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US ARMY TEST & EVALUATION COMMAND

USATECOM PROJECT NO. 8-3-7400-05K

FINAL REPORT OF
ENGINEER DESIGN TEST OF
MEAL, READY-TO-EAT, INDIVIDUAL

MAY 1964

US ARMY
QUARTERMASTER RESEARCH AND ENGINEERING
FIELD EVALUATION AGENCY
FORT LEE, VIRGINIA

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HEADQUARTERS
U.S. ARMY GENERAL EQUIPMENT TEST ACTIVITY
FORT LEE, VIRGINIA 23801

STEFA-ET 30 July 1964

SUBJECT: Correction to Engineer Design Test Report for: Meal, Ready-to-Eat, Individual, USATECOM Project No. 8-3-7400-05K

TO: See Distribution

The following corrections are made to subject report of test:

a. Correct last sentence of 3rd paragraph of Abstract (and each Abstract Card) to read: "It is also recommended that potato salad be eliminated as a menu component, the 'bulk' of the menus increased or their acceptability improved to assure their satiety characteristics, and the carton-stove be eliminated or redesigned."

b. Correct paragraph 1. 8e to read: "The satiety of the Meal, Ready-to-Eat is lower than that of the standard Meal, Combat."

c. Correct paragraph 1. 9c to read: "The 'bulk' of the menus be increased or their acceptability improved to assure their satiety characteristics."

d. Correct 1st sentence of paragraph 2. 7. 3b to read: "Of a total of 22 of each of menus 1, 4, and 6 dropped free-fall at an altitude of 100 feet, four foods showed evidence of major damage."

FOR THE COMMANDER:

for C. O. LIGHT, JR.
Captain, QMC
Adjutant

INSERT BEHIND FRONT COVER

HEADQUARTERS
U.S. ARMY QUARTERMASTER RESEARCH AND ENGINEERING
FIELD EVALUATION AGENCY
FORT LEE, VIRGINIA

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U.S. ARMY QUARTERMASTER RESEARCH AND ENGINEERING
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FORT LEE, VIRGINIA

USATECOM 8-3-7400-05K

Final Report of Engineer Design Test of Meal, Ready-to-Eat, Individual

Conducted at Camp A.P. Hill, Camp Pickett, Camp Pendleton, Fort Story, and Fort Lee, Virginia

May 1964

Abstract

The Meal, Ready-to-Eat, Individual, is one of three types of meals included in a simplified feeding system that commanders may use interchangeably, depending on prevailing tactical and logistical conditions. This meal is designed for issue to individuals and used to feed troops at times when it is impractical to provide either unit or small group messing.

An engineer design test of the Meal, Ready-to-Eat, Individual, was conducted by the Field Evaluation Agency during the period 10 February through 24 April 1964 to determine the performance of prototype menus 1, 4, and 6 of the individual meals in relation to their acceptability, utility and concept of use. Experimental and standard menus were evaluated under both normal use and accelerated use conditions. Measures were obtained of such factors as troop acceptability of meals and components, durability of packaging, utility of a combination carton-stove provided with each meal, and air delivery capability.

Test results show that menus of the standard Meal, Combat, Individual, are more acceptable than menus and components of the Meal, Ready-to-Eat, Individual (menus 1, 4, and 6); the combination carton-stove is not suitable in its present configuration; the Meal, Ready-to-Eat menus are capable of air delivery with or without parachute.

It is recommended that consideration be given to improving the acceptability of the Meal, Ready-to-Eat components with particular emphasis on the beef patty, bread roll, date pudding, cereal bar, fruitcake, and milk. It is also recommended that potato salad be eliminated as a menu component, the "bulk" of the menus increased to improve satiety characteristics, and the carton-stove be eliminated or redesigned.

SECTION 1 - GENERAL

1.1 REFERENCES

1. Burt, Thomas B., Feasibility Test of Food, Precooked, Dehydrated for Individual, Ready-to-Eat Meals, Technical Report, TECOM Project No. 8-3-7410-01K, QM R&E Field Evaluation Agency, Fort Lee, Virginia, July 1963.

2. Burt, Thomas B., Engineering Test of Packaging, Flexible for Heat Processed Beefsteak, Technical Report, TECOM Project No. 7K-3173-01, QM R&E Field Evaluation Agency, Fort Lee, Virginia, April 1963.

3. Letter, AMXRE-FPC, U.S. Army Natick Laboratories, 5 March 1964, subject: "TECOM Project 8-3-7400-04, Engineering Test of Meal, Ready-to-Eat, Individual, (NLABS 64014)."

4. Military Characteristics for Operational Rations. See Appendix B-1.

5. Combat Development Objective Guide, Change 21, paragraph 1439f(16)(U).

1.2 AUTHORITY

Letter, AMXRE-F, Headquarters, U.S. Army Natick Laboratories, 13 December 1963, subject: "NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual;" 1st Indorsement thereto, AMSTE-BC, Headquarters, U.S. Army Test and Evaluation Command, 23 December 1963. (Appendix A.)

1.3 OBJECTIVE

To determine the performance of prototype menus 1, 4, and 6 of the Meal, Ready-to-Eat, Individual in relation to their acceptability, utility and concept of use.

1.4 RESPONSIBILITIES

The QM R&E Field Evaluation Agency was responsible for the planning, conduct and reporting of this project.

1.5 DESCRIPTION OF MATERIEL

1.5.1 EXPERIMENTAL

The experimental items are prototype menus 1, 4, and 6 of the Meal, Ready-to-Eat, Individual. (Figure 1) Each menu consists of dehydrated and/or standard heat processed foods which constitute one third of a day's ration. Components are packaged in flexible containers which are overwrapped in a lightweight fiberboard carton. The meal carton is also designed for use as a stove for heating meal components. Each meal also includes standard accessory items in a flexible package.

1.5.2 STANDARD

The standard items are twelve menus of the standard Meal, Combat, Individual. Each menu consists of standard heat processed foods which constitute one third of a day's ration. Components are packaged in metal cans which are overwrapped in a lightweight fiberboard carton. Accessory items in a flexible package are included in each meal carton.

1.6 BACKGROUND

a. The Meal, Ready-to-Eat, Individual, is being developed based on a requirement established in paragraph 1439f(16) of CDOG. It is one of three types of meals included in a simplified feeding system which will be available for commanders to use interchangeably, depending on prevailing tactical and logistical conditions. This is the meal which will be available for issue to individuals and used to feed troops at times when it is impractical to provide either unit or small group messing. Both of the other two meals are packaged for group feeding: one, uncooked, for large groups under circumstances permitting operation of field preparation equipment; the other, precooked, for small groups under tactical and/or logistical conditions precluding the operation of field cooking equipment.

b. Work on development of components for this meal began in 1959. In 1962 certain items were considered ready for preliminary evaluation and a feasibility study was scheduled. Four types of dehydrated fruit and four types of meat patties were substituted for comparable canned items in the Meal, Combat, Individual, and the

Figure 1. Display of meal components and assembled carton-stove.

substituted meals were compared with the regular Meal, Combat, Individual, by troops operating in the field. This study was conducted in May 1963 (1).

c. During February 1964 six menus were made available for evaluation. Menus 2, 3, and 5 were subjected to an Engineering Test during the period 10 February through 24 April 1964. This report describes the conduct and findings of an Engineer Design test of menus 1, 4, and 6 which was conducted in conjunction with the Engineering Test. Results of the Engineering Test (menus 2, 3 and 5) are reported separately. See Technical Report USATECOM Project 8-3-7400-04K, dated May 1964, "Final Report of Engineering Test of Meal, Ready-to-Eat, Individual."

1.7 FINDINGS

See Section 2.

1.8 CONCLUSIONS

It is concluded that:

a. Menus and components of the standard Meal, Combat, Individual are more acceptable than menus and components of the Meal, Ready-to-Eat, Individual (menus 1, 4, and 6).

b. The acceptability of menus 1 and 6 of the Meal, Ready-to-Eat is higher than that of menu 4 when all are consumed cold.

c. A majority of the components of the Meal, Ready-to-Eat menus are acceptable when consumed hot or cold.

d. The least acceptable components of the Meal, Ready-to-Eat menus are potato salad, beef patty, bread roll, date pudding, cereal bar, fruitcake, chili seasoning powder, soup and gravy base, and milk.

e. The quantitative adequacy, or satiety value, of the Meal, Ready-to-Eat menus is lower than that of the standard Meal, Combat.

f. The combination carton-stove provided with each menu of the Meal, Ready-to-Eat is not suitable in its present configuration for use by the soldier as a stove.

g. The stove is a potential safety hazard to personnel and property.

h. The thermal efficiency of the carton-stove is slightly greater than that of an earlier prototype previously tested (2).

i. The Meal, Ready-to-Eat menus are capable of air delivery with parachute, and without parachute with approximately a 75 percent recovery rate (4).

j. The durability of flexibly packaged components of the Meal, Ready-to-Eat menus is satisfactory when subjected to 3 traversals of the major obstacles of the FEA Design and Fabric Courses.

1.9 RECOMMENDATIONS

It is recommended that:

a. The acceptability of the Meal, Ready-to-Eat components be improved wherever possible with particular emphasis on the beef patty, bread roll, date pudding, cereal bar, fruit cake and milk.

b. The potato salad as a menu component be eliminated.

c. The "bulk" of the menus be increased to improve their satiety characteristics.

d. The carton-stove of the Meal, Ready-to-Eat, Individual be eliminated entirely, or redesigned to make it less complex for the soldier to use and to eliminate the safety hazard.

SECTION 2 - DETAILS AND RESULTS OF SUB-TESTS

2.0 INTRODUCTION

The general approach to conducting this test involved the use of both subjective and objective testing techniques. Experimental and standard menus were evaluated under both normal use and accelerated use conditions. Measures were obtained of such factors as troop acceptability of meals and components, durability of packaging, utility of a combination carton-stove provided with each meal, and air delivery capability. Individual tests performed are described in subsequent paragraphs of this report.

2.1 ACCEPTABILITY RATINGS OF MEALS AND COMPONENTS

2.1.1 OBJECTIVE

To determine the acceptability of menus and components of the experimental Meal, Ready-to-Eat and standard Meal, Combat, Individual when major components are consumed both hot and cold.

2.1.2 METHOD

a. Three company size units of an Engineer Battalion subsisted on menus 1 through 6 of the Meal, Ready-to-Eat and 12 menus of the Meal, Combat, Individual while undergoing counterinsurgency training at Camp A.P. Hill, Virginia, during February 1964. Each ration was consumed for 2 days in each company. Individuals in the companies prepared their own meals utilizing the standard trioxane fuel bar as a source of heat. (Figure 2.) The combination carton-stove provided with the Meal, Ready-to-Eat (Figure 1) was used to prepare major components of this ration, while for the Meal, Combat, components to be heated were prepared in the metal cans. Participants rated complete menus and individual components during each meal. Ratings were obtained on the 9-point hedonic scale.

b. In addition to the above, five company size units consumed unheated meals from both rations at different times during February and March 1964. In each case one half of the company consumed the Meal, Ready-to-Eat while one half consumed the Meal, Combat, Individual at the noon meal on each test day. Meals were issued randomly

from both rations. The A Ration was consumed at breakfast and supper meals. All companies were engaged in normal field training exercises which included preparation for Army Training Tests by three QM Units at Camp Pickett and Fort Lee, Virginia, and over-the-beach training operations by two transportation companies at Fort Story and Camp Pendleton, Virginia. Rating questionnaires were administered to all participants at each test meal to determine the acceptability of dehydrated foods when rehydrated with unheated canteen water, or the acceptance of both dehydrated and non-dehydrated foods when consumed as they are found in the meal package.

2.1.3 RESULTS

2.1.3.1 Acceptability of Menus and Components When Consumed Hot and Cold

Appendix B-2 lists average ratings obtained for the standard Meal, Combat menus and components when major items were consumed heated, and also when all items were consumed unheated. Table I shows similar hot and cold ratings obtained for menus 1, 4 and 6 and components of the Meal, Ready-to-Eat.

2.1.4 ANALYSIS

a. Comparison of the average ratings in Table I and Appendix B-1 shows a general preference for the Meal, Combat menus and individual foods. Statistical analysis showed the difference between the overall mean for the 12 standard menus and the mean for individual menus of the Meal, Ready-to-Eat to differ significantly at the 5 percent probability level, both when rations were consumed hot and when consumed cold. A composite average was used for the Meal, Combat since menus in the two rations were not directly comparable.

b. With regard to the experimental menus per se, differences between average menu ratings did not differ significantly at the 5 percent level when main items in the meals were consumed hot. When consumed cold, however, the average rating for menu 4 was significantly lower than that obtained for menu 1 or menu 6.

c. Averages for individual foods show potato salad to be the least liked of all items in the menus and to be unacceptable. The dehydrated beef patties show a sharp decrease in average rating when

Figure 2.
Preparation of
Experimental
Meal.

Figure 3.
Observer-Recorder
checks plate waste.

UNITED STATES ARMY
QM R&E
FIELD EVALUATION
AGENCY
FORT LEE, VIRGINIA
TEST 8-3-7400-05K

NEGATIVE 6HH, 3HH

TABLE I

MEAL, READY TO EAT, INDIVIDUAL (MENUS 1, 4 AND 6)
AVERAGE RATINGS OBTAINED WHEN MAJOR COMPONENTS WERE HEATED PRIOR TO CONSUMPTION AND WHEN ALL COMPONENTS WERE CONSUMED UNHEATED

Item	Menu in Which Item Appeared	Avg. Rating When Major Items Were Heated*		Avg. Rating When Major Items Were Unheated**	
		Number of Men Rating	Avg. Hedonic Rating	Number of Men Rating	Avg. Hedonic Rating
Entire Meal	1	225	6.30	120	5.68
	4	221	5.92	115	5.03
	6	224	6.28	129	6.01
Pork Sausage	1	226	6.43	122	5.60
Beef Patties	4	227	6.44	118	4.73
Chicken a la King	6	225	6.36	131	6.17
Cereal Bar	1	193	5.59	98	5.49
Potato Salad	4	219	4.81	108	4.28
Bread Roll	1,4	444	5.16	233	552
Crackers	6	223	6.48	128	6.59
Military Spread	1	209	6.14	115	6.20
Cheese Spread	6	223	6.92	130	6.47
Chili Seasoning Powder	4	193	5.61	86	5.27
Applesauce	1	228	7.21	122	7.50
Pineapple	4	225	7.18	120	7.12
Apricots	6	219	6.56	122	5.91
Grape Juice	6	218	6.76	121	6.81
Soup and Gravy	4	205	5.60	90	5.09
Vanilla Cream Bar	1	223	6.61	111	6.88
Chocolate w/Almonds	6	216	6.62	120	6.53
Fruitcake	4	223	5.74	118	5.96
Date Pudding	6	220	5.41	121	5.20
Coffee	1,4,6	602	6.40	261	6.23
Cocoa	1	216	6.69	107	6.68
Milk	4	205	5.58	102	5.45

* Experimental meals used on a continuous basis for 2 days during normal field training at Camp A. P. Hill, Virginia

** Experimental meals used only at noon meal each test day. A Ration used at breakfast and supper.

consumed cold and would also be considered unacceptable unless heated. Other items with relatively low average ratings are the bread roll, date pudding, cereal bar, fruitcake, chili seasoning powder, soup and gravy base, and milk.

2.2 FOOD CONSUMPTION DATA

2.2.1 OBJECTIVE

To obtain estimates of the amount of individual foods consumed, as a further indication of the acceptability of the Meal, Ready-to-Eat and Meal, Combat menus.

2.2.2 METHOD

During the A.P. Hill test, observers recorded estimates of the proportion of each food item consumed by participants during each meal. (Figure 3.) Estimates were based on whether individuals consumed "all," "two-thirds," "one-third," or "none" of each food in each meal. From these data, the overall percentage of each item consumed was computed.

2.2.3 RESULTS

The overall percentage of each item consumed for components of the Meal, Ready-to-Eat and Meal, Combat, Individual menus are shown in Table II.

2.2.4 ANALYSIS

Food consumption percentages obtained generally follow the trend of average ratings as shown in Table I, in that experimental foods with the lowest average ratings also tend to have low consumption percentages. Also on the basis of these data the standard Meal, Combat items are considerably more acceptable than the experimental foods.

2.3 QUANTITATIVE ADEQUACY OF MEAL, READY-TO-EAT MENUS

2.3.1 OBJECTIVE

To determine that menus 1, 4 and 6 of the Meal, Ready-to-Eat provide an adequate quantity of food for one man for one meal.

TABLE II

OVERALL PERCENT CONSUMED OF MAJOR FOODS IN MEAL, READY-TO-EAT AND MEAL, COMBAT
(Major Components Heated Prior to Consumption)

Meal, Ready-to-Eat, Individual				Meal, Combat, Individual			
Item	Menu in Which Item Appeared	No. of Observations	Overall Percent Consumed	Item	Menu in Which Item Appeared	No. of Observations	Overall Percent Consumed
Pork Sausage	1	203	94	Beans w/Franks in Tomato Sauce	A	98	98
Beef Patties	4	206	94	Beefsteak with Juices	B	80	98
Chicken a la King	6	215	95	Beefsteak with Potatoes & Gravy	C	99	96
Cereal Bar	1	203	77	Boned Chicken	D	105	99
Potato Salad	4	206	86	Chicken & Noodles	E	101	97
Bread Roll	1,4	409	84	Ham and Eggs, Chopped	F	108	99
Crackers	6	215	93	Ham & Lima Beans in Tomato Sauce	G	103	97
Military Spread	1	203	85	Ham Fried	H	101	97
Cheese Spread	6	215	94	Meat Balls w/Beans in Tomato Sauce	I	96	98
Chili Seasoning Powder	4	206	83	Pork Steak w/Juices	J	111	98
Apple Sauce	1	203	98	Spiced Beef w/Sauce	K	82	97
Pineapple	4	206	95	Turkey Hash	L	88	97
Apricots	6	215	92	Apricots	B	80	100
Grape Juice	6	215	94	Peaches	E	101	97
Soup & Gravy	4	206	85	Pears	H	101	99
Vanilla Cream Bar	1	203	93	Fruit Cocktail	L	88	96
Chocolate with Almonds	6	215	95	Date Pudding	A	98	83
Fruitcake	4	206	89	Fruitcake	C	99	98
Date Pudding	6	215	87	Cookies	D,F,K	295	98
Coffee	1,4,6	624	90	Pecan Cake Roll	G	103	96
Cocoa	1	203	90	Pound Cake	I	96	96
Milk	4	206	81	Candy	B,E,H,L	370	96
				Crackers	A,B,C,E, G,H,I,L	766	96
				White Bread	D,F,J,K	406	95
				Spread	All	1172	96
				Coffee	All	1172	91
				Cocoa	D,F,J,K	406	95

2.3.2 METHOD

During testing conducted at Camp A.P. Hill participants were questioned as to whether they received enough to eat when consuming the Meal, Ready-to-Eat and the Meal, Combat, Individual. These data were obtained to determine if the quantity of food in the Meal, Ready-to-Eat menus was adequate from the standpoint of satiety.

2.3.3 RESULTS

The distribution of responses to the question "Did you get enough to eat when consuming menus of the Meal, Ready-to-Eat and Meal, Combat?" are shown in Table III.

TABLE III

ADEQUACY OF QUANTITY OF FOOD IN MEAL, READY-TO-EAT AND MEAL, COMBAT MENUS

Question Responses	Response Distribution			
	Meal, Ready-to-Eat		Meal, Combat	
	Number	Percent	Number	Percent
Quantity of Food:				
More than enough	3	2.0	7	4.9
Enough	55	37.2	96	67.1
Not enough	90	60.8	40	28.0

The number of individuals who said they did not get enough to eat is significantly larger, at the 5 percent probability level, for the Meal, Ready-to-Eat.

2.3.4 ANALYSIS

a. The fact that a larger number of individuals considered the Meal, Ready-to-Eat to be less filling than the standard meals is partly caused by the relatively low acceptability and consumption of major foods in the experimental menus, including the bread roll.

(Tables I and II.) Failure of many individuals to eat the bread also resulted in low consumption of the military spread. Voluntary comments of participants also showed the existence of a feeling that from the standpoint of satiety the experimental meal components were not as substantial as the standard canned items.

b. Another factor which probably influenced the opinions of individuals as to the adequacy of the quantity of food was difficulty experienced in using the carton-stove to prepare the experimental meals. (See paragraph 2. 4. 3.) Difficulty in setting up and operating the stove resulted in instances of inadequate, or partial preparation of foods.

2.4 UTILITY OF COMBINATION CARTON-STOVE

2.4.1 OBJECTIVE

To determine the utility and suitability of an expendable combination carton-stove (Figure 1) provided with each menu of the Meal, Ready-to-Eat for use by the soldier in the preparation of food components.

2.4.2 METHOD

Carton-stoves provided with the meals were used by personnel of three Engineer Companies (paragraph 2. 1. 2.) to heat necessary water and certain foods in the menus over a 4-day period at Camp A.P. Hill, Virginia. Participants were observed to determine problems encountered in using the stoves. Observations regarding time required for meal preparation using the carton-stove and standard trioxane fuel bar as a heat source were also recorded. The frequency with which the fiberboard stoves caught fire was also noted.

2.4.3 RESULTS

a. Conversion of the meal carton to a stove proved to be one of the most difficult tasks concerned with using this item. Instructions were provided with each meal, but were of little aid to the soldier who found the construction of the stove to be extremely complex and the item difficult to assemble. While with practice most individuals became

more proficient in assembling the stove, this task never became an easy one, and consistently required more of the soldier's time and effort than he cared to devote to it.

b. A previous test (2) in which an earlier prototype of the carton-stove was evaluated at Fort Lee showed that the heat source should be centered under the stove, and adequate shielding provided even in moderate winds, in order to prevent the stove from catching fire. This problem was also observed during the current test. In spite of the fact that the stove was chemically treated to make it fire resistant, troops found it difficult to prevent the stoves from burning. This in turn presented a safety hazard, and required that troops be alert to prevent the stove from burning completely. In this connection, a total of 125 carton-stoves were observed in operation by FEA personnel. Of this number 101, or 81 percent were found to be usable for more than one meal. The remaining 19 percent were severely damaged by burning due to high winds and failure to place the stove properly over the heat source.

c. During this test the safety hazard created by the stoves was reduced considerably by the fact the weather was extremely cold and precipitation in the form of snow left the ground wet throughout the entire test. Detailed weather data obtained during the A.P. Hill phase of the test are shown in Appendix B-3. It is recognized that fire and safety hazards also exist when heating the Meal, Combat, Individual with the standard trioxane fuel bar. The problem is compounded when using the Meal, Ready-to-Eat, however, since the stove itself presents an added fire hazard.

d. The purpose of the stove tested was simply to heat water, which in turn would be used to heat a standard heat processed (wet) food in a flexible package by the method illustrated in Appendix B-4. The success achieved in doing this was limited by several factors. Those meals prepared out of doors to be eaten hot were, in many instances, not heated properly due to the generally cold weather, heavy precipitation, inadequate performance of the trioxane fuel bar under even moderately windy conditions, and failure of the soldier to make the best use of the stove and fuel. Many meals were prepared inside tents under conditions which were conducive to satisfactory preparation. Under those conditions the stove and heat source generally performed in a satisfactory manner.

Figure 4. Weighing sample of Trioxane Fuel for use with Carton-Stove.

e. The proposed approach of using the stove to heat ration components by the "double boiler" method (Appendix B-4) was disregarded by some individuals. The method actually used was to submerge the packages in boiling water in the stove and, after heating or rehydrating the foods, to use the remaining hot water to make coffee or cocoa. This is the method which would most likely be used by the soldier in preparing foods if the present stove and ration were adopted. In this connection it is noted that use of this method would necessitate insurance of non-toxicity of the stove, the food packages, and glue used with these packages. Recorded observations as to preparation time for Ready-to-Eat Meals prepared outdoors showed an average preparation time of approximately 32.2 minutes. Eighteen individual preparation times observed ranged from 18 to 45 minutes.

2.4.4 ANALYSIS

Not applicable.

2.5 THERMAL EFFICIENCY OF CARTON-STOVE

2.5.1 OBJECTIVE

To determine the thermal efficiency of the meal carton when used as a stove.

2.5.2 METHOD

The thermal efficiency of the carton-stove in heating both water and flexibly packaged beefsteak in accordance with the printed instructions (Appendix B-4) was accomplished during 8 indoor trials. (Figure 4) The specific heat of beefsteak was obtained from results of a previous test (2) and was computed using a Bomb Calorimeter.

2.5.3 RESULTS

Table IV shows thermal efficiency values obtained for the carton-stove when heating water. Table V shows similar values obtained when heating the flexibly packaged steak. Ambient temperature during these trials was approximately 77°F. while relative humidity was 21.5 percent.

TABLE IV

THERMAL EFFICIENCY OF STOVE IN HEATING WATER ONLY (INDOORS)

Trial No.	(1) Weight of Fuel Bar (gms.)	(2) Available Heat = (1) x 4176 (calories)	(3) Initial Water Temp. t_o(°C)	(4) Final Water Temp. t_1(°C)	(5) Initial Water Weight w_o(gms.)	(6) Final Water Weight w_1(gms.)	(7) Calories to Heat Water $w_o(t_1-t_o)$	(8) Calories to Vaporize Water $540(w_o-w_1)$	(9) Total Heat Requirement (Calories)	(10) Thermal Efficiency = $\frac{100 \times (9)}{(2)}$ %
1	11.6	48441.6	21.1	100.0	174.9	157.3	13799.6	9504.0	23303.6	48.1
2	11.1	46403.6	21.1	100.0	174.9	156.7	13799.6	9828.0	23627.6	50.9
3	11.7	48859.2	21.1	100.0	174.9	159.6	13799.6	8262.0	22061.6	45.2
4	11.0	45936.0	21.1	100.0	174.9	158.4	13799.6	8910.0	22709.6	49.4
									Average	48.4

TABLE V

THERMAL EFFICIENCY OF STOVE IN HEATING 13½ OZ. (382.7 gms.) BEEFSTEAK (INDOORS)

Trial No.	(1) Weight of Fuel Bar (gms.)	(2) Available Heat = (1) x 4176 (calories)	(3) Initial Water Temp. t_o(°C)	(4) Final Water Temp. t_1(°C)	(5) Initial Water Weight w_o(gms.)	(6) Final Water Weight w_1(gms.)	(7) Calories to Heat Water $w_o(t_1-t_o)$	(8) Calories to Vaporize Water $540(w_o-w_1)$	(9) Calories to Heat and Vaporize Water (7)+(8)	(10) Initial Temp of Steak t_o(°C)	(11) Final Temp of Steak t_1(°C)	(12) Calories required to Heat Steak $0.773 \times 382.7 (t_1-t_o)$	(13) Total Calories Required (9)+(12)	(14) Thermal Efficiency = $\frac{100 \times (13)}{(2)}$ %
1	16.5	68904.0	23.3	100.0	174.9	144.5	13414.8	16416.0	29830.8	28.9	71.1	4160.9	33991.7	49.3
2	22.8	95212.8	21.1	100.0	174.9	123.3	13799.6	27864.0	41663.6	24.4	71.1	4604.6	46268.2	48.6
3	24.3	101476.8	21.1	100.0	174.9	121.4	13799.6	28890.0	42689.6	27.8	71.1	4269.4	46959.0	46.3
4	17.9	74750.4	23.3	100.0	174.9	141.7	13414.8	17928.0	31342.8	28.9	71.1	4160.9	35503.7	47.5
													Average	47.9

2.5.4 ANALYSIS

The average thermal efficiency obtained for the carton-stove is slightly higher than that obtained for an earlier prototype of the stove during a previous test (2). The average thermal efficiency of the earlier model in heating water with the same fuel under similarly controlled conditions was 43 percent. Thus from the standpoint of heating efficiency the present stove shows a slight improvement over the previous model.

2.6 OVERALL COMMAND AND TROOP ACCEPTABILITY

2.6.1 OBJECTIVE

To obtain an indication of officer, NCO, and enlisted personnel attitudes toward the Meal, Ready-to-Eat and Meal, Combat, Individual, after experience with menus of each ration.

2.6.2 METHOD

After 2 days' experience with each ration, officers and key NCOs in each of the 3 participating companies at A.P. Hill were asked to compare the experimental menus with the standard as to effects of their use on the ability to accomplish the unit mission, and overall suitability for field use. Enlisted personnel in the same companies were questioned separately regarding the overall suitability of the two rations for use by the soldier in the field. All personnel were further requested to make comments including specific likes and dislikes, or problems encountered.

2.6.3 RESULTS

a. Responses of 20 command personnel to specific questions are summarized in Table VI.

b. The average rating, and distribution of individual ratings of enlisted personnel, regarding the overall suitability of the Meal, Ready-to-Eat and Meal, Combat menus for use by the soldier are shown in Table VII.

TABLE VI

OVERALL SUITABILITY - COMMAND PERSONNEL

Question	Response Distribution	
	Meal, Ready-to-Eat	Meal, Combat
1. Did use adversely affect ability to accomplish unit mission:		
Yes, a great deal	3	2
Yes, some	9	2
No	8	16
2. Rate as to overall suitability for field use.		
Very or Moderately Suitable	6	20
Very or Moderately Unsuitable	14	0
3. Specific problems most often mentioned:		
Stove catches on fire	14	-
Too much time required for preparation	16	-
Too much trash to dispose of	13	
Too much water required	9	
Preparation requires constant attention	5	

TABLE VII

OVERALL SUITABILITY - ENLISTED PERSONNEL

Rating Scale Weight	Scale Category	Distribution of Ratings	
		Meal, Ready-to-Eat	Meal, Combat
7	Very Suitable	11	43
6	Moderately Suitable	26	52
5	Slightly Suitable	35	31
4	Neither Suitable Nor Unsuitable	17	11
3	Slightly Unsuitable	24	3
2	Moderately Unsuitable	6	1
1	Very Unsuitable	27	5
	Average Rating	4.02	5.67*

*The Meal, Combat, Individual rated more suitable than the Meal, Ready-to-Eat, at the 5 percent probability level.

2.6.4 ANALYSIS

a. Criticisms of the experimental meals made by enlisted personnel during the test, and noted by observers, generally followed the pattern of those shown in Table VI for the command personnel. Specific problems most apparent in using the Meal, Ready-to-Eat menus are summarized below.

(1) Difficulty in putting the stove together with or without instructions provided.

(2) Difficulty in preventing the stove from coming apart again.

(3) The ease with which the stove caught fire.

(4) The constant attention required during meal preparation to prevent the stoves from burning.

(5) The greater number of items in the experimental menus, some of which were difficult to handle during preparation, and all of which created a considerable trash disposal problem.

b. From the standpoint of preparation, menus of the Meal, Combat Individual appeared to the soldier to have many advantages over the experimental meals. Each meal, for example, contained 3 metal cans and an accessory pack - a total of 4 containers to handle. While the meat component of the standard rations was difficult to heat using the trioxane fuel bar, it appeared to be a relatively simple task compared to the experimental meals with their complicated and highly flammable stoves. The number of different containers in the Meal, Ready-to-Eat menus was 5 or 6, counting the accessory pack as a single item. All of these containers were flexible packages, many of which were difficult to handle during preparation and consumption of the meals.

2.7 AIR DELIVERY EVALUATION (MC 22b and c)

2.7.1 OBJECTIVE

To determine if menus of the Meal, Ready-to-Eat are capable of air delivery by parachute and without parachute with assurance of 75 percent recovery.

2.7.2 METHOD

a. A total of 27 cases of the Meal, Ready-to-Eat was rigged for air delivery, by qualified personnel of the 109th QM Company (Aerial Support). Each case contained two cartons of each of six different menus. An H-21 helicopter was utilized to accomplish all air drop operations. Air speed was from 60 to 70 knots.

b. Parachute Delivery

Two deliveries involving the use of parachutes were made as follows:

(1) High Velocity. Eight cases, grouped into 2 bundles of 4 each were rigged for a high velocity, 500-foot drop. (Figures 5 and 6.) Heavy straps secured the bundles which rested on 3 layers of 4-inch honeycomb. A small 68-inch pilot chute was attached to keep the load upright while falling.

(2) Low Velocity. Eight cases of meals were grouped into one bundle. The bundle was secured with a tarpaulin and heavy straps. Delivery was from an altitude of 1,250 feet using a G-13 cargo parachute.

c. Free Fall Delivery

One delivery without parachute was made as follows: One hundred foot drop - eleven cases were grouped into two bundles of 4 and one bundle of 3 each and rigged for a 100-foot free fall drop. Light straps were secured around each bundle so that the bundle would leave the aircraft as a single unit. Prior to impact, a mechanical knife cut the straps so that the meal cases landed individually.

2.7.3 RESULTS

a. There were 3 pineapple packages (menu 4) and 1 applesauce package (menu 1) with major leakage during the high velocity drop in which 16 of each menu were dropped from an altitude of 500 feet. There were no failures during the low velocity drop in which 16 of each menu were dropped from an altitude of 1,250 feet.

b. Of a total of 22 meals dropped free fall at an altitude of 100 feet, four foods showed evidence of major damage. These were applesauce (menu 1) with 9 failures; pineapple (menu 4) with 2 failures; chicken a la king (menu 6) with 4 failures; and cheese spread (menu 6) with 2 failures. For purposes of this evaluation a major failure was defined as a puncture or tear in the package where a majority of the food was lost. A total of 22 applesauce, pineapple, chicken a la king, and cheese spread packages showed minor leakage. Most of the contents of these packages were intact and were therefore considered usable.

2.7.4 ANALYSIS

The point of major interest in the air drop data is that the wet food packages (heat processed) were the only ones which sustained any major damage. Most of this occurred during the free fall drop. Applesauce showed the highest number of failures. Approximately 41 percent of the applesauce packages showed major failures during the free fall drop, while similar percentages for the pineapple, chicken a la king and cheese spread were 9, 18 and 9 percent, respectively. On this basis the air delivery performance of all three of the experimental menus with or without parachute is considered acceptable. However, the risk of major damage to the wet pack items is high when using the free fall delivery method at the 100-foot altitude.

2.8 ACCELERATED WEAR TEST

2.8.1 OBJECTIVE

To determine the effects on durability of exposing menus and components of the Meal, Ready-to-Eat to selected obstacles of the QM R&E FEA Design and Fabric Courses. (Appendix B-5).

2.8.2 METHOD

Fifteen enlisted men completed 3 traversals of selected obstacles of the FEA Design and Fabric Wear Courses while carrying either one-third, two-thirds or an entire ration (1, 2, or 3 menus) of the Meal, Ready-to-Eat dispersed in the pockets of their field jackets or fatigue clothing. (Figure 7) All six menus of the experimental ration were evaluated in this manner. Results reported here, however,

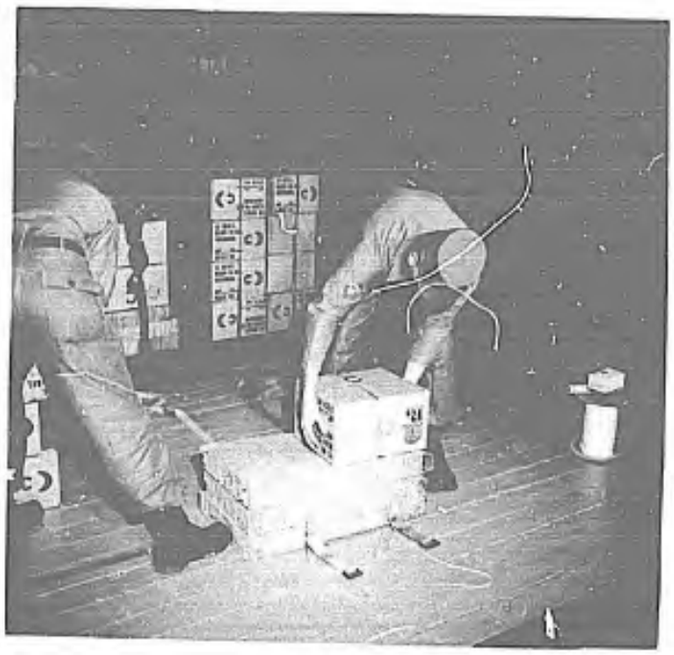

Figure 5.
Rigging Meal, Ready-to-Eat for high velocity drop.

Figure 6.
Loading rigged bundle in H21 Helicopter for delivery.

Figure 7. Obstacle 12 - Wooden Slide.

are for foods included only in menus 1, 4, and 6, and those which are common to all 6 menus. Results for 2, 3, and 5 are reported separately in technical report of TECOM Project No. 8-3-7400-04K, May 1964, covering the Engineering Test of the Meal, Ready-to-Eat, Individual.

2.8.3 RESULTS

a. Table VIII shows a summary of damages incurred by component packages of menus 1, 4, and 6. Damages are categorized as to whether they were of a major or minor nature. Examination of data obtained indicated that the number of meals carried by any one individual, whether 1, 2, or 3, had no appreciable bearing on the failure rate of the food packages. For this reason, and due to the small number of packages with major damage, Table VIII was prepared by combining damage data without regard to number of meals carried.

2.8.4 ANALYSIS

a. Dry products including the crackers, potato salad, pork sausage patty and beef patty showed evidence of crushing. Of particular interest are the crackers. Approximately 70 percent of the packages of this item carried had contents which were crushed. Approximately 57 percent of the beef patties carried were also crushed. Crushing rates for the other dry foods were considerably lower and ranged from approximately 25 to 33 percent. While there were items among those carried which showed badly crushed contents, most of the above products were found to be in an edible state and therefore crushing damage noted has been classified as minor.

b. With regard to pinholing and punctures or tears with slight or excessive leakage, neither the wet food nor dry food packages showed a large number of failures.

c. Overall the performance of the foods in the accelerated wear test was good. Treatment given these items during 3 traversals of the course obstacles is considerably more harsh than comparable type treatment expected under normal field conditions. Treatment of the items during this phase of the test was designed to provide maximum rather than normal stress. Such treatment, however, indicates that the dry foods in their present packaging configuration, are more susceptible to damage when carried by the soldier than other foods or items included in the menus tested.

TABLE VIII

NUMBER OF MEAL, READY-TO-EAT PACKAGES CARRIED AND DAMAGED DURING A MAXIMUM OF THREE TRAVERSALS OF SELECTED OBSTACLES OF THE FEA DESIGN AND FABRIC COURSES
(Menus 1, 4, and 6)

Food	Menu No.	No. Packages Carried	Number of Packages With:			
			Crushing of Contents (Minor)	Pinholes in Package Wall (Minor)	Puncture or Tear in Wall or Seal w/Slight Damage or Leakage. (Minor)	Puncture or Tear in Wall or Seal w/Moderate or Excessive Damage or Leakage (Major)
Chicken a la King	6	28	1		3	1
Date Pudding	6	28	5	1		
Fruitcake	4	30	6			
Bread	1,4	60	8			
Crackers	6	28	20			
Accessory Packs	1,4,6				1	4
Military Spread	1	30			3	
Cheese Spread	6	28			7	3
Potato Salad	4	30	11			
Apricots	6	28	7			
Milk	4	30				
Grape Juice	6	28		2	4	1
Cocoa	1	30				
Pork Sausage Patties	1	30	10	2		
Beef Patties	4	30	17			2
Apple Sauce	1	30				
Crushed Pineapple	4	30			3	3
Carton-Stove	1,4,6	88*				

* On 5 stoves, abrasion separated inside aluminum coating from fiberboard. Stove unusable.

SECTION 3 - APPENDICES

Appendix A - Test Directive

Appendix B - Test Data

Appendix C - Distribution List

APPENDIX A-1

AMSTE-BC (13 Dec 63) 1st Ind
SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual

Headquarters, United States Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 21005 23 DEC 1963

TO: Commanding Officer, U. S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia 23801

1. Reference is made to telephone conversation between Mrs. Klicka, Food Division, U. S. Army Natick Laboratories, and Mr. Dee, this headquarters, 19 December 1963.

2. The Engineering Design Test outlined in the basic correspondence has been assigned USATECOM Project No. 8-3-7400-05K. A directive to perform the test is attached.

3. Paragraph 5d, Test Design, basic letter, is amended to read as follows:

5d. Test Design

(1) Sustained Phases.

(a) Insofar as possible, issue Meal, Ready-to-Eat, to one or more companies (approximately 200 men) three times a day for two consecutive days under conditions where no other food is available.

(b) Issue Meal, Combat, Individual, to other companies under the same conditions.

(c) Issue menus randomly but with restriction that any given individual will not duplicate menus within one day.

(2) One Meal Use Phase.

(a) Select units totaling about 750 men that are in situations where it is logical and feasible to require use of an individual packaged ration for one meal each day for four consecutive days.

(b) For half of these units, issue Meal, Ready-to-Eat, for two days followed by Meal, Combat, Individual, for the next two days.

APPENDIX A-2

23 DEC 1963

AMSTE-BC (13 Dec 63) 1st Ind
SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual

(c) Reverse the order of issue for the other half of the units.

(d) Issue menus randomly to both groups.

FOR THE COMMANDER:

Roger G. Kemp
Lt Colonel GS
C, Admin Office

4 Incl
Added 1 incl
4. Test Directive (TEAMS Sheet)

Copy furnished: (w/o Incls)
CG, USA Natick Labs, ATTN: AMXRE-F

APPENDIX A-3

U.S. ARMY NATICK LABORATORIES
NATICK, MASSACHUSETTS

IN REPLY REFER TO
AMXRE-F

13 December 1963

SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual

TO: Commanding General
U.S. Army Test and Evaluation Command
Aberdeen Proving Ground, Maryland 21005

1. Introduction

a. It is requested that the QM R&E Field Evaluation Agency be authorized to conduct the test outlined in the following paragraphs.

b. If your Command does not concur in any part of this communication, it is requested that the problem be resolved with these Laboratories and necessary amendments be recommended by indorsement.

2. Background and Orientation

a. The Meal, Ready-to-Eat, Individual, is being developed based on a requirement established in paragraph 1439f(16) of CDOG. It is one of three types of meals included in a simplified feeding system which will be available for commanders to use interchangeably, depending on prevailing tactical and logistical conditions. This is the meal which will be available for issue to individuals and used to feed troops at times when it is impractical to provide either unit or small group messing. Both of the other two meals are packaged for group feeding: one, uncooked, for large groups under circumstances permitting operation of field preparation equipment, the other, precooked, for small groups under tactical and/or logistical conditions precluding the operation of field cooking equipment.

b. The Meal, Ready-to-Eat, Individual will be an individual, flexibly packaged, nutritionally complete meal which will require no preparation other than the possible reconstitution of a beverage and which will be highly acceptable when eaten cold as well as hot. Mess gear is not to be required for use of this meal. (Photograph showing typical components attached).

APPENDIX A-4

AMXRE-F 13 December 1963
SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat Individual

c. Work on development of components for this meal began in 1959. In 1962 certain items were considered ready for preliminary evaluation and a feasibility study was scheduled. Four types of dehydrated fruit and four types of meat patties were substituted for comparable canned items in the Meal, Combat, Individual, and the substituted meals were compared to the regular meal, Combat, Individual, by troops operating in the field. This study was conducted in May, 1963 (FEA 62064, Feasibility Study of the Use of Precooked Dehydrated Foods in Individual, Ready-to-Eat Meals).

d. Developmental work has continued. As of now, three menus, of the Meal, Ready-to-Eat are ready for Engineering Test (NLABS 64014, Engineering Test of Meal, Ready-to-Eat, Individual).

e. An additional three menus, numbers 1, 4 and 6 (Inclosure 2) have been developed and are ready for testing against most of the approved military characteristics (Inclosure 3) to obtain the necessary design information and correct deficiencies, if any are found.

3. Objectives

a. To determine the operational performance characteristics of three prototype Meal, Ready-to-Eat, Individual menus in relation to acceptability and utility.

b. To determine the degree of utility of the Meal, Ready-to-Eat in relation to its operational concept of use.

c. To obtain estimates of the probable suitability of the individual food items and the menu combinations.

4. Criteria

a. Preference ratings for the Meal, Ready-to-Eat, items and menus as compared to ratings for items and menus of the Meal, Combat, Individual.

b. Estimates of the percent consumption of the Meal, Ready-to-Eat, Individual items as compared to percent consumption of Meal, Combat, Individual, items

AMXRE-F 13 December 1963
SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual

c. Information on the utility of the Meal, Ready-to-Eat, and user's opinions as obtained by observation and questionnaires.

d. Troops' general attitudes toward the use of the Meal, Ready-to-Eat.

5. Special Conditions of Test

a. Test Items

(1) 3000 Meal, Ready-to-Eat, Individual - 1000 of each menu (possibility for enough for Battle Group, e.g. 1300).

(2) 3000 Meal, Combat, Individual - 500 (approximately) of each of only six of the menus. (Select 2 B-1 unit menus, 2 B-2 unit menus, and 2 B-3 unit menus. Reserve balance of B-1, B-2, and B-3 menus for test referenced in paragraph 6a below).

(3) Heat tablets (Fuel, Compressed, Trioxane, Ration Heating, MIL-F-10805B dated 16 June 1960) will be required to be issued with the Meal, Ready-to-Eat, in a ratio to be determined by FEA.

b. Test Subjects: Approximately 1300 Men, preferably a cross section of combat arms troops who are undergoing combat training or similar activity.

c. Test Location: Temperate climate only is required, the test may be run at any ZI post or exercise.

d. Test Design

(1) Sustained Phases

(a) Select units totaling about 750 men that are in situations where it is logical and feasible to require use of an individual packaged ration for one meal each day for four consecutive days.

(b) For half of these units, issue Meal, Ready-to-Eat, for two days, followed by Meal, Combat, Individual, for the next two days.

(c) Reverse the order of issue for the other half of the units.

(d) Issue menus randomly to both groups.

AMXRE-F
SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual 13 December 1963

e. Instruction of Test Subjects: Instructions are included with the Meal, Ready-to-Eat; therefore, the only instructions necessary will be in regard to the test procedures.

f. Data Required

(1) Preference ratings for items and menu combinations by both experimental and control groups in the Sustained - Use Phase.

(2) Preference ratings for items and menu combinations for both rations from a sampling of subjects in the One-Meal-Use Phase.

(3) Records of ration usage as necessary to provide reliable estimates of percent consumption of each item for the Sustained-Use Phase. This is not considered necessary for the One-Meal-Use Phase.

(4) Information relative to the portability of the Meal, Ready-to-Eat, i.e., dispersability of components in pockets, etc.

(5) Observer-recorders' notes relating to subjects' methods of using dehydrated items.

(6) Opinions of individual soldiers and of those in various command functions as to the suitability of the Meal, Ready-to-Eat.

6. Administrative Information

a. Conduct subject test concurrently with NLABS 64014, Engineering Test of Meal, Ready-to-Eat, Individual.

b. Experimental Meal, Ready-to-Eat, will be furnished by Food Division, US Army Natick Laboratories, Shipment is presently scheduled for onor about 1 January 1964. It is requested that shipping instructions for experimental meals be furnished not later than 15 December 1963.

c. Control meals (Meal, Combat, Individual) and standard heat tablets will be furnished by the test agency.

d. Food Division, US Army Natick Laboratories, will assist in design of questionnaires in collaboration with personnel of QMRE FEA as required.

e. QMRE FEA will tabulate and report data.

APPENDIX A-7

13 December 1963

AMXRE-F
SUBJECT: NLABS 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual

f. Disposition of unused meals will be at the discretion of the test agency unless otherwise advised.

g. Command Schedule requires initiation of Engineering Test (NLABS 64014) by the end of 3rd Quarter FY 1964. (See par. 6a.)

h. Tentative - evaluation report is requested in addition to final report.

i. Applicable Project No. is 1K6-43303-D548.

j. Plan of Test: 5 copies.

k. Test Report: 30 copies.

l. Authorization for direct communication between personnel of Food Division, US Army Natick Laboratories, and QMRE FEA is requested.

FOR THE COMMANDER:

JAMES H. FLANAGAN
Deputy Scientific Director
for Engineering

3 Incl
1. Photo
2. Menu
3. Mil Char

APPENDIX B-1 (1)

TECHNICAL CHARACTERISTICS FOR MEAL, READY-TO-EAT, INDIVIDUAL

1. General

a. Scope: These characteristics pertain to the technical aspects of the development of the Ready-to-Eat Individual Meal to fulfill the military characteristics of operational rations.

b. Purpose: The Meal, Ready-to-Eat, Individual, will be issued to individuals for operational conditions which permit planned resupply, but preclude provision or utilization of either the Meal, Uncooked, 25-Man, or the Meal, Quick-Serve. For maximum flexibility of use as the tactical situation changes and the tactical commander requires, the Meal, Ready-to-Eat, Individual, will be capable of interchangeability and/or use in conjunction with the other operational rations described by the military characteristics.

c. Non-common characteristics: Technical characteristics provided herein pertain to the Meal, Ready-to-Eat, Individual, only and, in general, are not common to other operational rations.

d. Using elements: Theater of operations.

2. Design: The Meal, Ready-to-Eat, Individual, will meet the following design standards:

a. Nutritional adequacy: Meals will be designed so that any three provide the daily nutritional requirements set forth in AR 40-564 (including 3600 calories) for one man, and any one meal provides 1/3 the daily nutritional requirement (including 1200 calories) for one man.

b. Acceptability: At least 12 meals will be designed so that any one meal is suitable for breakfast, dinner or supper and any three are suitable as a ration. Food components will be developed in terms of maximum acceptability when eaten cold; variety will be sufficient to avoid rejection when the Meal, Ready-to-Eat, Individual, is consumed as the sole diet over a period of one week. Human engineering principles will be applied throughout development of food components.

c. Stability: All food components, in the packaging used for the Individual Ready-to-Eat Meal, will be capable of withstanding at least six months at 100°F. without significant loss of nutritional adequacy, edibility, acceptability or utility, and will be capable of withstanding repeated freezing and thawing involving exposure, in the ration case, to temperatures as high as 125°F. for as long as two hours per day, and as low as minus 65°F. without significant loss of nutritional adequacy, acceptability and utility.

d. Utility: The meals will require no preparation other than opening of packages and no reconstitution except of beverage components.

APPENDIX B-1 (2)

MILITARY CHARACTERISTICS
FOR
OPERATIONAL RATIONS

I GENERAL

1. Statement of requirements -

a. Meal, Uncooked, 25-Man (U) - A ration, factory-assembled and packaged by meals, for a 25-man module, which will simplify field preparation, have reduced weight and volume, require no refrigeration, and yet be adequate in nutrition and acceptability to maintain the performance of combat forces when fed for an extended period without supplementation by perishables. (Maximum use will be made of preservation by dehydration and lightweight packaging materials. Preservation by ionizing radiation may be used when the technique is approved and becomes available.) Reference CDOG, paragraph 1439f(14).

b. Meal, Quick-Serve, 25-Man and 6-Man (U) - A nonperishable ration, factory-assembled and packaged by meals for 6-man and 25-man modules, packed suitably for air drop, which can be prepared for consumption by adding hot or cold water to the packages (as appropriate to the food), mixing, and holding for not more than 20 minutes. This ration should require no equipment other than a water-heating device for its preparation and consumption, all necessary mess gear being expendable and packaged with the meal. (Maximum use will be made of dehydrated precooked foods and of lightweight packaging.) Reference CDOG, paragraph 1439f(15).

c. Meal, Ready-to-Eat, Individual (U) - Individual meals, ready-to-eat, containing only quick-serve precooked, dehydrated, and irradiated components for use up to one week in the combat zone. Components should be highly acceptable when eaten cold. No preparation required. Normal supply of drinking water must be available. Packaging should be lightweight and also suitable for use in place of mess gear. Reference CDOG, paragraph 1439f(16).

2. Operational concept -

a. The 25-man uncooked meal will ultimately replace the B ration for normal feeding in the support section and in the combat area, except when prohibited by the tactical situation. During the interim period, until complete replacement is achieved, components of the 25-man uncooked meal will, as individually available, replace equivalent standard B ration components and the gradually modified B ration will be issued when operationally feasible for normal feeding in the support section.

b. The 25-man and 6-man quick-serve meals will be used both in the support section and in the combat areas when the tactical situation precludes the preparation and serving of the 25-man uncooked meal.

c. The individual, ready-to-eat meal will be used to feed troops at times when it is impractical to provide the 25-man uncooked meal or the 25-man and 6-man quick-serve meal.

Lightweight packaging capable of use as a heating vessel under conditions permitting heating will be used. The meal package will contain all accessories needed for consumption of the meal except canteen, canteen cup and water. Gross weight of each meal will not exceed one pound; gross weight of packed shipping containers will not exceed 25 pounds. The configuration of each meal will be compatible with pockets of field clothing. Cases in which the meals are packed will be designed for aerial delivery without parachute with assurance that 75% of the contents will be suitable for consumption within 24 hours after the cases are dropped on representative terrains at speeds and from altitudes normally used by Army rotary and fixed wing aircraft in support of tactical operations.

3. Components: The Meal, Ready-to-Eat, Individual, will consist of 12 meals in lighweight packages containing all required accessories and materials needed to prepare and eat the meals except canteen, canteen cup and water. An expendable means of heating the meal will also be provided separately and not as a meal component. The food components will be processed by whatever methods prove most successful in meeting the military characteristics; maximum use will be made of precooked foods processed by novel or improved thermal or other relevant methods; when the state of the art permits, precooked radiation processed components will be included.

3. Organizational concept -

a. The 25-man uncooked meal will be prepared by trained food service personnel using ranges and cooksets and usually will be served in unit messes. The new food processing techniques used to produce this type meal will, however, reduce the amount and degree of training required for food service personnel.

b. The 25-man and 6-man quick-serve meals will be used for feeding small groups when unit messing is impracticable. No trained food service personnel will be required to prepare the meal. Required equipment will consist solely of a means for heating water.

c. The individual ready-to-eat meal will be distributed to individuals and will require no preparation other than opening of packages, except for beverages; a small amount of water will be required to reconstitute drinks.

4. Consideration of tripartite, Navy, Air Force, and Marine Corps development activities - All the Armed Services have an interest in these rations. The rations are proposed for Tripartite Standardization.

5. Feasibility of development - If, during the development phase, it appears to the development agency that the characteristics listed herein require the incorporation of certain impractical features or unnecessarily expensive and complicated components or devices, costly manufacturing methods and processes, critical materials or restrictive specifications which serve as a detriment to the military value of the item, such matters will be brought to the immediate attention of the Chief of Research and Development, Department of the Army, and the Commanding General, USCONARC, for consideration before incorporation in a final design.

6. Background - In the future Theater of Operations, the actual or potential use of nuclear weapons will require increased dispersion of units and supplies and highly fluid, mobile operations. In consonance with these concepts, the efficiency of supplying operational rations must be increased. Specifically, operational rations are required which will permit:

a. Reduction in the number of food service personnel and kitchen equipment required for preparing meals, as well as reduction in the training level required of food service personnel.

b. Substantial reduction in refrigeration requirements.

c. Feeding of troops over an extended period with an adequate and tasteful ration.

d. Reduction in requirements for transport, storage areas, handling equipment and supply personnel. New developments in dehydration and irradiation techniques of food processing provide a means for obtaining operational rations which meet the requirements of these new concepts of organization and tactics.

II OPERATIONAL CHARACTERISTICS

Meal, Uncooked, 25-Man:

7. Configuration -

a. Shall be packaged as a meal for 25 men exclusive of breads and cakes which will be provided separately.

b. Each packaged meal shall be of minimum weight and bulk consistent with other requirements. Gross weight will not exceed 25 pounds.

8. Performance -

a. Shall, when supplemented with fresh bread and cake components, provide adequate quantity of food for 25 men for one meal. Appropriate breakfast, dinner, and supper menus will be provided.

b. Shall be well balanced and provided in sufficient variety to be acceptable to troops for consumption over an extended period under all climatic conditions.

c. Shall have no detrimental physiological effects when consumed over a period of a year as a sole diet with the bread and cakes which are provided separately.

d. Shall require no refrigeration.

e. Shall be simple to prepare by food service personnel who have received minimum training.

9. Durability and Reliability -

a. Cases and packages shall be water, insect, and rodent resistant.

b. Cases and packages shall be marked, and markings shall remain legible under all conditions encountered in storage, transport, and distribution.

c. Cases and packages shall be capable of withstanding military handling during transportation and storage prior to use.

d. Cases and packages shall be easily opened.

e. This ration shall be capable of storage without refrigeration for a minimum of 2 years (a longer period is desirable) without spoilage or detrimental decrease in nutritional value or palatability.

10. Transportability - Cases in which the rations are packed shall be capable of being transported in standard military vehicles, aircraft and vessels, and shall be capable of being aerial delivered by parachute.

11. Associated equipment - Kitchen facilities.

12. Environmental and terrain requirements -

a. Shall withstand transit and handling in temperatures ranging from -65°F. to +125°F. and shall be suitable for preparation in tents or other shelter during periods of extreme cold.

b. Safe storage temperatures shall conform to AR 705-15 as amended.

Meal, Quick-Serve, 25-Man and 6-Man:

13. Configuration* -

a. Shall be packaged on a meal basis.

b. Shall be of minimum weight and bulk consistent with other requirements. Gross weight of case containing 25 meals will not exceed 35 pounds. Gross weight of case containing 6 meals shall not exceed 9 pounds. (This weight includes bread and cake components, accessory items and expendable preparation and serving equipment, except for heating device.)

14. Performance -

a. Shall provide adequate quantity of food for 25 men (or 6 men) for one meal, all meals to be essentially equivalent in nutrition so that any three meals constitute a ration.

b. Shall be well balanced and provided in sufficient variety to be acceptable to troops.

c. Shall have no detrimental physiological effect when consumed as the sole diet for a period of not less than 120 days.

d. Shall be simply, quickly, and easily prepared for consumption by nontechnically trained personnel.

e. Shall contain, except for water and a heating device, all components necessary for preparation, serving, and consumption of the meal.

f. Shall contain simple directions for preparation.

g. An accessory packet containing cigarettes, matches, toilet paper, chewing gum, and weapon cleaning patches will be included with each meal.

15. Durability and Reliability -

a. Cases and packages shall be water, insect, and rodent resistant.

b. Cases and packages shall be marked, and markings shall remain legible under all conditions encountered in storage, transport, and distribution.

*Optimum module size will be dependent upon organizational structure of combat units during period of use.

c. Cases and packages shall be easily opened. If an opener is needed for this purpose, it shall be provided as a readily accessible part of the packaged meal.

d. Shall be capable of withstanding military handling during transportation and storage prior to use.

e. This ration shall be capable of storage without refrigeration for a minimum of 2 years (a longer period is desirable) without spoilage or detrimental decrease in nutritional value or palatability.

16. Transportability - Cases in which the rations are shipped shall be:

a. Suitable for all means of transportation including animal pack and man-carry.

b. Capable of aerial delivery by parachute.

c. Capable of aerial delivery without parachute with assurance of 75% recovery.

17. Associated equipment - Water heating device(s).

18. Environmental and terrain requirements -

a. Shall withstand transit and handling in temperatures ranging from -65°F. to +125°F. and shall be suitable for preparation in tents or other shelter during periods of extreme cold.

b. Safe storage temperatures shall conform to AR 705-15 as amended.

Meal, Ready-to-Eat, Individual:

19. Configuration -

a. Packaging shall be compatible with the pockets of field clothing.

b. Shall be of minimum weight and bulk consistent with other requirements. Gross weight will not exceed 1 pound.

c. The case in which the meals are packaged shall be of minimum weight and bulk consistent with other requirements. Gross weight will not exceed 25 pounds.

d. Components shall be packaged to the maximum extent in flexible containers.

20. Performance -

a. Shall provide an adequate quantity of food for one man for one meal, all meals to be essentially equivalent in nutrition so that any three meals will constitute a ration.

b. Shall be acceptable for consumption over a period of one week as a sole diet.

c. Shall conform to nutritional requirements.

d. Shall be acceptable when consumed hot or cold.

e. Shall require no preparation other than opening packages and shall require no water except for the reconstitution of drinks.

f. Shall include all accessories necessary for consumption of the meal, except canteen, canteen cup, and water.

g. An accessory packet containing cigarettes, matches, toilet paper, chewing gum, and cleaning patches will be included with each meal.

h. An expendable means of heating the meal will be provided.

21. Durability and Reliability -

a. Cases and packages shall be water, insect, and rodent resistant.

b. Cases and packages shall be marked, and markings shall remain legible under all conditions encountered in storage, transport, and distribution.

c. Shall be capable of withstanding military handling during transportation and storage prior to use.

d. Cases and packages shall be easily opened. If an opener is required for this purpose, it will be provided with each meal.

e. This ration shall be capable of storage without refrigeration for a minimum of 2 years (a longer period is desirable) without spoilage or detrimental decrease in nutritional value or palatability.

22. Transportability - Cases in which the rations are shipped shall be:

a. Suitable for all means of transportation including animal pack and man-carry.

b. Capable of aerial delivery by parachute.

c. Capable of aerial delivery without parachute with assurance of 75% recovery.

23. Associated equipment - None.

24. Environmental and terrain requirements - Safe storage and transit temperatures shall conform to AR 705-15 as amended.

III SPECIAL CHARACTERISTICS

25. CBR and atomic requirements - Cases and packages shall be at least as resistant to CBR and atomic effects as current standard item.

26. Kit requirements - None.

27. Maintenance and interchangeability requirement - None.

IV ORDER OR PRIORITY OF CHARACTERISTICS

A. Performance.

B. Configuration.

C. Durability and Reliability.

D. Transportability.

E. CBR and Atomic Requirements.

V ITEMS SUPERSEDED BY THESE ITEMS

A. Ration, Operational, "B" (Superseded by Meal, Uncooked, 25-Man, when production capability permits).

B. Ration, Small Detachment, 5-in-1 (Superseded by Meal, Quick-Serve, 25-Man and 6-Man).

C. Ration, Individual, Combat, and Meal, Combat, Individual (Superseded by Meal, Ready-to-Eat, Individual).

VI TRAINING AIDS - None required.

APPENDIX B-2

MEAL, COMBAT, INDIVIDUAL
AVERAGE RATINGS OBTAINED WHEN MAJOR COMPONENTS WERE CONSUMED HEATED PRIOR TO CONSUMPTION AND WHEN ALL COMPONENTS WERE CONSUMED UNHEATED

Item	Menu in Which Item Appeared	Avg. Rating With Major Foods Heated		Avg. Rating With All Foods Unheated	
		Number of Men Rating	Avg. Hedonic Rating	Number of Men Rating	Avg. Hedonic Rating
Entire Meal	A	107	7.35	72	6.68
	B	92	6.90	56	6.84
	C	111	6.83	64	6.59
	D	116	7.34	60	6.50
	E	110	7.02	58	6.64
	F	117	7.05	67	6.81
	G	106	6.82	58	6.05
	H	109	7.09	60	6.67
	I	108	7.21	56	6.68
	J	119	7.00	69	6.56
	K	94	6.66	61	6.01
	L	97	6.74	63	6.61
	All Combined	1286	7.01	744	6.56
Beans w/Franks in Tomato Sauce	A	100	7.61	72	7.08
Beefsteak w/Juices	B	96	7.35	55	6.71
Beefsteak w/Potatoes and Gravy	C	112	7.13	64	6.40
Boned Chicken	D	121	7.77	61	6.80
Chicken & Noodles	E	112	7.32	57	6.62
Ham & Eggs, Chopped	F	119	7.06	67	6.99
Ham & Lima Beans in Juices	G	107	6.76	58	5.66
Ham, Fried	H	113	7.42	60	6.77
Meat Balls w/Beans in Tomato Sauce	I	108	7.36	56	6.86
Pork Steak w/Juices	J	122	7.20	69	6.64
Spiced Beef w/Sauce	K	94	7.05	60	6.23
Turkey Hash	L	98	7.11	63	6.58
Apricots	B	96	7.53	55	7.80
Peaches	E	113	8.11	56	8.02
Pears	H	111	7.75	60	7.41
Fruit Cocktail	L	96	8.14	63	7.80
Date Pudding	A	100	6.33	71	5.87
Fruitcake	C	109	6.95	63	7.14
Cookies	D,F,K	331	7.49	186	7.38
Pecan Cake Roll	G	110	7.25	58	6.45
Pound Cake	I	108	7.28	56	7.28
Candy	B,E,H,L	414	6.87	236	6.96
Crackers	A,B,C,E G,H,I,L	852	6.87	482	6.62
White Bread	D,F,J,K	455	6.60	255	6.20
Spread	All	1285	7.08	707	6.68
Coffee	All	1190	6.77	503	6.31
Cocoa	D,F,J,K	437	7.13	224	6.43

APPENDIX B-3

DAILY WEATHER OBSERVATIONS
CAMP A. P. HILL, VIRGINIA
11 - 15 FEBRUARY 1964

Date	Max Temp °F.	Min Temp °F.	Humidity	Average Surface Winds, MPH	Maximum Wind Gust, MPH	Precipitation		
						Type	Amount Ins.	Time of Occurrence
11 Feb	31	18	97%	15 NW	20 NW	Snow	1.50	2100-2400
12 Feb	35	20	92%	15 NW	25 NW	Snow	3.00	2400-1730
13 Feb	33	20	97%	20 WSW	25 WSW	Rain	.01	0900-1700
14 Feb	39	29	94%	18 WNW	35 WNW	Rain	.01	0100-1135
15 Feb	42	33	84%	12 NW	15 NW	-	-	--

APPENDIX B-4

DIRECTIONS FOR SETTING UP AND USING MEAL CARTON AS STOVE

USE FOR HEATING (IN PACKAGE): Bacon, Barbecued Beef, Beans with Tomato Sauce, Beef Steak, and Chicken Ala King ONLY.

Do NOT open pouch before heating

CAUTION - Do NOT use carton for heating water for beverages or for rehydrating dry foods

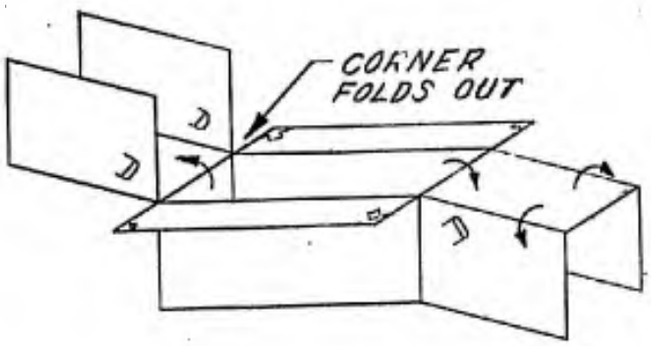

Figure 1
- a. Remove tape
- b. Fold end flaps down with corner folds out and behind ends
- c. Hold side flaps down
- d. Lock side flaps over ends

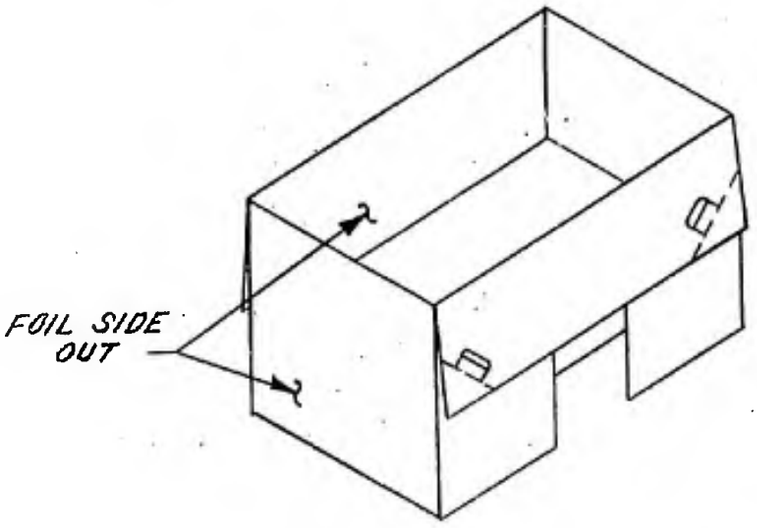

Figure 2
- e. Add about 2 ounces of water (use enough to cover carton bottom).

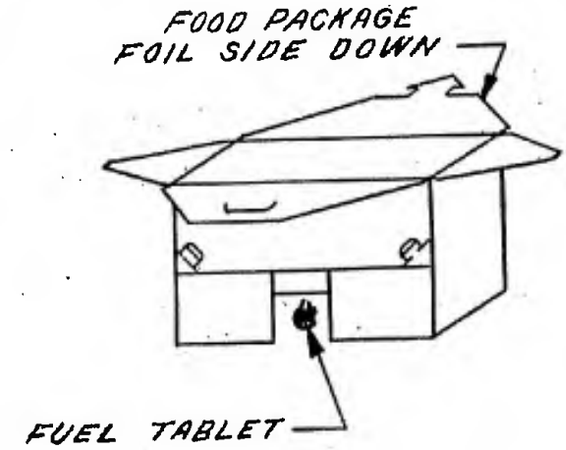

Figure 3
- f. Open folder ONLY and place on top, foil side down
- g. Place fuel tablet under carton and light same
- h. Steam will heat food (approx. 8-12 min).

APPENDIX B-5

OBSTACLES OF FEA DESIGN AND FABRIC COURSES USED - LISTED IN SEQUENCE OF USE

Obstacle

1. Sand Prones
2. Railroad cinder crawl
3. Belgian Block Embankment
4. Sand Prones
5. Slit Trench
6. Monkey Climb
7. Sand Prones
8. Gravel Crawl
9. Road Block
10. Rock Parapet
11. Sand Prones
12. Wooden Slide
13. Wooden Slide
14. Tank Trap
15. Up and Over Boxes
16. 25-Yard Combat Crawl

APPENDIX C

DISTRIBUTION LIST

USATECOM PROJECT NO. 8-3-7400-05K

2 - Commanding General
U.S. Army Test and Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Maryland 21005

30 - Commanding General
U.S. Army Natick Laboratories
ATTN: Assistant Deputy Scientific Director
for Engineering
Natick, Massachusetts 01762

AD Accession No.

Headquarters, U.S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia

FINAL REPORT OF ENGINEER DESIGN TEST OF MEAL, READY-TO-EAT, INDIVIDUAL, by Thomas B. Burt, May 1964. 61p. -tables, -illus., -graphs, 3 Appendices p33-61. (TECOM Project No. 8-3-7400-05K) Unclassified Report

The Meal, Ready-to-Eat, Individual, is one of three types of meals included in a simplified feeding system that commanders may use interchangeably, depending on prevailing tactical and logistical conditions. This meal is designed for issue to individuals and used to feed troops at times when it is impractical to provide either unit or small group messing.

An engineer design test of the Meal, Ready-to-Eat, Individual, was conducted by the Field Evaluation Agency during the period 10 February through 24 April 1964 to determine the performance of prototype menus 1, 4, and 6 of the individual meals in relation to their acceptability, utility and concept of use. Experimental and standard menus were evaluated under both normal use and accelerated use conditions. Measures were obtained of such factors as troop acceptability of meals and components, durability of packaging, utility of a combination carton-stove provided with each meal, and air delivery capability.

UNCLASSIFIED

1. Meal, Ready-to-Eat, Individual
2. Rations
I. Burt, Thomas B.
II. Title
III. TECOM Project No. 8-3-7400-05K
IV. Food Logistics Systems, Simplified

AD Accession No.

Headquarters, U.S. Army Quartermaster Research and Engineering Field Evaluation Agency, Fort Lee, Virginia

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UNCLASSIFIED

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2. Rations
I. Burt, Thomas B.
II. Title
III. TECOM Project No. 8-3-7400-05K
IV. Food Logistics Systems, Simplified

Test results show that menus of the standard Meal, Combat, Individual, are more acceptable than menus and components of the Meal, Ready-to-Eat, Individual (menus 1, 4, and 6); the combination carton-stove is not suitable in its present configuration; the Meal, Ready-to-Eat menus are capable of air delivery with or without parachute.

It is recommended that consideration be given to improving the acceptability of the Meal, Ready-to-Eat components with particular emphasis on the beef patty, bread roll, date pudding, cereal bar, fruitcake, and milk. It is also recommended that potato salad be eliminated as a menu component, the "bulk" of the menus increased to improve satiety characteristics, and the carton-stove be eliminated or redesigned.

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