percentages based on the number of bursts that hit a target versus total number of full bursts fired. Eight fired 2BCDC, six fired 3BCDC, and seven fired all others.

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-17

DEFENSE HIT PERCENTAGES BY FULL BURSTS

Weapon Configuration	Hit Percentages Based on All Bursts By Range (Meters)												Overall Hit Percentages
	390	340	360	295	290	300	250	220	180	130	110	50	
4 to 6+TM	09.52	38.00	06.67	12.12	00.00	05.88	07.69	16.00	07.41	38.10	25.00	18.75	15.06
3BCDC	00.00	07.69	08.33	04.17	03.23	11.76	06.06	26.47	17.65	32.43	21.05	37.50	13.90
2BCDC	00.00	05.97	02.38	09.38	05.56	06.38	09.09	16.18	21.95	20.63	25.00	13.95	10.59
2BCD	02.70	08.00	06.98	05.56	01.82	02.13	03.85	06.12	13.33	33.33	22.22	04.35	08.47
2 to 3TM	00.00	02.47	03.45	06.82	07.94	05.00	05.56	17.65	14.81	27.59	22.22	07.14	07.70
3BCD	00.00	07.84	09.62	00.00	02.04	06.82	00.00	16.13	11.11	50.00	09.09	08.33	07.38
Semi	04.21	04.08	04.82	05.00	05.05	03.45	03.26	11.76	09.62	25.33	05.13	04.60	07.17

Note: Hit percentages based on the number of bursts that hit a target versus the total number of bursts fired. Eight fired 2BCDC, six fired 3BCDC, and seven fired all others.

All bursts - Considers all bursts fired hy 2BCD, 2BCDC, 3BCD, and 3BCDC weapons, regardless of burst size.
Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3 TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-18

DEFENSE HIT PERCENTAGES BY ALL BURSTS

2.5.9.5 Test soldiers did not always fire full 2 or 3 round bursts when using the burst control devices. See paragraph 2.5.4.4, Subtest No 5, Phase I, Quick Fire. Table 2-19 compares the number of full-sized bursts with the number of odd-sized bursts.

Weapon Configuration	Total Bursts	Total Full Bursts	Odd-sized Bursts				
			Total 2-round Bursts	Percent 2-round Bursts	Total 1-round Bursts	Percent 1-round Bursts	Percent All Odd-sized Bursts
2BCDC	650	566	-	-	84	12.9	12.9
2BCD	568	499	-	-	69	12.1	12.1
3BCDC	393	280	55	14.0	58	14.7	28.8
3BCD	437	323	59	13.5	55	12.5	26.0

Full burst - A full 2 round burst for a 2 round BCD and a full 3 round burst for a 3BCD.
Odd-sized burst - Burst size less than 2 rounds for 2BCD and less than 3 rounds for 3BCD.

2BCDC - 2 round burst control device with compensator
2BCD - 2 round burst control device
3BCDC - 3 round burst control device with compensator
3BCD - 3 round burst control device

Table 2-19

DEFENSE FIRE
BURST SIZE DATA ON 2 AND 3 ROUND BURST CONTROL DEVICES

2.5.9.6 A comparison of targets hit by range versus ammunition expended by range is shown in Table 2-20.

Weapon Configuration	Range (meters) 390 Rds	390 TH/TE	360 Rds	360 TH/TE	340 Rds	340 TH/TE	300 Rds	300 TH/TE	295 Rds	295 TH/TE	290 Rds	290 TH/TE	250 Rds	250 TH/TE	220 Rds	220 TH/TE	180 Rds	180 TH/TE	130 Rds	130 TH/TE	110 Rds	110 TH/TE	50 Rds	50 TH/TE	Total Rds	Total TH/TE
Semi	95	4/66	83	4/70	98	4/67	87	3/58	60	2/29	99	5/68	92	3/47	85	8/45	104	9/48	75	14/66	39	2/38	87	3/43	1004	9.45
2BCDC	134	0/76	81	1/41	123	4/75	88	2/66	60	3/30	101	3/64	88	4/41	101	9/48	77	5/46	116	12/69	70	8/48	84	4/38	1161	8.56
3BCDC	87	0/56	97	3/60	98	2/51	83	4/58	66	1/28	66	1/58	82	2/33	97	8/38	84	6/26	103	10/46	53	4/28	36	5/21	923	9.14
2BCD	140	2/67	79	3/68	94	3/48	86	1/69	70	2/27	103	1/62	97	2/46	94	3/35	84	6/45	93	17/65	35	4/41	46	1/28	1021	7.48
3BCD	152	0/60	143	5/71	118	3/60	107	3/67	103	0/38	129	1/67	102	0/47	79	5/39	44	2/30	50	8/42	28	1/27	33	1/21	1102	5.09
2 to 3TM	144	0/72	138	2/72	188	2/66	141	3/71	103	3/43	149	5/70	129	3/47	80	6/32	64	4/33	65	10/46	21	2/18	37	1/17	1259	6.98
4 to 6+TM	119	5/67	114	2/45	157	8/67	120	2/57	113	3/42	140	0/65	135	3/46	78	4/34	95	2/39	66	8/40	21	2/14	49	3/24	1207	7.77

Note: Based on each target hit being counted as one hit regardless of how many rounds hit the target. Eight fired 2BCDC, six fired 3BCDC, and seven fired all others.

Rds - Rounds
TH - Targets hit
TE - Targets engaged
Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-20

DEFENSE FIRE
TARGETS HIT AT LEAST ONCE BASED ON ROUNDS FIRED, BY RANGE

2.5.10 Analysis

2.5.10.1 There were no significant differences detected between test and control configurations. The hit percentages based on rounds fired as a function of range are shown in Table 2-15. The relatively low hit percentages are attributed to a combination of factors. First, the test soldiers were required to fire the defense exercise from the foxhole unsupported position. Secondly, 13 test soldiers expended all of their ammunition prior to the presentation of the 50-meter targets, and 10 of these 13 firers expended all of their ammunition prior to the 110-meter targets being presented (table 2-16). A factor affecting all firers was the fact that the weapon forestock became hot and extremely uncomfortable to hold toward the end of the scenario. A final factor was that the 50-meter targets had the shortest exposure time. All of these conditions contributed to the low hit percentages and must be considered when evaluating performance of the test and control items. The overall percentages are the most meaningful since they include performance over a wide spectrum of ranges (50 to 390 meters). This test was not designed to detect a significant difference of 15 percent at 90-percent confidence level as a function of range.

2.5.10.2 The data on the 4 to 6+TM configuration are shown for information only. As discussed in paragraph 1.4.3 of the scope, 4 to 6+TM data have been eliminated from the analysis.

2.5.10.3 The information recorded on the number of hits on a group of targets shown in Tables 2-13 and 2-14 shows that the 2 round burst control device with compensator achieved the greatest number of hits on groups of targets. The 2BCDC configuration performed well below 300 meters, but performance dropped off sharply beyond 300 meters. The semiautomatic configuration achieved the third highest number of hits on groups of targets and performance was relatively uniform at all ranges. The 3 round BCD with compensator, 2 to 3TM, and 2BCD configurations were relatively close together but well below the 2BCDC and semiautomatic in number of hits on groups of targets. The uncompensated 3BCD achieved the lowest number of hits on groups of targets, but performed well beyond 300 meters. The compensated 3BCD did not perform well at ranges beyond 300 meters. This indicates that the compensator may have held down the spread within each burst, thus accounting for the better performance of the uncompensated 3BCD at ranges beyond 300 meters. The uncompensated 2BCD also performed better beyond 300 meters than the compensated 2BCD. This further supports the possibility that the compensator kept the burst from spreading when compared to the uncompensated bursts. However, the number of hits on a group of targets shown in Tables 2-13 and 2-14 is not very meaningful information, particularly when evaluated by range. The groups of targets do not all have the same number of targets within each group. Their group size varied from two to five targets.

2.5.10.4 A comparison of the weapons configurations based on rounds fired, as shown in Table 2-15, showed the semiautomatic achieving the highest hit percentage. The compensated configurations were higher in hit percentage than the uncompensated configurations.

2.5.10.5 In comparing the weapon configurations' performance based on full bursts fired, Table 2-17 shows the compensated burst control devices achieving higher hit percentages than the uncompensated weapons.

2.5.10.6 An examination of the data shown in Table 2-13 showed that some of the USASASA measures of effectiveness did not appear to be discriminating factors. There was no significant difference between configurations for the times to fire, between the times to first hit, and between the times to shift fire.

2.5.10.7 It is clear that analysis can be conducted based on the number of rounds fired, the number of proper-sized bursts fired, and the number of all-sized bursts fired. A comparison based on rounds fired will bias in favor of the semiautomatic configuration. A comparison based on bursts fired will bias in favor of the burst control device configurations and the trigger manipulated automatic fire configurations.

2.5.10.8 In Table 2-20 a comparison of test and control items, based on targets hit, i.e., mission accomplishment, was conducted. All firers had an equal opportunity to hit each target presented. All firers were allocated the same amount of ammunition. If each individual target that was hit is considered as an enemy casualty, then the configuration that hit the most individual targets achieved the greatest degree of mission accomplishment. Table 2-20 shows that the semiautomatic configuration achieves the highest overall hit percentage. Based only on this comparison, the semiautomatic is the best configuration.

2.5.10.9 There did not appear to be a pattern of consistency established by any of the configurations. The 2 round burst control device with compensator and the 3 round burst control device with compensator achieved higher hit percentages than the uncompensated burst control devices and the 2 to 3 round trigger manipulated automatic configuration. The 2 and 3 round burst control devices with compensators are clearly better than the uncompensated BCD and 2 to 3 round trigger manipulated configurations. The uncompensated 3 round burst control device demonstrated the worst performance with an overall hit percentage of 5.09. These relationships show the semiautomatic configuration to be the best when evaluated on the percentage of individual targets hit.

2.5.10.10 All of the test items fail to meet the criterion in that they do not demonstrate an increase of 15 percent in hit probability when compared to the semiautomatic mode of fire.

2.5.10.11 In analyzing all of the data obtained in this subtest, the inconsistencies in performance precluded a subjective determination of military potential.

2.6 SUBTEST NO 6, LOW LEVEL LIGHT FIRE

2.6.1 Objective

To determine and compare the relative hit probability of each weapon configuration when fired under conditions of limited visibility.

2.6.2 Criterion

The test items shall demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence when compared to the control items during low level light firing. (item 12, app II)

2.6.3 Method

2.6.3.1 During daylight hours 47 of the test soldiers used in group 1 were given a 1-hour orientation and demonstration on the fundamentals of individual night firing, range procedures, and range safety in accordance with chapter 7, FM 23-71, with changes 1-3, December 1966, and the USAIB Range Operation and Safety SOP. This was followed by daytime instructional firing. These test soldiers fired the same configurations that they fired in the quick-fire exercise.

2.6.3.2 Each weapon used in this subtest was zeroed by the individual test soldier during Subtest No 3, paragraph 2.3.3.2.

2.6.3.3 This subtest was restricted to light conditions where the targets were visible at a minimum of 36 meters under starlight or moonlight without night vision devices. Available ambient light before, during, and afer each firing order was measured with a photometer and the light readings varied from 2.6×10^{-4} to 7.1×10^{-3} foot candles.

2.6.3.4 Forty-seven test soldiers fired their assigned weapons a total of 30 rounds each from the foxhole supported position. Eight soldiers fired the 2BCDC, five fired semiautomatic, six fired 2BCD, and seven fired all others. The USAIB instrumented low level light firing facility was used. Modified E-type silhouette, electrically scored, targets located at a range of 36 meters were used. The targets were raised for 3 seconds, lowered, and raised again for 3 seconds. This procedure was repeated until each firer had expended 30 rounds. The targets were programed to record hits while erect, rising, and falling.

2.6.3.5 Prior to the initiation of this firing exercise, a data link confirmation exercise was conducted. This exercise was fired by one man (test supervisory personnel) as a controlled sample to insure the validity of electrically collected data.

2.6.3.6 The firing data obtained from this subtest were subjected to an analysis of variance test to determine whether any significant differences in hit probability existed between the weapon configurations. This analysis was based on the number of rounds fired.

2.6.3.7 The following data were recorded for each test soldier by weapon configuration (definitions of terms are included in Subtest No 5, Phase I, Quick Fire):

a. Percentage of hits per rounds fired

b. Number of target hits

c. Hits per trigger pull

d. Rounds fired per trigger pull

2.6.4 Results

2.6.4.1 The measures of effectiveness were summarized in Table 2-21.

Number of Firers	Weapon Configuration	Percentage of Hits Per Rounds Fired	Number of Target Hits	Hits Per Trigger Pull	Rounds Fired Per Trigger Pull
8	2BCDC	03.64	9	06.08	1.67
7	3BCDC	03.54	7	07.87	2.22
5	Semi	02.61	4	02.61	1.00
7	2 to 3TM	00.85	2	01.69	1.98
7	4 to 6+TM	00.46	1	01.19	2.58
6	2BCD	00.00	0	00.00	1.95
7	3BCD	00.00	0	00.00	2.29

Range was 36 meters.

Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-21

LOW LEVEL LIGHT MEASURES OF EFFECTIVENESS

2.6.4.2 As in Subtest No 5, the test soldiers did not always fire full bursts in the BCD weapons. Table 2-22 compares full-sized bursts with odd-sized bursts.

Weapon Configuration	Total Bursts	Total Full Bursts	Odd-sized Bursts				Percent All Odd-sized Bursts
			Total 2 round Bursts	Percent 2 round Bursts	Total 1 round Bursts	Percent 1 round Bursts	
2BCDC	148	99	-	-	49	33.1	33.1
2BCD	97	80	-	-	17	17.5	17.5
3BCDC	89	45	19	21.3	25	28.0	49.4
3BCD	91	51	15	16.4	25	27.4	43.9

Full burst - 3 rounds fired with 3BCD and 3BCDC and 2 rounds fired with 2BCD and 2BCDC, each burst.
Odd-sized burst - Burst size less than 2 rounds for 2BCD and less than 3 rounds for 3BCD.
2BCDC - 2 round burst control device with compensator
2BCD - 2 round burst control device
3BCDC - 3 round burst control device with compensator
3BCD - 3 round burst control device

Table 2-22

BURST SIZE DATA ON 2 AND 3 ROUND BURST CONTROL DEVICES

2.6.4.3 The hit percentages based on rounds fired, on full bursts, and on all bursts are shown in Table 2-23. Full bursts consider only proper sized bursts where BCD configurations are concerned. All bursts consider every burst, regardless of burst size. Since all firing for this subtest was conducted at 36-meter range, there is no analysis by range. The scenario was programed to present the same targets repeatedly until all rounds were expended. Therefore, there were no measurements of time to first round and time to first hit. Since there was one target per shooter there was no requirement to shift fire.

Weapon Configuration	Hit Percentages By Rounds	Hit Percentages By Full Bursts	Hit Percentages By All Bursts
2BCDC	03.64	09.09	06.08
3BCDC	03.54	13.33	07.87
Semi	02.61	02.61	02.61
2 to 3TM	00.85	01.69	01.69
4 to 6+TM	00.46	01.19	01.19
2BCD	00.00	00.00	00.00
3BCD	00.00	00.00	00.00

Range was 36 meters.
Full burst - 3 rounds fired with 3BCD and 3BCDC and 2 rounds fired with 2BCD and 2BCDC, each burst
All bursts - Considers all bursts fired by 2BCD and 2BCDC and 3BCD and 3BCDC, regardless of burst size
Semi - Semiautomatic
2BCDC - 2 round burst control device with compensator
3BCDC - 3 round burst control device with compensator
2BCD - 2 round burst control device
3BCD - 3 round burst control device
2 to 3 TM - 2 to 3 round burst, trigger manipulated
4 to 6+TM - 4 to 6+ round burst, trigger manipulated

Table 2-23

LOW LIGHT LEVEL HIT PERCENTAGES

2.6.5 Analysis

2.6.5.1 A comparison of the weapons configurations, based on rounds fired (table 2-21) shows the 2BCDC weapon and 3BCDC weapon close together in hit percentage with the 2BCDC slightly higher. In comparing these weapons by full bursts and all bursts, the data shows that the 3BCDC achieved the highest hit percentage in both cases. The 2BCDC remained the second best and the semiautomatic was third in all cases. This is particularly noticeable in the full bursts fired by the 3BCDC configuration (table 2-23). In this case, the 3BCDC fired the lowest

number of full bursts and scored the highest hit percentage, by a wide margin, of all other test and control items.

2.6.5.2 Even though the results of this test are based on a limited amount of data, the performance of the compensated burst control devices further supports the results of the quick-fire and defensive-fire subtests. The semiautomatic performance indicates that single-shot fire is at a disadvantage under conditions of low visibility. The performance of the 2 to 3TM configuration may indicate that uncompensated burst fire becomes less accurate as the size of the burst is increased. However, the limited data and very small differences in performance between both the trigger manipulated and uncompensated burst control device configurations do not provide a sound basis for comparison.

2.6.5.3 All of the test items fail to meet the criterion in that they do not demonstrate an increase of 15 percent in hit probability when compared to the semiautomatic mode of fire.

2.6.5.4 In analyzing all of the data obtained in this subtest, the inconsistencies in performance precluded a subjective determination of military porential.

2.7 SUBTEST NO 7, DURABILITY, RELIABILITY, AND MAINTAINABILITY

2.7.1 Objective

2.7.1.1 To develop and record limited data relevant to the durability of the test items.

2.7.1.2 To develop and record limited data relevant to the reliability of the test items.

2.7.1.3 To develop and record data relevant to the maintenance requirements of the test items.

2.7.2 Criteria

2.7.2.1 The installation and use of the test items shall not adversely affect the durability of the M16A1. (item 14, app II)

2.7.2.2 The installation and use of the test items shall not adversely affect the reliability of the M16A1. (item 15, app II)

2.7.2.3 The installation and use of the test items shall not substantially increase the operator or organizational maintenance requirements of the M16A1. (item 16, app II)

2.7.3 Method

2.7.3.1 Throughout testing records were maintained reflecting all damage and breakages and whether such damage and breakages resulted from the installation and/or use of the test items.

2.7.3.2 Throughout testing records were maintained reflecting all malfunctions and whether they were the result of installation and/or use of the test items.

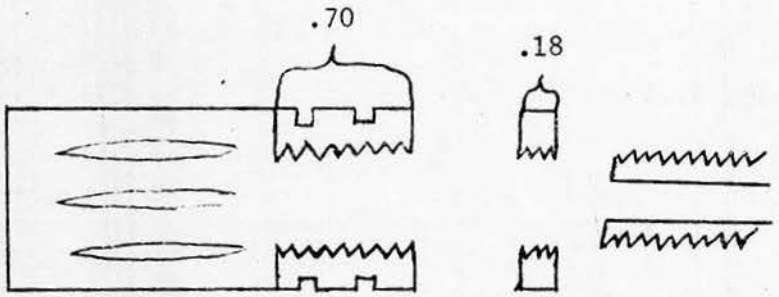
2.7.3.3 Throughout testing records were maintained reflecting operator and organizational maintenance support requirements and whether these requirements were a result of the installation and/or use of the test items. Particular attention was given to repair parts requirements.

2.7.4 Results

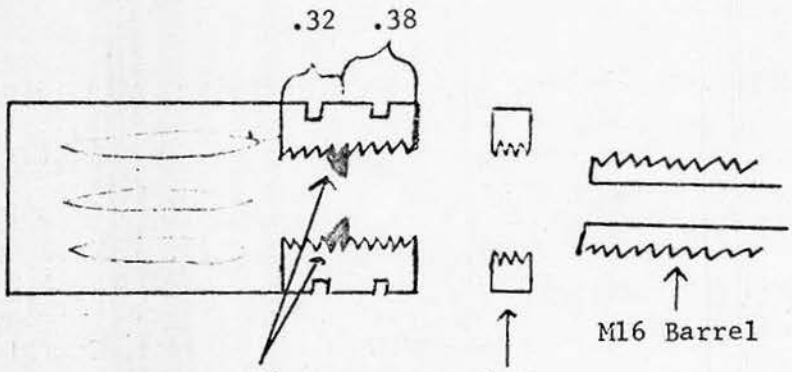
2.7.4.1 The installation of the burst control devices and compensators, did not adversely affect the durability of the M16A1 rifles. However, the decal furnished with the BCD kit did not withstand normal use.

2.7.4.2 The installation and use of the test items did not adversely affect the reliability of the M16A1 rifles. There were no reliability failures that could be attributed to the burst control device or compensator.

2.7.4.3 The installation and use of the test items did not increase the operator or organizational maintenance requirements for the M16A1 rifle. However, when the compensators were removed from the M16A1's at the completion of all testing, a carbon buildup was found that was not visible when the compensators were mounted. This carbon buildup was located .38 inch from the base end of the compensator (fig 1). The carbon buildup appears not to have affected firing performance. The carbon buildup does not come out during normal cleaning of the bore with the compensator mounted. This carbon buildup was the result of approximately 450 rounds of firing per compensated weapon.



Clean Compensator Lock Nut



Compensator with Carbon Build Up

Note: Numbers expressed in inches.

Figure 1

COMPARISON OF CLEAN COMPENSATOR
AND COMPENSATOR WITH CARBON BUILD UP

2.7.4.4 There were no incidents of damage or breakage of any of the test or control items.

2.7.4.5 None of the malfunctions experienced were attributable to the burst control devices or compensators. The types of malfunctions which occurred are reflected in Table 3-1, Appendix I. A summary of malfunctions and rates is shown in Table 2-24.

Weapons by Configuration	Number and Type Malfunction							Total Number of Rounds Fired	Malfunction Rate Per 1000 Rounds
	FF	FC	FR	FX	FE	DF	Other		
Semi			2					3132	.638
2 to 3TM								3331	0
4 to 6+TM						3		3353	.894
2 BCD	2		2			1	2*	3092	1.621
2 BCDC			2					3168	.631
3 BCD	2		2		1	1		3327	1.803
3 BCDC	1	1	1		1			3065	1.305

*No failure of firing cycle. Selector lever difficult to move and bolt difficult to move manually to the rear caused by pieces of cleaning patch in receiver. (Not counted in rate.) Seven rifles per configuration were fired.

Semi - Semiautomatic
2 to 3TM - 2 to 3 round bursts, trigger manipulated
4 to 6+TM - 4 to 6+ round bursts, trigger manipulated
2 BCD - 2 round burst control device
2 BCDC - 2 round burst control device with compensator
3 BCD - 3 round burst control device
3 BCDC - 3 round burst control device with compensator

FF - Fail to feed
FC - Fail to chamber
FR - Fail to fire
FX - Fail to extract
FE - Fail to eject
DF - Double feed

Table 2-24

MALFUNCTION RATE PER 1000 ROUNDS

2.7.4.6 The number of full-sized bursts and odd-sized bursts fired by all BCD weapons was recorded. The results are shown in Table 2-25.

Weapon Configuration	Total Bursts	Total Full Bursts	Odd-sized Bursts				
			Total 2 round Bursts	Percent 2 round Bursts	Total 1 round Bursts	Percent 1 round Bursts	Percent All Odd-sized Bursts
2BCDC	1051	873	-	-	178	16.9	16.9
2BCD	919	789	-	-	130	14.1	14.1
3BCDC	687	460	101	14.7	126	18.3	33.0
3BCD	749	494	111	14.8	144	19.2	34.0

Full burst - A full 2 round burst for a 2-round BCD and a full 3 round burst for a 3BCD.
Odd-sized burst - Burst size less than 2 rounds for 2BCD and less than 3 rounds for 3BCD.
2BCDC - 2 round burst control device with compensator
2BCD - 2 round burst control device
3BCDC - 3 round burst control device with compensator
3BCD - 3 round burst control device

Table 2-25

OVERALL BURST DATA ON 2 AND 3 ROUND BURST CONTROL DEVICES

2.7.4.7 The decalcomania for the selector lever on all test weapons became loose after two exposures to cleaning solvent. However, this did not adversely affect the durability of the M16A1 rifle.

2.7.5 Analysis

2.7.5.1 There were no incidents experienced reflecting lack of durability (with the exception of the decalcomania), reliability, or maintainability of the test items. The burst control device and compensator did not cause any malfunctions during this test.

2.7.5.2 The test items require no more maintenance than a standard M16A1 rifle with the exception of time required for installation of the burst control devices and compensators.

2.7.5.3 The decalcomania for the selector lever is not durable enough for normal use. This is a shortcoming. Consideration should be given to some other method of marking, i.e., engraving the firing mode positions.

2.7.5.4 The burst control devices and compensators met the criteria of durability, reliability, and maintainability. The carbon buildup in the compensator did not affect firing accuracy. However, tests should be conducted to determine if the carbon buildup will cause projectile instability or muzzle velocity changes and to determine how often the compensator must be removed in order to clean out the carbon buildup.

2.7.5.5 The number of odd-sized bursts fired by the BCD weapons is shown in Table 2-25. The 3BCD weapons have a higher odd-sized burst figure because there are two opportunities to release the trigger and interrupt the firing cycle: one after the first shot and one after the second shot. There is only one opportunity with the 2BCD to let up and stop the firing cycle. Therefore, inadvertent premature release of the trigger is more frequent when firing the 3BCD weapons as compared to the 2BCD weapons. This is a characteristic of the burst control device that must be recognized in order to be able to design effective training programs for a device of this nature.

2.7.5.6 The burst control devices do not have a memory capability or re-set capability that will automatically re-position the cam when the BCD position is initially selected. Because of this the cam may be in a position to fire one round, or two in the case of a 3 round BCD, instead of the full 2 round or 3 round burst. This situation can be partially overcome by the following training procedure: during unloading the procedure should be as follows:

a. Place the selector lever on SAFE.

b. Remove the magazine.

c. Pull the bolt to the rear, extracting and ejecting the live chambered round.

d. Let the bolt ride forward, pull it to the rear a second time and let it ride forward without pulling the trigger. Then, pull the bolt to the rear for the third time and lock it back.

This procedure will set the cam in position to fire a full burst when the weapon is re-loaded. Whenever a 2 round BCD mode is used, follow the above procedures, except after ejecting the live chambered round, lock the bolt to the rear. This will result in a full 2 shot burst when the weapon is re-loaded and fired.

2.8 SUBTEST NO 8, HUMAN FACTORS

2.8.1 Objective

To determine whether the test items are suitably engineered from a human factors standpoint.

2.8.2 Criterion

The installation and use of the test items should not adversely affect the firer's operation of the M16A1. (item 17, app II)

2.8.3 Method

2.8.3.1 Throughout Subtests No 3, 4, 5, and 6 test soldiers were observed and interviewed as to their interaction with the test items with which they were associated. Areas of observation included:

a. Difficulty in selecting the desired mode of fire.

b. Difficulty in operation of the firing mode selector switch.

c. Difficulty in determining which mode of fire had been selected without referring to the decalcomania.

d. Effects of the compensator with respect to changes in handling characteristics of the M16A1.

e. Effects of the compensator with respect to increased noise level.

f. Effects of the compensator with respect to sight recovery time.

g. Arrangement of the selector switch.

2.8.4 Results

2.8.4.1 A total of 35 test soldiers were interviewed who had fired the burst control device weapons. Out of the 35, seven test soldiers fired both compensated and uncompensated weapons. Fourteen fired only compensated burst control weapons and 14 fired uncompensated burst control device weapons.

2.8.4.2 All 35 test soldiers stated that they encountered no difficulty in selecting the desired mode of fire with the selector switch.

2.8.4.3 All test soldiers interviewed stated that they had no difficulty operating the selector switch.

2.8.4.4 All test soldiers stated that they knew which mode of fire had been selected without looking at the decalcomania.

2.8.4.5 Fourteen test soldiers, who fired the burst control device weapons equipped with compensator, stated that the compensator did not noticeably change handling characteristics.

2.8.4.6 All test soldiers who fired the compensated weapons reported that they were unable to detect any differences in noise level between the compensated and uncompensated M16A1 rifles.

2.8.4.7 The test soldiers who fired the compensated weapons could not state positively that sight recovery was improved or degraded by the compensator.

2.8.4.8 The present selector switch allows it to move through 360 degrees in either direction. Test soldiers were asked what they would recommend for the selector sequence of the mode of fire and the direction of rotation of the selector switch. All possible combinations of arrangements of modes of fire are shown in Figure 2. The existing SAFE position was not changed in these combinations because of the safety problem that would be associated with re-training soldiers already trained on the M16A1 rifle. Thirty test soldiers agreed that the modes of fire should go from SAFE to SEMI, to BURST, to AUTO (E, Figure 2). Their rationale was the simplicity afforded by going from the least volume (SEMI) to the most volume (AUTO) of fire in one direction of rotation. These same test soldiers stated that a mechanical stop should be at the last mode of fire in rotation (full AUTO) to prevent inadvertently rotating into the SAFE position. They also agreed that the direction of rotation should be in the opposite direction to return to the SAFE position with a mechanical stop at SAFE to prevent inadvertently rotating past SAFE into full AUTO. Five test soldiers selected the arrangements as shown in A and B, Figure 2. The rationale for

selection B was that less re-training would be involved by adding the BURST mode without changing the existing arrangement.

Auto Safe A Semi Burst	Semi Safe B Auto Burst	Burst Safe C Auto Semi
Auto Safe D Burst Semi	Semi Safe E Burst Auto	Burst Safe F Semi Auto

B thru F - Choices of combinations of positions for modes of fire.
A - Existing arrangement.
1 test soldier selected combination A
4 test soldiers selected combination B
30 test soldiers selected combination E

Figure 2

POSSIBLE POSITIONS FOR MODES OF FIRE
ON M16A1 WITH BURST CONTROL DEVICES INSTALLED

2.8.4.9 The test soldiers all stated that they would want to retain the full AUTO capability, even if they had a burst control device of 2 or 3 rounds. The consensus was that there are times when full AUTO would be desirable even though inaccurate fire resulted. An example given was returning fire when ambushed, since they felt that a large volume of fire in the general direction of the enemy ambushes will reduce the enemy's accuracy momentarily while the ambushed unit deploys to counter the ambush.

2.8.5 Analysis

2.8.5.1 The test items meet the human factor criterion. However, in any future decision to adopt a burst control device, consideration must be given to location of the firing mode positions and their relative positions.

2.8.5.2 During testing, the test officer and test NCO observed that the ability to select the desired mode of fire with the present designs of the selector lever may be difficult under conditions of soldier stress and/or darkness. The comments of the test soldiers concerning mechanical stops appear to be valid and should be given consideration.

2.8.5.3 Although not a problem related to burst control devices, the test supervisory personnel noted that in the defensive fire automatic fire for both trigger manipulated and burst control configurations the forestock of the M16A1 rifle became very hot. After approximately 140 rounds fired in 8-10 minutes the test soldiers kept shifting their grip on the forestock because of the discomfort caused by the hot forestock. The effects of this situation on accuracy were not objectively measured, but the hot forestock did not add to performance.

SECTION 3. APPENDICES

APPENDIX I. TEST DATA

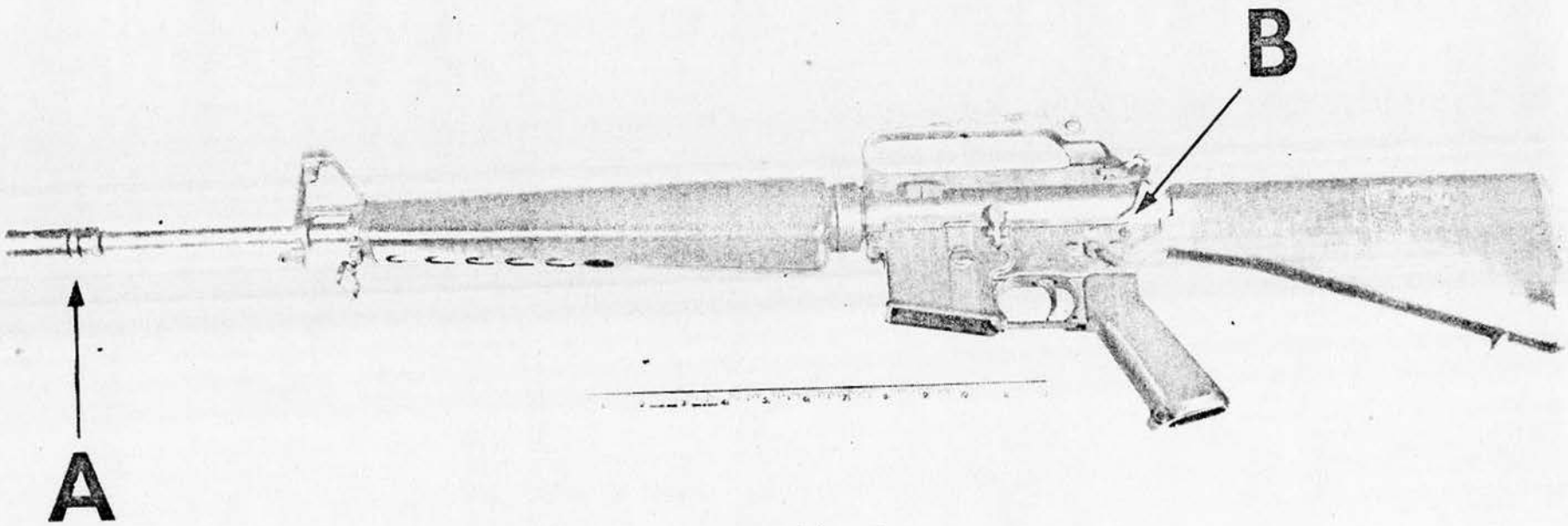


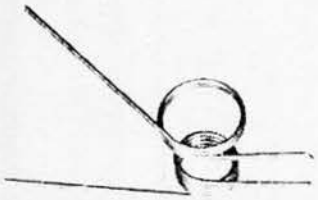
Figure 1

M16A1 Rifle with Compensator and BCD Installed

Legend

A - Compensator
B - Decal of BCD selector position indicator
(Note: Internal parts not visible)

AUTOMATIC SEAR

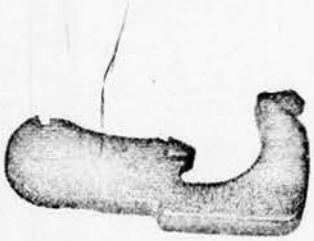


HAMMER SPRING

BURST DISCONNECT

DISCONNECT ASSEMLBY PIN

SAFETY SELECTOR



HAMMER

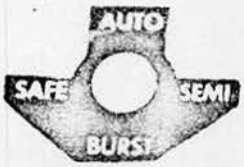
SEMIAUTOMATIC DISCONNECT

DISCONNECT SPRING

AUXILIARY DISCONNECT SPRING

CAM (two-shot) CAM (three-shot)

TRIGGER



DECALCOMANIA

CAM SPRING

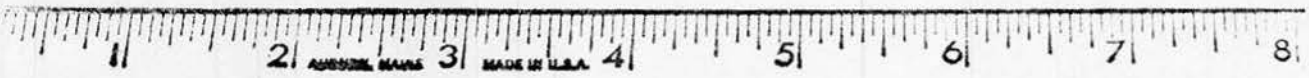


Figure 2

Burst Control Kit Parts

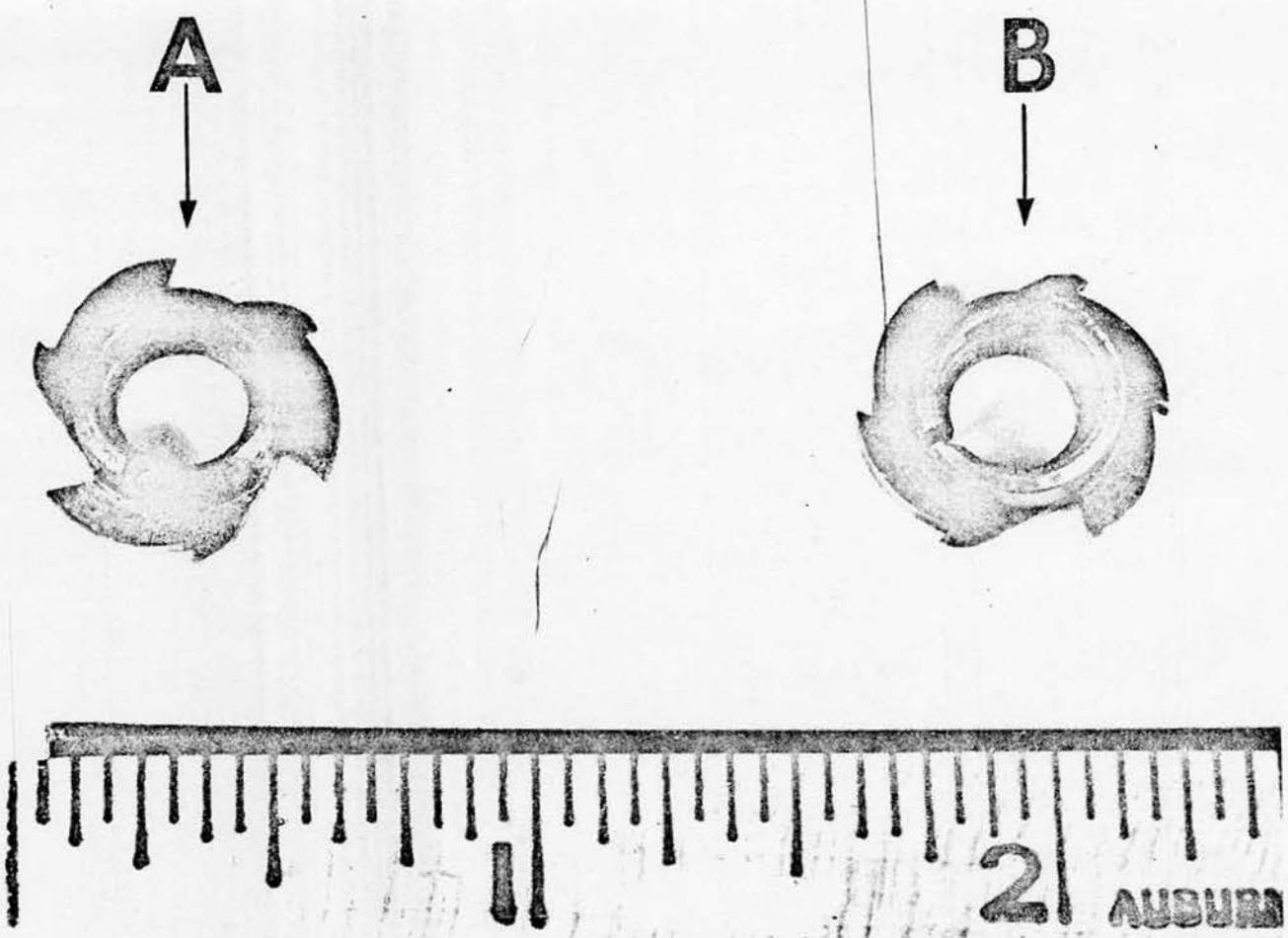


Figure 3

2- and 3-shot Cams

Legend

A - 2-shot cam
B - 3-shot cam

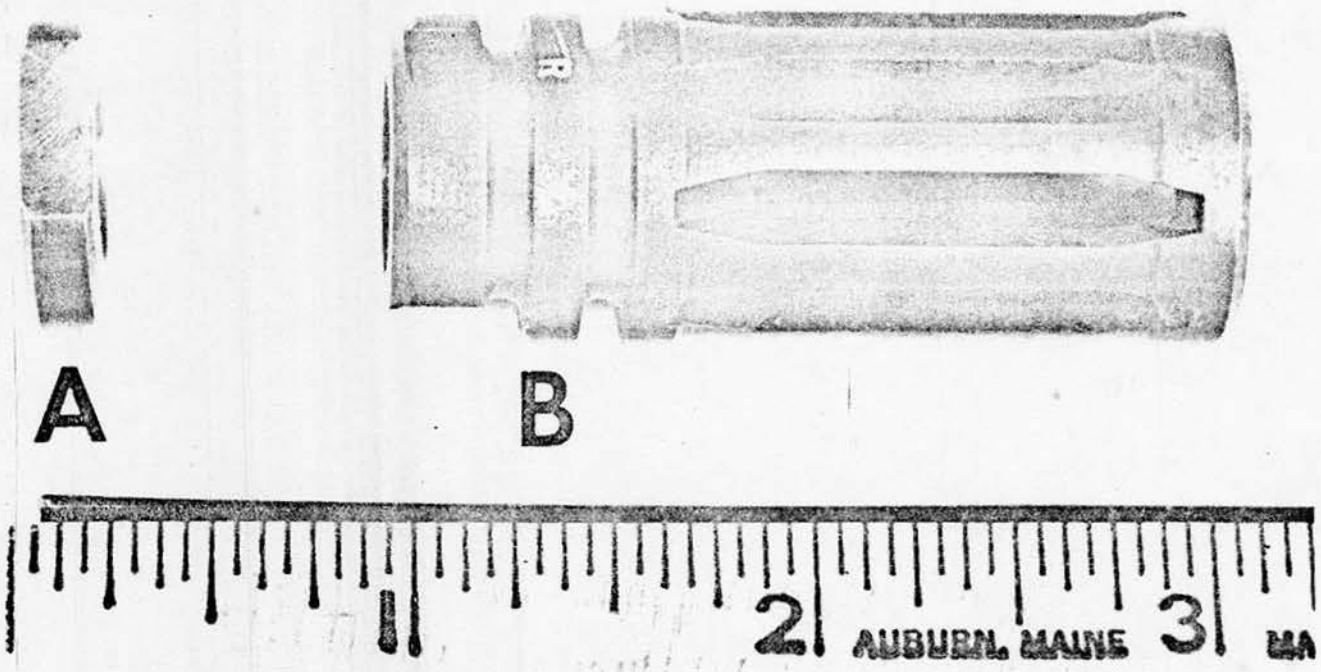


Figure 4

Compensator, Top View

Legend

A - Lock nut

B - Compensator

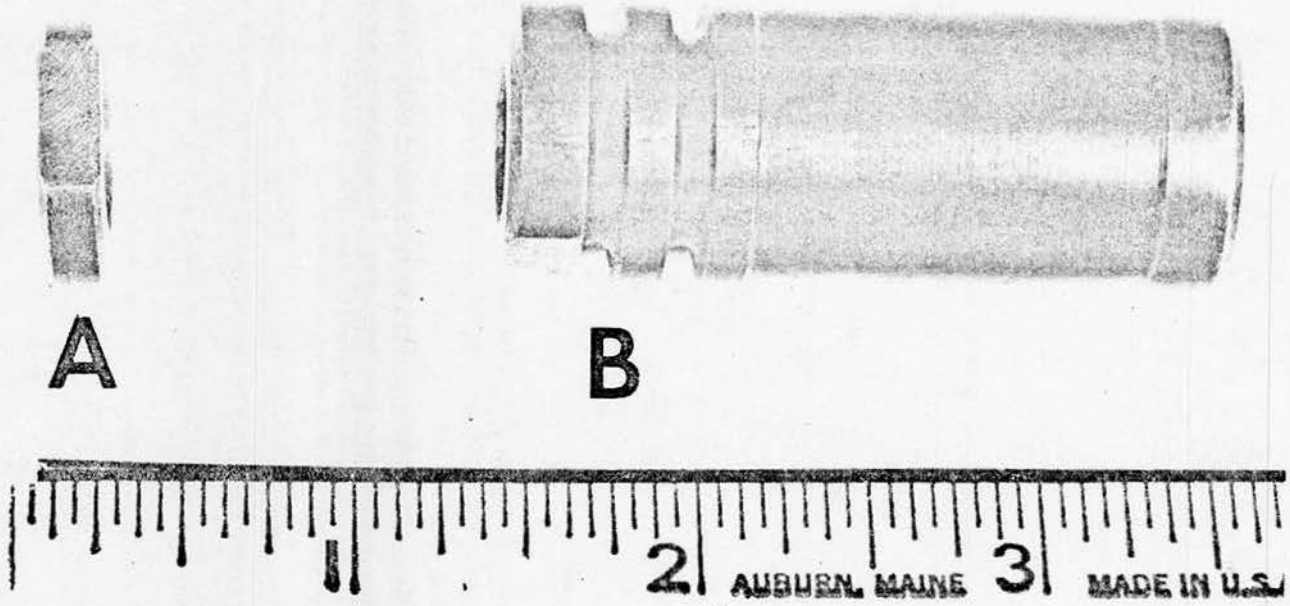


Figure 5

Compensator, Bottom View

Legend

A - Lock nut

B - Compensator

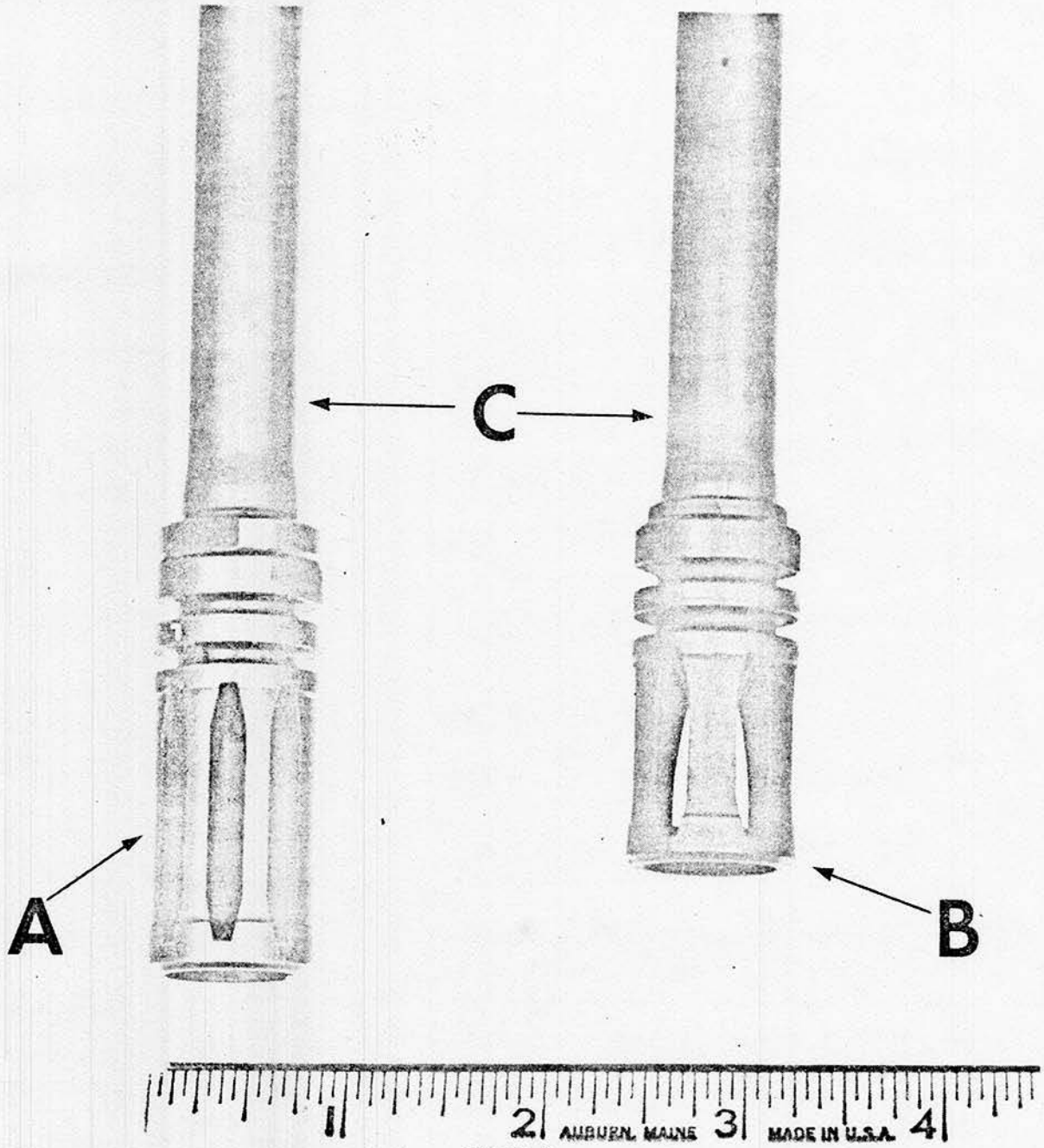


Figure 6

Compensator Compared to Standard M16A1 Flash Suppressor, Top View, Attached to M16A1 Barrels

Legend

A - Compensator
B - Standard M16A1 flash suppressor
C - M16A1 barrels

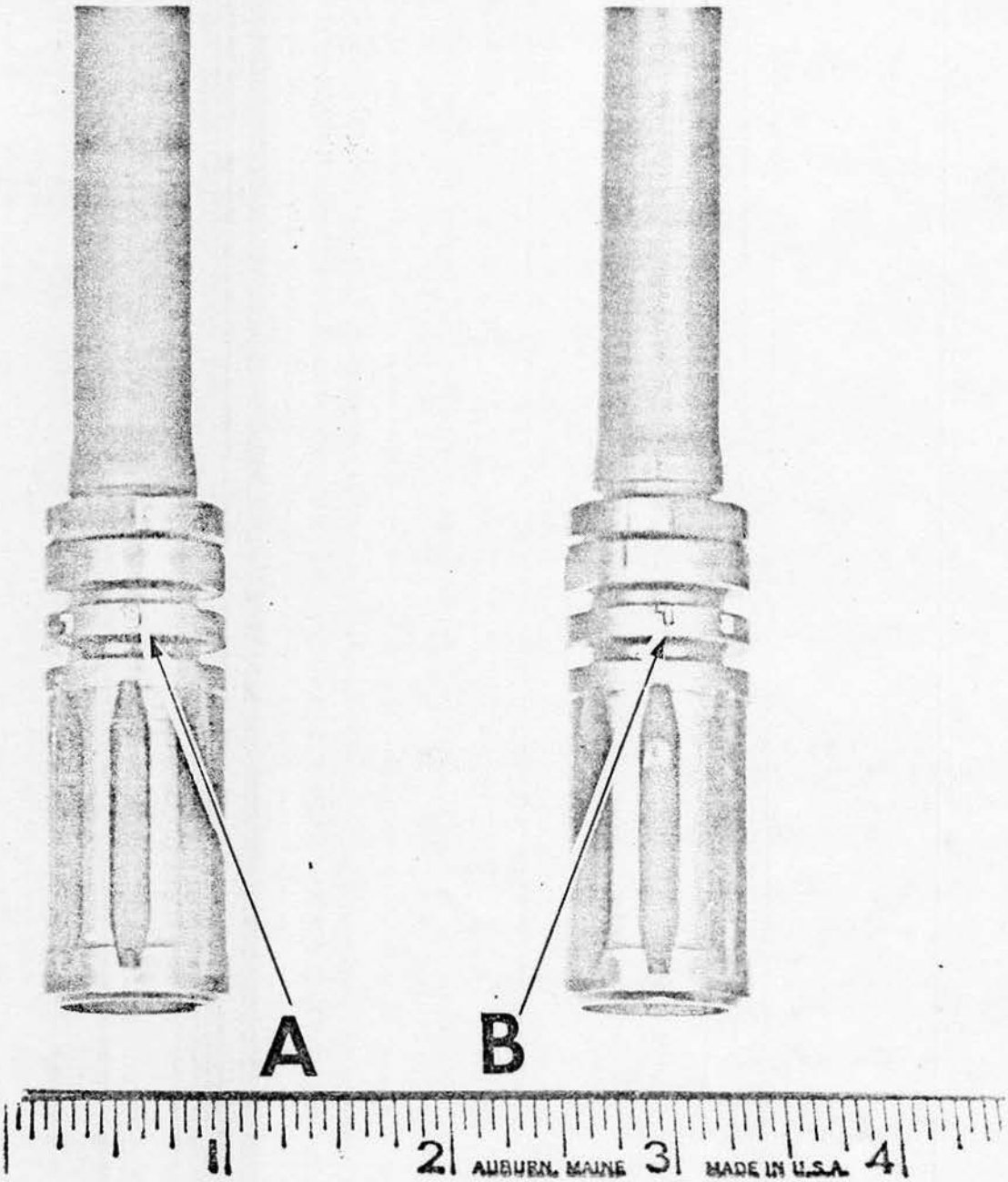


Figure 7

Compensators, Top View, Comparing Left- and Right-handed Positions

Legend

A - Compensator oriented for right-handed firer. Orientation indicated by letter R.

B - Compensator oriented for left-handed firer. Orientation indicated by letter L.

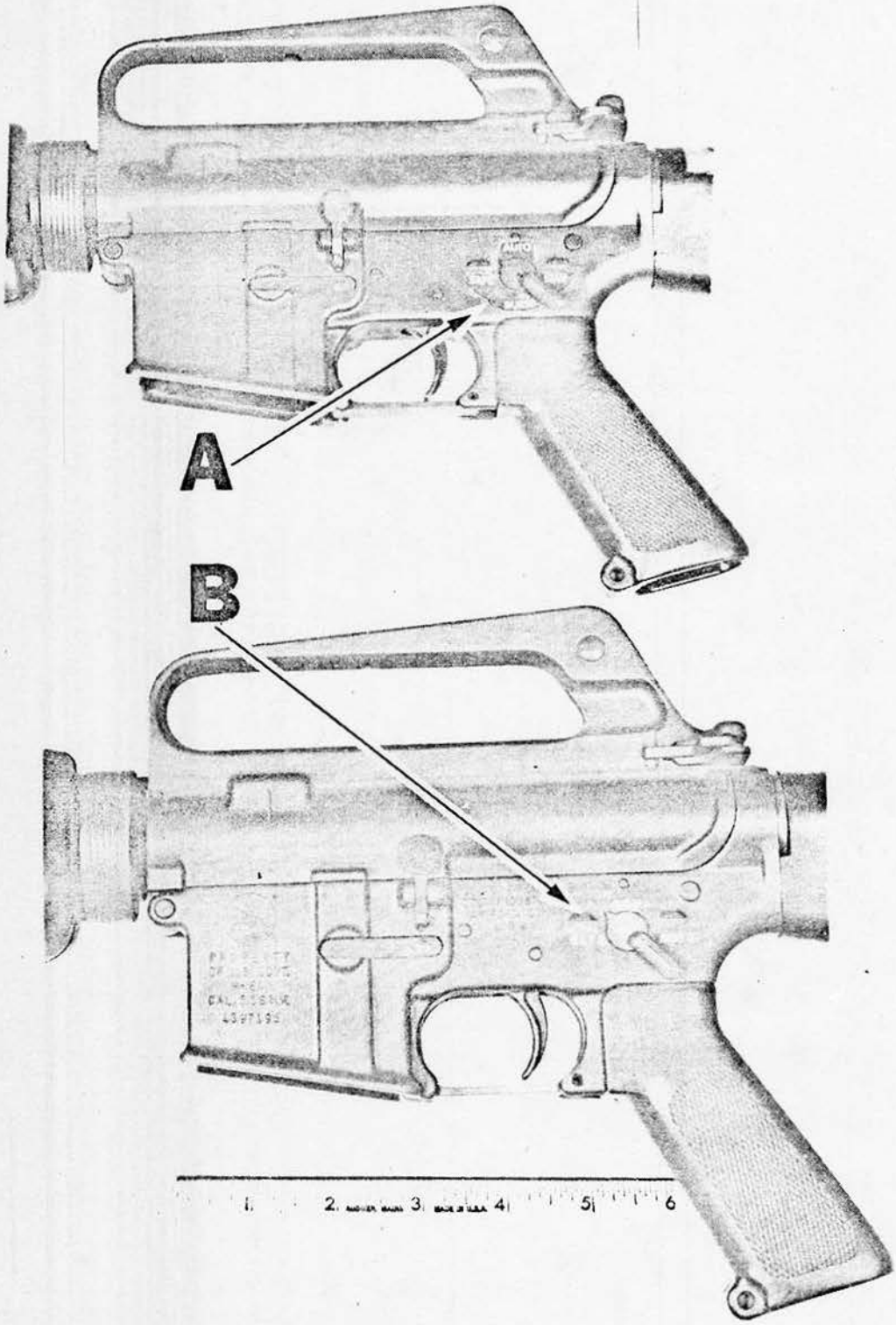


Figure 8

Comparison of Burst Controller M16A1 (top)
and Standard M16A1 (bottom), Left View

Weapon Configuration	Sub-test No	Rounds Fired at Time of Malfunction	Type of Malfunction							Cause
			FF	FC	FR	FX	FE	DF	Other	
2 BCDC	1	<100			X					Short recoil failed to cock weapon. Re-fired and found OK
2 BCD	1	<100			X					Short recoil failed to cock weapon. Re-fired and found OK
2 BCD	1	<100	X							Defective magazine
3 BCDC	1	<100	X							Magazine improperly loaded (long round)
3 BCD	1	<100	X							Magazine improperly loaded
3 BCD	1	<100			X					Short recoil failed to cock weapon. Re-fired and found OK
3 BCDC	4	<200		X						Magazine not fully seated
2 BCD	4	<200							Bolt difficult to retract to clear weapon	Dirty chamber
2 BCD	4	<200	X						Selector lever difficult to move	Pieces of cleaning patch in receiver
Semi	4	<200			X					Bad round, primer fully indented
3 BCDC	4	<200			X					Bad round, primer fully indented
2 BCDC	4	<200			X					Bad round, primer fully indented
Semi	4	<200			X					Bad round, primer fully indented

Data continued on next page

Weapon Configuration	Sub-test No	Rounds Fired at Time of Malfunction	Type of Malfunction							Cause
			FF	FC	FR	FX	FE	DF	Other	
3 BCD	4	<200	X							Magazine not fully seated
3 BCD	4	<200			X					Bad round, primer fully indented
2 BCD	5 Phase I	<300			X					Improperly installed firing pin
3 BCD	5 Phase I	<300					X			Insufficient lubrication on bolt face. Re-fired and found OK.
4-6+	5 Phase II	<500						X		Magazine improperly loaded
4-6+	5 Phase II	<500						X		Magazine improperly loaded
3 BCD	5 Phase II	<500						X		Magazine improperly loaded
4-6+	5 Phase II	<500						X		Magazine improperly loaded
2 BCD	5 Phase II	<500						X		Magazine improperly loaded
3 BCDC	5 Phase II	<400					X			Weapon would not eject spent cartridge. Weapon sent to repair.

Legend:
2 BCD - 2-round burst control device
2 BCDC - 2-round burst control device with compensator
3 BCD - 3-round burst control device
3 BCDC - 3-round burst control device with compensator
Semi - semiautomatic
4-6+ - 4- to 6+-round bursts of trigger manipulated fire

< - less than, i.e., <100 is less than 100 rounds
FF - fail to feed
FC - fail to chamber
FR - fail to fire
FX - fail to extract
FE - fail to eject
DF - double feed

Table 3-1

MALFUNCTIONS

APPENDIX II. TEST FINDINGS

Item	Source	Criteria	Applicable Subtest	Remarks
1	USAIB	All test and control items must be in the proper condition for testing.	2.1	Met. See para 2.1.5.1.
2	USAIB	The test and control items must function properly.	2.1	Met. See para 2.1.5.5.
3	USAIB	The average extreme spread of the lot of ammunition used during testing shall not exceed the accuracy standards for acceptance testing.	2.1	Met. See para 2.1.5.7.
4	USAIB	The signature effects (flash, smoke, dust, and sound) of the test items with compensator shall not exceed that of the control items.	2.1	Met. See para 2.1.5.7.
5	USAIB	The burst control devices and compensators must be safe for their intended use when operated in all available modes of fire.	2.2	Met. See para 2.2.5.
6	USAIB	All test soldiers shall be sufficiently trained to use both the test and control items properly.	2.3	Met. See para 2.3.5.
7	USAIB	All test soldiers shall be familiar with each weapon configuration being tested and each mode of fire to be used during testing.	2.3	Met. See para 2.3.4.3.
8	USAIB	All test soldiers will have established their individual zero for the weapons they will fire during testing.	2.3	Met. See para 2.3.4.2.
9	USAIB	The average extreme spread of the test items shall be equal to or less than that of the control items when fired by representative test soldiers in the prone supported and standing positions.	2.4	Not met. See para 2.4.5.1, 2.4.5.2, and 2.4.5.3.

Item	Source	Criteria	Applicable Subtest	Remarks
10	USASASA (Letter, AMXAA-CD, 16 Dec 71)	The test items shall demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence when compared to the control items in the quick fire environment.	2.5 Phase I	Not met. See para 2.5.5.9.
11	USASASA (Letter, AMXAA-CD, 16 Dec 71)	The test items shall demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence when compared to the control items in the defensive firing environment.	2.5 Phase II	Not met. See para 2.5.10.1.
12	USASASA (Letter, AMXAA-CD, 16 Dec 71)	The test items shall demonstrate an increase in hit probability of at least 15 percent at 90-percent confidence when compared to the control items during low level light firing.	2.6	Not met. See para 2.6.5.3.
13	USAIB	The muzzle flash of the test items, with compensator, shall not exceed that of the control items.	2.1	Met. See Item No 4.
14	USAIB	The installation and use of the test items shall not adversely affect the durability of the M16A1.	2.7	Met. See para 2.7.5.1.
15	USAIB	The installation and use of the test items shall not adversely affect the reliability of the M16A1.	2.7	Met. See para 2.7.5.1.
16	USAIB	The installation and use of the test items shall not substantially increase the operator or organizational maintenance requirements of the M16A1.	2.7	Met. See para 2.7.5.2.
17	USAIB	The installation and use of the test items should not adversely affect the firer's operation of the M16A1.	2.8	Met. See para 2.8.5.1.

APPENDIX III. DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
None		

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
A lack of durability of the decalcomania, part number GX-6039 of the burst control kit. This was noted during cleaning of the rifles and during normal use throughout testing.	Use engraving to mark the selector lever settings.	Throughout testing the decalcomania became loose. This was caused by the adhesive surfaces of the decalcomania becoming unglued during normal field use and cleaning of the rifle.

APPENDIX IV. MAINTENANCE EVALUATION

Not used.

APPENDIX V. REFERENCES

1. FM 23-71, Rifle Marksmanship, December 1966, with changes 1 through 3.

2. FM 23-9, Rifle, 5.56-mm, M16A1, March 1970.

3. TM 9-1005-249-20, Organizational Maintenance Manual, Including Spare Parts and Special Tools Lists, Rifle, 5.56-mm, M16A1, September 1971.

4. TC 23-71-1, US Army Infantry School, Principles of Quick Kill, May 1967.

5. Instructions for the Installation and Operation of the Two-Shot and Three-Shot Burst Control provided by the developer.

6. Technical Report 71-4, An Experimental Review of Basic Combat Rifle Marksmanship, MARKSMAN PHASE I, Human Resources Research Organization, March 1971.

7. Letter, ATSIN-W-D, USAIS, 21 May 1971, subject: M16A1 Burst Control Device.

8. Letter, Commanding General, Marine Corps Development and Education Command, 17 June 1971, subject: M16A1 Burst Limiting Device.

9. Letter, CDCIN-CM, USACDCINA, 22 June 1971, subject: Burst Control Device for the M16A1 Rifle.

10. Letter, AMXAA-CD, USASASA, 16 December 1971, subject: Request for Military Potential Test of Two- and Three-Round Burst Control Devices/ Compensators for M16A1 Rifle, TPR-SA/CD-102, with 1st Indorsement, TECOM, AMSTE-BC, 2 Feb 72.

11. Letter, AMSTE-BC, TECOM, 21 January 1972, subject: Customer Test Directive for Military Potential Test of Two- and Three-round Burst Control Devices with Compensator for M16A1 Rifle, TECOM Project No 8-WE-604-016-001, TPR-SA-CD-102.

12. USAIB Test Plan, Military Potential Test of Two- and Three-round Burst Control Devices with Compensator for M16A1 Rifle, March 1972, USAIB Project No P3367, TECOM Project No 8-WE-604-016-001.

13. 1st Ind, AMXAA-CD, USASASA, 6 April 1972, subject: Proposed Plan of Military Potential Test of Two- and Three-round Burst Control Devices with Compensator for M16A1 Rifles, TECOM Project No 8-WE-604-016-001.

APPENDIX VI. ABBREVIATIONS

1. BCD - Burst control device
2. M16A1 - Rifle, 5.56-mm, M16A1
3. MPT - Military potential test
4. Semi - Semiautomatic
5. SOP - Standing operating procedure
6. TECOM - US Army Test and Evaluation Command
7. USAIB - US Army Infantry Board
8. USAIS - US Army Infantry School
9. USASASA - US Army Small Arms Systems Agency

2BCD - 2 round burst control device

3BCD - 3 round burst control device

2BCDC - 2 round burst control device with compensator

3BCDC - 3 round burst control device with compensator

2 to 3TM - 2 to 3 round burst, trigger manipulated

4 to 6+TM - 4 to 6+ round burst, trigger manipulated

APPENDIX VII. DISTRIBUTION LIST

Addressee	Test Plan	Final Report
Commander US Army Test and Evaluation Command ATTN: AMSTE-BC AMSTE-AD-B Aberdeen Proving Ground, Maryland 21005	5	1 1
Commander US Army Small Arms Systems Agency ATTN: AMXAA-CD Aberdeen Proving Ground, Maryland 21005	5	15
President US Army Infantry Board ATTN: STEBC-TE-SA Fort Benning, Georgia 31905		15