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ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96243

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BAR ARMOR KIT
(M113) (U)

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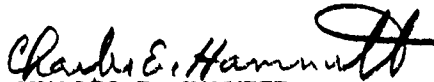
REPORT EVALUATION BY DIRECTOR, JRATA

The inconclusive findings as regards to the capability of the Bar Armor to defeat enemy 57mm and 75mm HEAT rounds is normal to testing in a combat environment and should not be weighed against the Bar Armor concept. More significant to this evaluation is the restrictions imposed on the M-113 as a result of increased size. Restrictions on bridge access and maneuvering within areas such as rubber plantations reduces the combat effectiveness and utility of the M-113. These restrictions probably more than offset the advantage of increased protection provided by the Bar Armor Kit in its present configuration.

I concur with the recommendations of this report.

Approved:

15 September 1966


CHARLES E. HAMMETT
Colonel, USAF
Acting Director, JRATA

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ARMY CONCEPT TEAM IN VIETNAM
APO San Francisco 96243

FINAL REPORT

**BAR ARMOR KIT
(M113) (U)**

JRATA Project No. 1B-172.0

31 August 1966

Approved:

Merrill J. Hatch

MERRILL G. HATCH
Colonel, Artillery
Chief

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SUMMARY

Bolt-on uparmoring kits fashioned from rods and bars designed for the M113 armored personnel carrier in such a way as to detonate a HEAT round before the full force of the jet strikes the APC body were evaluated in combat operations in the Republic of Vietnam. An increase in width and length of APC's equipped with bar armor kits restricted movement across bridges, canals, and plantation areas that would normally be accessible to the standard APC. No actual combat data were obtained on the capability of the kits to defeat HEAT rounds because the test vehicles were not fired on. Kits were vulnerable to damage from vibration and from hitting obstacles.

It is recommended that, because of their design deficiencies, bar armor kits not be employed in Vietnam.

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APO San Francisco 96243

ACTIV-GCD

31 August 1966

BAR ARMOR KIT (M113) (U)

1. (U) REFERENCES.

- a. Letter, Headquarters USAMC, 7 October 1964, subject: Feasibility of Uparmoring the M113 Armored Personnel Carrier (APC).
- b. Letter, Chief ACTIV, 1 July 1965, subject: Armor Protection Kit for the M113 Armored Personnel Carrier.
- c. Message, USAMC 8-2007, subject: Shipment of Armor Kits for M113, dated 25 August 1965.
- d. BRL Memorandum Report 1725, dated December 1965.

2. (U) AUTHORITY.

Letter, AGAM-P(M) (17 Jul 64) ACSFOR, DA, 31 July 1964, subject: Army Troop Test Program in Vietnam (U), as amended. CINCPAC Message, DTG 050541Z January 1966.

3. (U) PURPOSE

The purpose of this evaluation was to determine the suitability of a bar armor kit for the M113 and to recommend a basis of issue.

4. (C) BACKGROUND

The Viet Cong (VC) insurgents operating in the Republic of Vietnam (RVN) use 57mm and 75mm recoilless rifles in addition to rocket launchers. The rocket launchers include 2.36 inch and 3.5 inch US models and the Russian 82mm model.

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These weapons fire high explosive anti-tank (HEAT) ammunition that has been effective in penetrating the aluminum armor of the M113 armored personnel carriers (APC) used by the Army of the Republic of Vietnam (ARVN) armored cavalry squadrons.

In July 1964, the United States Army Materiel Command (USAMC) investigated the feasibility of uparmoring the M113 to defeat 57mm and 75mm HEAT ammunition. Recommendations were made against this uparmoring by USAMC but the problem continued to be investigated by the Ballistic Research Laboratory (BRL)...

In April 1965, after exhaustive tests as to its effectiveness and suitability, BRL recommended that panels of bar armor be fabricated in test quantities for evaluation as a solution to defeating the HEAT ammunition (see Ref 1d).

The US Army Tank Automotive Center (USATAC) then fabricated a prototype bar armor kit, demonstrating the feasibility of the concept, and in July 1965, the Army Concept Team in Vietnam (ACTIV) requested a quantity of the bar armor kits be shipped to Vietnam for evaluation.

USAMC approved the production of an evaluation quantity of eight bar armor kits and they were shipped to Vietnam on 20 August 1965.

Seven bar armor kits were installed on M113 armored personnel carriers and one on a M132 mechanized flamethrower (M113 basic chassis) by the 80th Ordnance Rebuild Base Depot (80th ORBD), between 8 October 1965 and 16 December 1965.

The seven M113's with bar armor kits were issued to the 10th Armored Cavalry Squadron for evaluation. The tactical area of responsibility for the 10th Armored Cavalry Squadron during the period of the evaluation included a heavily jungled area of Tay Ninh Province; Long An Province, which has a network of small streams and canals; and the rice paddy and rubber plantation areas of Hau Nghia Province, which was the principal area of operations.

The kit installed on the M132 remained at the 80th ORBD for a considerable period of time because of technical difficulties concerning the flamethrower and, as a result, was not evaluated. However, since the conclusion of the evaluation period, the M132 has been employed in combat operations. ACTIV will continue to monitor the use of this vehicle.

Records maintained by the 80th ORBD indicate that approximately 105 man hours were required to install each bar armor kit. The bar armor kits were evaluated from 15 January through 15 April 1966.

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5. (C) DISCUSSION

a. Objective 1 - Protection Capability

"Determine if the bar armor kit is effective in defeating the 57mm and 75mm HEAT ammunition used by the VC."

The 10th Armored Cavalry Squadron engaged in approximately 36 combat operations during the evaluation. The majority of these operations were road security, vehicle convoy security, and static blocking positions in conjunction with search and destroy missions in which contact with the VC occurred on 10 occasions. These contacts were apparently limited to small arms fire and sniper fire and the bar armor kits were not hit by 57mm or 75mm HEAT rounds. The flotation boxes and the side grille frames received some minor damage as a result of the small arms fire.

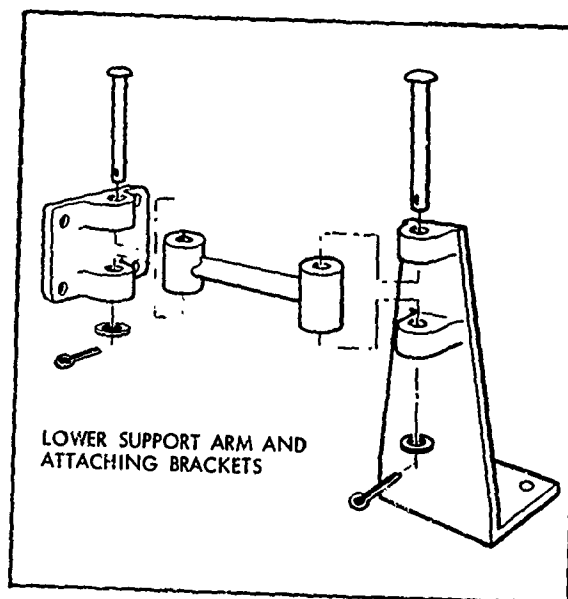
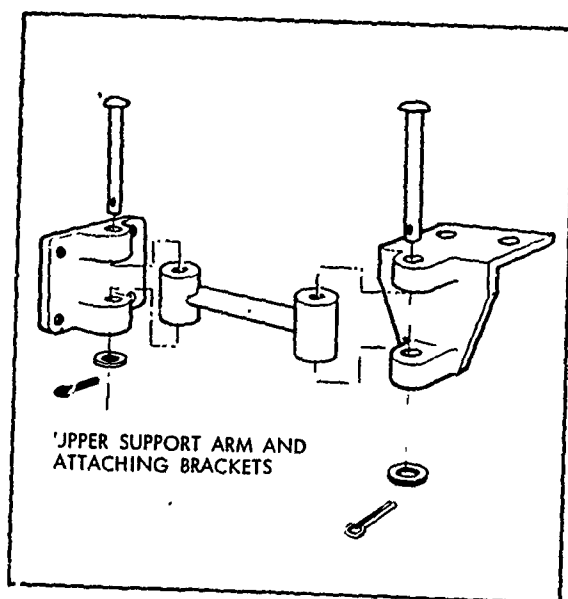
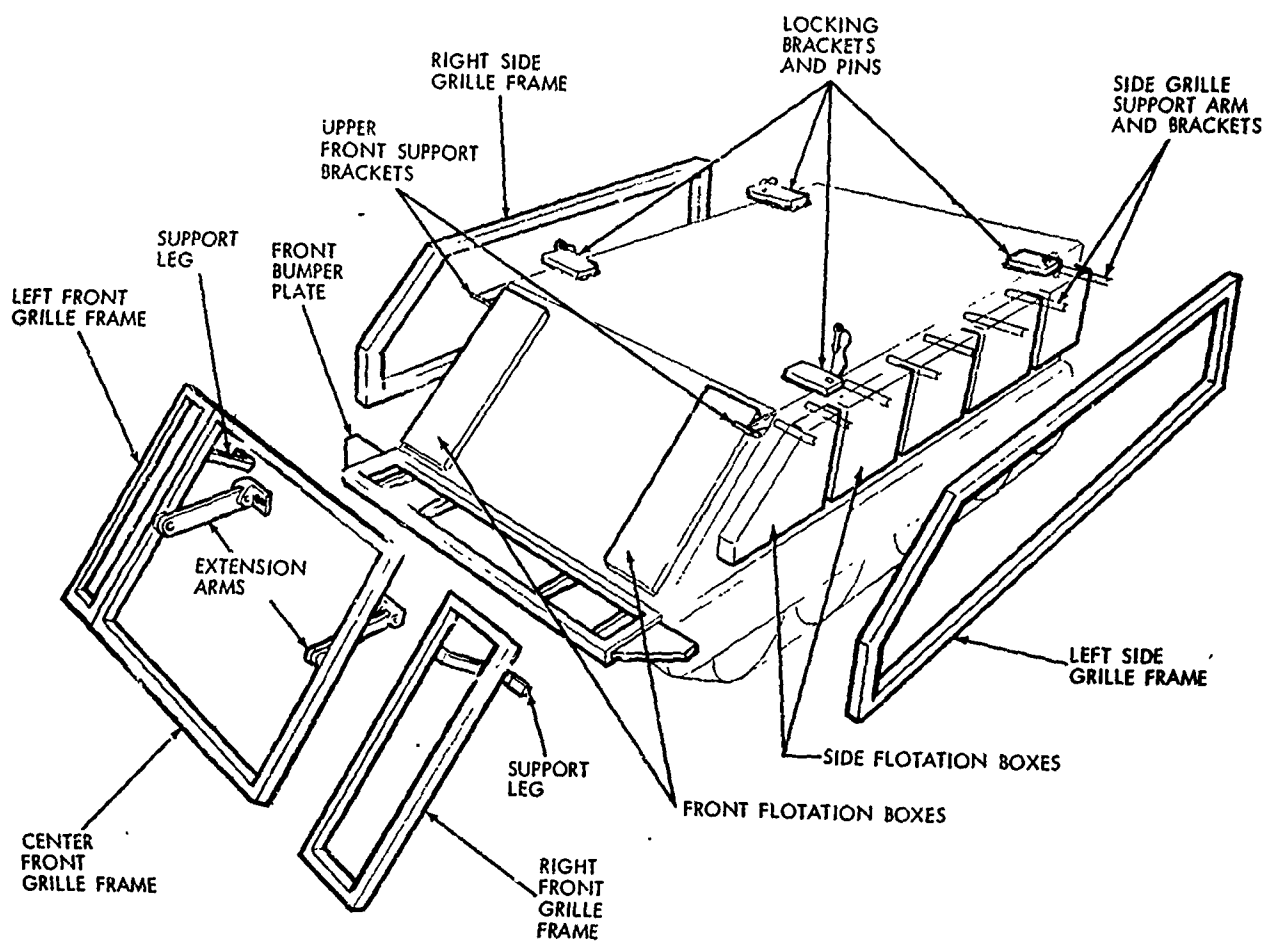
b. Objective 2 - Effect on Performance of the M113

"Determine if the weight or physical characteristics of the bar armor kit degrade the performance of the M113 and determine if the bar armor restricts the mobility of the M113."

The bar armor kit as presently designed for the M113 APC is cumbersome and bulky. (See figure 1.) The center front grille frame extends approximately 14 inches in front of the leading edge of the vehicle. This requires the driver to approach a ditch with much more caution and at a slower speed than he would without the kit to be sure that the center front grille frame does not strike the bank before the tracks can grip the soil. If the center front grille frame strikes the bottom of the ditch, even at very slow speeds, the grille will bend and the front bumper plate support brackets may crack. If the grille is bent, the J bolts either snap off or become loose and the grille bars fall out.

The width of a M113 APC without a bar armor kit installed is 105-3/4 inches. Minimum width, less the track shroud is 100 inches. An M113 equipped with a bar armor kit in the unextended position is 112 inches wide. This increase in width becomes a factor limiting performance because of the width of the Bailey-type bridges found on the primary and secondary road nets in Vietnam. On two occasions during the evaluation period, vehicles with bar armor kits could not cross Bailey-type bridges in the area of tactical operations because the bridges were not wide enough. Since these bridges have elevated steel sidings, there is no way to overcome the problem of the width of the bridge, such as there might be on a bridge with no sidings, where the track of the vehicle could extend beyond the edge of the bridge roadway.

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(U) FIGURE 1. Major kit components.

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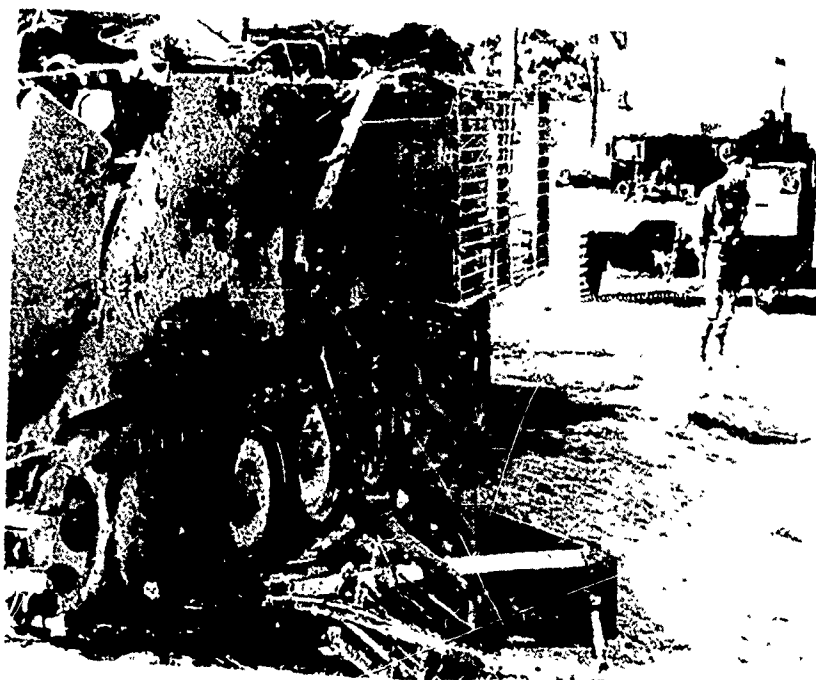
The bridges found on primary roads are usually wide enough to accept the vehicles with bar armor kits but bridges on secondary roads are smaller and narrower and have been repaired frequently. It is not uncommon to see normal M113 APC's with scrape marks extending the length of the vehicle. By-passing these narrow bridges is not an acceptable solution for two reasons. First, many times the banks of the streams are too steep or the speed of the water is excessive. Second, the time it would take to find and clear a fording site for vehicles with bar armor kits might jeopardize the accomplishment of the unit tactical mission.

When the left and right side grille frames are extended, each frame is approximately 14 inches from the side of the vehicle, which increases the overall width of the vehicle to approximately 128 inches. This additional width does not cause any loss of mobility in open terrain but, when the M113 is operating in high grass or rubber plantations, the driver must look not only to the front for obstacles but must also watch for obstacles that could strike the grille frames. Turning from one lane to another within the rubber plantation is more difficult and must be done at slow speed because of the width of the vehicle and the danger of damaging the grille frames by striking rubber trees.

During the evaluation no opportunity for deep water swimming presented itself, so a separate test was made. One of the bar armor kits was damaged when the vehicle on which it was mounted struck an anti-tank mine. (See figure 2.) The right side grille frame and flotation boxes were repaired and replaced by the 80th ORBD. Records indicate that 105 man-hours were required to repair the kit. Because this was a major repair of the kit, a swimming test was conducted to insure that the vehicle could swim with the repaired kit. The vehicle entered the water with no difficulty and maneuvered freely. It was slightly nose heavy but there was no loss of swim capability.

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(U) FIGURE 2. Damage to bar armor kit by mine of undetermined size.

Since the conclusion of the evaluation period, two additional vehicles with bar armor kits and firing observation ports have been received by ACTIV. Initially, these two vehicles were assigned to the 2nd Armored Cavalry Squadron located in the Delta area of Vietnam. It was necessary, however, for the commander of the unit to have the bar armor kits removed so that he could cross the bridges located in his tactical area of operations. As a result, the vehicles were reassigned to the 1st Cavalry Squadron in the II Corps area north of Saigon.

c. Objective 3 - Equipment Faults

"Determine if the bar armor kit has any deficiencies, shortcomings, or limitations which may degrade its capability."

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(1) Deficiencies

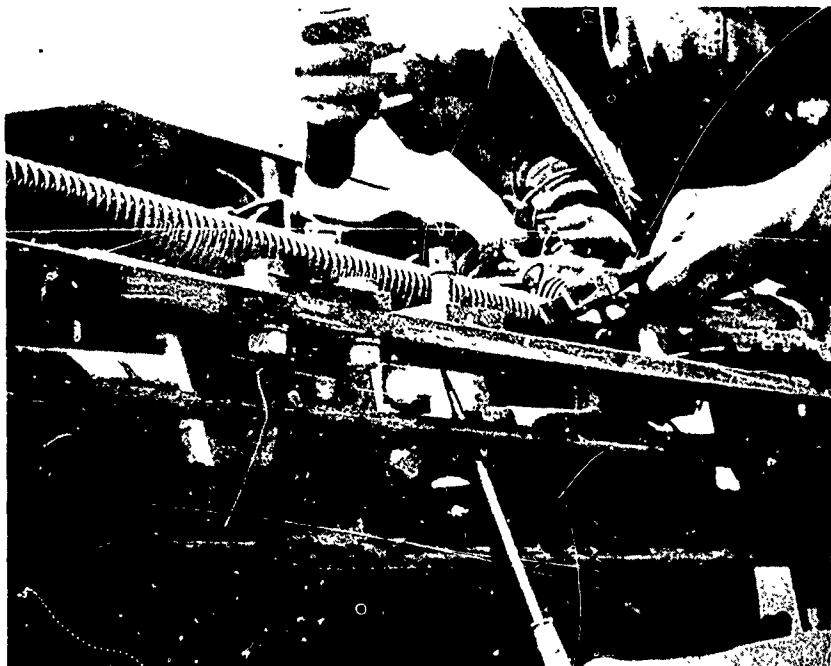
During the evaluation of the bar armor kits, no equipment deficiencies were apparent.

(2) Shortcomings

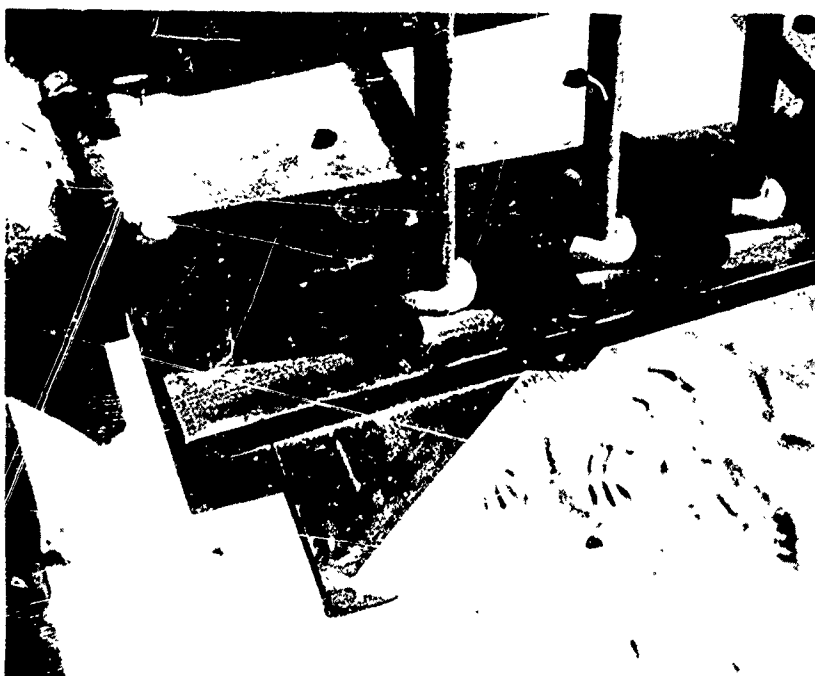
The following shortcomings were noted during the evaluation:

- (a) Locking Bracket Pins. The locking bracket pins seize in the locking bracket and are difficult to remove in order to extend the side grille frame. (See figure 3.) The cause of this shortcoming appears to be twofold: first, the accumulation of dirt and moisture in the locking bracket hole; second, misalignment of the side grille frame in relation to the locking bracket, caused by vibration and impact during normal operation of the vehicle.
- (b) Front Bumper Plates. If the front bumper plates strike an obstacle they have a tendency to shear their retaining bolts and freeze in a partially retracted position. (See figure 4.)
- (c) Front Bumper Plate Support Bracket. The front bumper plate support bracket develops cracks at the point where it is bolted to the hull of the vehicle. These cracks are caused both by vibration and impact of the front bumper against obstacles. (See figure 5.)
- (d) J-Bolts. The J-bolt nuts which secure the J-bolt and the steel bars to the grille frames become loose because of vibration of the kit during normal cross-country operation. Considering that there are 424 J-bolts, an excessive amount of crew maintenance is required to keep the J-bolts and nuts secure.

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(U) FIGURE 3. Removal of locking pin from side grille frame locking bracket



(U) FIGURE 4. Jammed front bumper plate in partially extended position.

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(U) FIGURE 5. Cracked front bumper plate support bracket.

(3) Limitations

As pointed out above, the only combat damage incurred to the bar armor kit-equipped APC's during the evaluation was the destruction of the right grille frame by an anti-tank mine under the right track and minor damage to the floating boxes as a result of small arms fire. The damage described below, listed by vehicle number, is a result of normal operational movement of the vehicles both cross-country and on dirt surface roads. The damage is cumulative because the vehicles could not be withdrawn from combat operations in order to make repairs as damage occurred. The damage occurred between 15 January and 1 March 1966.

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APC USA No. 80945

- (a) Front bumper plate support bracket - cracked.
- (b) Right front bumper plate - missing.
- (c) Right upper support arms - broken (figure 6).

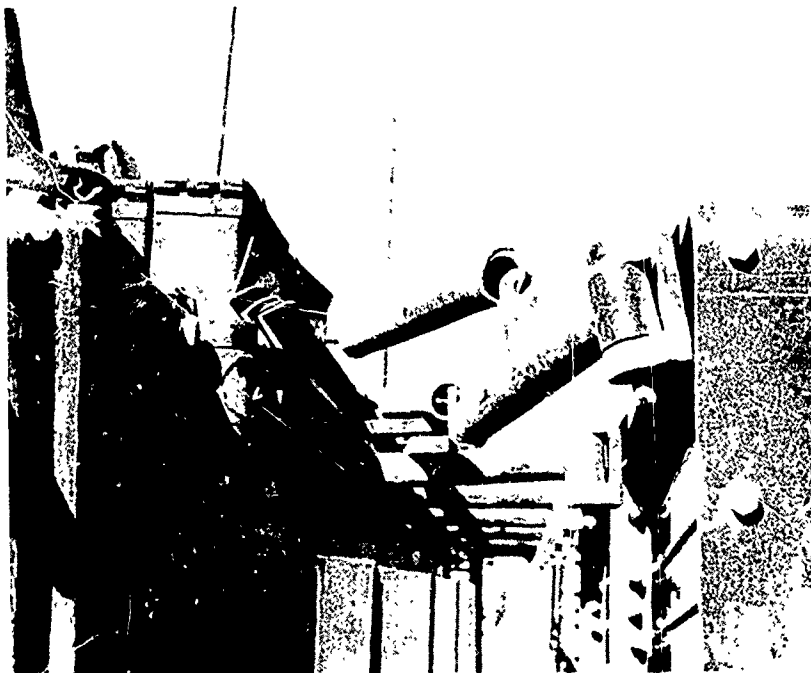
APC USA No. 81185

- (a) Front bumper plate support bracket - cracked.
- (b) Side grille frame locking pin - missing.
- (c) Lower support arms, right side - broken (figure 7).
- (d) Right side grille frame - bent (figure 8).

APC USA No. 80952

- (a) Front bumper plate support bracket - cracked.
- (b) Side grille frame mounting brackets - cracked.
- (c) Right center grille frame extension arm - broken.
- (d) Right front bumper plate - jammed.

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(U) FIGURE 6. Broken upper support arms.



(U) FIGURE 7. Broken lower support arms.

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(U) FIGURE 8. Bent right side grille frame.

APC USA No. 81722

- (a) Center front grille frame - bent (figure 9).
- (b) Left side grille frame - bent.
- (c) Front bumper plate support bracket - cracked.
- (d) Upper and lower left support arms - broken.

APC USA No. 80951

- (a) Front mounting brackets - cracked.

APC USA No. 81264

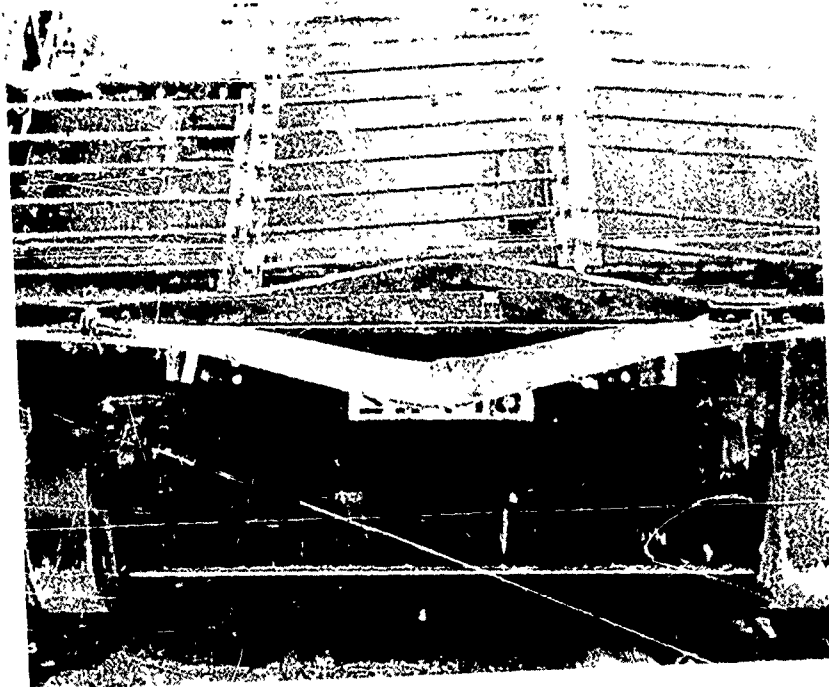
- (a) Left side grille frame - bent.
- (b) Left and right side grille support arms - broken.

APC USA No. 80947

- (a) Left and right grille support arms - broken.
- (b) Left and right front bumper plate - jammed.

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(U) FIGURE 9. Bent center front grille frame.

At the conclusion of the evaluation period all of the M113s with bar armor kits installed were operational but with damage to the kits as described above. An inspection team from the 80th ORBD visited the 10th Armored Cavalry Squadron to determine the extent of damage to the armor kits. Listed below is an estimate of the man-hours required for repair of the kits:

<u>Vehicle No.</u>	<u>Type of Damage</u>	<u>Est. Man-Hours</u>
80945	Non-combat	45
80947	Non-combat	40
80951	Non-combat	2
80952	Small arms fire damage and non-combat	20
81185	Non-combat	80
81264	Non Combat	10
81722	Non-combat	65
TOTAL		<u>262</u>

d. Objective 4 - Requirement

"Recommend what the basis of issue should be for ARVN units."

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Since the bar armor kits were not hit by 57mm or 75mm HEAT rounds during the evaluation, and in view of the damage to the kits by tactical movement, there is no foundation in data or professional judgement upon which to base a recommended basis of issue.

6. (C) FINDINGS

a. Because of the lack of frequent enemy contact during the evaluation, and the fact that when contact was made enemy fire was limited to small arms, no determination could be made as to the protection capability of the bar armor kit against attack by 57mm or 75mm HEAT rounds.

b. The increase in overall width of the M113 with a bar armor kit installed degrades the performance of the vehicle by requiring the driver to drive slowly and cautiously in an effort to minimize damage to the front and side grille frames which would be caused by striking obstacles to the front or sides of the vehicles.

c. The bar armor kit is subject to damage from normal vehicle vibration during cross-country movement and the front and side grille frames cannot withstand impact with obstacles that otherwise do not affect the movement or combat capability of the M113 APC.

7. (C) CONCLUSIONS

a. Because the bar armor kits were not hit by 57mm or 75mm HEAT rounds, no valid conclusions can be arrived at as to the capability of the kit to defeat these weapons.

b. The bar armor kit as presently designed and constructed is not durable enough for combat operations in Vietnam.

8. (C) RECOMMENDATION

It is recommended that the bar armor kit for the M113 armored personnel carrier not be made an item of issue for ARVN or US units in Vietnam.

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11. SUPPLEMENTARY NOTES None	12. SPONSORING MILITARY ACTIVITY Combat Developments Command Fort Belvoir, Virginia	
13. ABSTRACT Bolt-on kits constructed of iron bars strung on iron frames were produced to uparmor the M113 armored personnel carrier to defeat 57 and 75 mm HEAT rounds in combat operations in the Republic of Vietnam. The kits were not struck by HEAT rounds during the evaluation. Even though armoring capability of the kits was not obtained, it was determined that the kits were not suitable for combat operations in Vietnam because they were not durable enough. (C)		

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There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

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