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# EVALUATION OF ALTERNATIVE CONCEPTS FOR REMOTE FEEDING

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13. ABSTRACT (Maximum 200 words) Rations, heating devices, and food service equipment proposed for Army Field Feeding System (AFFS) were evaluated at Fort Carson, CO with 4 units of the 4th Mechanized Infantry Division from 10-20 April 1989. Data were collected through questionnaires, focus groups (moderated group discussions), and structured interviews. Results show the Mounted Ration Heating Device (MRHD) was the best liked of the heating devices due to its convenience and versatility. The Zesto Therm (ZT) Energy Pads heated the rations faster and were especially acceptable to dismounted soldiers. The MORE (Meal, Operational, Ready-to-Eat), which included commercial items, was well liked and a morale booster. The MRE Supplemental Pack's new items were a welcome addition. The response to the T Rations was not favorable, due in part to cool serving and eating temperatures and lack of variety. The focus groups supported the findings from the questionnaires and contributed significantly to the understanding of the troops' usage of the items. The combination of methods allowed a more thorough evaluation. Food service equipment was evaluated by cooks and senior food service personnel and was rated well. Recommendations were made for adjustments. It was also recommended that future studies on feeding concepts should evaluate fewer items at once, to simplify test logistics.			
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## PREFACE

The objective of this field evaluation was to provide the data required for the U. S. Army to assess proposed improvements to the Army Field Feeding System. These improvements included enhancements to both operational rations and food service equipment.

## ACKNOWLEDGEMENTS

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EVALUATION OF ALTERNATIVE CONCEPTS  
FOR REMOTE FEEDING

INTRODUCTION

1. Background Information.

The recent experience with the Army Field Feeding System (AFFS) during training exercises in Germany (Reforger 88) has intensified senior Army leadership's interest in near-term improvements to field feeding. Several such improvements were outlined in a message from MG McLean, Quartermaster School, dated 10 Nov 1988. A Joint Working Group meeting<sup>(1)</sup> further addressed the specific steps to be undertaken as part of a coordinated strategy to evaluate proposed improvements.

Improvements under consideration include enhancements to food service equipment and operational rations and are designed primarily to enhance AFFS' capability to provide highly-acceptable hot meals to troops at remote sites. One of the feeding problems during Reforger 88, and similar training exercises, has been providing hot food to soldiers who cannot

receive their meals at a company or battalion-level consolidated feeding point. This includes soldiers in tanks, foxholes, or remote areas. Laboratory research<sup>(2)</sup> has shown that serving temperature affects the acceptability of foods and beverages and the importance of a hot meal for morale has often been cited. In addition, the frequent inability of soldiers in the field to heat their Meal, Ready-to-Eat (MRE) operational rations, due to tactical constraints or lack of heating equipment, may account in part for the reduced consumption of that ration that has been observed in field studies.<sup>(3)</sup> Consequently, the possibilities of increasing the likelihood of troops receiving a hot meal need to be explored.

The purpose of the evaluation reported here was to identify any problems in concept, design, or operation of the proposed improvements of the AFFS. The evaluation was not designed to prove the effectiveness of any improvements nor are the results intended to serve as the basis for implementing changes to the system. Subsequent studies will need to be conducted to quantify the effectiveness of alternative improvements and to recommend the most preferred solutions.

## 2. Items Evaluated.

The items evaluated can be divided into two categories: individual rations and heating devices, and food service

equipment. A brief description of the items follows.

Individual Rations and Heating Equipment:

a. Meal, Operational, Ready-to-Eat (MORE). The concept of the MORE is that of an individually packaged meal to be consumed in place of the T Ration by remotely located troops. Field experience indicates that current methods of remote feeding using T Rations fail to regularly deliver a hot meal to the soldier. The MORE addresses this problem by including a heating device with the individual meal.

Although the identity of the particular components of the MORE is subject to change in the future, a "surrogate" version was used for this evaluation. This version consists of an MRE VIII with the following modifications:

The MRE entree was replaced by a Hormel<sup>R</sup> Top Shelf<sup>R</sup> entree from a line of shelf-stable single serving entrees, which are currently in test market.

The dehydrated fruit was replaced by a Del Monte<sup>R</sup> single serving fruit cup or pudding.

The crackers were replaced by the MRE pouch bread.

A Zesto Therm chemical heating device (see below) was included for heating the entree.

b. Zesto Therm (ZT) Energy Pads. The ZT pads were developed by Natick and are available commercially. In this evaluation, ZT pads were provided as a means of heating both the Top Shelf<sup>R</sup> entree and the MRE entree. To heat an entree, one or two ZT pads are placed inside a bag together with the entree; a small amount of water is then added to trigger an exothermic electrochemical reaction.

c. Mounted Ration Heating Device (MRHD). (Figure 1) The MRHD is a bag with individual compartments in which MRE or Top Shelf<sup>R</sup> entrees can be heated. The bag is operated by connecting it to a vehicle's electrical system through an auxiliary power receptacle. The MRHD can also be used to heat water in a plastic ziploc bag. Two versions of the MRHD were evaluated: a fabric version and a plastic one. The fabric version uses a thermostatically controlled element for rapid heat transfer. The plastic version is cheaper to produce and uses a self-regulating, semi-conductive heating element for slower, but more controlled, heating.

d. Canteen Cup Stand (CCS). The CCS is designed to facilitate the use of the canteen cup for heating water, either for a beverage or as a medium to heat an MRE entree. To heat water, the CCS is placed on the ground or some other surface and a heat tab (trioxane tablet) is placed inside the stand. The canteen cup rests on the stand, approximately 3in above the burning

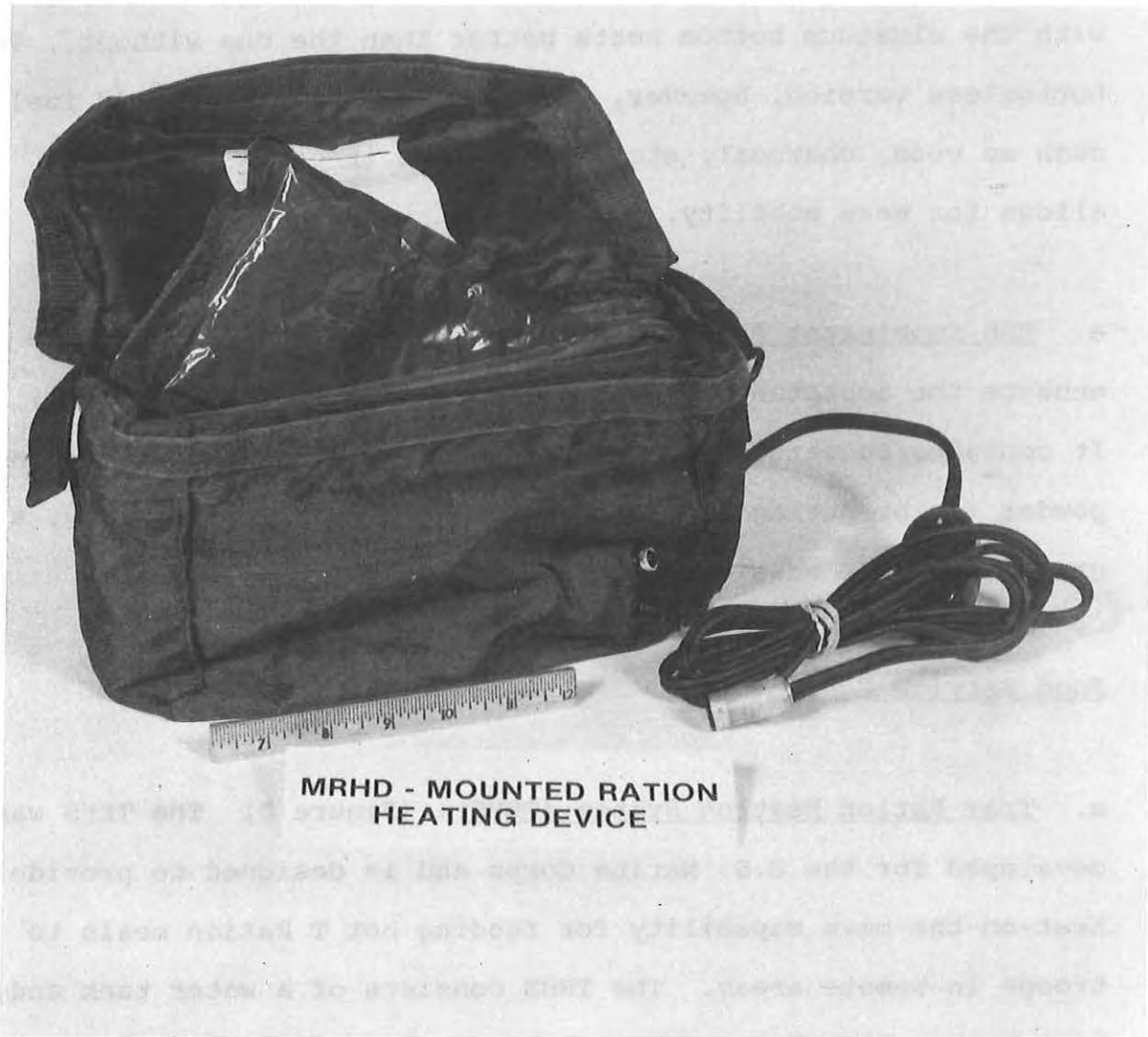


Figure 1. Mounted Ration Heating Device (MRHD)

tab. Two versions of the CCS, differing somewhat in design, were evaluated. One version had an aluminum bottom, the other version had none. Laboratory tests have shown that the version with the aluminum bottom heats better than the one without. The bottomless version, however, can be heated by other solid fuels such as wood, charcoal, etc., and, since it cools quicker, allows for more mobility.

e. MRE Supplement Pack. The MRE Supplement Pack is intended to enhance the acceptability of MRE procurements IV through VII. It contains commercial candy, hot sauce, pouch bread, a beverage powder for preparing a cold beverage, and either beef jerky, a granola bar, or raisin-nut trail mix.

#### Food Service Equipment:

a. Tray Ration Heating System (TRHS). (Figure 2) The TRHS was developed for the U.S. Marine Corps and is designed to provide a heat-on-the-move capability for feeding hot T Ration meals to troops in remote areas. The TRHS consists of a water tank and heater assembly that can be mounted on a vehicle, permitting Tray Packs to be kept hot as the vehicle is moved to different locations.

b. Karcher Kitchen. (Figure 3) The Karcher Tactical Field Kitchen (TFK), produced in West Germany, was included in this evaluation



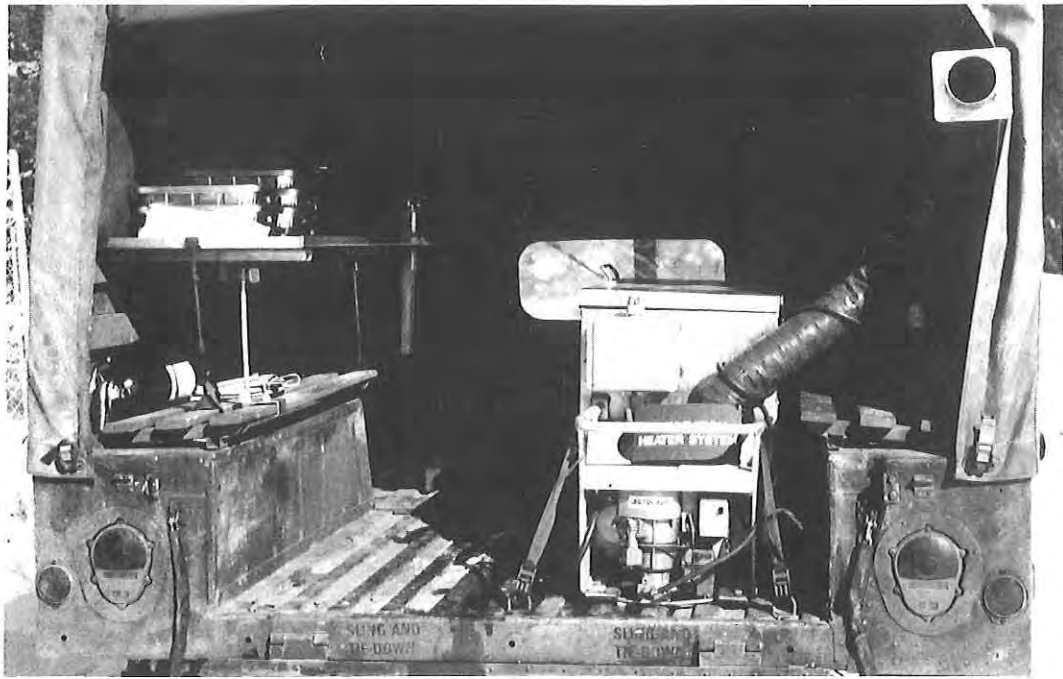


Figure 2. Tray Ration Heating System



Figure 3. Kitchen Company Level

because it represents a potential alternative to the Mobile Kitchen Trailer (MKT). Some of its features could also be incorporated in future modifications of the MKT or into the new developmental High Mobility Kitchen (HMK).

(Figure 3)

c. Kitchen, Company Level (KCL). The KCL provides the facility for heating T Rations. The heater tank will accommodate 20 tray packs in 20 gal of boiling water and will heat them to 165°F in 45 minutes.

d. Individual T-Ration Insulated Containers. (Figure 4) The individual containers are designed to hold single T Rations at serving temperature prior to opening the T Ration or between servings.

e. Miscellaneous Food Service Items. Other food service items included in this evaluation were plastic liners for the Mermite inserts (Figure 5) and different types of hand-held can openers for opening T Rations at remote sites. The purpose of the plastic liners is to reduce the amount of clean-up following use of the Mermite containers.

## METHODOLOGY

### 1. Evaluation Design.



Figure 4. Individual T Ration Insulated Containers

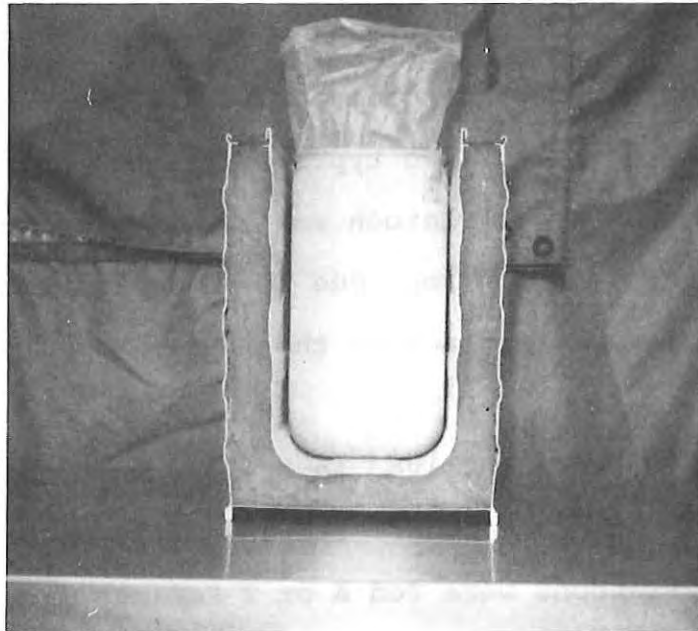


Figure 5. Mermite with liner

The evaluation was conducted with units of the 4th Mechanized Infantry Division, Ft. Carson, CO. The evaluation was conducted at Ft. Carson when the units were participating in a scheduled field exercise. During the week of April 3, 1989, the units were briefed by Natick personnel on the use of individual heating devices, and food service personnel were trained on the operation of the food service equipment. The units were provided the items for evaluation during the period April 10-14 and April 17-20. During the intervening weekend, troops returned from the field to garrison.

Four test units were assigned the combinations of individual heating devices and rations shown in Table 1. Each test group consisted of one platoon, except in the case of the Artillery group, where a battery (two platoons) was the test unit. Each group received an A Ration breakfast each day (frequently served as the midday meal). The remainder of the meals consisted of T Rations, MOREs or MREs. Two types of MREs were issued: MRE VII or MRE VIII. The Armor Platoon was intended to receive the MORE in place of the T Ration; but due to an administrative error, the MORE was issued in place of the MRE.

Three mess teams were involved in the operation of the food service equipment. The Mechanized Infantry, Armor and Headquarters Platoons were fed A or T Rations from the Karcher Kitchen, MKT or KCL. The T Rations for the Artillery Battery were served using the TRHS.

Table 1. Assignment of Operational Rations  
and Heating Devices to Test Units

MECHANIZED INFANTRY PLT

-A RATION  
-MORE  
W/ZESTO-THERM  
-MRE VIII W/ZESTO-  
THERM  
-MRHD (FABRIC)  
-CCS (WITH BOTTOM)  
  
-KARCHER

ARMOR PLT

-A RATION  
-T RATION  
MORE W/  
ZESTO-THERM  
-MRE SUPPLEMENT PACK  
-MRHD (PLASTIC)  
-CCS (WITH BOTTOM)

ARTILLERY BTRY

-A RATION  
-T RATION  
-MRE VIII  
-TRHS  
-MRHD (1ST PLT=FABRIC, 2ND PLT=PLASTI  
-CCS (W/O BOTTOM)  
-BLACK HANDLE CAN-OPENER (GERMAN CAN  
OPENER)  
-T RATION INSULATED CONTAINERS

HEADQUARTERS UNIT PLT

-A RATION  
-T RATION  
-MRE VII  
-MRE SUPPLEMENT PACK  
-MRHD (FABRIC)  
-CCS (W/O BOTTOM)  
-BENT HANDLE CAN OPENER (STANDARD  
HAND-HELD T RATION CAN OPENER)  
-T RATION INSULATED CONTAINERS

## 2. Data Collection.

Data were collected during the period April 18-20. Each test unit completed a questionnaire about the individual rations and heating devices. The number of respondents surveyed ranged from 11 (Headquarters Platoon) to 53 (Artillery Battery). Out of the 11 individuals surveyed in the Headquarters unit, only one or two had used the MRHD or CCS. This was due to the fact that the individuals either did not have a need to use them (five were cooks with access to kitchen facilities) or did not have an opportunity to do so (several of them were assigned to vehicles without appropriate hook-ups for the MRHD, wheeled vehicles). Therefore, the data from the Headquarters Platoon concerning individual ration heating devices are not further considered in this report.

In addition to administering questionnaires, a total of seven focus groups (moderated group discussions) were conducted. In each focus group, about 6 to 12 members of a test unit participated in a discussion (45-60 min) of the items being evaluated. All focus groups were videotaped.

Command perspective on the evaluation items was obtained from unstructured interviews with two of the company commanders (Armor and Mechanized Infantry).

Data from food service personnel on the food service equipment were collected in the form of structured interviews. Sixteen personnel were available for interviews on the days data were collected. Most interviews lasted approximately 45 minutes. The opportunity also arose to talk to two senior food service personnel briefly in an unstructured setting.

### 3. Data Summary.

Questionnaire data on individual rations and heating equipment are summarized in terms of percentage responses. The focus groups were used to aid in the interpretation of the questionnaire responses and to provide better insight into troop reactions.

The opinions of the food service personnel, as obtained in the extended interviews, are summarized by equipment item.

Only limited use is made of inferential statistics. The differences among units in the combinations of items tested and in their type of mission prohibited a meaningful comparison among groups.

### 4. Test Limitations.

During the evaluation, environmental temperatures typically

ranged from the low 30's<sup>o</sup>F at night to the low 60's<sup>o</sup>F during the day. Colder temperatures would have provided more demanding conditions for providing hot meals at remote sites.

Several problems occurred in the distribution of items to the test units. As noted above, during the evaluation, the Armor Platoon received an A Ration, a MORE, and a T Ration. As a consequence, this unit viewed the MORE as a substitute for the MRE, whereas the MORE was actually intended as an alternative to the T Ration. The extent to which this circumstance affected their opinion of the MORE is difficult to estimate.

In the Artillery Battery several troops reported not having received the CCS, or not having been aware of the availability of heat tabs for use with the CCS. This circumstance contributed to the limited use the CCS received during this evaluation.

## RESULTS

### SECTION I: INDIVIDUAL RATIONS AND HEATING DEVICES

#### 1. Mounted Ration Heating Device (MRHD).

Questionnaire responses to the MRHD are summarized in Table 2. Almost all the troops used the MRHD to heat the entree component



TABLE 2  
USING MRHD WITH TOP SHELF<sup>TM</sup> ENTREE

	MECH INF	ARM
	-----	
<u>Used MRHD to Heat MORE</u>		
Number of respondents	24	12
% Yes	83.3*	83.3
<u>How Often Got Hot Enough</u>		
% Almost always	70.0	77.8
<u>Did It Heat Fast Enough</u>		
% Yes	85.0	88.9
<u>Minutes to Heat</u>		
Mean	23.7	17.9
St. Dev.	7.5	4.2

USING MRHD WITH MRE ENTREE

	MECH INF	ARM	ARTY 1st PLT	ARTY 2nd PLT
	-----			
<u>Used MRHD to Heat MRE</u>				
Number of respondents	23	11	24	27
% Yes	82.6	90.9	79.2	81.5
<u>How Often Got Hot Enough</u>				
% Almost always	78.9	100.0	78.9	50.0
<u>Did It Heat Fast Enough</u>				
% Yes	89.5	100.0	89.5	80.0
<u>Minutes to Heat</u>				
Mean	18.1	9.4	13.2	17.1
St. Dev.	7.7	5.4	4.6	10.7

\* All percentages based on the number of respondents who used a piece of equipment and answered a particular question.

Table 2  
(Cont'd.)

OTHER QUESTIONS REGARDING MRHD

	MECH INF	ARM	ARTY 1st PLT	ARTY 2nd PL
<u>Used to Heat Water</u>				
% Yes	0.0	30.0	31.6	33.3
<u>Electrical Cord</u>				
% Too short	100.0	0.0	52.6	42.9
% Just right	0.0	100.0	47.4	57.1
% Too long	0.0	0.0	0.0	0.0
<u>Would Use to Heat Food (If Issued)</u>				
% Yes	100.0	100.0	100.0	95.2
<u>Would Use to Heat Water (If Issued)</u>				
% Yes	66.7	100.0	83.3	68.4
<u>More Than One MRHD Needed</u>				
% Yes	50.0	80.0	47.4	45.0
<u>Reasons Would Not Use MRHD**</u>				
Hard to use	-	-	-	-
Too long to heat food	2	1	3	5
Too long to heat water	-	-	2	3
No access to power	2	2	-	1
Doesn't heat food well	-	-	-	1
Doesn't heat water well	1	-	-	1
No time to use	2	1	5	10
Not safe	-	-	-	-
Prefer other methods	-	-	-	1

\*\* Responses to this question represent frequency of mention.

of their individual rations. In the 1st Platoon of the Artillery Company, three M109 vehicles and one M548 had malfunctioning auxiliary outlets, which prevented the MRHD from being used with those vehicles. On one heater, the bulb for the "on" light burned out. However, at no time did the MRHD ever fail to operate.

When using the MRHD to heat the Top Shelf<sup>R</sup> or MRE entrees, the majority of the troops reported the food was almost always hot enough; they also reported it got hot fast enough. The troops were almost unanimous in their opinion that they would use the MRHD to heat food if the device were issued to them again.

Less than 1/3 of the troops used the MRHD and the plastic ziploc bags to heat water for a beverage. This may be due to the fact that other, more convenient means of heating water were available, such as the canteen cup (with stand) or the privately-purchased stoves present on many of the vehicles. The majority of the troops indicated they would use the MRHD for heating water for a beverage if the device were available in the future.

The questionnaire responses showed no differences in the performance of the two types of heaters. In the Artillery Company, only 50% of the 2nd Platoon (plastic MRHD) reported

that the MRE entree almost always got hot enough, compared to 79% in the 1st Platoon (fabric MRHD). The 2nd Platoon also reported somewhat longer heating times. However, neither of these differences was statistically significant. Table 2 also shows that the Armor Platoon, which used the plastic MRHD, was satisfied with the heating performance of the device and reported some of the shortest heating times. It should be noted that the small sample sizes and the variability in the time estimates limit any conclusions concerning differences between the two types of heaters.

There was only one reported instance of a soldier burning his hands using the MRHD. Storage of the MRHD did not appear to be a problem, as only one soldier stated that the MRHD got in the way. Comments from troops suggested that the MRHD could easily be stored in existing storage trays or compartments. However, Table 2 shows a number of the troops felt the electrical cord was too short. This opinion appeared to vary depending on the vehicle in which the MRHD was used. (For example, all respondents in the Armor Platoon rated the length of the cord as just right, whereas all the respondents in the Mechanized Infantry Platoon rated it as too short.) In the Artillery Platoons, opinion was about evenly divided. The nature of the problem with the length of the cord was made clear by some of the comments of the troops. For example, in the M109 artillery gun, the outlet for the MRHD is positioned in the driver's

area. As a result, the MRHD is not as accessible to the other members of the crew as it would be if the length of the cord permitted it to be brought further toward the rear of the vehicle. A similar situation existed in the M60, except that there the MRHD was placed in the turret, which made access by the driver more difficult.

The difficulty in accessing the MRHD from different locations may be one reason why more than half of the troops reported that more than one MRHD was needed per vehicle (see Table 2). Generally, the preference was for two per vehicle. The other reason for preferring a second MRHD may be the limited number of entrees (especially Top Shelf<sup>TM</sup> entrees) that can be heated at one time.

Responses in the focus groups support the conclusions from the questionnaires. Almost all the soldiers gave the MRHD their vote of approval. They liked the ease of use, the ability to heat their rations while on the move and the flexibility of using the device for heating rations, water, and privately purchased food they brought to the field. Some said they even used the device for warming their hands. A few soldiers commented that the MRHD took somewhat longer than the ZT pads to heat food, but since they were able to continue with their duties while waiting for the food to heat, time was not an issue.

Several soldiers who used the MRHD to heat the Top Shelf<sup>TM</sup> entrees commented that the pockets inside the MRHD were too small since they could only accommodate two Top Shelf<sup>TM</sup> entrees as opposed to four MREs. A few soldiers complained that the brightness of the green light on the MRHD compromised light discipline when the vehicle hatch was open. This point bears further investigation. One recommendation was that a cover for the light be provided, or that the color of the light be changed to red. Other recommendations for improvement include: attaching Velcro to the bottom of the MRHD and to the wall of the vehicle for easier mounting, making the MRHD battery-operable, so the vehicle does not have to be running to operate the device, and issuing two devices per vehicle.

The following quotes from the focus groups reflect some of the respondents' feelings about the MRHD:

"That thing is real convenient. You just pull it out, plug it in and go about your business and when you're ready to eat you come back, take it out and eat it."

"The pouch was good and it stayed at a constant temperature too. I put some food in and didn't have a chance to eat for a few hours and when I pulled them out they didn't explode or anything."

"Quick, clean and easy."

"I stuck cheese inside the bread and put it inside the pocket of the heater. That heater did a great job."

"My favorite thing was the track heater. I used it for everything...I heated cans of spaghetti and some ravioli in a ziploc bag. It worked great."

"The heating pouch is good. You slap the food in and let it heat while you're moving. When you stop you have time to either eat one packet or the whole meal. It remains hot. Without that, you either have to break out your stove or use the heat tabs."

"That bag is the best idea I've seen in a long time since sliced toast. It'd be good for everybody."

## 2. Zesto Therm (ZT) Energy Pads.

Questionnaire responses to the ZT pads are summarized in Table 3. Almost everybody in the Armor Platoon used the ZT pads to heat the Top Shelf<sup>TM</sup> entree at least once, whereas only about 50% in the Mechanized Infantry Platoon did so. Similar percentages were observed for heating the MRE entree. It should

be noted that the Armor Platoon was not issued MREs as originally planned, but occasionally obtained MREs from other platoons that were not part of the test. In addition, the plastic bags for heating the MREs with the ZT pads were not regularly provided to this group. For these reasons, the Armor Platoon had limited exposure to heating the MRE as opposed to the Top Shelf<sup>TM</sup> entree, and the opinions concerning the ZT pads primarily reflect their use with the Top Shelf<sup>TM</sup> entree.

The majority of the troops that used the ZT pads found they almost always got the food hot enough and heated it fast enough. Some of the soldiers in the Armor Platoon noted differences between the ZT pads in their heating capacity. The source of these differences was not clear; some soldiers speculated it might be due to variations in the thickness of the pads (i.e. the amount of active ingredient). Almost all the soldiers who used the pads indicated they would use them in the future if they were made available.

The ease of using the ZT pads was rated about "6" ("moderately easy") on a 7-point scale. Perhaps the most frequent complaint expressed in the focus groups was that the ZT pads were messy to use, due to the residue that results from the heating process. Soldiers recommended that more napkins be provided for wiping off the residue. Another suggestion was to add an outside layer of packaging material that would keep the pouch containing the food clean.



TABLE 3  
USING ZT PADS WITH TOP SHELF<sup>TM</sup> AND MRE ENTREES

	<u>TOP SHELF<sup>TM</sup></u>		<u>MRE</u>	
	<u>MECH</u> <u>INF</u>	<u>ARM</u>	<u>MECH</u> <u>INF</u>	<u>ARM</u>
<u>Used ZT Pads to Heat MORE</u>				
Number of respondents	24	12	23	11
% Yes	54.2*	91.7	43.5	72.7
<u>How Often Got Hot Enough</u>				
% Almost always	61.5	80.0	70.0	100.0
<u>Did It Heat Fast Enough</u>				
% Yes	69.2	100.0	90.0	100.0
<u>Minutes to Heat</u>				
Mean	18.2	13.4	16.8	10.1
St. Dev.	5.6	4.2	6.0	2.9
<u>Ease of Use (1=Difficult, 7=Easy)</u>				
Mean	5.5	6.7	6.2	6.9
St. Dev.	1.7	.5	1.2	.4
<u>Problems with ZT Pads</u> (% Reporting At Least Slight Problem)				
Burning hands	44.4	42.9	20.0	37.5
Not heat up	23.1	27.3	20.0	25.0
Smell	38.5	9.1	60.0	25.0
Water spilling	53.8	63.6	60.0	62.5
Keeping bag closed	46.2	45.5	60.0	37.5
<u>Would Use ZT Pad (If Issued)</u>				
% Yes	92.3	100.0	90.0	100.0
<u>Reasons Not Use ZT Pads**</u>				
Too complicated	1	-	-	-
Takes too long to heat	5	-	2	-
Wastes water	6	3	3	1
Doesn't heat well	-	-	-	-
No time to use	3	2	3	1
Not safe	-	-	-	-
Produces bad smell	2	-	2	-
White foam creates mess	5	4	-	2
Prefer other methods to heat	2	2	1	3

\* All percentages based on the number of respondents who used a piece of equipment and answered a particular question.

\*\* Responses to this question represent frequency of mention.

The items on the list of potential problem areas (burning hands, pads not heating up, etc.) were generally rated as "not a problem" or a "slight problem." Water spilling out of the bag was among the more frequently reported problems. The tendency for water to spill out of the bag may be related to the amount of water used. The amount of water to be added was indicated by a line on the bags, but the line was mistakenly drawn too high. The Armor Platoon reported they used even more water than recommended, because they felt the ZT pads worked better with the extra water. While this possibility cannot be ruled out, it is also conceivable that troops believed the function of the water was to boil the entree, whereas the water is needed primarily as a wetting agent to initiate the exothermic reaction. In training troops to use the ZT pads, the maximum amount of water to be used should be indicated on the bag and the purpose of adding the water clarified in the instructions. Some soldiers reported that on a few occasions plastic bags used to heat the Top Shelf<sup>TM</sup> entree were punctured and could not be used for heating the entree with the ZT pads (the water would leak out). A suggestion was made to include extra bags as a backup. Soldiers also indicated they would like to see a trash bag supplied with the MORE to help in collecting the trash.

In comparing the MRHD to the ZT pads, troops in the focus groups noted the ZT pads heated faster, but were messier to use. They commented that a potential benefit of the ZT pads was that they

could be used while operating away from the vehicle, where a device such as the MRHD would not be available. In addition, it was stated that certain members of a vehicle crew, such as the driver in the M60, might find it more convenient to use the ZT pads instead of using the MRHD, which might be inconveniently located (e.g. in the turret). In a few instances, concern was expressed regarding safety of the residue or the fumes created by the ZT heating process. Another concern was the amount of water needed to activate the ZT pads in situations where drinking water was limited.

None of the troops tried to heat the MRE entree with the ZT pad "on the move" by carrying the entree box in a BDU pocket. This method of heating may simply not be applicable to mounted troops. On the other hand, it is possible that the steps involved in heating a meal with the ZT pads resulted in the ZT pads only being used when there was sufficient time to prepare and consume a meal.

The following quotes from the focus groups reflect some of the opinions concerning the ZT pads:

"This heater is more convenient because it's faster than the other two [the MRHD or the CCS]."

"I like the individuality of being able to use the Zesto pads by yourself in your own area rather than going to find

the green thing [the MRHD] because it [the MRHD] only heats two at a time and you have to wait until the rest of the crew heats theirs."

"It's a little faster than the vehicle type heater [the MRHD] but it's messier. It has all this goop you've gotta wipe off."

"It gives off too much residue which I had to wipe off with my BDU's. We need more napkins."

"They're a lot easier time-wise. Stick 'em in here for about 10 minutes and flip 'em over for another 10 minutes until it boils the other side. In the wintertime you can get to use it as a heater because they get real hot and you can warm up your hands and it serves a good secondary purpose."

"If you go dismounted, Zesto is a good idea. I wouldn't use it next to the track as you waste a lot of water. It's not worth getting dehydrated. Look at all the water you've got to carry too."

"This was really messy and sucked up a lot of water. It might be handy for those in a light unit."

"This works really great. When you get away from your vehicle at least you have a way to heat [the food]. We've used both [the MRHD and the ZT pads] out here and they both work equally as well. It just depends on what situation you're in. If you're off your vehicle, you could have a hot meal just with a canteen of water."

3. The Tray Ration Heating System (TRHS).

In order to assess the heating performance of the TRHS, troops in the Artillery Platoons were asked to rate how often during the exercise the T Rations were hot enough. Only about 6% of the respondents (N=48) thought the T Rations were almost always hot enough, whereas about one-third of the respondents rated them as almost never hot enough. In discussing the T Rations with the soldiers, some said they noticed an improvement in serving temperature. Others said they did not notice any difference compared to before.

Several factors complicate the interpretation of these results. First, due to a breakdown of the TRHS, the TRHS was not used at one T Ration meal. At that meal, soldiers reported the rice was served cold, an experience which may have influenced their ratings. Secondly, some soldiers said that while the food might have been hot when it was served to them, by the time they walked back from the serving line to where they ate (usually at their gun) it had cooled off. A typical comment was:

"It's hot when they put it on your plate but by the time you walk 200 meters you've got cold food. You're carrying an open tray in the wind and doing your best not to spill it."

Finally, any ratings of the temperature of the T Rations are likely to be influenced by the fact that the rations themselves are not popular. One soldier commented:

"When you hear T Rats, the first thing that pops into your mind is, Great! ... I'm not even going to go to chow. Guys don't even want to go. They just sit on the track and eat what food they brought, unless you find out it's lasagna from the first three guinea pigs that have gone out and then you'll get dressed and go to chow."

One of the limitations of the test was that they used the T Ration heater on the 2-1/2 ton truck. The system was designed to be used on the HMWV which is more mobile. This may have limited the demonstration of the system as an effective way to feed at remote sites. While there were complaints about the quality of the food, an overriding issue with the troops was the lack of variety in what they are generally served. One soldier said that he has only been served seven different T Ration menus in the years that he has been in service. Another respondent said that he went hungry for two nights because he did not like Chili and it was served two nights in a row. The reason for the

lack of variety is not clear, since it was subsequently determined that the TISA (troop issue support activity) at Ft. Carson had most of the 14 T Ration menus in stock. However, this type of complaint is not new; improvements in one aspect of the T Rations (serving temperature) may have limited effect if other aspects such as variety are not attended to simultaneously.

#### 4. Canteen Cup Stand (CCS).

A minority of the troops in this evaluation used the CCS. Although problems with the distribution of the CCS or the heat tabs may partially account for the lack of use by the Artillery units, there were other reasons as well. Troops commented that they lacked the time to use the CCS or that they did not want to go to the trouble of setting it up, especially given the number of alternative heating devices provided during this evaluation. Another reason cited for not using the CCS was that the CCS could not be used inside the vehicle due to the open flame and the fumes generated by the heat tabs. In the case of the Artillery units, safety considerations dictated that troops use the CCS at some distance from the weapon, adding to the inconvenience of using the item.

Questionnaire responses to the CCS are summarized in Table 4. The response rate in the Mechanized Infantry and Armor units was too low to warrant separate tabulation in Table 4. Since these

two groups were the ones issued the CCS with the bottom, a comparison between types of CCS is not possible. Table 4 shows that among the soldiers that used the CCS to heat the MRE entree, a majority felt that the entree was almost always hot enough and heated up fast enough. No instances were reported of the CCS tipping over. Occasionally, a soldier reported burning his hands while touching the surface of the CCS. Using the CCS was considered easy, except that one individual in the Armor unit, who was issued the CSS with the bottom, indicated a problem with igniting the fuel: the match would go out when he inserted it through the holes in the CCS. In order to ignite the heat tab, he dropped the match in from the top.

Several soldiers commented that the heat tabs left a black film on the canteen cups which was difficult to clean and discouraged the use of the canteen cup and the CCS.

Despite the limited use the CCS received, almost all the troops using it indicated they would use it again to heat an entree or to make a beverage.

##### 5. Acceptability of the Rations.

Tables 5-7 summarize the ratings of acceptability of the individual operational rations served during this exercise. Table 5 shows that the commercial items in the MORE received high ratings (above "8" = "like very much"). The troops'



TABLE 4  
USING CSS WITH MRE ENTREE

	MECH INF	ARM	ARTY 1st PLT	ARTY 2nd PLT
<u>Used CSS to Heat MRE</u>				
Number of respondents	23	11	24	27
% Yes	17.4	0.0	41.7	25.9
<u>How Often Got Hot Enough</u>				
% Almost Always			55.6	85.7
<u>Did it Heat Fast Enough</u>				
% Yes			88.9	83.3
<u>Minutes to Heat</u>				
Mean			16.8	10.1
St. Dev.			12.6	3.5
<u>OTHER QUESTIONS REGARDING CSS</u>				
<u>Used CSS to Heat Water for Beverage</u>				
% Yes			40.0	37.5
<u>Would Use to Heat Food (If Issued)</u>				
% Yes			90.0	87.5
<u>Would Use to Heat Water For Beverage (If Issued)</u>				
% Yes			88.9	87.5
<u>Reasons Would Not Use CSS*</u>				
Hard to use			-	-
Too long to heat food			2	1
Too long to heat water			1	-
Doesn't heat food well			2	-
Doesn't heat water well			1	-
No time to use			5	1
Not safe			1	1
Takes too long to cool off			-	-
Don't usually have heat tabs			1	1
Won't waste water			-	-
Prefer other methods			2	-

\* Responses to this question represent frequency of mention.

reactions in the focus groups clearly indicated the value they placed on commercial items. Troops liked the variety in the entrees and felt the commercial brand name communicated quality and freshness. In contrast, the MREs and T Rations, because of their extended shelf life, were perceived by some to have more preservatives than the commercial items. The commercial packaging was more appealing to troops than the military packaging, and made the food seem similar to something they could buy at the supermarket. Some comments from the focus groups are as follows:

"I think the troops like something commercial. It reminds them a little bit of home. They think they're getting something special."

"If it weren't for the Top Shelf<sup>TM</sup> I wouldn't be eating at all. I like these a lot better than anything the Army's ever made."

"These Topshelf's<sup>TM</sup> are like TV dinners and that's all I eat at home."

"With the MOREs and the new MREs almost everything gets eaten."

"I liked the little puddings they had. It was DelMonte<sup>R</sup>, a brand that you know is good. When a regular manufacturer makes it, you know they put more care into it."

Table 5. MORE Acceptability Ratings

	MECH INF	ARM
	-----	
Number of Respondents	24	12
<u>Top Shelf</u> <sup>TM</sup>		
Mean	8.3	8.7
St. Dev.	1.1	.5
<u>Bread</u>		
Mean	8.8	8.5
St. Dev.	.6	.8
<u>Del Monte</u> <sup>R</sup> <u>Fruit</u>		
Mean	8.1	8.7
St. Dev.	1.3	.7
<u>Del Monte</u> <sup>R</sup> <u>Pudding</u>		
Mean	8.7	8.4
St. Dev.	.6	.9

SCALE: 1 = Dislike Extremely, 9 = Like Extremely

"It's a psychological factor...eating something you can buy in a supermarket instead of eating something nobody would want to touch."

"It's nice to see a brand name out there instead of Army #6952. You know you're getting something. You trust it and you have a better attitude."

Table 6 shows that the ratings for the new items in the MRE VIII (entrees, fruit-flavored beverages and candy) were positive and, in the case of the entrees and the candy, higher than the ratings for the equivalent category in the MRE VII (there were no fruit-flavored beverages in MRE VII).

While the ratings for the Supplement Pack (Table 7) should be weighed with caution due to the small sample size (N=23), the items were nonetheless given highly acceptable ratings. The pouch bread was especially liked, and it was also included in the MORE. Most of the items were rated above 7 = "Like moderately", with the exception of the trail mix and the granola bar as rated by the Armor Platoon (the Headquarters Platoon rated these items higher). The majority of the troops wanted the items in the Supplement Pack added to some or all of the MRE's (see Table 7). Some comments on the supplementary items were:

"The bread ... is really good. I definitely liked it. I warmed it up in the heater and it was great. Fresh hot bread! It's soft, warm and tastes good. I put the cheese in it and melted it."

"The bread was the best thing that they added. Take out the cracker and the stupid dehydrated cakes they have and put that bread in there. That's good stuff."

"It was good with the peanut butter and jelly. It wasn't dry. It was moist and didn't taste like stale bread."

"I like the Tabasco. Give us a bigger bottle. 1/8 oz. is too small."

"The beverage was great! It's definitely a better alternative to the cocoa. They should put in two packets so I could have a whole canteen full or make it more concentrated."

#### 6. Command Perspective.

Only two company commanders were available for interviews during the evaluation. The commander of the Mechanized Infantry viewed the MRHD as redundant with heating devices presently available,

TABLE 6

MRE  
ACCEPTABILITY RATINGS  
(SCALE: 1=Dislike Extremely, 9=Like Extremely)

	MECH INF	* ARM	ARTY	* HQ
	MRE VIII	MRE VII	MRE VIII	MRE VII
	-----			
Number of Respondents	24	11	53	11
<u>Entree</u>				
Mean	7.3	4.7	6.0	3.6
St. Dev.	1.6	2.5	2.3	2.2
<u>Crackers</u>				
Mean	5.1	4.1	5.8	4.7
St. Dev.	2.9	2.1	2.0	2.1
<u>Spreads</u>				
Mean	6.8	5.4	6.6	6.9
St. Dev.	2.2	.9	1.7	1.1
<u>Dehydrated fruit</u>				
Mean	4.0	2.5	5.3	3.9
St. Dev.	2.8	1.4	2.6	3.3
<u>Desserts</u>				
Mean	6.3	4.0	6.3	5.4
St. Dev.	2.6	2.6	2.3	2.5
<u>Fruit beverages</u>				
Mean	7.7	-	6.9	-
St. Dev.	2.3	-	1.9	-
<u>Candy</u>				
Mean	8.4	6.0	7.6	7.0
St. Dev.	.8	2.1	1.9	1.1

\* Caution should be exercised when interpreting results involving the ARMOR group or the HEADQUARTERS group due to the small sample sizes.

Table 7. Supplement Pack Acceptability Ratings

	ARM	HQ
Number of Respondents	12	11
<u>Pouched bread</u>		
Mean	8.4	8.3
St. Dev.	1.0	1.0
<u>Fruit beverages</u>		
Mean	8.3	7.9
St. Dev.	1.0	1.6
<u>Hot pepper sauce</u>		
Mean	7.5	7.0
St. Dev.	1.4	2.4
<u>Charms</u>		
Mean	8.3	8.3
St. Dev.	1.1	1.1
<u>Beef jerky</u>		
Mean	8.4	8.1
St. Dev.	1.4	1.4
<u>Granola bar</u>		
Mean	5.9	7.6
St. Dev.	4.0	1.9
<u>Trail mix</u>		
Mean	4.9	7.9
St. Dev.	2.7	1.4

SCALE: 1 = Dislike Extremely, 9 = Like Extremely

Table 8. Supplement Pack - Items to Add/Drop

	ARM	HQ
Number of Respondents	12	11
<u>Pouched bread</u>		
Drop	-	-
Add to some MRE's	-	1
Add to most MRE's	2	2
Add to all MRE's	10	8
<u>Fruit beverages</u>		
Drop	-	1
Add to some MRE's	-	2
Add to most MRE's	2	1
Add to all MRE's	10	7
<u>Hot pepper sauce</u>		
Drop	-	-
Add to some MRE's	2	2
Add to most MRE's	3	2
Add to all MRE's	7	7
<u>Charms</u>		
Drop	1	-
Add to some MRE's	-	2
Add to most MRE's	1	3
Add to all MRE's	10	6
<u>Beef jerky</u>		
Drop	1	-
Add to some MRE's	1	2
Add to most MRE's	-	3
Add to all MRE's	10	6
<u>Granola bar</u>		
Drop	2	-
Add to some MRE's	2	2
Add to most MRE's	2	3
Add to all MRE's	5	6
<u>Trail mix</u>		
Drop	5	-
Add to some MRE's	1	2
Add to most MRE's	3	4
Add to all MRE's	2	5
<u>Towelette</u>		
Drop	1	-
Add to some MRE's	1	1
Add to most MRE's	1	2
Add to all MRE's	8	8



in particular the privately purchased stoves such as the Coleman or the squad stoves. On the other hand, he was very favorably disposed toward the ZT pads and the general idea of providing the individual soldier with the facility to heat his own meal, as in the MORE. He described the current situation of feeding a hot meal to a company at one time as unsatisfactory, and indicated that the self-heating facility would reduce the logistical burden involved in feeding troops and would provide needed flexibility in scheduling training.

The commander of the Armor Company similarly stressed the value of providing troops with the means for heating their rations, due to the increased flexibility for tactical maneuvers that this facility would provide. He commented that the MOREs were "like eating out of a restaurant" and tasted "much better than any T Ration ever tasted." He saw no disadvantages to the self-heating concept, other than some of the social functions of eating a meal together might be lost without a common meal time. He also commented that he did not view the amount of water needed to activate the ZT pads as a critical issue.

## 7. Conclusions.

No overall problems in concept, design, or operation were identified with the potential improvements to the AFFS. The

major conclusions concerning the individual heating devices and rations are:

MRHD: The MRHD functioned reliably and was well liked by the troops. It got the food hot in sufficient time and was convenient to use. Troops indicated a preference for a second MRHD for each vehicle. Overall, the MRHD was the most popular heating device included in this evaluation.

ZT Energy Pads: The ZT pads were considered fast and effective in heating food, but less convenient than the MRHD. The residue created during heating detracted from this heating method. Nevertheless, many troops saw the ZT pads as complementary to the MRHD, for use especially by those crew members who do not have easy access to the MRHD inside the vehicle, or are operating away from the vehicle.

CCS: The CCS received limited use during this evaluation, primarily due to the number of other, preferred heating devices available to mounted troops. While effective when used, the CCS is less appropriate for mounted than dismounted troops.

TRHS: The TRHS did not result in a marked favorable response to the serving temperature of the Tray Packs. As noted in the report, test conditions and the unpopularity of the T Rations may have limited the positive impact of this piece of equipment.

MORE: The MORE was well liked, especially due to the commercial items included in the ration. Several comments from the troops indicated the psychological advantage of including commercial items in the ration.

MRE Supplement Pack: The items in the Supplement Pack were well liked. In particular, the pouch bread was very popular and considered a desirable addition to all MREs.

## 8. Recommendations.

a. Future evaluations of remote feeding concepts should involve a smaller number of test items. The complexity of the ration and equipment distribution schedule resulted in several administrative errors. Also, the number of heating devices available to troops may have detracted from the amount of use any one item received during the evaluation.

b. The focus groups conducted as part of this evaluation provided useful information on the remote feeding concepts and contributed significantly to the understanding of how troops used the various items evaluated. Future evaluations should continue to include focus groups as an integral part of concept evaluations.

- c. A continuing need exists to understand and remedy the problem of a limited variety of T Ration menus being served in the field.
  
- d. The line on the bag indicating the amount of water to be used with the ZT pads should be corrected, and the instructions need to emphasize the importance of using the correct amount of water.
  
- e. Additional napkins should be provided for removing the residue that results from using the ZT pads.
  
- f. Additional plastic bags should be provided as a backup for heating the TopShelf<sup>TM</sup> entree with the ZT pads in case the original bag becomes punctured. Alternatively, a stronger bag should be used.
  
- g. The possibility of extending the length of the electrical cord on the MRHD should be investigated.
  
- h. Several trash bags should be included with each case of the MORE rations to aid in garbage collection.

## SECTION II: FOOD SERVICE EQUIPMENT

Demographics. All 16 of the interviewees were males, all ranged

in rank from E-3 to E-6, and all except 2 held food service MOS's. The number of years spent in a food service MOS ranged from 2 to 16.

Overall Considerations. As stated earlier, the terrain and climate were not harsh enough to test some equipment performance variables, and the effects of severe heat, severe cold, snow, rain, and mud would be expected to have considerable influence on equipment performance and acceptability. There were, however, some stiff breezes, and, as that part of Colorado is semi-arid, dust was an ever-present nuisance.

Although the altitude is high (over 6,000 ft.), and the terrain rocky, much of the area is easily negotiable with four-wheel drive vehicles. Part of the terrain the units operated in, however, was difficult to negotiate because of steep grades.

Selecting a site for setting up the various kitchens was more a function of mission considerations than equipment characteristics. The site selection is often a joint decision of the mess sergeant and the unit CO. An ideal site would be level, provide easy drainage, foliage for camouflage, access to roads, and be near a water supply. No kitchen in this evaluation offered a major problem in site selection.

Discussion of set up/take down times for the kitchens also revealed that although there may be some factors dependent on

the equipment, the largest influence on the time element was mission related -- the camouflage netting takes considerable time.

The cooks were relieved of much of the sanitation work, as KPs were furnished by the units on a rotating basis for this purpose.

1. KARCHER KITCHEN/MKT (N=16).

The Karcher Kitchen and the MKT were used by 1/77 Armored Battalion during this evaluation. The food service personnel always used them simultaneously to prepare any given meal, whether it was A Rations or Tray Packs. A pragmatic approach to getting the job done is characteristic of the military, especially in the field, and this unit "piggybacked" the two kitchens to prepare both A Rations and T Rations. Personnel used the Karcher wells to prepare the Tray Packs and coffee, and served every meal out of the MKT.

The kitchens were used to feed a battalion (approximately 700) and all of the 16 interviewees had used them. However, any given cook prepared either the A Rations or the T Rations on them during the evaluation. No one prepared both rations. Interviewee usage of the kitchens ranged from a minimum of 6 times to the duration of the test, and involvement in moving them (which they call "jumps") ranged from 3 to 5 times. These cooks did not go to any remote sites, and the number of personnel served at the site was around 50.

The 1/77 sent the T Rations out in the meal carriers, and would occasionally use one of the insulated containers provided for the evaluation, but had no meaningful feedback to give about them. This unit also did not use the plastic cover for the insulated container, nor did it use the plastic liners for the Mermite containers sent out to battalion personnel. The insulated containers unique to the Karcher also were not used.

These cooks felt that A Rations generated light trash, while estimates for the T Ration trash ranged from moderate to heavy. Trash for both rations was generated by the food items and from cleaning materials such as terry towels.

Most of the cooks interviewed had previous experience with the MKT. Their responses are often based on total experience with the MKT and not confined to their use of it just during this evaluation.

Comments on Karcher (N=6)

Mobility            All felt it had good mobility, except one who was neutral about it. He said that it didn't have enough ground clearance for the area's rough terrain, but was more stable than the MKT.

Set up/            Set up time estimates for A Rations ranged from  
Take down        30-60 minutes. T Ration estimates ranged from

10-30 minutes. The process for both rations was considered fast and easy. One person qualified the speed of set up by saying it was fast when you became more adept. Take down estimates ranged from 10-30 minutes for both rations. No one considered it a slow process, but a few commented that putting on the tarp slowed things down, as did dipping out the shallow wells to remove water. Nonetheless, the process was considered easy.

Meal  
Preparation

Three people were involved in preparing each ration. Not only was that number adequate, but most felt both rations could be prepared by two people. Meal preparation time for the T Rations was estimated at 3 hours for 300-400 served, and up to 5 hours for 700. A Ration times were contingent on what was being prepared, with estimates of 1 hour for breakfast and up to 5 hours for more complex meals. Those who prepared T Rations considered them a fast process, while those who prepared A Rations felt this was not a fast process. Reasons given were that the cooking vessels took too long to heat, and that the process had to be stopped mid-meal as the burners ran out of fuel (when they were feeding 700).



Number of Meals            The cooks' estimates for the number of T Ration meals the Karcher could support when used alone ranged from 300 to 500, while they estimated 300-350 for A rations.

Pressure Cookers        Most felt it was easy to operate the pressure cookers, but there were comments that the shallow ones were hard to lift up with a lot of pressure in them. Estimates of time to pressurize the cookers ranged from 20-60 minutes.

Working Space/ Layout/ Ground level            The Karcher working heights were satisfactory and everything was in easy reach. The shortest cook of this group was 5ft 7in (in the 25th percentile) and the tallest 6ft 3in (in the 99th percentile). Most considered the layout satisfactory but there were comments that the tongue got in the way. The amount of work space could be improved - two tables were put in the kitchen for that reason. The burners and deep wells were considered heavy, with the burners generally requiring two people to lift them. As for working directly on the ground, one cook commented that it was fine for now, but would be a problem if the ground was muddy or cold. The others not only did not mind working on the ground either, but felt that working on cold

ground would still be better than working on the metal floor of the MKT in winter.

Clean up            Estimates for clean up of A Rations ranged from 25 to 90 minutes, and from 30 to 60 minutes for T Rations. Clean up of the T Rations was easy, and ease of clean up for the A Rations depended on what was prepared. The deep cookers were not a problem, but shallow cookers had to be dipped out, and that could be a problem. As one cook put it, "I won't ever use them again for sausage!"

Cooking            The only cooking functions the Karcher was used for were boiling, grilling, and simmering. The Performance        only problem was that the heat was very difficult to regulate for grilling, i.e. it couldn't be lowered enough, and items such as pancakes burned easily.

Burners            Operating the burners was easy, but the cooks were unanimous in their dislike of having to clean them after each meal, as required by the manufacturer's manual. Pressurizing the burners was a simple, quick process with an air hose attached to a 2 1/2-ton truck. They used diesel fuel. The only maintenance performed on the burners was

cleaning, which they estimated took between 30 to 90 minutes per day. One person commented that the fuel caps were difficult to take off.

Water/Fuel Usage      Water usage was moderate to heavy for both A and T Rations. Water was required for cooking, beverages, sanitation and the trailer itself because cookers had to be charged with water. Fuel usage estimates ranged from light to moderate for A Rations, and from moderate to heavy for T Rations.

Mechanical Performance/Safety      Except for one comment that the burners went out sometimes, the consensus was that the mechanical performance was good. The kitchen was considered safe, with a few adding, "If you know what you're doing." One commented that the BDU cargo pockets get caught on well spouts, which then release water.

Side Curtains      The side curtains worked well and were used chiefly for light discipline. One person also said they blocked the wind effectively.

Interviewees' opinions:

Karcher's best features:

- Easy set up and take down (N=3)
- The deep wells' capacity (N=3)
- Cleans easily (N=1)

Karcher's worst features:

- Can't regulate heat in shallow wells, they're too hot (N=4)
- Opening kettles produces so much steam it's hard to see; foresee ice formation on ceiling in winter. (N=2)
- Have to dip shallow wells to clean (N=2)
- Fuel knobs hard to twist off once sealed (N=1)

Suggestions for improvement:

- Deep wells should have own water supply
- Needs storage/cabinet space
- Should be able to heat up just a few of the burners.

Rating for the Karcher Kitchen:

The cooks rated the kitchen overall on a 1 (very bad) to 7 (very good) scale. The average rating (N=5) was 5.6 (SD=.6) No individual rating was less than a 5.

Comments on MKT (N=6) (Figure 6)

Mobility All felt it had good mobility, except one who said it was top heavy.

Set up/  
Take Down Set up time estimates for A Rations ranged from 45-60 minutes. T Ration estimates ranged from 30-45 minutes. Take down time estimates were about the same. No one said either process was difficult, but three of the interviewees didn't consider set up a fast process, as there is a lot to it - e.g., levelling, popping the top, and dropping the legs and ceilings. While most of the set up/take down process can be done by two to three people, some parts of it, such as lifting the MKT/popping the top, require four. While jacks are provided for the kitchen, all felt that using the jacks was "too much hassle" and didn't use them.

Meal Preparation The number of people involved in preparing A Rations was three. That was considered adequate, and a few felt that two personnel could handle it, depending on how many people were fed. Meal preparation time for A Rations was estimated from 1 to 4 hours (shorter times when the burners work well). Again, A Ration times were also contingent

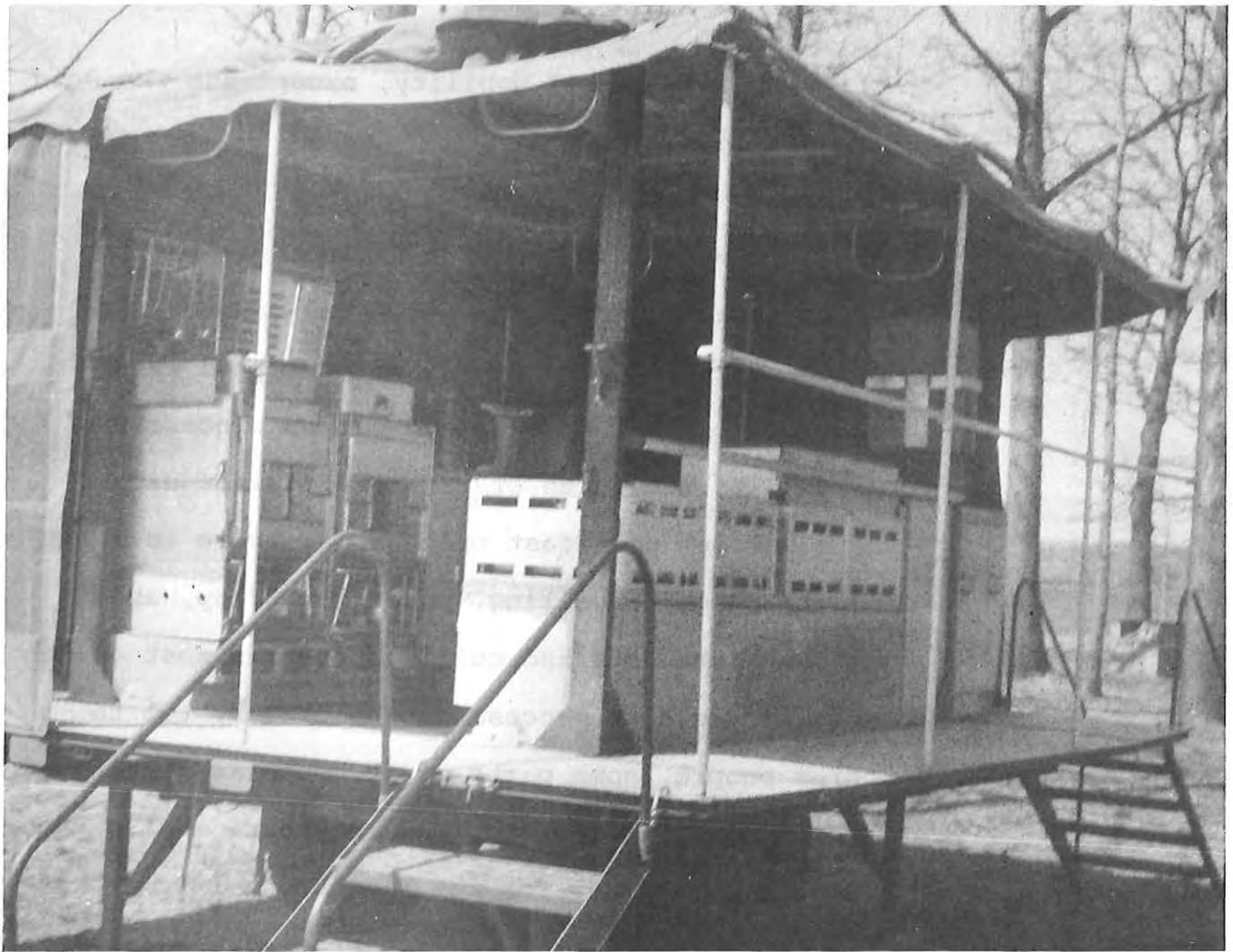


Figure 6. Mobile Kitchen Trailer

on what was being prepared. Those preparing T rations used the MKT primarily to serve out of it. The T Rations were mostly prepared in the Karcher and in garbage cans.

Number of Meals      The cooks' estimates for the number of A Rations meals the MKT could support when used alone ranged from 400 to 500.

Burners            Most felt it was easy to operate the M-2 burners, and most estimated it only took a minute or two to pressurize them. (They had a hand pump.)

Working Space/Layout/  
Lifting            There were complaints about the workspace and layout; more room is needed. It is crowded with two people working in it, and only one person felt that as many as three could be accommodated. Working heights were good. (Heights of the cooks ranged from 5'7" to 6'3".) The weights of anything that had to be lifted were no problem for one person to manage, except for the 15-gallon pots.

Clean up           Estimates for clean up of A Rations ranged from 30 to 120 minutes and were in the 30-minute range for

T Rations. Sanitizing the cooking vessels was considered easy, and was done by KPs during this evaluation.

Cooking Performance The only cooking functions the MKT was used for were boiling, grilling, and simmering. Its performance for those functions was considered good, except for one who felt its boiling performance was only fair (not enough heat).

Serving Line The serving line was usually set up in an L shape and operated smoothly.

Water/Fuel Estimations of water usage ranged from light to moderate for the A rations, as did the fuel usage leaded gasoline (MOGAS) estimates. Water was required for cooking, beverages, and sanitation.

Mechanical Performance/Safety Mechanical performance was good. Three interviewees considered the MKT safe. The others voiced concerns. Two commented that the steps were very slippery in winter. Ice builds up, and the steps are often not level. Another voiced an opinion that a high wind could blow down the camouflage, catch fire and spread to the canvas.



Interviewee opinions:

MKT's best features:

- Easy set up (N=3)
- Venting (N=1)
- Lots of storage space (N=1)
- Easy to clean, move (N=1)

MKT's worst features:

- Floor too cold in winter (N=6)
- Too small to work in (N=1)
- Aluminum very flimsy, rods/poles break (N=1)

Suggestions for improvement:

- Modify MKT by getting rid of the M59. Put the M59 in the KCLFF.
- Make sides more like those of Karcher.
- Since it is not used for baking, eliminate a cabinet and put in steam vat (like Karcher)

Rating for the MKT:

The cooks' (N=5) rated the MKT overall on a 1 (very bad) to 7 (very good) scale. The average rating (N=5) was 5.4 (SD=.5). No one rated the MKT less than 5.

2. KCL (N=7)

The KCL was used by HHC, 2nd Brigade. The interviewees' experience with the KCL for the evaluation ranged from 3 days to the duration of the test. The unit moved three times, and they loaded the KCL into the MKT to move it. The T Rations were prepared outside the MKT, loaded onto it, and served from it. All meals were prepared for a company, and all were fed on site. There were no small, remote uses of the KCL.

Set up/ Take down	Set up and take down was considered easy, and involved 5-6 personnel. Set-up time estimates ranged from 60-120 minutes and take down from 60-90 minutes. These estimates obviously reflect integrated MKT/KCL processes, a much more time consuming process than when operating the KCL out of a truck. None of these cooks had any previous familiarity with the KCL and some had a confused notion of what the system components were; a few even thought it was just the ration heater itself. In any event, those few who did not consider those integrated times fast said it was because of the camouflage. It wasn't any problem to load any item into the MKT.
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Meal Preparation	Two personnel were involved in preparing and serving the T Rations, and users considered that
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an adequate number.

Number of Meals	The cooks' estimates for the number of T Rations they could support with this MKT/KCL system went up to 600-700.
Burners/ Maintenance	Most felt it was easy to operate the burners (with a few adding "when you know how"), and most estimated it only took a minute or two to pressurize them with their hand pump. No maintenance was performed on the M-2 burners except to occasionally clean the preheater. Thorough cleaning or any other maintenance-chores are accomplished in garrison.
Clean up	Most estimates for clean up ranged from 20 to 60 minutes with 2-3 people, and was considered an easy process by all.
Serving line	The serving line was usually set up in an L-shape using the MKT, and operated smoothly.
Water/Fuel	Most estimations of water usage were in the light to moderate range. Water was required for the rations, beverages, and sanitation. The fuel used

was MOGAS, and consumption was light to moderate. Four of the cooks said they didn't have to recharge the burners for as long as 8 hours. One also said the immersion heater process required more fuel than the KCL.

Trash                   The consensus was that T Rations produce heavy trash. This unit also had to transport other unit trash, which made the burden even greater. It is not an uncommon practice to use food service vehicles to carry trash produced by others.

Lifting                   The items that had to be lifted in this system evoked no serious complaints as to difficulty except perhaps for the T Ration modules. Three of the interviewees felt some modules were especially heavy, and that the weight was not balanced. The only lifting task requiring two people is the ration heater.

Safety                   The burner was generally considered safe, with some also adding that you have to know what you're doing and follow the guidelines.

Interviewees' opinions:

KCL's best features:

- Convenient, easy system (N=3)
- Insulator kept food warm (N=2)
- Fast, small, compact (N=1)

KCL's worst features:

- Ration holder doesn't hold Tray Packs well (N=1)
- Soldiers don't like the T Ration (N=2)

Suggestions for improvement:

- Find a good can opener.

3. TRHS (N=3)

The TRHS was virtually a one-man operation in the Artillery battery, the 1/29 FA, that used it. The operator was a 13B (Artilleryman), not a cook. A few of the cooks and other Artillerymen in the unit had a nodding acquaintance with the TRHS, e.g., either they had a class on it, or may have loaded or unloaded rations in it, or been involved with some other aspects of the system process, but none were familiar with all aspects of the system.

During the first week of the test the system broke down twice. The operator stated he was able to use the TRHS to prepare

approximately five company-size meals and transported every meal in a 2-1/2 ton truck. The insulated containers were used with the system, and the plastic lids were tried.

The opinions expressed here are primarily those of the chief operator, with comments from two others who had some experience with the system. The system was not used for any small group remote feeding.

Set up/            Set up was easy and take down "nothing." Set up  
Take down        time (filling the tank with water, fueling, etc.)  
                     was 15 min and take down about 5. A second  
                     person was involved - and considered necessary -  
                     only for driving the truck and serving the  
                     rations. Meal preparation times for 18 Tray Packs  
                     were 35-40 min.

Number            The system supported approximately 90 meals, and  
                     that was considered about maximum.

Clean up         The time estimate for clean up was 5 minutes, and  
                     sanitation was easy. Leftovers were thrown away.

Serving line     Tables were set up outside the truck with all  
                     items needed for the meal, except for the hot T  
                     Ration items which were served out of the back of  
                     the truck. Soldiers fed into the line spaced at 5

meters apart (a military requirement) and the flow was smooth.

Water/Fuel/  
Trash

Water usage was considered moderate. It would have been considered light except water spilled out of the tank when on the move. The truck was soaked after every meal. Diesel fuel was used, and usage was light when the system was operating normally. The amount of trash generated was considered heavy, and it was all food related.

Lifting/  
Working

The items that had to be lifted in this system evoked no serious complaints. It was considered easy to operate inside the truck. That was also the opinion of the two other personnel who had worked in the back of the truck. Those two, however, also commented that there was not enough room between the lid of the heater and the truck canvas. The heights of the three interviewees ranged from 5ft 6in to 6ft 6in.

Safety

The system was generally considered safe by the three interviewees, with the caveat that common sense has to be used. The water temperature is at a controlled level, and the system is far superior to the "trash can" method which uses the immersion

heater. One interviewee stated that the immersion heater has blown up on him personally at least four times (no serious injury, however).

Mechanical Performance The TRHS' ability to heat on the move was good. Connecting the inverter and turning it on were easy procedures, as was starting the heater system. However, the TRHS did break down twice during the evaluation.

Interviewees' opinions:

TRHS' best features:

- Quick, efficient (N=3)
- Easy to lift T Rations out, holds more than garbage can (N=3)
- Insulated containers keep food hotter (N=1)

TRHS' worst features:

- Rubber seal on heater doesn't work (N=1)

Suggestions for improvement:

- Needs a bigger fuel can for the present (too many trips for refills).



- Needs mounting system for 2-1/2 ton truck.

#### 4. INSULATED CONTAINERS

##### 1/77 Armored Battalion (N=2)

The containers were used by those feeding out of the Karcher/MKT configuration on just a few occasions when there was a Tray Pack or two that did not fit into the food carriers being sent out. These personnel felt they had no real utility for feeding battalion-size groups. They also had no information about how hot they kept the food, as they were not present at the distribution sites.

##### 1/29 Field Artillery (N=1)

The soldier who was the principal operator of the TRHS used the containers (the ones without the clips) when it was cold, or if there were delays between servings. He estimated they kept the food warm between servings for about 30-45 min. He could not comment on any differences in performance due to weather. Sanitizing them was easy, as was storage (they were kept in the original boxes). They were light, small, and easy to use, but often would not stay closed. In his situation they did not reduce the amount of waste. He felt they would only have limited usage if adopted, as he didn't think most soldiers would take the time to use them.

Plastic Lids. The TRHS principal operator was the only person in the whole evaluation who used the plastic lids provided for the T Rations, and he only used them once. He found they didn't work if the pack was damaged/dented or swollen from the cooking process.

HHC, 2nd Brigade (N=7)

This unit used three of the containers with every meal, and had the type with the metal clips. They used them to keep the Tray Packs hot until served, and did not use them between servings, as the company-size group they fed always went through the line continuously. They liked the containers and felt they did a very good job of keeping the rations hot. The E-6 in charge of this group said the containers kept the food warm for up to 5 hours. They were also easy to sanitize.

This method of keeping the rations warm was considered far preferable to using a water bath, which requires using an M-2 burner. No differences were noticed in the containers' ability to keep food warm with the differences in temperatures experienced during this evaluation.

This unit also did not feed at small, remote sites, but felt loading a few of these containers on a HMMWV would work very well for feeding just a few people.

There were a few concerns expressed about the containers. One was that they may not function as well in really cold weather, and the other that the metal clips may not hold up well. A few clips were beginning to bend, probably as a result of trying to loosen them. It seems that the ration, when heated, causes pressure in the container which makes the clips hard to release.

5. MERMITE WITH T RATIONS (N=2)

Very little data were available on use of Mermite with T Rations. Only two of the interviewees had any information, and that was sketchy. They considered using Mermites with T Rations (putting the unopened Tray Packs in the containers) an easy approach to feeding 12-15 people, and a difficult way to feed a large group (e.g. company size). Regardless of the situation, neither thought highly of it as a standard practice. Neither had any first-hand knowledge of how long the food stayed hot in the Mermite, but one commented that once the food is opened there obviously is no way to keep it hot. There were no opinions as to amount of food waste.

6. MERMITE CONTAINERS w/PLASTIC LINER (N=7)

Only one unit, HHC, 2nd Brigade, used the plastic liners for the Mermite, and it used them throughout the evaluation. Personnel used them on site for feeding A ration breakfasts to the company - they were not sent out. The users were very enthusiastic

about them, as they kept the Mermite much cleaner and considerably reduced sanitation time. They had no problems serving out of them, except that when they tried to bend the bags over the sides they didn't fit well. They had no trouble putting the bag in the insert, and food didn't leak out if the containers were not too full. The chief criticisms are that the bag is too long (one estimated by as much as 4in) and it needs some sort of closure system. The only way it can be closed now is by twisting the top.

#### 7. CAN OPENERS

##### HHC, 2nd Brigade (N=7)

HHC used only hand held can openers designed for home use during the evaluation. They referred to them as "disposable" can openers as the blades dull rapidly. They find them preferable to the table mounted for T Ration use as the table mounted are too inconvenient and take up too much space. Also, the blade on the table-mounted opener is not deep enough.

##### 1/77 Armored Battalion (N=2)

Two personnel reported using the bent-handle and black-handle can openers. They felt the bent-handle kind was better than the black, but was not as durable. The criticisms of the black-handle type were that it didn't go around the corners of

the Tray Pack easily, and using it was a slow process.

1/29 Field Artillery (N=3)

The three artillery personnel stated that the most often used can opener used for Tray Pack on this exercise was the table mounted. Their opinion of it was that it was no good and time consuming. One had used the bent- and black-handle openers and stated that the bent handle was "garbage" and that the black handle was not durable (in contrast to the remarks from the armor personnel), as well as "no good on corners."

8. Comments from Senior Food Service Personnel (N=2)

Unstructured interviews with two senior food service NCOs - one of whom was assigned at brigade level - elicited these comments on the Karcher and the MKT:

Karcher Kitchen

- \*Concept is great.
- \*Is easier to set up than the MKT.
- \*Needs drains for the shallow pans.
- \*Not designed for an American breakfast.
- \*Cooks T rations well.
- \*Cleaning the burners everytime is a problem and one-time cleaning is sometimes not enough.

- \*Not really feasible to serve from.
- \*Needs tables for work room.
- \*Need some sort of ground cover/platform.
- \*Need vents; gives off lots of steam.
- \*Not enough fuel capacity.

#### MKT

- \*Floor too cold in MKT in winter; steps hazardous.
- \*MKT too small, can take only two cooks.
- \*No place for refrigerator/ice.

#### 9. CONCLUSIONS.

The major advantages and disadvantages to the systems and equipment involved in this concept evaluation were:

Karcher Kitchen - Set up and take down were considered both fast and easy. Personnel like how the sides work. It is apparently hard to serve from, and needs to be "Americanized." (American eating styles call for more grilling surfaces, fewer stewing type vessels.) Working directly on the ground may be another disadvantage in winter or muddy conditions. More working surfaces are needed. The heat is hard to regulate in shallow wells (too hot) and their sanitation difficult (no drains). The wells are very good for T Ration and coffee preparation. All

objected to cleaning burners with every use. Overall rating was 5.6 (7=very good).

MKT - The MKT is easy to set up and serve from, but too small for more than two to work in comfortably. The take down is a slower process than for the Karcher. It needs to be winterized (floor and steps). Personnel do not like using the jacks. Overall rating was 5.4 (7=very good).

KCL - The KCL was considered a convenient, easy system.

TRHS - It seems as if this system may have a lot to offer once the mechanical difficulties are solved. Only one person, an artilleryman, was involved with it in any overall capacity during this evaluation, but he found it very easy and quick to use.

Insulated Containers - Those who used them for company-level feeding liked them. Doubts were expressed, however, as to how well they would function in cold weather, and they were not seen as useful for large groups.

Plastic Liners for Mermite - The few who used them were enthusiastic about them. They simplified sanitation. The liner needs to be shortened, however, and needs a closure method.

Mermite Use with T Rations. The two personnel who had experience with this configuration did not think highly of it.

The conclusions should be referenced against the following factors:

- a. The sample response size is small. The number replying to questions on any individual system or item ranged from 1 to 7, an especially notable situation in regard to the TRHS.
- b. The weather and terrain did not seriously tax any item or system.
- c. No valid conclusions can be drawn about the Karcher used as a stand alone. While the MKT was not used as a stand alone, most cooks were at least familiar with it as such. If the Karcher had been used alone, there may have been a shift in opinion about it. For instance, while the cooks perceived that serving out of the Karcher was a problem, actually having had to do so might have lessened their opinion of it overall if it were as awkward as feared.
- d. Using the Karcher and the MKT in tandem to feed a battalion size unit may have resulted in some different effects than when feeding on a smaller scale whether the kitchens were used in tandem or not. For instance, there would not have been a meal



interruption to refuel burners. Also, the one A Ration served each day was breakfast. If it had been supper, more differences in performance may also have been observed.

e. The KCL was used with the MKT. Use with a 2-1/2 ton truck may also have resulted in different opinions and estimates in regard to performance.

f. No one was involved with feeding less than a company-size group.

10. RECOMMENDATIONS.

1) Recommend that if there are any other data supporting the need for the MKT to have the floor and steps improved for winter use, that this be done as quickly as possible.

2) In future evaluations, objective measures of set up and take down times for the kitchens should be taken. Subjective estimates can be influenced by many factors and may be far from accurate. Also, people may have somewhat different perceptions of the range of activities that constitute the set up and take down processes. Different supervisors may also specify differing procedures that influence the times taken.

3) Some criteria for what constitutes ease-of-use should be

described for food service equipment. Human beings are very adaptive, and subjectively perceive items and systems as being easy to use, when in reality they are not. That situation is cued by statements such as "It's easy when you know what you're doing," or "It's easy after you get used to it." Another problem in this arena is that many young, military males do not like to admit something is difficult. Difficulty is couched in words such as "It's a hassle." The bottom line here is that an objectively easy system is easier to train, makes for a more efficient operation with fewer errors, and is safer.

4) One portent of the future is the cooks' dislike of cleaning the Karcher diesel burners after each meal, which they were told to do during this evaluation. The Army is moving to diesel burners, and while diesel is inherently safer, it requires much more maintenance (cleaning). The M-3, the Army diesel burner currently in development, was designed to limit maintenance requirements. However, continued use of Karcher burners will require some maintainability redesign. This is important because just as the M-2 is not routinely cleaned in the field, the probability is high that the diesel burners will not be cleaned as required, especially if the process is tedious or otherwise aversive. The implication is that design changes be planned now to make the cleaning as palatable as possible, e.g. a burner should have as few parts as possible, parts that are easy to clean (no small crevices or sharp edges) and a solvent provided to expedite the process.

5) Although units should use equipment in a "real world" way in a field test, steps should be taken to prevent scenarios that do not appear to have any future reality, or seriously affect being able to acquire the desired data. For instance, use of the Karcher with the MKT is not a viable combination and in this case precluded being able to acquire any data on the Karcher's use as a stand alone. If any similar situation is observed in future evaluations, we recommend that it be changed.

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