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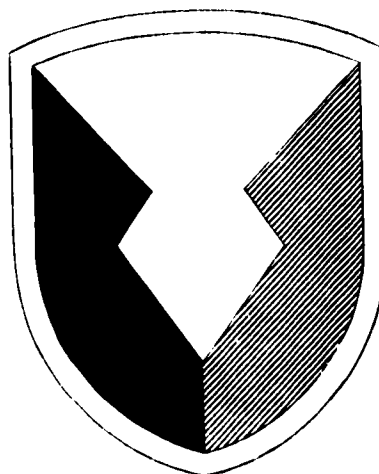
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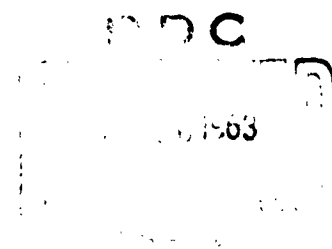
US ARMY
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US ARMY
INFANTRY BOARD
FORT BENNING, GEORGIA

NO. OTS



**REPORT OF SERVICE TEST PHASE OF
USATECOM PROJECT NO 8-3-4130-02
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT
FOR TRUCK, 1/4-TON, M151
19 August 1963**

UNITED STATES ARMY INFANTRY BOARD
Fort Benning, Georgia 31905

Capt Mahaffey/kb/545-1092

STEBG-SW (P-3002)

19 August 1963

SUBJECT: Report of Service Test Phase of USATECOM Project No 8-3-4130-02,
Integrated Engineering/Service Test of 106-mm Recoilless Rifle
Mount for Truck, 1/4-Ton, M151

TO: See Distribution

1. This letter transmits final report of subject project.

2. Test Results.

a. The 106-mm Recoilless Rifle Mount for mounting the Rifle, 106-mm, M40A1, on the Truck, Utility, 1/4-Ton, 4x4, M151, was service tested under actual field conditions in the temperate zone.

b. There are no Military Characteristics or Qualitative Materiel Requirement for the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151, but it met all requirements contained in published user development guidance.

(1) The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151, when installed on the M151 vehicle provides a major improvement over the Truck, Utility, 1/4-Ton, M38A1(C), in adequacy of the ammunition stowage system, crew space, comfort and convenience, and in ease of vehicularly mounting and dismounting the 106-mm rifle.

(2) The raised metal frame of folding crew seats provided in the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151, constitutes a safety hazard and materiel deficiency.

3. Conclusions. The US Army Infantry Board concludes that:

a. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), must be modified to correct the deficiency.

b. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), should be modified to correct as many of the shortcomings as feasible.

STBEC-SW (P-3002)

16 Aug 63

SUBJECT: Report of Service Test Phase of USATECOM Project No 8-3-4130-02,
Integrated Engineering/Service Test of 106-mm Recoilless Rifle
Mount for Truck, 1/4-Ton, M151

c. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), contains no nonessential or "nice-to-have" components.

d. The individual rifle brackets provided as part of the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), have potential application to other weapon mounting kits installed in either tracked or wheeled vehicles.

e. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), and overload suspension system should be completely installed on the vehicle before it is issued to the user.

f. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), is not suitable for mounting the Rifle, 106-mm, M40A1, on the Truck, Utility, 1/4-Ton, 4x4, M151, but will be suitable when the deficiency and as many as feasible of the shortcomings have been corrected.

g. The 106-mm Recoilless Rifle Mount for the Truck, Utility 1/4-Ton, 4x4, M151 (test kit), is not safe for its intended use but will be safe when the deficiency has been corrected.

h. The Truck, Utility, 1/4-Ton, 4x4, M151, with the Rifle, 106-mm, M40A1, and combat load should be driven only by a highly trained, carefully selected driver who is thoroughly familiar with the provisions of DA Circular 385-3.

4. Recommendations. It is recommended that:

a. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), be modified to correct the deficiency and as many as feasible of the shortcomings.

b. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), be considered unsuitable for type classification until the deficiency and as many as feasible of the shortcomings have been corrected.

c. Verification of correction of the deficiency and as many shortcomings as feasible be made by US Army Infantry Board inspection in lieu of conducting a formal Check Test.

STEBE-SW (P-3002)

16 Aug 63


SUBJECT: Report of Service Test Phase of USATECOM Project No 8-3-4130-02,
Integrated Engineering/Service Test of 106-mm Recoilless Rifle
Mount for Truck, 1/4-Ton, M151

d. The draft Technical Manual for operation of the Truck, Utility, 1/4-Ton, 4x4, M151, with mounted Rifle, 106-mm, M40A1, include the following precautionary instructions:

"The Truck, Utility, 1/4-Ton, 4x4, M151, with the Rifle, 106-mm, M40A1, and combat load should be driven only by a highly trained, carefully selected driver who is thoroughly familiar with the provisions of DA Circular 385-3."

FOR THE PRESIDENT:

1 Incl
as


A. B. CANNON
Captain, AGC
Adjutant

DISTRIBUTION:
Part IV

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UNITED STATES ARMY INFANTRY BOARD
Fort Benning, Georgia 31905

Capt Mahaffey/kb/545-1092

STBEC-SW (P-3002)

19 August 1963

REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151
22 October 1962 - 28 June 1963

PART I - GENERAL.

A. References. Annex A, Part III.

B. Authority.

1. Directive. Letter, AMSTE-BC, USATECOM, 7 Sep 62, subject: "Joint Engineering/Service Test of the 106-mm Recoilless Rifle Mount for the Truck, 1/4-Ton, M151," as amended by letter, AMSTE-BC, USATECOM, 4 Oct 62, subject: "Change to Test Directive."

2. Purpose. To determine the suitability of the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151, for US Army use.

C. Description of Materiel.

1. Photographs. See Annex B, Part III.

2. Test Item. The 106-mm Recoilless Rifle Mount for mounting the Rifle, 106-mm, M40A1, on the Truck, Utility, 1/4-Ton, 4x4, M151, is hereinafter referred to as the test kit (Type I and/or Type II). Principal components of the test kit (Type I and Type II) are an adjustable travel lock, individual rifle brackets, a mount wheel retainer, folding crew seats, a stowage box for spotter ammunition, and a unitized insert comprising braces for the rear portion of the vehicle body, major caliber ammunition stowage racks and covers, a mount wheel channel guide, mount trail-leg locking receptacles, and a folding tailgate. A radio mount and modified ammunition cover are also provided for the test kit (Type II) (see Annex B-3, Part III). The function of each of these components is described in paragraph 4 below as part of a test system.

3. Associated Items.

a. The Rifle, 106-mm, M40A1, with Rifle, Caliber .50, Spotting, MSC, hereinafter referred to as the weapon, is a standard recoilless rifle intended for use in both antitank and assault roles (ref 4, Annex A, Part III). For purposes of this test the weapon is considered as a component of the test system described in paragraph 4 below.

b. The Mount, M79, hereinafter referred to as the mount, is the standard mount for the Rifle, 106-mm, M40A1. It is a wheelbarrow-type tripod mount with a front wheel and two trail legs, each with a clamping lever. The mount includes elevating and traversing mechanisms for the weapon and provides a stable base for firing the weapon from the ground. The mount also provides a means of attaching the weapon to a 1/4-ton truck (ref 2, Annex A, Part III). For purposes of this test the mount is considered as a component of the test system described in paragraph 4 below.

c. The Cartridges, 106-mm, HEAT, M344A1, or HEP-T, M346A1, hereinafter referred to as the major caliber cartridges, are the standard cartridges fired from the weapon (ref 4, Annex A, Part III). For purposes of this test the major caliber cartridges are considered as a component of the test system described in paragraph 4 below.

d. The Cartridge, Caliber .50, Spotter-Tracer, M48A1, hereinafter referred to as the spotter cartridge, is the standard spotter-tracer cartridge fired from the Rifle, Caliber .50, Spotting, M8C (ref 4, Annex A, Part III). For purposes of this test the spotter cartridges are considered as a component of the test system described in paragraph 4 below.

e. The Truck, Utility, 1/4-Ton, 4x4, M151 (Modified), hereinafter referred to as the vehicle, is a standard 1/4-ton vehicle (ref 3, Annex A, Part III) which, when modified by installation of the test kit (Type I and type II) and an overload suspension system, will receive, transport, and provide a firing platform with the mount for the weapon and ammunition. Installation of the overload suspension system gives the vehicle a capability for transporting loads of 1,640 pounds (ref 8, Annex A, Part III). For purposes of this test the vehicle is considered as a component of the test system described in paragraph 4 below.

4. Test System (Annex B-1, Part III). The developmental and standard items described in paragraph 2 and 3 above are employed collectively and are hereinafter referred to as the test system. When installed on the vehicle, the test kit (Type I and Type II) provides the following test system features:

a. An adjustable travel lock (Annex B-2, Part III) located forward and to the left of the passenger seat of the vehicle. The travel lock secures the muzzle of the weapon for transport. The adjustment feature permits the muzzle of the weapon to be secured in either a high travel position with the vehicle windshield up or a low travel position with the vehicle windshield down.

b. A mount wheel retainer (Annex B-2, Part III) which receives and secures the front wheel of the mount for transport and firing.

c. Folding crew seats for the gunner and loader (Annex B-2, Part III).

d. A stowage box for spotter cartridges (Annex B-2, Part III) which is attached to the forward edge of the left wheel-well cover so that spotter cartridges are easily accessible to the gunner.

e. A unitized insert frame (Annex B-2, Part III) which when bolted into the rear of the vehicle body serves to reinforce the body, provides stowage racks and covers for major caliber cartridges, provides a channel to guide the mount wheel during mounting and dismounting of the weapon, provides locking receptacles for the mount trail-leg clamps, and provides a folding tailgate to prevent major caliber cartridges from sliding out the rear of the vehicle while ascending steep slopes.

f. Individual rifle brackets (Annex B-3, Part III) which secure the driver's and squad leader's rifles during transport.

g. A radio mount and modified ammunition cover for the test kit (Type II) (Annex B-3, Part III) are issued only for test systems manned by crews who are authorized a vehicularly mounted radio.

5. Control System. A control system was used in the service test phase of this project for purposes of obtaining comparative data. The control system consists of the standard items listed in paragraph 3 above but includes the Truck, Utility, 1/4-Ton, 4x4, M38A1C, rather than the Truck, Utility, 1/4-Ton, 4x4, M151 (Modified) with the test kit.

D. Background.

1. The Military Characteristics for the Truck, Utility, 1/4-Ton, M151, which were established in May 1952, did not contain a requirement for the vehicle to perform as a vehicular mount for Army weapons (ref 1, Annex A, Part III).

2. In August 1960, USCONARC requested amendment of the military characteristics, to reflect a requirement for the vehicle to perform as a vehicular mount for the Rifle, 106-mm, M40A1; the Rifle, 120-mm, XM105; Battle Group Delivery Systems, XM28 and XM29 (DAVY CROCKETT); and the ENTAC Antitank Guided Missile System (ref 5, Annex A, Part III).

3. A prototype test kit for mounting the Rifle, 106-mm, M40A1, on the M151 vehicle was subsequently designed and developed by the US Army Tank-Automotive Center (USATKAUTMVCEN) at Warren, Michigan (ref 8, Annex A, Part III).

4. A prototype test kit and an M151 vehicle were received for test by the US Army Infantry Board from USATKAUTMVCEN on 22 October 1962 (ref 9, Annex A, Part III). Installation of the test kit and an overload suspension system on the vehicle was completed and testing commenced shortly thereafter. Testing was suspended on 15 November 1962 because of a potential safety hazard created during cross-country driving when major caliber cartridges (carried in ammunition stowage tubes integral to

the prototype kit) separated at the point where the cartridge case was crimped to the projectile. The separation resulted from inadequate design of the ammunition stowage tubes which allowed the cartridges to bounce excessively during cross-country driving. It was also determined at this time that the covers from the ammunition stowage tubes and locking receptacles for the mount trail-legs were not durable enough to withstand field use (ref 10 and 11, Annex A, Part III).

5. On 10 December 1962 a modified ammunition stowage assembly was received by the USAIB from USATKAUTMVCEN and testing was re-initiated on 11 December 1962 (ref 12, Annex A, Part III). The modification to the ammunition stowage assembly consisted of adding an aluminum insert to each of the six ammunition tubes comprising the stowage assembly. The inserts were intended to reduce the interior dimensions of the ammunition tubes to prevent excessive bouncing and movement of the stowed major caliber cartridges during cross-country driving. After 370 miles additional cross-country driving, testing was again suspended on 20 December 1962 when it was determined that stowed major caliber cartridges were again separating at the cartridge crimp point, creating a potential safety hazard and denying an operational capability with the test system. At this time the USAIB recommended that the test be terminated, that consideration be given to developing a unitized insert kit incorporating desirable features and that the USAIB be authorized to modify the test vehicle and locally fabricate an insert-type kit (ref 13, Annex A, Part III).

6. On 31 December 1962 authorization was received from USATECOM for the USAIB to modify the M151 vehicle body and to begin fabrication of a redesigned test kit. As the initial step in fabricating a redesigned test kit, a scale model of a redesigned test kit was constructed by the USAIB. This model was to have served as a guide for Fort Benning Ordnance personnel in the construction of a full sized kit and for modifying the M151 vehicle; however, on 11 January 1963 the USAIB was informed that a decision had been made at USATKAUTMVCEN that the test of the modified prototype test kit would be terminated and that "an installation incorporating all the desirable features will be designed, fabricated, and a trial installation made at this center" (ref 16, Annex A, Part III). On 21 January 1963, an USATKAUTMVCEN representative visited the USAIB to examine and obtain photographs of the USAIB scale model. On 8 April 1963 the redesigned test kit which is similar in configuration to the USAIB scale model was received from USATKAUTMVCEN and testing of the redesigned test kit began on 9 April 1963 (ref 17, Annex A, Part III).

7. The test kit (Type I and Type II) is proposed for Tripartite Standardization and is included on Priority and Normal Standardization List Sheet Number 1-8-103-4.

E. Test Objectives.

1. The service test phase of this project was conducted to find the extent to which the test item meets each applicable characteristic

prescribed by user development guidance in order to determine the suitability of the test item for US Army use in the temperate zone.

2. The following tests were conducted:

- a. Test No 1, PHYSICAL CHARACTERISTICS.
- b. Test No 2, COMPATIBILITY OF KITS/SYSTEM.
- c. Test No 3, LIMITS OF TRAVERSE, DEPRESSION, AND ELEVATION.
- d. Test No 4, EASE OF TRACKING.
- e. Test No 5, STABILITY AND ACCURACY.
- f. Test No 6, MOUNTING AND DISMOUNTING.
- g. Test No 7, RUGGEDNESS AND DURABILITY.
- h. Test No 8, KIT INSTALLATION AND ORGANIZATIONAL MAINTENANCE.
- i. Test No 9, HUMAN FACTORS ENGINEERING.
- j. Test No 10, SAFETY CONFIRMATION.

F. Findings. The test kit meets user development guidance to the extent indicated below:

<u>Requirement</u>	<u>Findings</u>
1. (ref 5 and 6, Annex A, Part III).	
a. "It has been determined that a requirement exists for the following additional weapons to be mounted on the M151, 1/4-ton vehicle: ... 106-mm Recoilless Rifle.	Requirement met (all tests).
b. "Modify the standard top for the M151, 1/4-ton truck so that it can be used when the windshield is raised and the weapon is in the travel position.	Not applicable. No modified canvas was provided for the test. According to USATKAUTMVCEN, instructions for local (unit) canvas modification will be included in the Technical Manual for installation of the test kit.
"It is desirable to protect the crew and their equipment from the elements under garrison conditions. A minor modification to the standard top will suffice; however, this should not delay availability of the mounting kit.	

Requirement

c. "Provide a hold down device with quick release between the two front seats of the vehicle to secure the front wheel of the weapon mount. No mention has been made of any device to lock the front of the recoilless rifle mount in place. A device of this type is essential to prevent recoilless rifle from bouncing during travel and thereby damaging the floor of the vehicle.

Requirement met (Tests No 1, 5, and 7).

d. "Provide a satisfactory ammunition stowage system. Stowage of ammunition in the back of the M151 truck is complicated by the short distance from the back of the front seats to the rear of the truck, and by the need to retain structural strength in the rear of the truck. The placement of ammunition is critical because a small error in loading or a slight shift in the load could result in damage to the rounds when the weapon mount is moved or locked into place. Racks of containers must assure safe, ready ammunition stowage.

Requirement met (Tests No 1, 2, 6, 7, and 9).

e. "Relocate the spare tire so that it will not interfere with operating or dismounting the weapon or hinder the crew when entering or leaving the vehicle. The spare tire, which is essential and must be carried on the vehicle, cannot be mounted in the usual place at the rear of the M151, 1/4-ton truck because it would interfere with operating and dismounting the weapon."

Requirement met (Tests No 1 and 9).

2. (ref 7, Annex A, Part III).

a. "After an informal review of the mounting in April 1962, the Infantry School submitted a letter of guidance concerning the M151 jeep mounting of the 106-mm recoilless rifle attached. The recommendations were:

(1) "Eliminate the arctic heater kit.

Requirement met. Arctic heater kit was not provided with the test system.

(2) "Use the standard windshield.

Requirement met (Test No 1).

(3) "Try a travel lock on top of the windshield.

Not determined. Travel lock mounted on top of windshield not provided.

Requirement

Findings

- (4) " * * *)
- (5) " * * *)
- (6) " * * *)
- (7) " * * *)."

Requirements met. These requirements are stated in paragraphs 1b, c, d, and e above.

3. (ref 13, Annex A, Part III). "Analysis of Equipment Failures and Human Factors Trials indicates the following features are desirable for incorporation in a redesigned adapter kit:

a. "Modify or cut rear panel of vehicle to provide for easy mounting and dismounting of 106-mm rifle, ready access to stowed ammunition, and installation of redesigned adapter kit.

Requirement met (Tests No 6, 8, and 9.

b. "A unitized insert-type kit to act as reinforcement for the modified vehicle body and allow simple and rapid field installation.

Requirement met regarding reinforcement for modified vehicle body but not met for simple and rapid field installation (Test No 8). Installation of test kit should be completed prior to issue of the vehicle to the user.

c. "An ammunition stowage system, integral to the unitized insert, containing a simple bracket and strap device for securing packaged ammunition.

Requirement met (Test No 1).

d. "A channel guide, integral to the unitized insert, which will rest flat on the vehicle rear deck.

Requirement met (Test No 1).

e. "Rear mount retainers, integral to the unitized insert, which will ensure that the weapon mount is level when attached to the vehicle.

Requirement met (Test No 1).

f. "A gunner's and a loader's safety seat.

Requirement met (Test No 1).

g. "Radio mounting bracket for AN/VRC-10 radio."

Requirement met (Test No 1).

4. Although there are no stated requirements nor development guidance concerning the following characteristics of the test system, tests were

conducted to obtain findings as to the extent to which these characteristics met an acceptable standard of suitability.

a. Physical Characteristics. Because of the characteristics of the test kit (Type I and Type II), the combat payload of the test system is greater than the combat payload of the control system. However, the overload (i.e., combat payload vs. rated payload) of the test system is 560 pounds (Type I kit) or 425 pounds (Type II kit) less than the overload of the control system. Except for weight, the physical characteristics of the test and control systems are similar and are primarily determined by body dimensions of the Trucks, Utility, 1/4-Ton, 4x4, M151 and M38A1 (C) (see Test No 1, Part II).

b. Compatibility of Kits/System. The test kit (Type I and Type II) is compatible with the vehicle, the mount, the weapon, the ammunition, the crew members and their equipment (see Test No 2, Part II). It was also determined that with minor modifications, the test kit will permit mounting the Rifle, 120-mm, XM105E1, on the vehicle.

c. Limits of Traverse, Depression, and Elevation. The weapon was fired from -12° to $+18^{\circ}$ elevation (with respect to the vehicle) throughout a field of traverse from 112° left of the vehicle center line to 115° right of the vehicle center line without seriously damaging the vehicle or other components of the test system except when firing at 0° traverse (directly over the hood of the vehicle) where elevation limits were -5° to $+31^{\circ}$ with respect to the vehicle body (see Test No 3, Part II).

d. Ease of Tracking. The test kit (Type I and Type II) permitted the gunner to track a moving target as easily and accurately from the test system as from the control system (see Test No 4, Part II).

e. Stability and Accuracy. During firing there was no evidence of weapon or mount movement with respect to the vehicle. Accuracy results achieved when firing major caliber and spotter cartridges from the test system were not degraded by cant as a result of weapon orientation (see Test No 5, Part II).

f. Mounting and Dismounting. The weapon and mount were mounted and dismounted more rapidly and easily with the test system than with the control system (see Test No 6, Part II).

g. Ruggedness and Durability. The test system proved to be sufficiently rugged and durable after being subjected to firing tests and 2,130 miles of driving with combat payload over improved roads, cross-country, and over tank trails and unimproved roads (see Test No 7, Part II).

h. Kit Installation and Organizational Maintenance. Daily crew maintenance of the test system was easily and readily accomplished by the test crew. Approximately 35 man-hours were required to modify

the vehicle body and install the overload suspension system and test kit (Type I and Type II) (see Test No 8, Part II).

i. Human Factors Engineering. It was determined that a highly trained, carefully selected driver is required for the test system. The "different feel" characteristics of the vehicle, outlined in DA Circular 385-3, "Safe Operations of the Truck, Utility, 1/4-Ton, 4x4, M151," 26 Mar 63, are accentuated with the additional weight of the test kit (Type I and Type II), the mount, the weapon, a basic load of ammunition, and a combat equipped crew (see Test No 9, Part II).

j. Safety Confirmation. The "different feel" involved in driving the vehicle together with actions necessary to become accustomed to this "feel" are outlined in DA Circular 385-3 and paragraph i above. During cross-country driving the sharp edge of the metal frame around the seat cushion of the folding crew seats struck the base of the loader's and gunner's spines on repeated occasions. This is a potentially serious safety hazard (see Test No 10, Part II).

5. The following deficiency and shortcomings were noted during the test:

a. Deficiency. The raised metal frame of the folding crew seats strikes the base of the loader's and gunner's spines during transport (Test No 10 and Annex C).

b. Shortcomings.

(1) The bolts which secure the spare wheel to its mounting and support assembly are 5/8-inch hexagonal head while the lug wrench provided in the vehicle OVE set is designed for 11/16-inch hexagonal head (Test No 8 and Annex C).

(2) The rubber padding on the interior of the travel lock clamp separated from the clamp (Test No 7 and Annex C).

(3) An ammunition grip-pad, which prevents packaged major caliber cartridges from sliding out of the ammunition stowage racks, separated from the rack frame (Test No 7 and Annex C).

(4) During transport crew member's backs were repeatedly pinched between the back cushion of the folding crew seats and the metal stripping along the top of the crew seat frames (Test No 7 and Annex C).

(5) The handle of the left tailgate latch broke off during transport when it struck the top of the left rear bumperette (Test No 8 and Annex C).

(6) The handles of the tailgate latches are difficult to grasp with the bare hand (Test No 9 and Annex C).

(7) The gunner and loader have no suitable device to grasp to prevent being bounced out of the crew seats when traveling over rough terrain (Test No 10 and Annex C).

(8) During transport the metal stripping along the top of the loader's folding crew seat split loose from the seat frame (Test No 7 and Annex C).

G. Conclusions. The US Army Infantry Board concludes that:

1. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), must be modified to correct the deficiency.

2. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), should be modified to correct as many of the shortcomings as feasible.

3. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), contains no nonessential or "nice-to-have" components.

4. The individual rifle brackets provided as part of the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), have potential application to other weapon mounting kits installed in either tracked or wheeled vehicles.

5. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), and overload suspension system should be completely installed on the vehicle before it is issued to the user.

6. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), is not suitable for mounting the Rifle, 106-mm, M40A1, on the Truck, Utility, 1/4-Ton, 4x4, M151, but will be suitable when the deficiency and as many as feasible of the shortcomings have been corrected.

7. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), is not safe for its intended use but will be safe when the deficiency has been corrected.

8. With minor modifications the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, M151 (test kit), will permit mounting the Rifle, 120-mm, XM105E1, on the Truck, Utility, 1/4-Ton, 4x4, M151.

9. The Truck, Utility, 1/4-Ton, 4x4, M151, with the Rifle, 106-mm, M40A1, and combat load should be driven only by a highly trained, carefully selected driver who is thoroughly familiar with the provisions of DA Circular 385-3.

H. Recommendations. It is recommended that:


1. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), be modified to correct the deficiency and as many as feasible of the shortcomings.

2. The 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151 (test kit), be considered unsuitable for type classification until the deficiency and as many as feasible of the shortcomings have been corrected.

3. Verification of correction of the deficiency and as many shortcomings as feasible be made by US Army Infantry Board inspection in lieu of conducting a formal Check Test.

4. The draft Technical Manual for operation of the Truck, Utility, 1/4-Ton, 4x4, M151, with mounted Rifle, 106-mm, M40A1, include the following precautionary instructions:

"The Truck, Utility, 1/4-Ton, 4x4, M151, with the Rifle, 106-mm, M40A1, and combat load should be driven only by a highly trained, carefully selected driver who is thoroughly familiar with the provisions of DA Circular 385-3."


R. C. WILLIAMS
Colonel, Infantry
President

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PART II - TEST DATA

TEST NO 1, PHYSICAL CHARACTERISTICS.

1. PURPOSE. To determine the physical characteristics of the test system when combat loaded.

2. METHOD.

a. Each major component of the test system was inspected, weighed, measured, and photographed. This same procedure was followed for the combat loaded test system after the test kit (Type I and Type II) had been installed on the vehicle.

b. To obtain comparative data the combat loaded control system was also weighed and measured.

c. Data obtained were recorded and analyzed.

3. RESULTS.

a. Factual Data.

(1) <u>Weight</u> (Pounds).	<u>Test System</u>	<u>Control System</u>
(a) Vehicle Less Crew and Payload...	2,280	3,180
(b) <u>Payload</u> (Less Crew):		
Test Kit (Type I).....	278	
Test Kit (Type II).....	(300)	
Weapon with Mount.....	(483) 483	483
6 Rds Major Caliber Ammunition.....	(251) 251	251
4 Magazines/Spotter Ammunition.....	(15) 15	15
AN/VRC-10 Radio for Test Kit (Type II).....	(115) _____	_____
Payload Subtotal.....	1,164 1,027	749
(c) Rated Payload (Cross- Country).....	1,640 1,640	800

	<u>Test System</u>	<u>Control System</u>
(2) <u>Height</u> (Inches).	78	71
Reducible to	68.25	71
(3) <u>Width</u> (Inches).	72	67
(4) <u>Length</u> (Inches).	140.75	152

b. Observations of Test Personnel. Crew members stated that the space available for them and their equipment on the test system is more adequate and consequently more comfortable than that available on the control system. This results both from the increased width of the vehicle and the manner in which the test kit (Type I and Type II) utilizes available space in the rear of the vehicle.

c. Photographs obtained of the test system are shown in Annex B, Part III.

4. ANALYSIS.

a. Assuming the average weight of a combat equipped soldier as being 246 pounds (ref 13, Annex A, Part III), the average four-man crew weight of 984 pounds added to the payload subtotal gives a total combat load of 2,011 pounds (Type I kit) or 2,148 pounds (Type II kit). This is 371 pounds (Type I kit) or 508 pounds (Type II kit) more than the rated payload of 1,640 pounds for the vehicle with the overload suspension system. Using identical four-man crew weight added to the payload subtotal for the control system, the combat loaded control system comprises a load of 933 pounds more than the 800-pound rated payload of the M38A1(C) vehicle.

b. The gross weight of the combat loaded test system is 622 pounds (Type I kit) or 485 pounds (Type II kit) less than the gross weight of the combat loaded control system.

TEST NO 2, COMPATIBILITY OF KIT/SYSTEM.

1. PURPOSE. To determine compatibility of the test kit (Type I and Type II) with the vehicle, mount, weapon, combat load, and crew.

2. METHOD.

a. Throughout all tests observations were made and crews were interrogated concerning:

(1) Compatibility of the test kit (Type I and Type II) with components of the test system.

(2) Any nonessential or "nice-to-have" features in the test kit (Type I and Type II).

b. As outlined in Test No 6, Mounting and Dismounting, repetitive time trials were conducted during which the crew was timed while vehicularly mounting and dismounting the weapon.

c. During transport and firing tests particular emphasis was placed on determining:

(1) The adequacy of stowage and seating space of the test system.

(2) The ease and speed with which the weapon and mount can be mounted and dismounted.

(3) The effect of test system weight and load distribution on driving the vehicle and on the overload suspension system.

(4) Adequacy of mount and ammunition retaining devices.

(5) Ability of the gunner to manipulate the vehicularly mounted weapon.

(6) Peculiarities of test system configuration.

(7) Effect of breech and muzzle blast upon the vehicle, stowed ammunition, and crew equipment.

d. Authorization was received from USATECOM and USATKAUTMVCEN to modify the test kit (Type I) in order to determine if it could be made compatible with the Rifle, 120-mm, XM105E1, which concurrently underwent test at the USAIB. The necessary modifications were made by USAIB organizational maintenance personnel.

3. RESULTS.

a. Factual Data.

(1) The combat loaded test system was driven 2,130 miles with no adverse effect on the vehicle suspension system (see Test No 7).

(2) The weapon and mount were easily and rapidly mounted and dismounted with the test system (see Test No 6).

(3) All individual weapons and equipment, and squad TOE equipment were stowed and transported in the vehicle.

(4) Retaining devices provided by the test kit (Type I and Type II) secured the weapon, mount, and ammunition firmly to the vehicle during all transport and firing tests.

(5) Results of tracking and firing tests showed no degradation of the gunner's ability to manipulate the vehicularly mounted weapon.

(6) The only noticeable peculiarity in test system configuration occurs when the weapon is transported with the travel lock in the high travel position. This provides an overall test system height of 78 inches (see Annex B-4, Part III). This height is reducible to 68 1/4 inches when the weapon is transported in the low travel position (see Annex B-4, Part III).

(7) Breech and muzzle blast had no adverse effect on the vehicle, stowed ammunition, or crew equipment except that the hood and radiator of the vehicle were slightly damaged (see Annex B-6, Part III) when the weapon was fired over the hood of the vehicle at -5° depression (with respect to the vehicle).

(8) Stowed ammunition was not damaged as a result of transport, firing, or the vehicle accident discussed in paragraph (9) below.

(9) On 1 May 1963 the test system and crew were involved in an accident in which the test system, while being driven cross-country, went into a skid and over-turned completely.

(10) It was determined that the test kit (Type I), when modified as shown below and installed on the vehicle, will permit vehicular mounting of the Rifle, 120-mm, XM105E1:

(a) The front portion of the mount wheel channel guide must be widened to 4 inches.

(b) The circumference of the travel lock clamp must be increased approximately 1 inch.

(c) The mount wheel retainer must be widened approximately 1 inch.

(d) Photographs of the modified test kit (Type I) and vehicularly mounted 120-mm rifle are contained in Annex B-7, Part III.

b. Observations of Test Personnel.

(1) Test crews stated the seating space provided in the test system was adequate and considerably more comfortable and convenient than that provided in the control system.

(2) Test crews stated that mounting and dismounting the weapon and mount were easier with the test system than with the control system.

(3) Results of an accident investigation conducted by the test officer following the accident described in paragraph 3a(9) indicated that the "different feel" of driving the vehicle, as outlined in DA Circular 385-3, is accentuated by the additional weight and "top heavy" condition encountered when the test kit (Type I), weapon, mount, ammunition, crew, and their equipment are transported on the vehicle. In the opinion of the test officer this condition was definitely a contributing factor in the accident.

4. DISCUSSION.

a. The comparative ease of mounting and dismounting the weapon and mount of the test system, appears to result from the lower height of the bed of the vehicle from that of the M38A1(C) vehicle and the arrangement of mount retaining devices provided in the test kit (Type I and Type II).

b. In view of the results of the accident investigation discussed in paragraph 3b(3) above, it is considered that the soldier assigned as driver of the test system must be highly trained, carefully selected, and thoroughly familiar with the vehicle operating characteristics. Additionally, extra caution must be exercised by the driver and by other crew members when traveling cross-country or over unimproved roads with the test system.

5. ANALYSIS.

a. Average time to vehicularly mount and dismount the weapon and mount of the test system was less than that required for the control system.

b. The net effect of weight and load distribution on the vehicle is to accentuate the "different feel" encountered when driving the test system.

c. If the Rifle, 120-mm, XM105E1, is adopted, the test kit (Type I) with minor modifications will permit mounting the rifle on the vehicle.

d. The test kit (Type I and Type II) has no nonessential or "nice-to-have" features.

TEST NO 3, LIMITS OF TRAVERSE, DEPRESSION, AND ELEVATION.

1. PURPOSE. To determine the practical limits of traverse, depression, and elevation of the test system.

2. METHOD.

a. Measured limits of traverse, depression, and elevation (with respect to the vehicle) of the test system were determined by means of an aiming circle and a gunner's quadrant.

b. During accuracy firing described in Test No 5, Stability and Accuracy, the weapon was fired at the following angles of traverse with respect to the center line of the vehicle.

- (1) 45° to the left front.
- (2) 90° to the left.
- (3) 112° to the left rear.

c. Measured limits were confirmed by remotely firing major caliber ammunition from the test system at the following extremes of traverse, depression, and elevation (with respect to the vehicle) to determine any limitations imposed by muzzle and breach blast:

<u>Traverse</u>	<u>Elevation With Respect to Vehicle Body</u>	<u>Depression With Respect to Vehicle Body</u>
Left 112°	18°	-12°
Right 115°	18°	-12°
0° (Over Vehicle Hood)	31°	-5°

3. RESULTS.

a. The measured limits of traverse from the center line of the vehicle body and measured limits of elevation and depression with respect to the vehicle body were as shown below (except over the hood steering wheel, and spare wheel of the vehicle):

<u>Traverse From To</u>	<u>Maximum Elevation Throughout Traverse</u>	<u>Maximum Depression Throughout Traverse</u>
0° Left 112°	18°	-12°
0° Right 115°	18°	-12°

b. The confirmed limits of elevation and depression (with respect to the vehicle) when firing over the hood, steering wheel, and spare tire were:

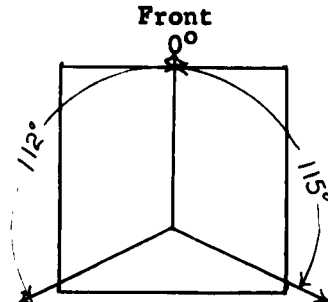
<u>Location</u>	<u>Maximum Elevation</u>	<u>Maximum Depression</u>
Over Vehicle Hood	31°	-5°
Over Steering Wheel	31°	0°
Over Spare Wheel	18°	-8°

c. Except as indicated below, the test system was not damaged during the firing discussed in paragraph 2c above.

d. The hood and radiator of the vehicle were slightly damaged during the firing discussed in paragraph 2c with the weapon fired directly over the hood of the vehicle at -5° depression with respect to the vehicle body. The vehicle was not immobilized by this damage.

4. ANALYSIS.

a. Analysis of measured and confirmed firing limits established during this test shows the practical limit of traverse, elevation, and depression of the system to be:

<u>Traverse</u>	<u>Elevation</u>	<u>Depression</u>
	1. $+18^{\circ}$ throughout traverse except over the hood of the vehicle.	1. -12° throughout traverse except when limited by physical contact between muzzle and vehicle body or when firing over the hood of the vehicle.
	2. $+31^{\circ}$ over the hood of the vehicle.	2. -5° over the hood of the vehicle.

b. Tactical limitations imposed by the above listed limits may be overcome by either dismounting the weapon from the vehicle or by re-orienting the vehicle with respect to the target area.

TEST NO 4, EASE OF TRACKING.

1. PURPOSE. To determine if the gunner can adequately track a moving target when employing the test system.

2. METHOD

a. Repetitive trials were conducted during which each of three gunners, alternately employing the test and control systems, tracked and engaged a target moving laterally for a distance of 300 meters at varied speeds at a range of 300 meters.

b. During Test No 5, Stability and Accuracy, each of three gunners engaged a moving target traveling laterally at 10 miles-per-hour at a range of 300 meters.

c. During both of the above exercises, the target was engaged utilizing a subcaliber device firing caliber .30 cartridges.

3. RESULTS.

a. At a target speed of 5 miles-per-hour the gunners experienced no difficulty in tracking the target with either the test or control system and were able to fire a minimum of four cartridges each at the target.

b. At a target speed of 10 miles-per-hour the gunners experienced slight difficulty in tracking the target with both the test and control systems and were able to fire a maximum of three cartridges each at the target.

c. At a target speed of 20 miles-per-hour the gunners experienced extreme difficulty in tracking the target with both test and control systems and were able to fire a maximum of one cartridge each at the target.

4. ANALYSIS.

a. The difficulty experienced by the gunners in attempting to track a moving target at speeds of 10 and 20 miles-per-hour was not a limitation of the test kit (Type I and Type II). It is a limitation of the geared traversing and elevating handwheels provided in the mount for the weapon.

b. There was no relative difference in the ability of the gunners to track a moving target with either the test or control system.

TEST NO 5, STABILITY AND ACCURACY.

1. PURPOSE. To determine:

a. Accuracy of the test system against moving and stationary targets.

b. The adequacy of the test kit (Type I and Type II) for securing the weapon and mount to the vehicle during firing.

2. METHOD.

a. Stationary Targets.

(1) The weapon was vehicularly mounted, boresighted, and aligned.

(2) Five major caliber cartridges and twenty-five spotter cartridges were fired by a gunner for each of the following conditions:

<u>Target Range</u>	<u>Weapon Orientation</u> <u>(With Respect to the Center</u> <u>Line of the Vehicle)</u>
1,000 Meters	45° Left Front
1,000 Meters	90° Left
1,000 Meters	112° Left Rear

(3) The centers of impact of the spotter cartridges and the major caliber cartridges were computed and compared for each of these conditions to determine if weapon cant affected the accuracy of the test system under each condition.

b. Moving Targets.

(1) Each of three gunners fired eight spotter cartridges at a target moving laterally at 300 meters range at a speed of 10 miles-per-hour.

(2) The number of hits achieved by each gunner was recorded.

c. During accuracy firing photography and chalk indices were used to record any movement of the weapon or mount with respect to the vehicle on which it was mounted.

3. RESULTS.

a. Results of firing against stationary targets showed no adverse effect of cant on the accuracy of the test system.

b. An average of 6.6 hits out of the spotter cartridges described in 2b(1) above was achieved against moving targets by the three gunners.

c. Examination of photographic records and chalk indices both during and after firing revealed no indications of weapon or mount movement with respect to the vehicle.

4. ANALYSIS.

a. Analysis of firing results revealed no degradation of the accuracy of the weapon as a result of mounting and securing it on the vehicle by means of the test kit (Type I and Type II).

b. The test kit (Type I and Type II) adequately secures the weapon and mount to the vehicle when firing against either stationary or moving targets.

TEST NO 6, MOUNTING AND DISMOUNTING.

1. PURPOSE. To determine the ease and speed with which the weapon and mount can be vehicularly mounted and dismounted when employing the test system.

2. METHOD.

a. The test crew conducted 10 repetitions of "CREW DRILL - MOUNTING AND DISMOUNTING THE RIFLE" with the test system as prescribed in reference 4, Annex A, Part III. This procedure was repeated with the control system.

b. Each trial for both the test and control systems was timed with three stop watches.

c. An average time for each trial was computed and recorded. Based on these average trial times, the average time required to vehicularly mount and dismount the weapon and mount was determined and recorded for both the test and control systems.

d. Crew members were questioned concerning the comparative ease with which the weapon and mount were vehicularly mounted and dismounted when employing the test and control systems.

3. RESULTS.

a. Factual Data.

(1) The average time required to vehicularly mount and dismount the weapon and mount when utilizing the test and control system was as follows:

	<u>Average Time For Mounting (Seconds)</u>	<u>Average Time For Dismounting (Seconds)</u>
(a) Test System	16.3	8.9
(b) Control System	22.1	12.8

(2) Major caliber cartridges, stowed alongside the mount wheel channel guide in the test system did not interfere with mounting and dismounting of the weapon and mount nor were the cartridge containers damaged.

b. Observations of Test Personnel. Test personnel stated that it was easier to vehicularly mount and dismount the weapon and mount when employing the test system than when employing the control system. On several occasions the test crew experienced difficulty in lifting the weapon and mount onto the M38A1(C) vehicle and in guiding them into the bed of the vehicle.

4. DISCUSSION. The comparative ease with which the weapon and mount can be vehicularly mounted and dismounted with the test system appears to result from the lower height of the bed of the vehicle and from the internal arrangement of the components of the test kit (Type I and Type II).

5. ANALYSIS. In view of the results of mounting and dismounting time trials and crew comments concerning mounting and dismounting of the weapon and mount, it is considered that vehicular mounting and dismounting of the weapon and mount can be accomplished both easily and rapidly by a trained crew employing the test system.

TEST NO 7, RUGGEDNESS AND DURABILITY.

1. PURPOSE. To determine the ruggedness and durability of the test system with combat load.

2. METHOD.

a. Data concerning ruggedness and durability of the test system were recorded during all phases of this project.

b. The combat loaded test system (less two combat equipped crew members) was driven by two combat equipped soldiers over the following courses:

(1) 600 miles of improved roads.

(2) 802 miles of tank trails and unimproved secondary roads.

(3) 728 miles cross-country

Total 2,130 miles.

c. The test kit (Type I) was used during the first 1,000 miles of road testing. The test kit (Type II) with the Radio AN/VRC-10 was used during the last 1,130 miles of road testing.

d. Portions of each phase of transport listed above were conducted in dust, mud, and rain.

e. Test data were obtained from an inspection of the test system following the vehicle accident discussed in Test No 2, Compatibility of Kit/System.

3. RESULTS.

a. The test system was not adversely affected by firing the vehicularly mounted weapon except as a direct result of muzzle blast on the hood of the vehicle (see Test No 3).

b. During cross-country driving metal stripping along the top of the loader's folding crew seat split loose from the seat frame; an ammunition grip pad came loose from the ammunition stowage rack; a handle on the tail-gate latch broke off when it struck the vehicle bumperette, and the rubber padding on the interior of the travel lock clamp separated from the clamp.

c. Dust, mud, and rain had no adverse effect on the test system.

d. Inspection of the test system following the vehicle accident revealed the following:

(1) The weapon and mount were not damaged. (Major caliber and spotter cartridges were subsequently fired from the weapon.)

(2) The vehicle frame remained in alignment and was not visibly damaged.

(3) The overload suspension system was intact.

(4) Hinges on the folding crew seats were sprung and the seat frames were bent.

(5) The left front fender of the vehicle and the vehicle windshield were damaged and required repair and replacement, respectively.

(6) The unitized insert component of the test kit (Type I and Type II) remained firmly attached to the vehicle body and, in turn, firmly secured the weapon, mount, and ammunition to the test system even though the vehicle rolled completely over during the accident.

e. The AN/VRC-10 radio remained operable at all times during the last 1,130 miles of transport of the test system.

4. ANALYSIS.

a. Based on the results of transport and firing tests and the results of the accident investigation and inspection, it is considered that with the exceptions listed in paragraph 3b above the test kit (Type I and Type II) and test system are sufficiently rugged and durable.

b. The failures of the test kit (Type I and Type II) described in paragraph 3b above, are shortcomings (ref 18, Annex A, Part III)

TEST NO 8, KIT INSTALLATION AND ORGANIZATIONAL MAINTENANCE.

1. PURPOSE. To determine:

a. The level of skill and number of man-hours required to install the test kit (Type I and Type II) and overload suspension system on the vehicle.

b. If daily crew maintenance of the test system can be readily performed.

2. METHOD.

a. During installation of the test kit (Type I and Type II) and overload suspension system, a log was maintained of the man-hours required to complete the installations.

b. The installation was performed by USAIB maintenance personnel.

c. During the conduct of this project a log was maintained of the man-hours required to perform daily crew maintenance of the test system and of any difficulty encountered in performing this maintenance.

3. RESULTS.

a. The following man-hours were required to complete installation of the test kit (Type I and Type II) and the overload suspension system on the vehicle.

<u>Component</u>	<u>Man-Hours Required</u>
(1) Overload Suspension System	5 hours 15 minutes
(2) Modification of Vehicle Body	4 hours
(3) Installation of Test Kit (Type I)	<u>20 hours</u>
SUBTOTAL29 Hours 15 minutes	
(4) Installation of Test Kit (Type II):	
(a) Radio Mount	5 hours 15 minutes
(b) Modified Ammunition Cover	<u>30 minutes</u>
TOTAL 35 man-hours.	

b. USAIB maintenance personnel who modified the vehicle body and installed the overload suspension system and test kit (Type I and Type II) are qualified to perform limited field maintenance installations and repairs.

c. Photographs depicting necessary vehicle modifications and installation of the test kit (Type I) are shown in Annex B-5, Part III.

d. A three-man crew required an average of 45 minutes daily to perform crew maintenance of the test system.

e. In attempting to change vehicle wheels, it was determined that the bolts which secure the spare wheel to the spare wheel mounting and support assembly have a 5/8-inch hexagonal head. The lug wrench provided for this purpose as part of the On Vehicle Equipment (OVE) Set is designed to fit 11/16-inch hexagonal nuts which secure the wheels to the vehicle.

4. ANALYSIS.

a. Because of the number of man-hours and level of skill required to properly modify the vehicle body and install the overload suspension system and test kit (Type I and Type II), the installation should be completed before the vehicle is issued to the user.

b. Daily maintenance of the test system can be readily performed by a trained crew.

c. The bolts provided for securing the spare wheel to the mounting and support assembly should have an 11/16-inch hexagonal head to facilitate use of the 11/16-inch lug wrench provided in the OVE set. The 5/8-inch head bolts currently provided are a shortcoming (ref 11, Annex A, Part III).

TEST NO 9. HUMAN FACTORS ENGINEERING.

1. PURPOSE. To determine if the test kit (Type I and Type II) has any features which adversely affect soldier operation of the test system or the safety and comfort of using soldiers.

2. METHOD.

a. This test was conducted concurrently with all tests. Observations were made and test soldiers instructed to report all difficulties experienced with the test system.

b. Particular emphasis was placed on determining:

(1) Fatiguing body positions or operations requiring undue physical effort.

(2) Existence of any hazards such as projections, moving parts, obstacles, etc.

(3) Compatibility of the test system with the skills and proficiency of the test soldiers.

(4) Any procedures, techniques, training requirements, or equipment peculiar to the test system.

3. RESULTS.

a. Factual Data. None.

b. Observations of Test Personnel.

(1) Although a great deal of physical effort is required to vehicularly mount and dismount the weapon and mount of the test system, crew members stated it was considerably less than that required to accomplish the same job with the control system.

(2) The spare wheel of the vehicle which is positioned on the right side of the vehicle did not interfere with the squad leader entering and exiting the vehicle.

(3) The additional leg room and equipment stowage space provided in the test system was well liked by the crew members.

(4) In the opinion of test soldiers, the test system is compatible with the skills and proficiency of the members of an average trained crew.

(5) The loader experienced difficulty in grasping the latch handles for the test kit tail gate (see Annex B-8).

(6) A requirement for a highly trained, carefully selected driver for the test system is discussed in Test No 10, Safety Confirmation.

(7) The individual rifle brackets provided as part of the test kit (Type I and Type II) were liked by the crew members since they precluded the crew having to maintain control of their rifles during transport, particularly during administrative and rough cross-country movements.

4. ANALYSIS.

a. Other than those features discussed in Test No 10, Safety Confirmation, the test kit (Type I and Type II) exhibited no features which adversely affect the operation of the test system by using soldiers.

b. Because of the simplicity and adequacy of the individual rifle brackets provided in the test kit (Type I and Type II), it is considered that they have potential application to other types of weapon adapter kits installed in either tracked or wheeled vehicles.

c. In view of the difficulty experienced by the loader in grasping the tail-gate latch handles with his bare hands, it is considered that this condition would be aggravated if the loader were wearing gloves or arctic mittens and the handles should therefore be more suitably designed. This is a shortcoming (ref 18, Annex A, Part III).

TEST NO 10. SAFETY CONFIRMATION.

1. PURPOSE. To determine:

- a. If the test system is mechanically safe to operate.
- b. Any safety limitations on the tactical employment of the test system.
- c. Actions necessary to reduce potential hazards to personnel employing the test system.

2. METHOD.

- a. DA Circular 385-3, 26 Mar 63, "Safe Operation of the Truck, Utility, 1/4-Ton, 4x4, M151," was reviewed.
- b. Test results contained in the "Second Memorandum Report of Engineering Test of the 106-mm Recoilless Rifle Mount for the Truck, Utility, 1/4-Ton, 4x4, M151," USAD&PS, 28 May 63, were reviewed.
- c. During all phases of the project a record was maintained of any occurrence or test kit feature that constituted a possible safety hazard.
- d. Immediately following the vehicle accident described in Test No 2, Compatibility of Kit/System, an accident investigation was conducted to determine contributing factors to the accident.
- e. Throughout the project crew members were periodically questioned concerning any possible safety hazards experienced by them.

3. RESULTS.

a. Factual Data.

(1) DA Circular 385-3 outlines in detail the following mechanical factors which "give the driver a different 'feel' from that to which he is accustomed on other military vehicles":

- (a) Faster acceleration.
- (b) Less weight.
- (c) Lower center of gravity.
- (d) Shorter turning radius.
- (e) Independent wheel suspension.
- (f) Less body pitch and lean.

(2) Possible limitations on the tactical use of the vehicle are also outlined in detail in DA Circular 385-3.

b. Observations of Test Personnel.

(1) During cross-country driving the raised metal frame around the seat cushion of the folding crew seats provided as part of the test kit (Type I and Type II) repeatedly struck the base of the gunner's and loader's spines.

(2) Crew members stated that on several occasions during cross-country driving, their backs were pinched between the back cushion of the folding crew seats and the metal stripping along the top of the crew seat frame.

(3) In the opinion of the test officer who investigated the vehicle accident each of the mechanical features listed in paragraph 3a above contributed in some degree to the accident. In addition it was concluded that mounting the weapon on the vehicle and the additional weight of the test kit (Type I and Type II), weapon, mount, ammunition, and crew accentuated the "different feel" experienced by the test driver when driving the test system.

(4) During cross-country driving of the test system the gunner and loader had to grasp the weapon or mount in order to prevent being bounced out of the folding crew seats.

4. DISCUSSION.

a. From visual inspection of the folding crew seats it appears that crew members could be severely injured by having the base of their spines struck by the sharp edge of the raised metal frame of the seats. This potential hazard can be eliminated by reducing the height of the metal frame below that of the seat cushion.

b. The "top heavy" condition of the control system has previously been recognized by the user as a potential safety hazard when driving the system cross-country or on slopes. This condition is accentuated in the test system because of the "different feel" which the driver experiences while driving the vehicle.

5. ANALYSIS.

a. Because of the "different feel" driving characteristics of the test system, assigned drivers must be highly trained and carefully selected. As part of this training the driver should be made thoroughly familiar with the provisions of DA Circular 385-3 and should receive an orientation or "check-out" ride in the basic vehicle before attempting to

perform as driver of the test system. Additionally , all members of the crew should remain constantly alert to changing road, terrain, and vehicle speed conditions during transport on the test system.

b. The metal frame of the crew seat must be modified to preclude injury to the gunner and loader.

c. Addition of a simple hand grip as part of the test kit (Type I and Type II) would assist in preventing the gunner and loader from being bounced out of the crew seats during cross-country transport.

d. In its present configuration the raised metal frame around the seat cushion of the folding crew seat is a deficiency (ref 18, Annex A, Part III).

e. The metal stripping along the top of the folding crew seat and the lack of a suitable hand grip for the gunner and loader are shortcomings (ref 18 and 19, Annex A, Part III).

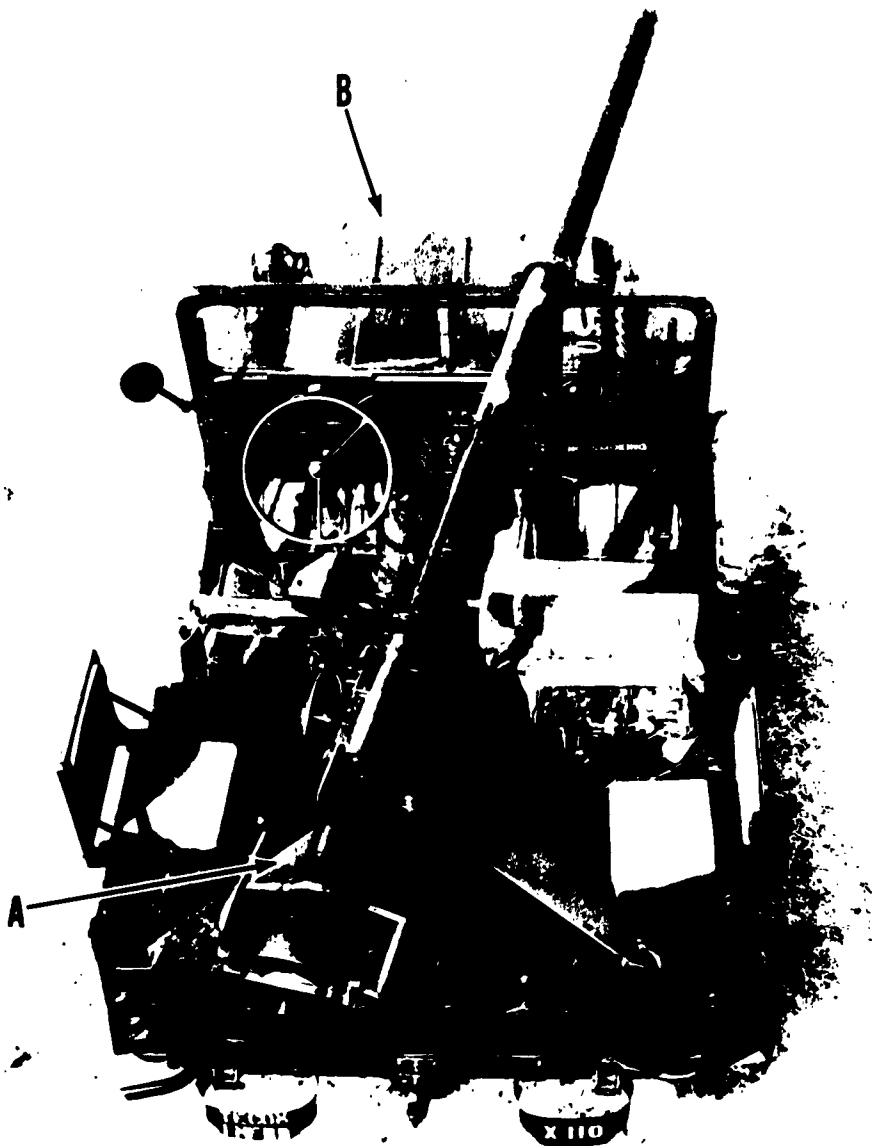
ANNEX A - REFERENCES

1. OTCM Item 34266, OCoFORD, DA, 22 May 52, subject: "TRUCK, UTILITY, 1/4-TON, 4x4, M151 -- Initiation of Project for Supplemental Development and Revision of Military Characteristics of."
2. TM 9-3058, DA, April 1955, "Caliber .50 Spotting Rifle, M8; 106-mm Rifle, M40; and 106-mm Rifle Mount, M79."
3. OTCM Item 36575, OCoFORD, DA, 11 Jul 57, subject: "TRUCK, UTILITY, 1/4-TON, 4x4, M151 - Classification as Standard Type; TRUCK, UTILITY, 1/4-TON, 4x4, M38A1 - Reclassification as Limited Standard Type; TRUCK, UTILITY, 1/4-TON, 4x4, M38A1C - Reclassification as Limited Standard Type (U)."
4. FM 23-82, DA, June 1958, "106-mm Rifle M40A1."
5. Letter, ATDEV-2 400.114, USCONARC, 18 Aug 60, subject: "Amendment of Military Characteristics of Truck, Utility, 1/4-Ton, 4x4, M151."
6. Letter, AJIIS-R, USAIS, 19 May 62, subject: "106-mm Recoilless Rifle Mounting for M151 1/4-Ton Truck."
7. Office Memorandum, USAICDA, 3 Aug 62, subject: "106-mm Recoilless Rifle Mount on M151, 1/4-Ton Truck."
8. Letter, STEBC, USAIB, 7 Aug 62, subject: "Report of Trip to Detroit Arsenal, Mobility Command, Centerline, Michigan, 1-3 August 1962 (U)."
9. Letter, STEBC, USAIB, 29 Oct 62, subject: "Report of Materiel Received."
10. Message 11-19, STEBC, USAIB, 15 Nov 62.
11. Letter, STEBC, USAIB, 19 Nov 62, subject: "Report of Equipment Failure."
12. Message 12-11, STEBC, USAIB, 12 Dec 62.
13. Message 12-14, STEBC, USAIB, 20 Dec 62.
14. Final Report, USAICDA-USAIB, 1962, subject: "A Study to Reduce the Load of the Infantry Combat Soldier."
15. Letter, STEBC, USAIB, 27 Dec 62, subject: "Report of Equipment Failure."
16. Message 00442, SMOTA-RCF.4, USATKAUTMVCEN, 11 Jan 63.

17. Letter, STEBC, USAIB, 11 Apr 63, subject: "Report of Materiel Received."

18. Letter, STEBC, USAIB, 23 Apr 63, subject: "Report of Equipment Failure."

19. Letter, STEBC, USAIB, 20 Jun 63, subject: "Report of Equipment Failure."

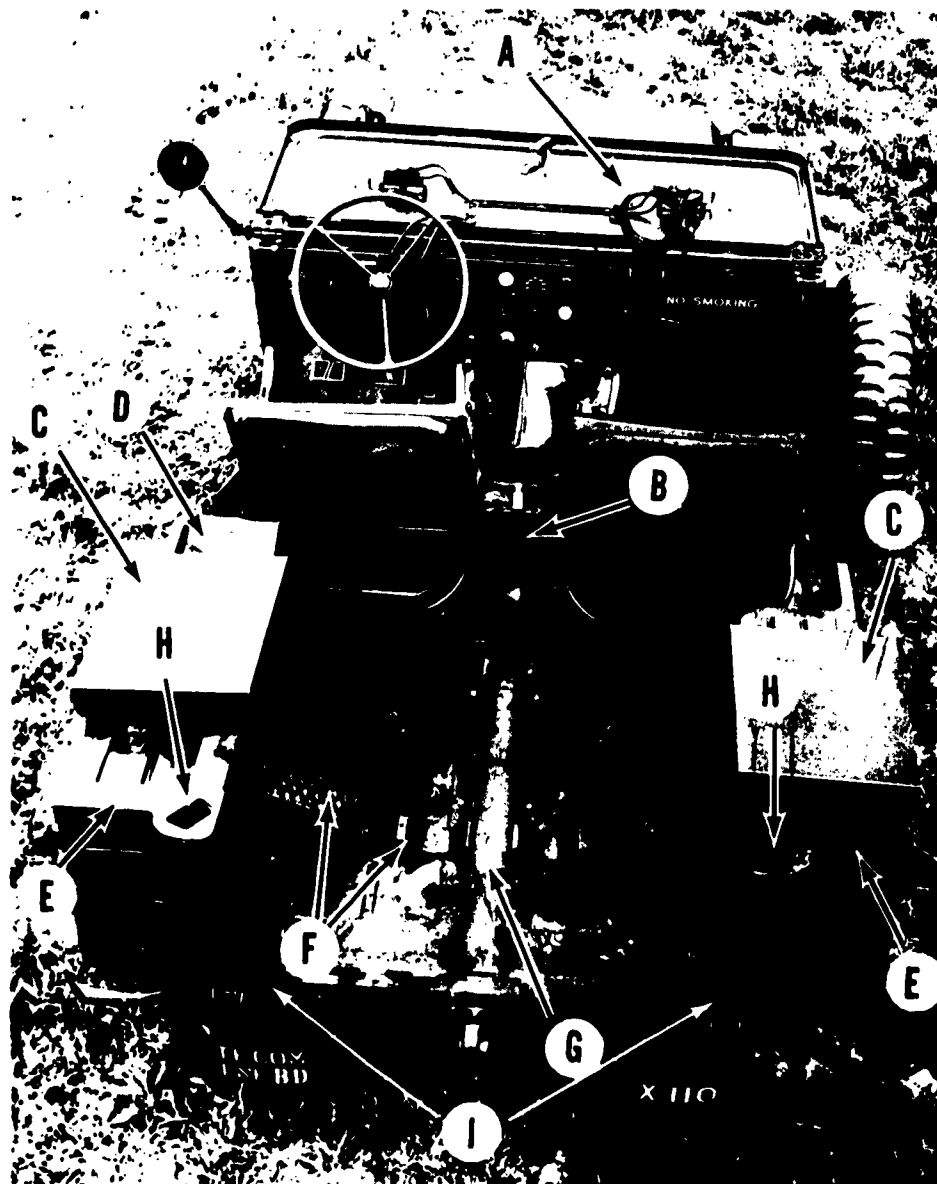


**UNITED STATES ARMY INFANTRY BOARD
FORT BENNING, GEORGIA**

**REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151**

**Photo Shows the Test System Consisting of the
Following Major Components:**

- A. Rifle, 106-mm, M40A1, on Mount, Tripod, M79.**
- B. Truck, Utility, 1/4-Ton, 4x4, M151, with
Test Kit (Type II) Installed.**



UNITED STATES ARMY INFANTRY BOARD FORT BENNING, GEORGIA

REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151

Test Kit (Type I) for Mounting the Rifle,
106-mm, M40A1, on the Truck, Utility, 1/4-Ton, M151

- A. Adjustable Travel Lock in Low Travel Position.
- B. Mount Wheel Retainer.
- C. Folding Crew Seats.
- D. Stowage Box for Spotter-Tracer Ammunition.
- E. Unitized Insert.
- F. Major Caliber Ammunition Stowage Racks and Covers.
- G. Mount Wheel Channel Guide.
- H. Mount Trail-Leg Locking Receptacles.
- I. Folding Tail Gate.

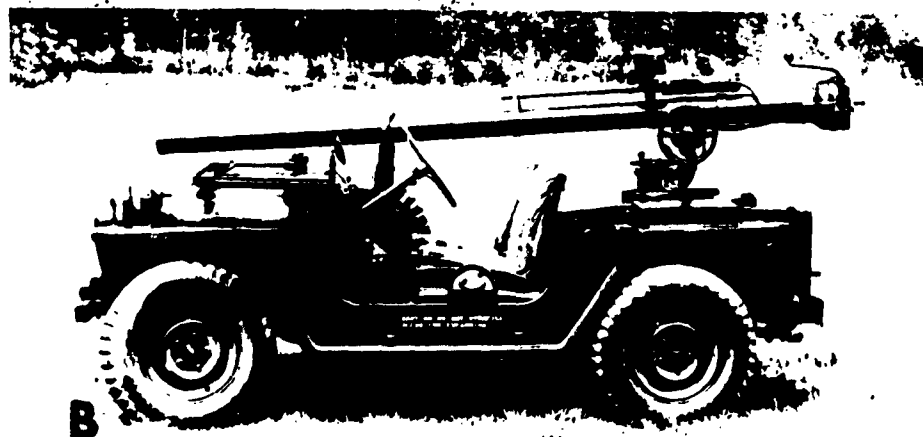


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**REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151**

**Test Kit for Mounting the Rifle, 106-mm, M40A1,
on the Truck, Utility, 1/4-Ton, M151**

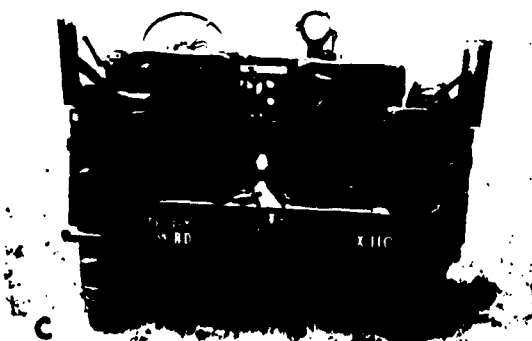
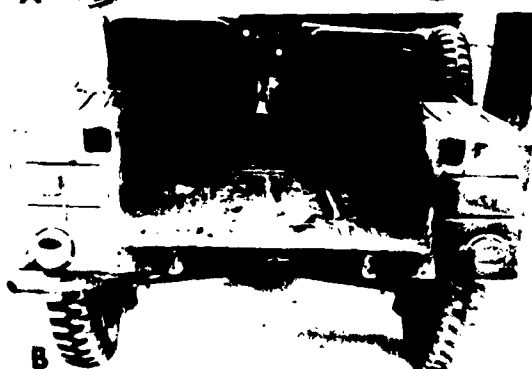
- A. Individual Rifle Bracket (Without Weapon).**
- B. Individual Rifle Bracket with Rifle in Position.**
- C. Additional Components for Type II Kit:**
 - (1) Radio Mount.**
 - (2) Modified Ammunition Cover.**



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**REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151**

- A. Test Kit (Type II) Installed on the Truck,
Utility, 1/4-Ton, M151, with Travel Lock and
Vehicle Windshield in High Travel Position.
- B. Test Kit (Type I) Installed on the Truck,
Utility, 1/4-Ton, M151, with Travel Lock and
Vehicle Windshield in Low Travel Position.



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REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
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106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151

- A. Truck, Utility, 1/4-Ton, M151 (Unmodified).
- B. Truck, Utility, 1/4-Ton, M151, Modified for Installation of the Test Kit (Type I and Type II).
- C. Truck, Utility, 1/4-Ton, M151, with the Test Kit (Type I) Installed.



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106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151**

**Photo shows Damage Caused to the Vehicle when
the Weapon was Fired at 0° Traversal (Directly
Over the Hood of the Vehicle) and -5° Depression
with Respect to the Vehicle.**

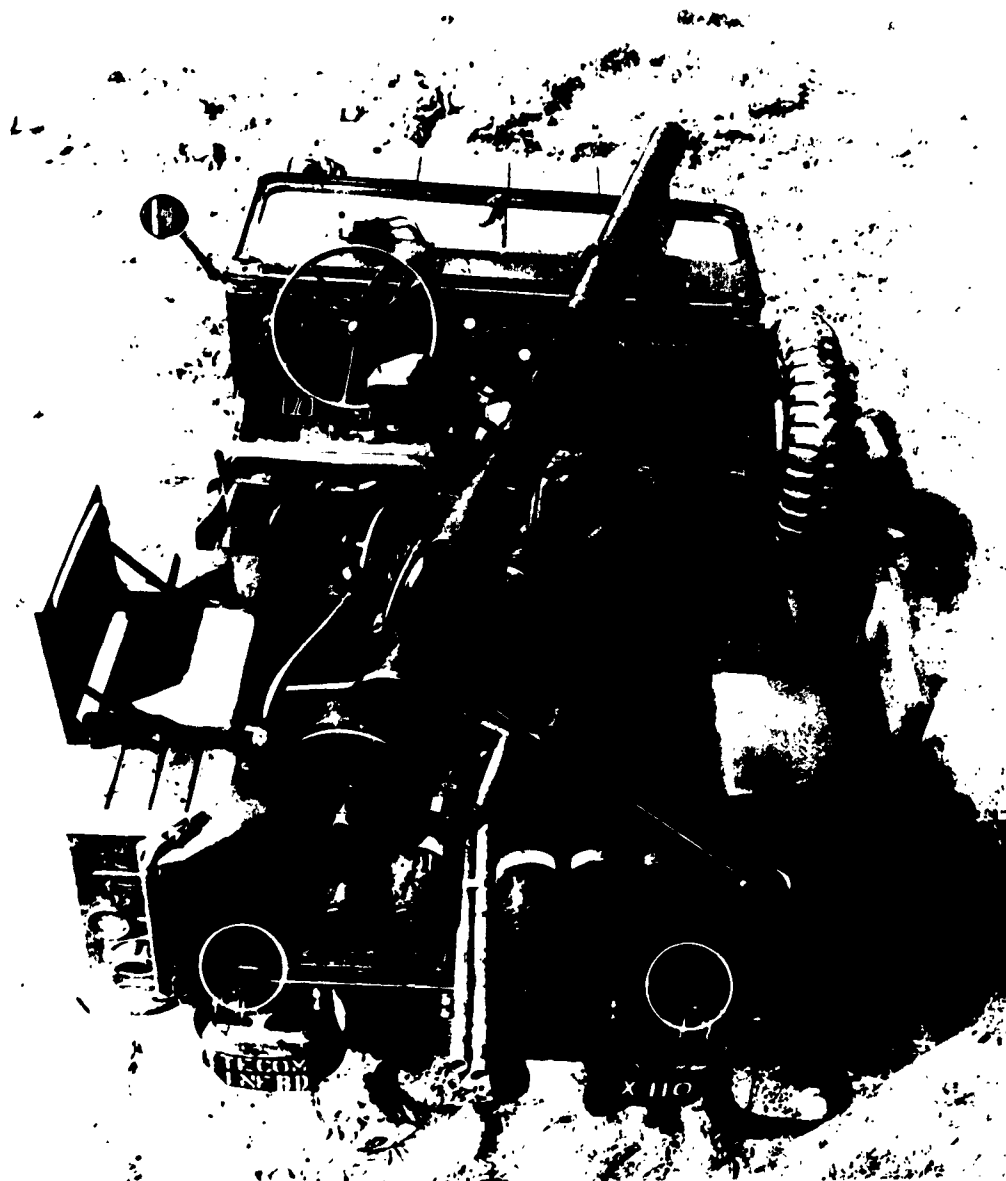


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**REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
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106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151**

**Photo shows Rifle, 120-mm XM105E1,
Mounted on the Vehicle**

Annex B-7



**UNITED STATES ARMY INFANTRY BOARD
FORT BENNING, GEORGIA**

**REPORT OF SERVICE TEST PHASE OF USATECOM PROJECT NO 8-3-4130-02,
INTEGRATED ENGINEERING/SERVICE TEST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151**

Photo Shows Tailgate Latches (Circled).

ANNEX C
DEFICIENCIES/SHORTCOMINGS

SECTION 1

This section contains deficiency requiring elimination in order to make the test item acceptable.

<u>Deficiency</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
1. The raised metal frame of the folding crew seats strikes the base of the loader's and gunner's spines during transport.	Reduce the height of the metal frame below that of the seat cushion.	USAIB Report of Equipment Failure (REF) No 9. Test No 10, Part II.

SECTION 2

This section contains shortcomings which should be corrected, if it can be done without unduly complicating the item or inducing another undesirable characteristic.

<u>Shortcomings</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
2. The bolts which secure the spare wheel to its mounting and support assembly are 5/8-inch hexagonal head while the lug wrench provided in the vehicle OVE set is designed for 11/16-inch hexagonal head.	Bolts with an 11/16-inch hexagonal head should be provided to secure the spare wheel to its mounting and support assembly.	USAIB REF No 2. Test No 8, Part II.
3. The rubber padding on the interior of the travel lock clamp separated from the clamp.	An improved method of attaching the rubber padding to the travel lock clamp should be used.	USAIB REF No 5. Test No 7, Part II.
4. An ammunition grip-pad, which prevents packaged major caliber cartridges from sliding out of the ammunition stowage racks, separated from the rack frame.	An improved method of attaching the grip-pad to the ammunition stowage rack should be used.	USAIB REF No 8. Test No 7, Part II.

<u>Shortcomings</u>	<u>Suggested Corrective Action</u>	<u>Remarks</u>
5. During transport crew members' backs were repeatedly pinched between the back cushion of the folding crew seats and the metal stripping along the top of the crew seat frames.	Eliminate the metal stripping along the top of the crew seat frames.	USAIB REF No 9. Test No 7, Part II.
6. The handle of the left tail-gate latch broke off during transport when it struck the top of the left rear bumperette.	Handles for the tail-gate latches should be made of more durable material.	USAIB REF No 10, Test No 7, Part II.
7. The handles of the tail-gate latches are difficult to grasp with the bare hand.	The tail-gate latches should be more suitably designed to provide for easier grasping by a loader wearing gloves or arctic mittens.	USAIB REF No 10. Test No 9, Part II.
8. The gunner and loader have no suitable device to grasp to prevent being bounced out of the crew seats when traveling over rough terrain.	Provide a simple grip device alongside each folding crew seat.	USAIB REF No 11. Test No 10, Part II.
9. During transport the metal stripping along the top of the loader's folding crew seat split loose from the seat frame.	Eliminate the metal stripping on both crew seats.	USAIB REF No 9. Test No 7, Part II.

(Note: Reports of Equipment Failure Nos 1, 3, 4, 6, and 7, pertained to the original prototype test kit and are not applicable to this report.)

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FINAL REPORT OF SERVICE TEST PHASE OF INTEGRATED ET/ST OF
106-MM RECOILLESS RIFLE MOUNT FOR TRUCK, 1/4-TON, M151,
DA Proj No 548-19-005. ____pp. ____photos. UNCLASSIFIED Re-
port. Tests were conducted to determine the suitability of
the test kit for Army use. The kit was compatible w/M151
vehicle, 106-mm rifle; and w/minor modifications, it was
compatible w/Rifle, 120-mm, XM105E1. It was found suitable
except for a deficiency & several shortcomings. Deficiency
occurred during cross-country driving when the metal frame
around the folding crew seats repeatedly struck base of crew
members' spines. This was considered a potential safety
hazard. It was concluded that after modification to elimi-
nate deficiency and shortcomings as feasible, the test kit
would be suitable for Army use. It was recommended that a
visual inspection be performed by USAIB to verify the re-
quired modifications in lieu of conducting a Check Test.

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