DEPARTMENT OF THE ARMY
UNITED STATES ARMY INFANTRY BOARD
Fort Benning, Georgia 31905 MAJ Lee/es/545-3456

STEBC-SA (P-3159) 10 April 1967

SUBJECT: Letter Report of Product Improvement Test of 30-Round Magazine and Redesigned Handguard for M16/XM16E1 Rifle and Colt Submachine Gun, USATECOM Project No 8-6-0200-03

TO: Commanding General
US Army Test and Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Maryland 21005

1. REFERENCES.

a. Message APG 4731, AMSTE-BC, USATECOM, 23 March 1966, subject: "Product Improvement Test of 30-Round Magazine for M16/XM16E1 Rifle and Colt SMG."

b. Letter, STEBC-SA (P-3159), USAIB, 7 April 1966, subject: "Product Improvement Test of 30-Round Magazine for M16/XM16E1 Rifle and Colt Submachine Gun, USATECOM Project No 8-6-0200-03."

c. Letter, AMSTE-BC (8-6-0200-02), USATECOM, 8 November 1966, subject: "Test Directive for Concurrent Product Improvement Testing of the Handguard and Handguard Cap for the XM16E1 Rifle with the 30-Round Magazine Test for the XM16E1 Rifle and Colt Submachine Gun."

d. Letter, STEBC-SA (P-3159), USAIB, 25 November 1966, subject: "Addendum to Product Improvement Test of 30-Round Magazine (and Redesigned Handguard) for M16/XM16E1 Rifle and Colt Submachine Gun, USATECOM Project No 8-6-0200-03."

e. Letter, STEAP-DS-T1, APG, 12 December 1966, subject: "Concurrent Product Improvement Testing of Handguard and Handguard Cap for XM16E1 Rifle with 30-Round Magazine Test for XM16E1 Rifle and Colt Submachine Gun, USATECOM Project No 8-6-0200-02, 03."

f. Letter, AMSTE-BC (8-6-0200-02, 03), USATECOM, 19 December 1966, subject: "Addendum to Product Improvement Test of 30-Round Magazine and Redesigned Handguard) for M16/XM16E1 Rifle and Colt Submachine Gun."

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2. BACKGROUND.

a. On 23 March 1966 the US Army Test and Evaluation Command (USATECOM) directed the US Army Infantry Board (USAIB) to conduct a product improvement test of the 30-round magazine and redesigned ammunition pouch for the M16/XM16E1 rifle and CAR15 submachine gun (SMG) (ref 1a).

b. On 8 November 1966 USAIB was directed to conduct a product improvement test of redesigned handguards and handguard caps for the M16/XM16E1 rifle, CAR15 SMG, and XM16E1 rifle with XM148 grenade launcher attached concurrently with the test of the 30-round magazine and redesigned ammunition pouch (ref 1c).

c. The following materiel was received for test:

(1) Fifty 30-round magazines (test magazine)

(2) Six redesigned ammunition pouches (test pouch)

(3) Four redesigned handguards and handguard caps for the M16/XM16E1 rifles, and XM16E1 rifle with XM148 grenade launcher (test handguard M16) attached, and one redesigned handguard and handguard cap for the CAR15 SMG (test handguard CAR15).

d. The following items were used as control items:

(1) The standard 20-round magazine for the M16/XM16E1 rifle (control magazine) and the universal ammunition pouch (control pouch).

(2) The standard handguard and handguard cap for the M16/XM16E1 rifle, and XM16E1 rifle with XM148 grenade launcher attached (control handguard M16), and CAR15 submachine gun (control handguard CAR15).

e. Testing began on 6 February 1967 and was completed on 10 March 1967.

3. OBJECTIVES

a. To determine the suitability of the test magazine and pouch for Army use with the M16/XM16E1 rifle, CAR15 submachine gun, and XM16E1 rifle with XM148 grenade launcher attached.

b. To determine if the test handguard is equal to, or better than, the control handguard in design and durability.

4. SUMMARY OF RESULTS.

a. Test Magazine and Pouch

(1) Preoperational Inspection and Physical Characteristics

(a) All test magazines and pouches were received in proper condition for testing.

(b) The average weight, length, and width of the test and control magazines and pouches are shown in Table 1.

TABLE 1

DIMENSIONS, IN INCHES, AND WEIGHT, IN POUNDS, OF THE TEST AND CONTROL MAGAZINES

Item	Length	Width	Weight	
			Loaded	Empty
Test Magazine	7.14	.88	1.00	.23
Test Pouch	7.40	3.00	3.74	.73
Control Magazine	4.87	.88	.69	.18
Control Pouch	7.40	4.00	3.83	.75

(c) Each of the test and control magazines was function fired in the XM16E1 rifle and CAR15 SMG. There were numerous instances of the bolt failing to lock to the rear after firing the last round. This occurred during the function firing of both test and control magazines.

(2) Operational Suitability

(a) Three test soldiers each charged and stripped a test and control magazine ten times with their bare hands. The magazine was stripped by placing the charged magazine into the weapon, pulling the charging handle to the rear and allowing it to go forward. The exercise was repeated with the test soldiers wearing arctic mittens.

(b) The average time required to load and unload the test and control magazines, with bare hands and arctic mittens, is shown in Table 2.

TABLE 2

LOADING AND UNLOADING

Item	Bare Hands		Arctic Mittens	
	Load (Min: Sec)	Unload (Min: Sec)	Load (Min: Sec)	Unload (Min: Sec)
Test Magazine	:48	:12	1:36	:12
Control Magazine	:26	:06	1:06	:08

(c) A few instances of double feed with both test and control magazines were noted during the unloading exercise. Since this did not occur during actual firing, it was concluded that test soldiers were "riding" the bolt forward, instead of releasing it to go forward freely. When this situation was corrected, the incidents of double feed ceased.

(d) Three test soldiers, armed with the XM16E1 rifle, made five magazine changes with the test and control magazines which were carried in their respective test and control pouches. The exercise was first conducted with test soldiers using their bare hands, and again wearing arctic mittens, in each of five firing positions: standing, kneeling, squatting, sitting, and prone. The average time, in seconds, required to change the test and control magazine is shown in Tables 3 and 4.

(e) Test soldiers remarked that it was difficult to place a test magazine in a test pouch which already contained two test magazines. This difficulty was not experienced with the control magazine and pouch.

TABLE 3

MAGAZINE CHANGING
(Bare Hands)

Item	Standing	Kneeling	Squatting	Sitting	Prone
Test Magazine	:05	:07	:06	:06	:06
Control Magazine	:07	:06	:10	:06	:06

TABLE 4

MAGAZINE CHANGING
(Arctic Mittens)

Item	Standing	Kneeling	Squatting	Sitting	Prone
Test Magazine	:06	:09	:08	:06	:07
Control Magazine	:09	:09	:08	:09	:09

(f) Test soldiers remarked that the test pouch, when mounted on the front of the pistol belt (see fig 4, incl 1), made it difficult for them to assume the squatting and sitting positions. This difficulty was not encountered when the test pouches were mounted on the side. The control pouches did not cause this difficulty.

(g) Three combat-equipped test soldiers, each with the test magazine and pouch, moved cross-country for 3 miles under simulated combat conditions in controlled tactical exercises. The exercises were repeated with test soldiers using control items. No difficulties were encountered by test soldiers during the exercises. No significant difference was noted between the operational suitability and compatibility of the test and control magazines.

(3) Durability and Reliability

(a) Three test soldiers each charged and stripped 5 different test and control magazines 100 times each. After every twentieth charging of the magazine, the charged magazine was inserted into a weapon and fired. No malfunctions in weapon firing attributable to the test or control magazine were noted.

(b) One test magazine accepted 31 rounds during the sixty-seventh reloading of the magazine. This magazine continued to accept 31 rounds throughout the remainder of test. The weapon could not be fired with this magazine, however, as the bolt was unable to strip the first round from the magazine. Only one test magazine accepted 31 rounds during the conduct of the exercise. This was a very small percentage of the magazines being tested and was therefore not considered serious. None of the other test magazines would accept 31 rounds.

(c) All control magazines accepted 21 rounds during the conduct of the exercise. The rifle usually failed to fire on the second or third round when loaded with a control magazine containing 21 rounds.

(d) On 13 February 1967, 1,200 rounds were fired from each of 5 test magazines with the XM16E1 rifle. No malfunctions were noted.

(4) Human Factors Engineering. The test items contained no features which were considered incompatible with the skills, aptitudes, and limitations of test soldiers who will use them in the field.

(5) Value Analysis. The test items contained no features which are considered nonessential or costly.

b. Redesigned Handguard and Cap

(1) Preoperational Inspection and Physical Characteristics

(a) All test handguards were received in proper condition for testing.

(b) The weights and dimensions of the test and control handguards are shown in Table 5.

TABLE 5

DIMENSIONS, IN INCHES, AND WEIGHT, IN POUNDS, OF THE TEST AND CONTROL HANDGUARDS

Item	Weapon	Length	Diameter	Weight
Test Handguard	CAR15 SMG	6.11	2.00	.30
	XM16E1 Rifle	12.00	2.03	.58
Control Handguard	CAR15 SMG	6.80	2.4 to 1.12	.29
	XM16E1 Rifle	12.01	2.4 to 1.12	.56

(c) Photographs of the test and control handguards, both assembled to and disassembled from weapons, are shown in inclosure 1.

(d) The two halves of the test handguard are identical and therefore completely interchangeable. The test handguard is attached on the top and bottom of the barrel of the rifle. The control

handguard has a right and left half and is attached to the sides of the barrel. The halves of the control handguard are not interchangeable (fig 6 and 7, incl 1).

(2) Durability. One test handguard was damaged during disassembly from the XM16E1 rifle (fig 8, incl 1). Since this incident occurred during the early stages of the test, it was difficult to determine whether it was the result of defective materiel or use by an inexperienced test soldier. No other incident occurred during testing which reflected unfavorably on the durability of the test or control handguard.

(3) Maintenance. The test and control handguards were maintained in accordance with applicable instructions contained in TM 9-1005-249-14. No difficulties were encountered. The test and control handguards required a minimum amount of maintenance. Ease of maintenance was comparable between the test and control items.

(4) Human Factors Engineering

(a) The test and control handguards were disassembled from and assembled to the XM16E1 rifle 50 times by test soldiers. The average time for assembly and disassembly is as follows:

	Assembly	Disassembly
Test Handguard	:22	:20
Control Handguard	:22	:04

(b) Test soldiers complained that the configuration of the retaining ring made it difficult to remove the handguard from the weapon. The retaining ring was difficult to grasp, and test soldiers had difficulty relieving the tension on the handguard. This applied to both test and control handguards.

(c) The XM16E1 rifle equipped with the test and control handguards, including the rifle with the XM148 grenade launcher attached, was fired by test soldiers at the listed maximum and sustained rate of fire for periods varying between 1 to 5 minutes. A comparison was made of the effects of heat transfer upon the ability of the soldier to handle the weapon.

(d) Test soldiers reported that the test handguard on the XM16E1 rifle had less heat transfer than the control model on the XM16E1 rifle when firing up to 400 rounds. Little difference was noted in heat transfer between test and control models after firing in excess of 400 rounds. Both handguards were too hot for test soldiers to grasp or handle.

(e) The test handguard mounted on the rifle with the XM148 grenade launcher attached was considered unsuitable (fig 9, incl 1). The test handguard did not completely encircle the rifle barrel, and hence did not provide sufficient protection to the firer from the heat of the barrel. This is a shortcoming. However, the control handguard was also considered unsatisfactory because it was made of metal, and it became hot very quickly during firing.

(f) The test handguard for the rifle equipped with the XM148 grenade launcher was modified by USAIB test personnel so as to encircle the rifle barrel completely. The modified handguard had less heat transfer than the test or control model, and was considered better in design and operational suitability (fig 10 and 11, incl 1).

(5) Operational Suitability

(a) Weapons equipped with the test and control handguards, including the rifle with the XM148 grenade launcher attached, were carried by test soldiers in various tactical exercises over varied terrain. The relative ease of handling the weapons equipped with the test and control handguards was determined.

(b) Test soldiers expressed a preference for the test handguard. They commented that it provided a firmer surface, thereby insuring a better grip. Test soldiers liked the "feel" of the test handguard.

(c) Weapons equipped with the test and control handguard were transported in an unrestrained condition in the bed of a military vehicle for a distance of approximately 25 miles over varying road and terrain conditions. No damage to either test or control handguards was noted.

(d) Sand, water, mud, or other debris did not seem to have any significant adverse effect upon either the test or control handguard. Both test and control handguards provided adequate protection for the barrel and other weapon parts except when the rifle was equipped with the XM148 grenade launcher (see also para 4b(4)(e)).

(6) Value Analysis. The test items contained no features which are considered nonessential or costly.

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

a. The 30-round magazine and redesigned ammunition pouch are suitable for US Army use with the M16/XM16E1 rifle and CAR15 submachine gun.

b. The 30-round magazine functions as well as the standard 20-round magazine with the M16/XM16E1 rifle and CAR15 submachine gun.

c. The additional ten rounds provided by the 30-round magazine afford a distinct advantage over the standard 20-round magazine.

d. The redesigned handguards and handguard caps are better than the standard handguards and handguard caps in durability, operational suitability, and design.

e. The interchangeability of the components of the redesigned handguard provides an additional advantage over the standard handguard.

f. The redesigned handguard for the XM148 grenade launcher is unsatisfactory.

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

a. The 30-round test magazine and pouch replace the standard 20-round magazine and universal ammunition pouch, respectively.

b. The redesigned handguards and handguard caps be incorporated into the design of the M16/XM16E1 rifle and CAR15 submachine gun replacing the current model.

c. The redesigned handguard for the XM148 grenade launcher be modified to afford greater protection for the firer and the barrel.

FOR THE PRESIDENT:

Sarah L. Morris

SARAH L. MORRIS
Captain, WAC
Adjutant

1 Incl
Photographs
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PHOTOGRAPHS

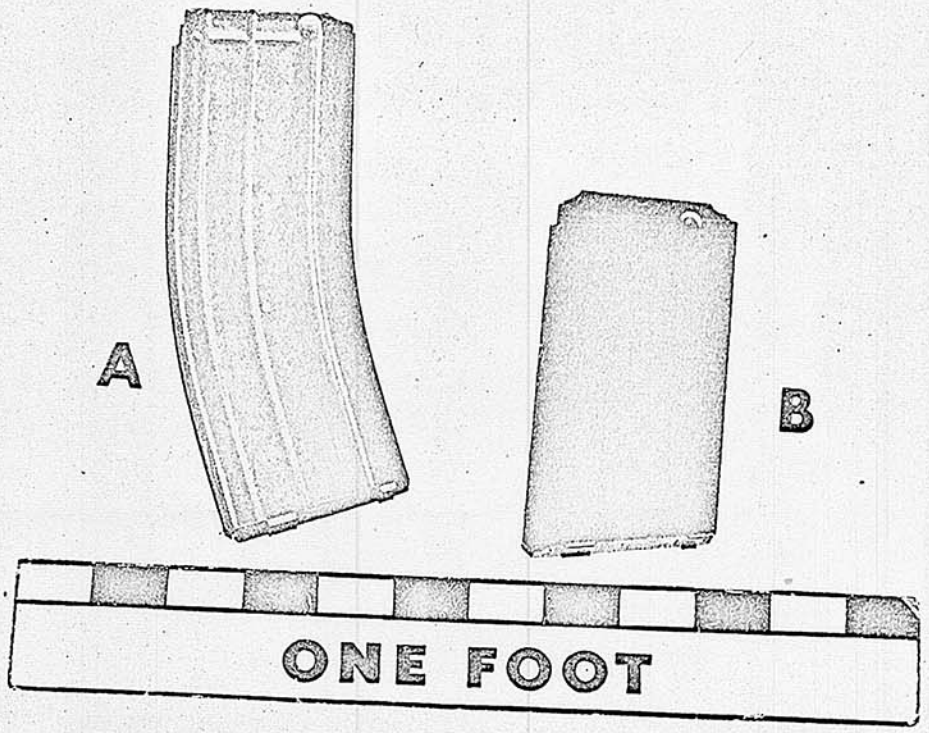

Figure 1. Magazines for M16/XM16E1 Rifle and CAR15 Submachine Gun

A - 30-round magazine

B - 20-round magazine

Incl 1

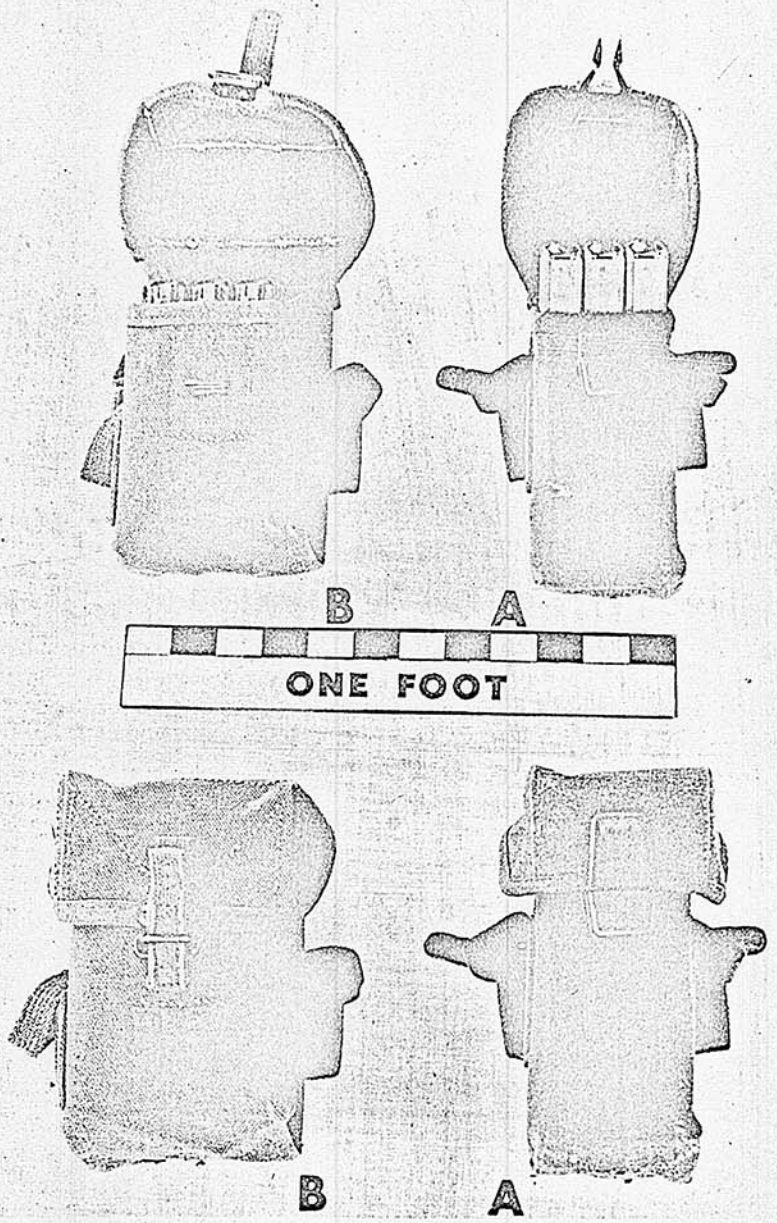

Figure 2. Ammunition Pouches
(Open and closed views)

A.- Redesigned Ammunition Pouch

B - Standard Universal Ammunition Pouch

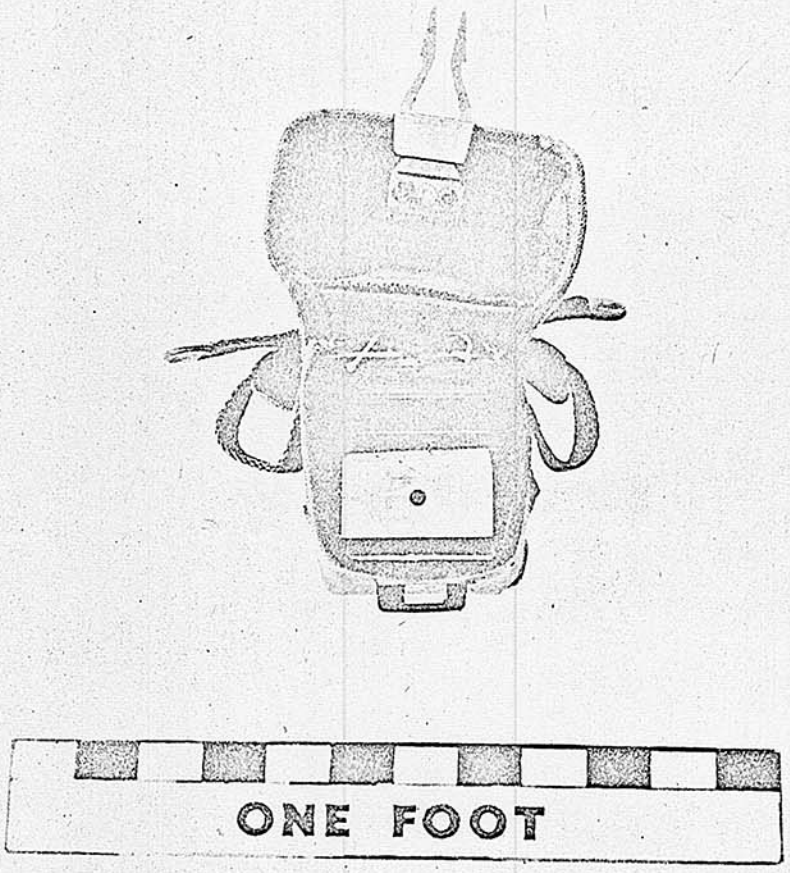

Figure 3. Redesigned Ammunition Pouch, Top Open View

Figure 4. Test Soldier with Redesigned Ammunition Pouch Attached to Pistol Belt

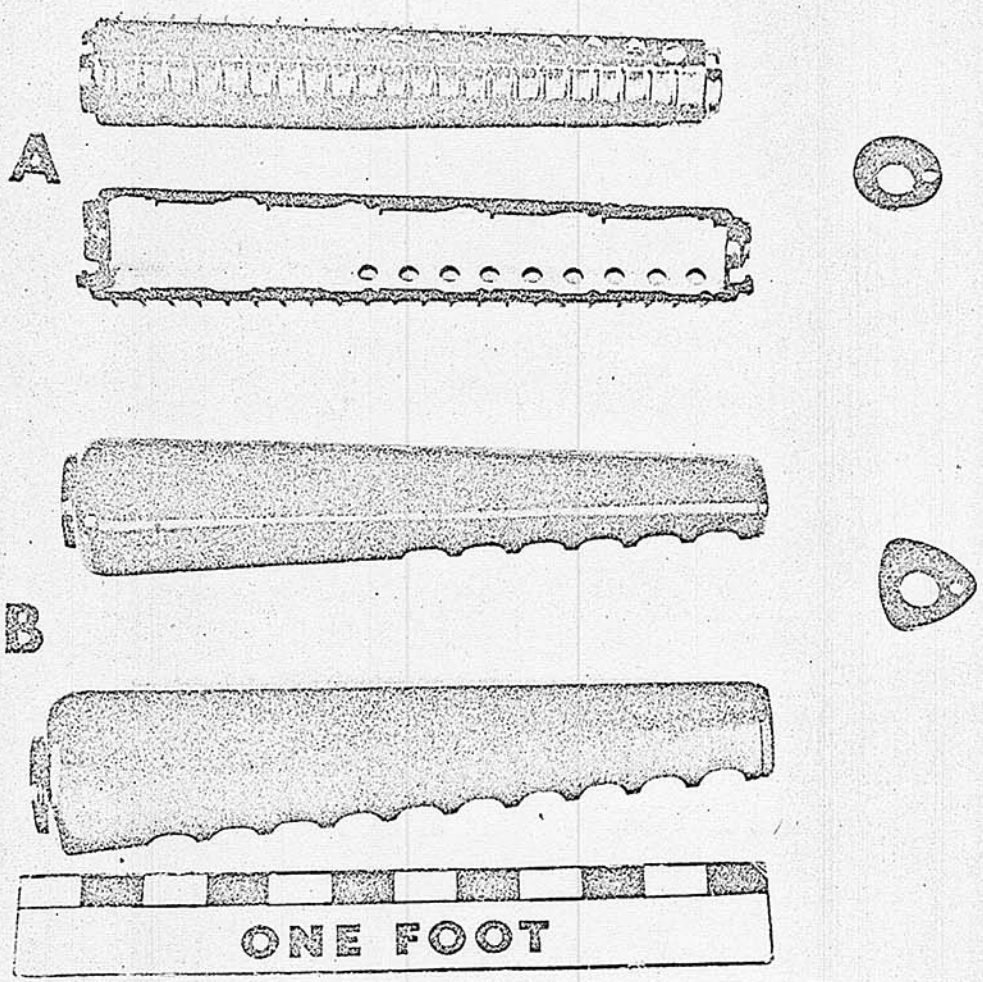

Figure 5. Handguards and Caps for M16/XM16E1 Rifle

A - Redesigned Handguard and Cap

B - Standard Design, Handguard and Cap

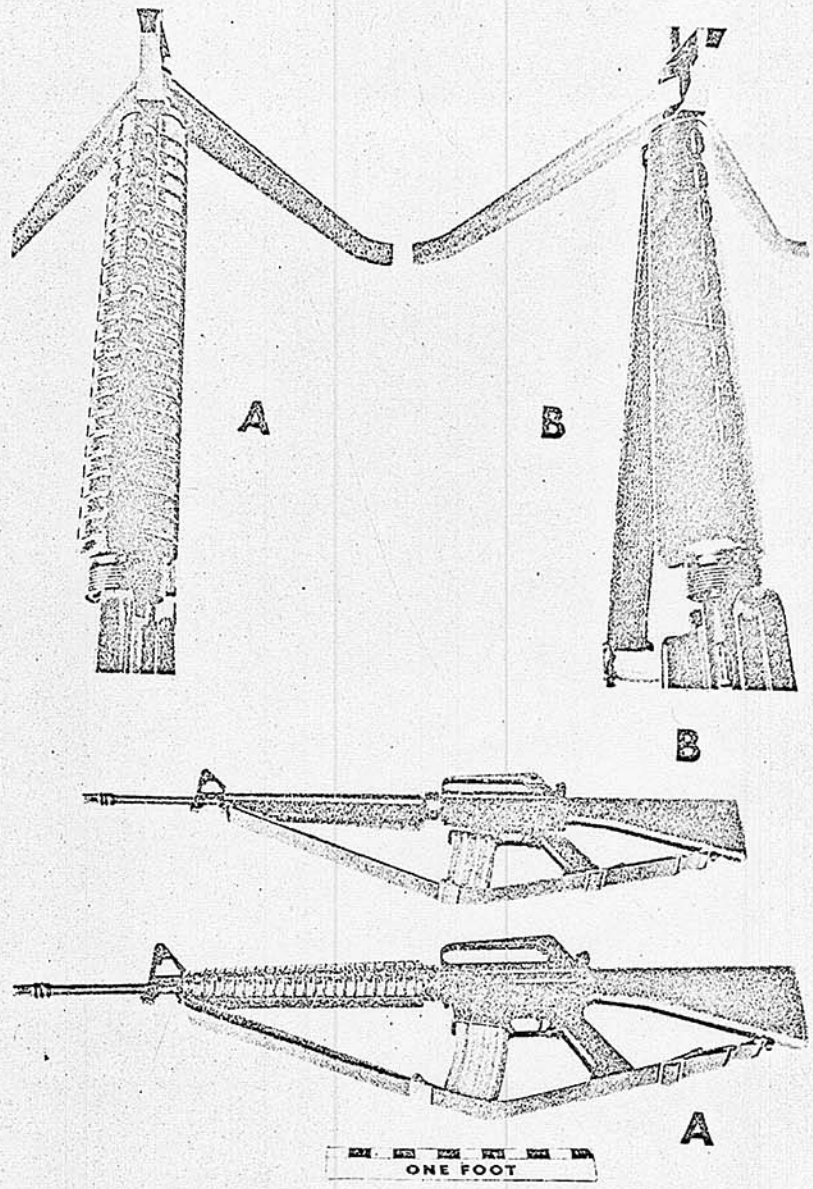

Figure 6. Handguard Attached to XM16E1 Rifle
(Top and left view)

A - Redesigned Handguard

B - Standard Design, Handguard

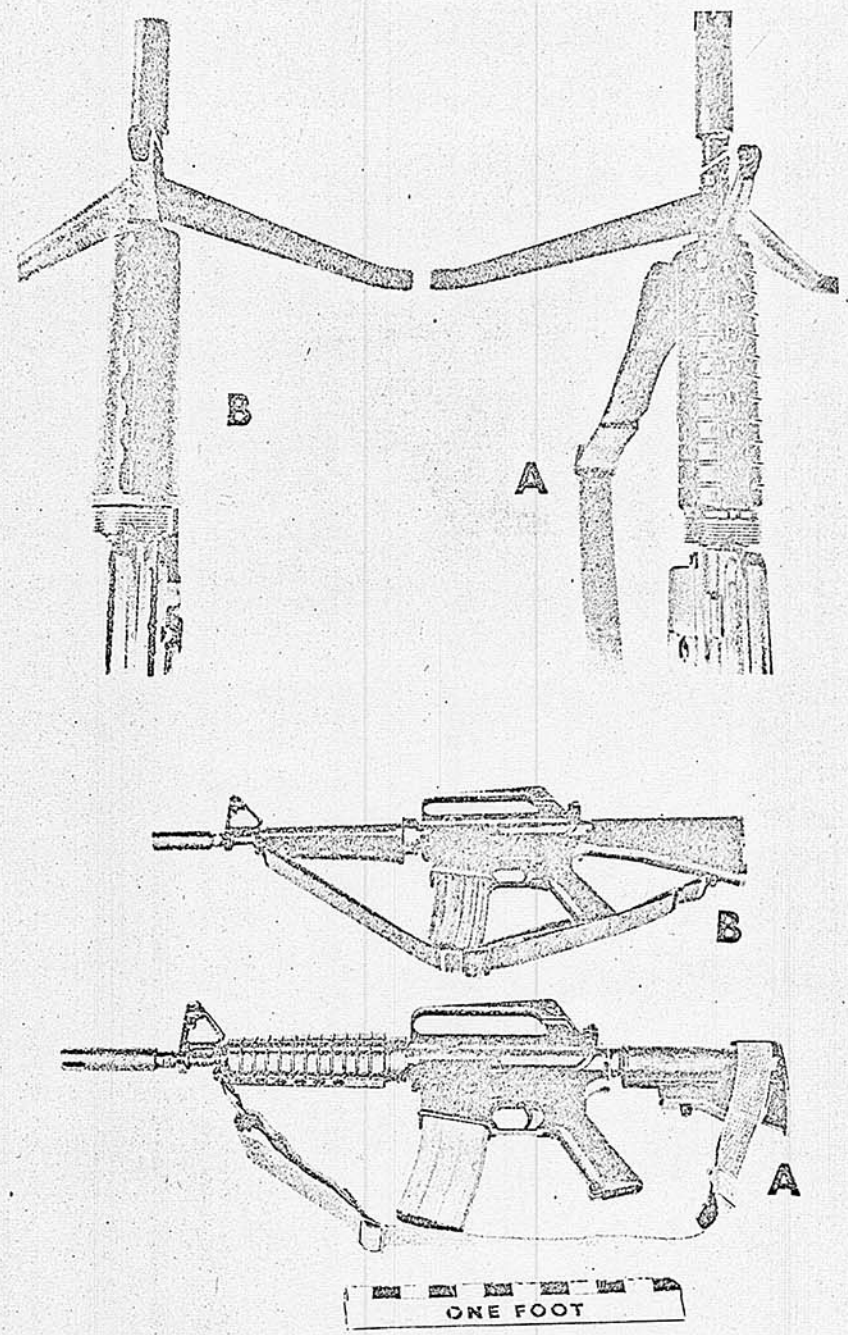

Figure 7. Handguard Attached to CAR15 Submachine Gun
(Top and left view)

A - Redesigned Handguard

B - Standard Design, Handguard

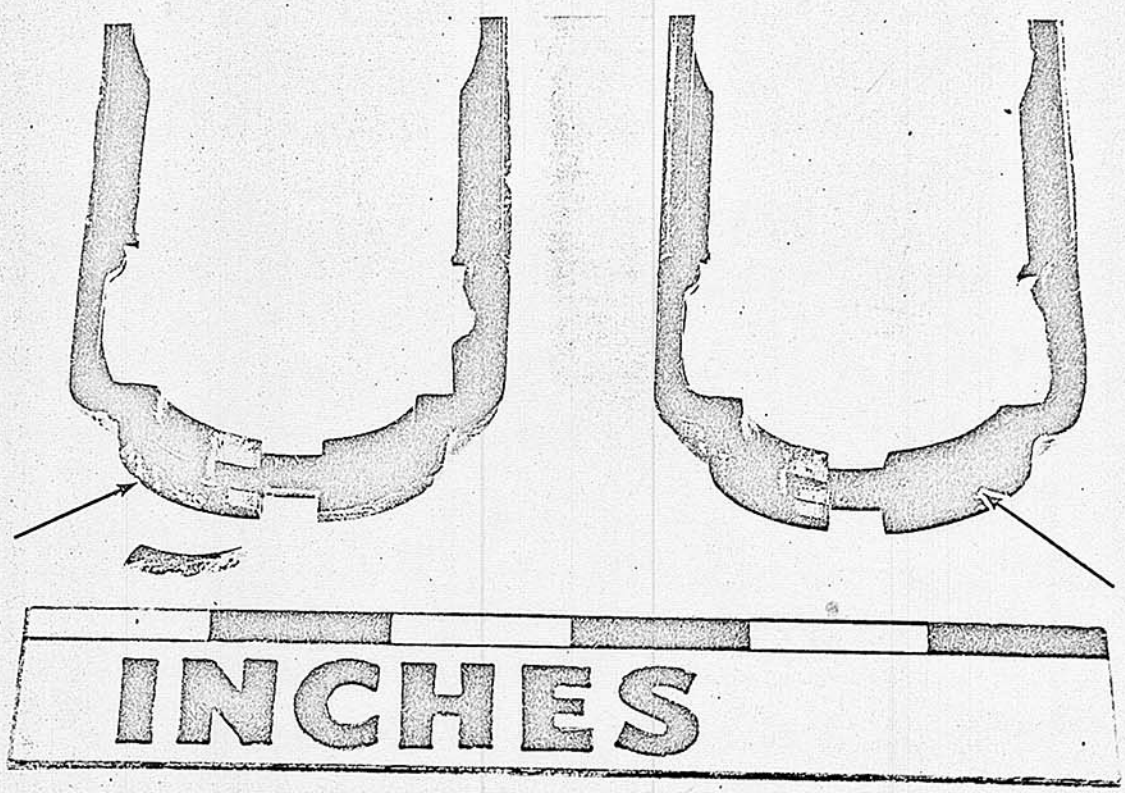

Figure 8. Redesigned Handguard Damaged during Disassembly from XM16E1 Rifle

Arrows indicate damaged area.

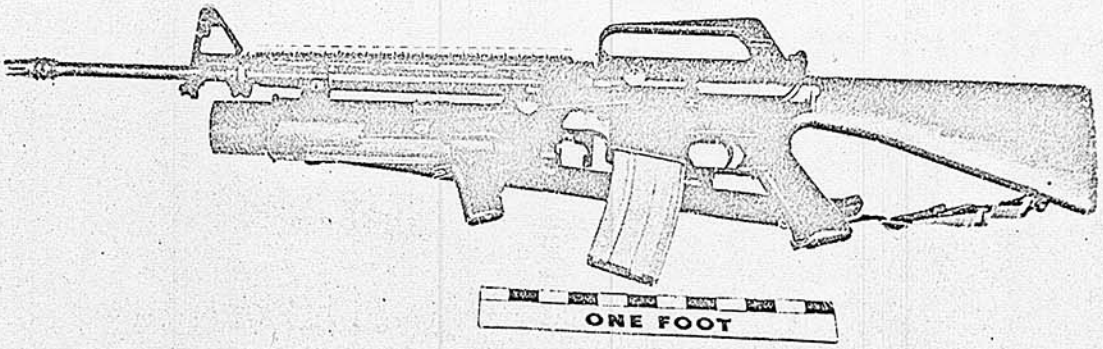

Figure 9. Redesigned Handguard Attached to XM16E1 Rifle with XM148 Grenade Launcher

(Note that handguard does not completely encircle the rifle barrel.)

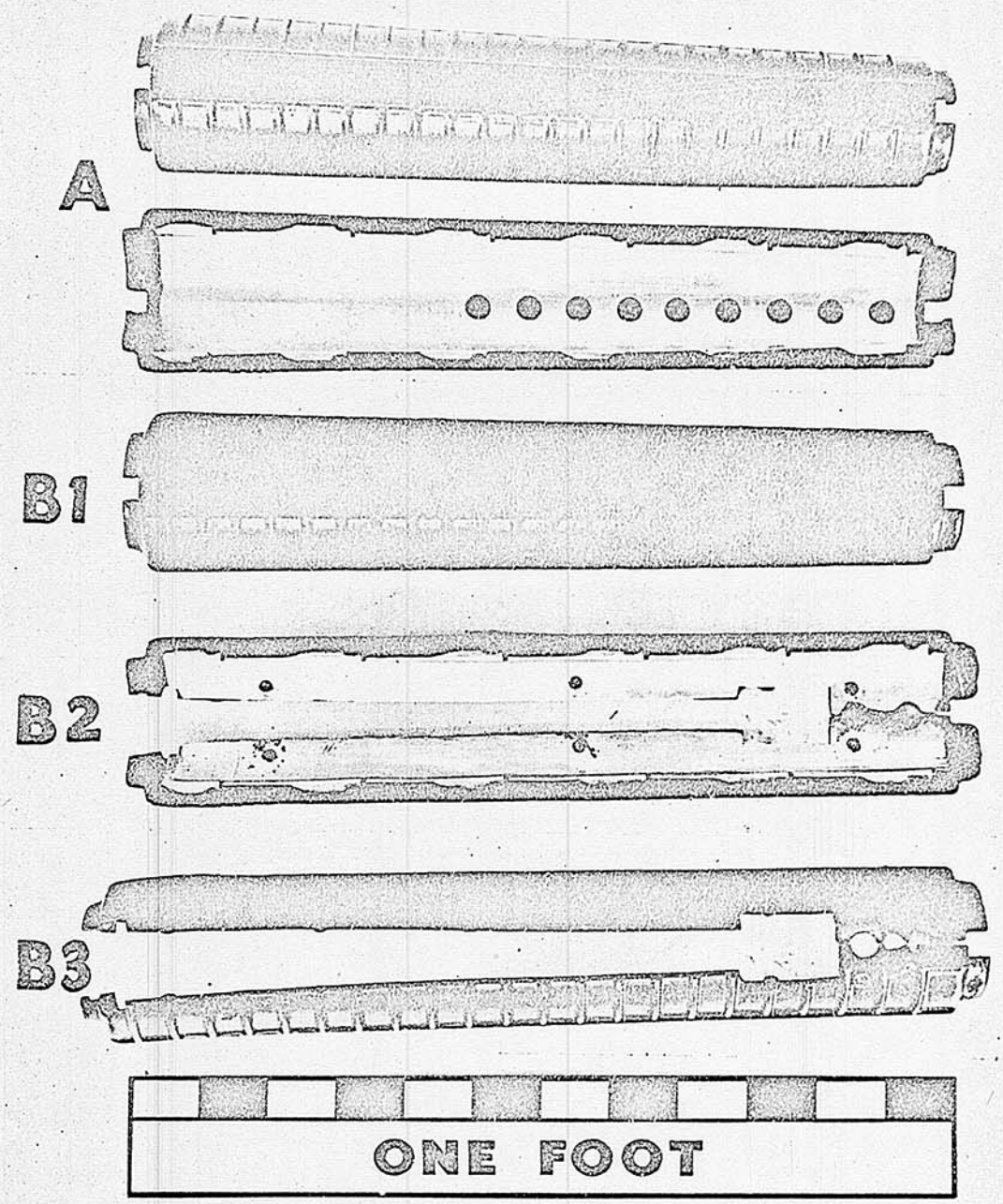

Figure 10. Redesigned and Modified Redesigned Handguards

A - Redesigned Handguard

B - Redesigned Handguard Modified for Attachment to XM16E1 Rifle with XM148 Grenade Launcher

B1 - Top Half, Modified Redesigned Handguard

B2 - Bottom Half (top view), Modified Redesigned Handguard

B3 - Bottom Half (bottom view), Modified Redesigned Handguard

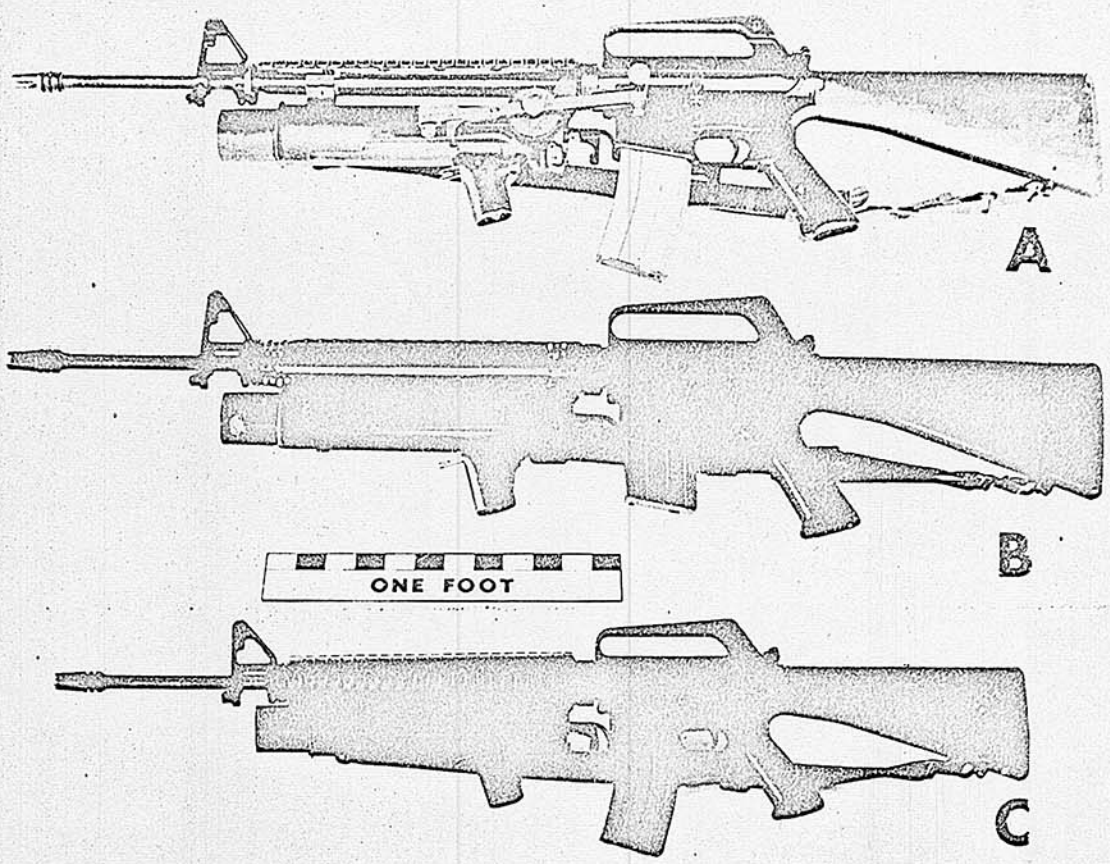

Figure 11. Handguard Attached to XM16E1 Rifle with XM148 Grenade Launcher

A - Redesigned Handguard

B - Standard Design, Handguard

C - Modified Redesigned Handguard