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US ARMY TEST & EVALUATION COMMAND

USATECOM PROJECT NO. 8-3-7400-04K

FINAL REPORT OF
ENGINEERING TEST OF
MEAL, READY-TO-EAT, INDIVIDUAL

MAY 1964

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

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

SEP 15 1964

STEFA-TS

SUBJECT: Final Report of Engineering Test of Meal, Ready-to-Eat, Individual, USATECOM Project No. 8-3-7400-04K

TO: See Distribution

1. Subject document is forwarded for information and retention.

2. Inclosed is action letter from USATECOM to AMC.

FOR THE COMMANDER:

ERVAN E. ZOUZALIK
Captain, OMC
Adjutant

2 Incl
as

HEADQUARTERS

U.S. ARMY TEST AND EVALUATION COMMAND

Aberdeen Proving Ground, Maryland 21005

[illegible]

4 SEP 1964

SUBJECT: Final Report of Engineering Test of Meal, Ready-to-Eat, Individual, USATECOM Project No [illegible]-3-7400-[illegible]

TO: Commanding General
U. S. Army Materiel Command
ATTN: AMCRD-[illegible]
Washington, D. C. 20315

1. The report, subject above, has been approved by this Headquarters with the following corrections:

a. Correct paragraph 1.4h to read as follows: The satiety of the Meal, Ready-to-Eat is lower than that of the standard Meal, Combat.

b. Correct 1st sentence paragraph E.12.3b to read: Of a total of 22 each of the menus 2, 3, and 5 dropped free-fall at an altitude of 100 feet, only three foods showed evidence of major damage.

2. It is recommended that:

a. Menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual be considered suitable for Service Test upon correction of the shortcomings listed in Appendix C of the report.

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

c. Consideration be given to delay of Service Test of the Meal, Ready-to-Eat, Individual until all menus of the proposed ration have been subjected to Engineering Testing.

FOR THE COMMANDER:

Francis D. Smith
f/ OLIVER H. ASPINWALL, JR.
Capt, AGC
Asst Admin Officer

1 Incl (5 cys)
Subject Report

Copy furnished:
USACDCTA w/o Incl
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CO USA Natick Labs w/Incl

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

SEP 15 1966

STEFA-ET

SUBJECT: Correction to Engineering Test Report for: Meal, Ready-to-Eat, Individual, USATECOM Project No. 8-3-7400-04K

TO: See Distribution

The following corrections are made to subject report of test:

a. Correct paragraph 1.8h to read: "The satiety of the Meal, Ready-to-Eat, is lower than that of the standard Meal, Combat."

b. Correct 1st sentence of paragraph 2.12.3b to read: "Of a total of 22 of each of menus 2, 3, and 5 dropped free-fall at an altitude of 100 feet, only three foods showed evidence of major damage."

FOR THE COMMANDER:

ERVAN E. ZOUZALIK
Captain, QMC
Adjutant

INSERT BEHIND FRONT COVER

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

FOR INFORMATION ONLY

ACTION BY HIGHER AUTHORITY PENDING

FINAL REPORT OF ENGINEERING TEST OF MEAL, READY-TO-EAT, INDIVIDUAL

DA PROJECT NO. 1K643303D548

USATECOM PROJECT NO. 8-3-7400-04K

Thomas B. Burt
Supervisory Technologist
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Lt Col QMC
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Colonel, QMC
Commanding

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

USATECOM 8-3-7400-04K

Final Report of Engineering 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 engineering 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 if menus 2, 3 and 5 of the meal are suitable for service test. Experimental and standard menus were evaluated under both normal and accelerated use conditions to obtain measures of such factors as troop acceptability and utility of meals and components; durability of packaging; suitability of the carton-stove; air delivery factors; and safety.

It is concluded that menus 2,3 and 5 of the Meal, Ready-to-Eat are suitable for service test, provided that shortcomings listed in the report are corrected. The expendable carton-stove is not satisfactory in its present configuration and is considered a deficiency. Test results show that menus and components of the standard meal are preferred to those of the experimental; the durability of flexibly packaged components is satisfactory; and the experimental meal is capable of air delivery by parachute; and without parachute, with assurance of 75 percent recovery.

It is recommended that menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual be considered suitable for service test upon correction of the cited shortcomings, and that the carton-stove be eliminated entirely or be redesigned. Consideration should be given to delaying any service testing of the experimental meal until after all menus proposed for the ration have been engineering tested.

SECTION I - 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, May 1963.

3. Military and Technical Characteristics for the Meal, Ready-to-Eat, Individual.

4. 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 64014, Engineering Test of Meal, Ready-to-Eat, Individual." See Appendix A.

1.3 OBJECTIVE

To determine the technical performance and safety characteristics of menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual as described in the QMR, the Technical Characteristics, and as indicated by the particular design and to determine the technical and maintenance suitability of the item for service test.

1.4 RESPONSIBILITIES

The QM R&E Field Evaluation Agency was responsible for preparation of the plan of test, execution of the test and preparation of the test report.

1.5 DESCRIPTION OF MATERIEL

a. The experimental item consists of prototype menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual. See Figure 1. Each menu constitutes a one-third day ration and consists of dehydrated and heat processed foods. 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 includes accessory items in a flexible package. Twelve meals are packed in a V2s shipping container with sleeve and metal bands.

b. The standard item consists of the twelve menus of the Meal, Combat, Individual. Each menu consists of heat processed foods, and constitutes a one-third day 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. Twelve meals are packed in a V2s shipping container with sleeve and wire bands.

1.6 BACKGROUND

a. Development of the Meal, Ready-to-Eat, Individual is 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 commanders will be able to use interchangeably, depending on prevailing tactical and logistical conditions. This meal is designed for issue to individuals and is to be used to feed troops at times when it is impractical to provide either unit or small group messing. Both of the other 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 or logistical conditions precluding the operation of field cooking equipment.

b. Development of components of the 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

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

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

c. In February 1964 six menus of the Meal, Ready-to-Eat, Individual were made available for testing. An Engineering Test of Menus 2, 3 and 5 was conducted concurrently with an Engineer Design Test of Menus 1, 4 and 6 during the period 10 February - 24 April 1964 at Camps Pickett, A. P. Hill, and Pendleton, and at Fort Story and Fort Lee, Virginia. This report describes the conduct and findings of the Engineering Test. The Engineer Design Test is reported in USATECOM Project 8-3-7400-05K, Final Report of Engineer Design Test of the Meal, Ready-to-Eat, Individual, dated May 1964.

1.7 FINDINGS

a. Menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual meet the requirements of all Military and Technical Characteristics except those as shown below.

		Does Not Meet	Meets Partially	Not Determined
MC	19b - Weight and Bulk limitation	x		
MC	20a - Quantitative and Nutritional Adequacy of Meals		x	
MC	20b - Acceptability for Consumption over a period of 1 week			x
MC	20h - Suitability of Expendable Heating Device	x		
MC	21a - Resistance of Packages to Water, Insects and Rodents		x	
MC	21e - Storage Capability			x
MC	24& - Safe Storage and			x
TC	2c Transit Conditions			
MC	25 - CBR and Atomic Requirements			x

b. Deficiences and shortcomings noted in connection with the above findings are shown in Appendix C.

1.8 CONCLUSIONS

It is concluded that:

a. Menus 2, 3, and 5 of the Meal, Ready-to-Eat are suitable for service test, provided the shortcomings cited in Appendix C are corrected.

b. The expendable carton-stove provided with each menu of the Meal, Ready-to-Eat is not satisfactory in its present configuration for use by the soldier as a stove. This is considered a deficiency.

c. The carton-stove is a potential safety hazard to personnel and property.

d. Individual component packages of the Meal, Ready-to-Eat menus are, for practical purposes, compatible with the pockets of the soldier's field jacket and fatigue uniform.

e. The weight of individual meals exceeds the 1-pound limitation imposed by the MC.

f. Menus and components of the Meal, Combat, Individual are preferred to those of the Meal, Ready-to-Eat, Individual.

g. All menus and components of the Meal, Ready-to-Eat, with the possible exception of the bread roll, are acceptable when major foods are consumed hot. When all foods are consumed cold, the acceptability of the bread, potato patty and milk is questionable.

h. The quantitative adequacy, or satiety value, of the Meal, Ready-to-Eat menus is not as high as that of the Meal, Combat, Individual.

i. 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.

j. The Meal, Ready-to-Eat is capable of air delivery by parachute; and without parachute, with assurance of 75 percent recovery.

1.9 RECOMMENDATIONS

It is recommended that:

a. Menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual be considered suitable for service test upon correction of the shortcomings cited in Appendix C.

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

c. Consideration be given to delaying any service testing of the Meal, Ready-to-Eat, Individual until after all menus proposed for the ration have been engineering tested.

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 and methodology. Experimental and standard menus were evaluated under both normal and accelerated use conditions to obtain measures of such factors as troop acceptability and the utility of the meals and components; durability of packaging; suitability of a combination carton-stove provided with each meal; logistical factors including air delivery; human factors; safety and other functional characteristics. Individual tests performed are described in subsequent paragraphs of this report.

2.1 TEST OF CONFIGURATION OF MEALS (MC 19a, b, c and d).

2.1.1 OBJECTIVE

To determine the suitability of the Meal, Ready-to-Eat and its components with respect to compatibility of the flexible packaging with the pockets of the soldier's field clothing, weight and cube characteristics, and extent of use of flexible packaging in the meals.

2.1.2 METHOD

2.1.2.1 Compatibility of Packaging with Field Clothing.

Fifteen enlisted men were issued one packaged menu (one-third of a ration) of the Meal, Ready-to-Eat and requested to disperse the components of the meal and the carton-stove in the pockets of their clothing. The clothing consisted of a field jacket, Trousers, Man's, Cotton Sateen, OG 107 (fatigue), and Shirt, Man's, Cotton Sateen, OG 107 (fatigue). This procedure was repeated with both 2 and 3 meals to determine the compatibility of the individual meal components with uniform pockets and to determine the ability of the soldier to disperse one-third, two-thirds and a complete ration on his person.

2.1.2.2 Weight and Cube Characteristics and Use of Flexible Packaging.

A total of 15 cases of the Meal, Ready-to-Eat, and the 12 meals included in each case, were weighed to determine conformance

of the ration to limitations on weight imposed by the Military Characteristics. Although the MC's prescribed no specific limitations on cube, measurements of 15 cases of the Meal, Ready-to-Eat and 15 cases of the Meal, Combat, Individual were obtained for comparative purposes. In addition, all components in each menu were examined to determine the extent to which flexible packaging had been used.

2.1.3 RESULTS

2.1.3.1 Compatibility of Packaging with Pockets.

a. When wearing standard load carrying equipment including pack harness, pistol belt and canteen, it was found that components of any one of the Ready-to-Eat menus tested could be dispersed in the pockets of the field jacket without unduly affecting the soldier's mobility. This was also true of the standard ration. Dispersal of the components of either 2 or 3 meals of either ration in the pockets of the field jacket resulted in considerable bulging and difficulty in closing the pockets. To attempt to carry as much as one ration (3 meals) in the pockets while operating with or without the standard load carrying equipment would seriously reduce the ability of the soldier to move about effectively under field conditions.

b. Further trials regarding compatibility of the experimental meal components with pockets of the uniform showed the wet meat and fruit package to be too long for the fatigue jacket pockets in some instances. This was also true of the carton-stove when folded for carrying on the person. It was found, however, that both items could be placed in the rear fatigue trousers pockets and the pockets closed. On this basis the soldier would experience no major difficulties in carrying a single menu of the experimental ration in his basic fatigue clothing pockets.

c. Examination of all major packages in the menus indicated that several items contained packaging material which is in excess of that actually required to inclose and protect the items. Much of this could be corrected by reducing the number of different sized packages, i.e., by placing as many different types of items in the same size package as is possible. Most of the excess material appeared to be in the length of the packages. Following is a list of packages, with approximate dimensions, for which possible reduction

in length might be effected. Any such savings whether accomplished by standardization of package sizes, or reduction of individual package lengths, would reduce the volume and weight of the meals, making them more suitable for carrying and use by the soldier.

Package	Approximate Dimensions	Excessive Length
Accessory Package	7 3/4" x 5 1/4"	Approximately 2"
Dehydrated Drinks	5 1/2" x 4 3/4"	Approximately 2"
Bread Roll	6" x 6"	Approximately 1"
Dehydrated Fruit	7 1/4" x 5 1/2"	1 to 1 1/2"
Pound Cake	7" x 4 1/2"	Approximately 1"
Potato Patty	7" x 4"	Approximately 1"

d. During the A.P. Hill phase of the test, participants carried at least one menu of the Meal, Ready-to-Eat or Meal, Combat on their persons each day, and in one instance were required to carry as many as 2 or 3 meals for up to 4 hours. When carrying 2 or 3 meals, participating troops carried them in their field packs. Troops were questioned afterwards as to whether carrying the meals interfered with their mission performance. Responses to this question, as tabulated below, showed no difference between the Meal, Ready-to-Eat and Meal, Combat, with respect to the effects of carrying the meals, on mission performance. Approximately 30 percent stated that carrying both rations interfered with their training activities.

Carrying Meals Interfered with Mission Performance	Number Responses	
	Meal, Ready-to-Eat	Meal, Combat
A great deal	9	7
Some	32	33
None	93	94

2.1.3.2 Weight and Cube Requirements and Use of Flexible Packages.

a. Recorded weights of 15 cases of the Meal, Ready-to-Eat showed all cases to be well within the 25-pound weight limitation imposed by the Military Characteristics. Specifically, all cases weighed between 21 pounds 8 ounces, and 21 pounds 11 ounces. The appropriate MC stipulates that the weight of individual meals will not exceed one

pound. Actual weights recorded for 180 meals evaluated showed that none of the meals are within the one-pound limitation. The average weight for the 180 meals evaluated was 1 pound 6 ounces. The weight for individual menus ranged from one pound 4 ounces, to 1 pound 10 ounces.

b. With regard to volume, the dimensions of typical cases and meal cartons of both the Meal, Ready-to-Eat and Meal, Combat, Individual were obtained. Measurements showed negligible variation in case and meal carton sizes evaluated. Results showed that the volume of the cases and meal cartons for the Meal, Ready-to-Eat exceeded those of the Standard Meal, Combat, Individual. Approximate cube measurements were as follows:

Ration	Volume
Meal, Ready-to-Eat	
Case (12 meals per case)	.93 cu. ft.
Meal carton	.06 cu. ft.
Meal, Combat, Individual	
Case (12 meals per case)	.68 cu. ft.
Meal carton	.05 cu. ft.

c. Examination of meals showed that all components were packaged in flexible packaging consisting of laminated plastic and aluminum foil. The heat processed food packages consisted of a mylar/foil/polyolefin lamination. The dehydrated and other foods were packaged in a mylar/foil/vinyl lamination.

2.1.4 ANALYSIS

Not applicable.

2.2 ACCEPTABILITY OF MEALS AND COMPONENTS (MC 20d)

2.2.1 OBJECTIVE

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

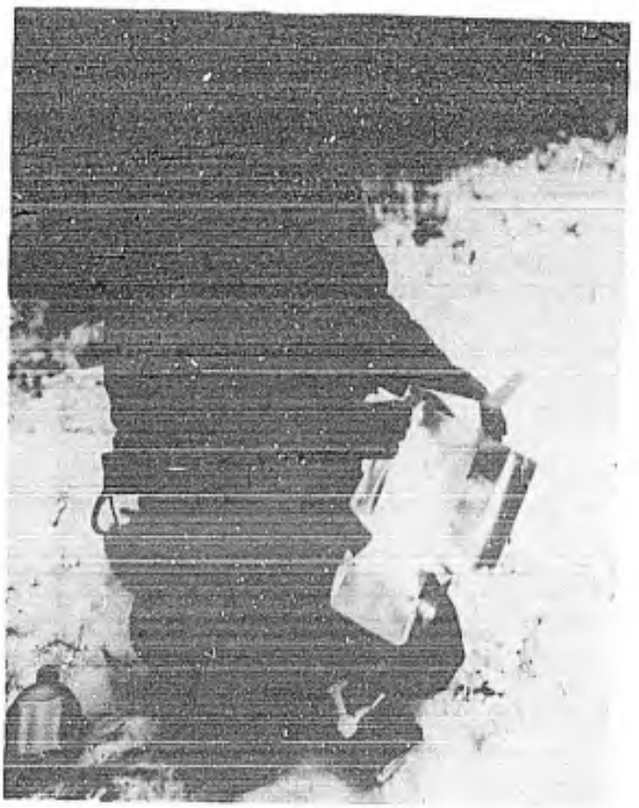

Figure 2.
Meal preparation and assembly of carton-stove.

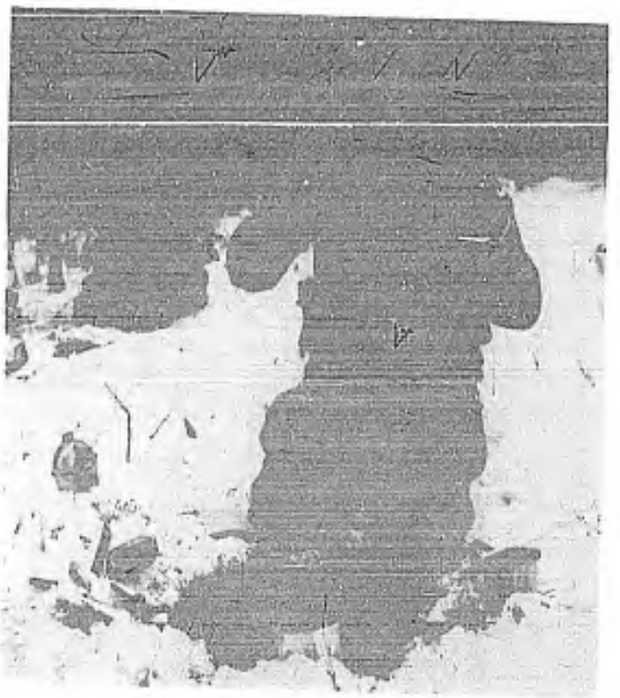

Figure 3.
Eating directly from flexible package.

2.2.2 METHOD

a. Three companies of an Engineer Battalion subsisted on menus 1 through 6 of the Meal, Ready-to-Eat and menus of the Meal, Combat while undergoing counterinsurgency training at Camp A.P. Hill, Virginia, during February 1964. (Figures 2 and 3). 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. The combination carton-stove provided with the Meal, Ready-to-Eat 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. Estimates of the proportion of each food consumed by individuals were also made by members of the FEA test team.

b. In addition to the above, five companies 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 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.

c. As a further measure of acceptability, test observers recorded estimates of the proportion of each food item consumed by participants during each meal. From these data, the overall percentage of each item consumed was computed.

2.2.3 RESULTS

Appendix D-1 lists average ratings obtained for the Meal, Combat menus and components when major items were consumed heated,

TABLE I

MEAL, READY TO EAT, INDIVIDUAL
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 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	2	244	6.35	103	6.19
	3	226	6.85	134	5.96
	5	231	6.54	122	6.48
Bacon	2	243	6.72	101	6.14
Beefsteak	3	228	7.19	134	6.36
Barbecued Beef	5	233	7.34	125	7.19
Beans w/Tomato Sauce	2	249	6.81	106	6.78
Potato Patty	5	227	6.15	121	5.47
Bread Roll	2,3,5	698	5.53	362	5.75
Peanut Butter	2	239	6.67	104	7.05
Jelly	3	216	7.25	112	6.97
Military Spread	5	227	6.35	121	5.96
Pears	2	246	5.93	99	5.83
Peaches	3	222	6.80	127	5.99
Strawberries	5	230	7.12	122	7.05
Orange Juice	2	242	6.98	98	6.78
Pineapple Juice	3	221	6.99	126	6.54
Chocolate Caramel Roll	2	231	7.08	95	7.30
Coconut Bar	3	211	7.08	126	6.53
Chocolate Fudge Bar	5	226	6.98	122	6.94
Pound Cake	3	225	7.24	133	6.94
Coffee	2,3,5	625	6.52	260	6.20
Milk	5	210	6.34	110	5.46

* 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.

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 Obser-vations	Overall Percent Consumed	Item	Menu in Which Item Appeared	No. of Obser-vations	Percent Consumed
Bacon	2	229	93	Beans w/Franks in Tomato Sauce	A	98	98
Beefsteak	3	205	97	Beefsteak w/Juices	B	80	98
Barbecued Beef	5	216	96	Beefsteak w/Potatoes and Gravy	C	99	96
Beans w/Tomato Sauce	2	229	96	Boned Chicken	D	105	99
Potato Patty	5	216	90	Chicken and Noodles	E	101	97
Bread Roll	2,3,5	650	85	Ham and Eggs, Chopped	F	108	99
Peanut Butter	2	229	90	Ham & Lima Beans in Tomato Sauce	G	103	97
Jelly	3	205	92	Ham, Fried	H	101	97
Military Spread	5	216	89	Meat Balls w/Beans in Tomato Sauce	I	96	98
Pears	2	229	91	Pork Steak w/Juices	J	111	98
Peaches	3	205	93	Spiced Beef w/Sauce	K	82	97
Strawberries	5	216	93	Turkey Hash	L	88	97
Orange Juice	2	229	93	Apricots	B	80	100
Pineapple Juice	3	205	94	Peaches	E	101	97
Choc. Caramel Roll	2	229	92	Pears	H	101	99
Coconut Bar	3	205	93	Fruit Cocktail	L	88	96
Choc Fudge Bar	5	216	94	Date Pudding	A	98	83
Pound Cake	3	205	98	Fruit Cake	C	99	98
				Cookies	D,F,K	295	98
				Pecan Cake Roll	G	103	96
				Pound Cake	I	96	96
				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	95

and also when all items were consumed unheated. Table I shows ratings obtained for the Meal, Ready-to-Eat, menus and components under both hot and cold consumption conditions. Overall consumption percentages for major components of the experimental and standard meals, when major components were heated, are shown in Table II.

2.2.4 ANALYSIS

a. Comparison of the averages in Appendix D-1 with the data in Table I shows a general preference for the standard menus and foods. Ratings for experimental menus when consumed hot (Table I) were compared statistically with the overall average rating for the 12 control menus (Appendix D-1). Results showed that only the rating for experimental menu 3 did not differ significantly, at the 5 percent probability level, from the overall rating obtained for the standard menus. On this basis, menu 3 is as acceptable as the standard menus, while menus 2 and 5 are not when major foods in all meals are consumed hot. Menu 3 was less acceptable than the standard meals when consumed cold; menus 2 and 5 did not differ from the standard in acceptability when consumed cold.

b. Considering only the experimental menu ratings in Table I, a similar statistical test showed no difference between average ratings for menus 3 and 5, at the 5 percent probability level, when consumed hot. The rating for menu 2, however, was significantly lower than the average for menu 3. There were no significant differences between mean ratings for the 3 experimental menus when consumed cold. The greatest decrease between hot and cold menu averages occurred with menu 3 which was the most acceptable when consumed hot. The decrease for this menu when consumed cold was .89 hedonic scale points, which was significant at the 5 percent probability level.

c. With regard to individual foods these results indicate a close relationship between the ratings for the experimental meat items and overall menu averages when the major items are consumed hot. Barbecued beef in menu 5 and beefsteak in menu 3 both rated above 7 on the hedonic scale, with a negligible difference between their mean ratings, as was the case with averages for menus 3 and 5, which included these items. Bacon in menu 2, on the other hand, rated approximately a half point lower than either of the beef items when consumed hot. This difference proved statistically significant at the 5

percent probability level. Further examination of the Table I data shows a sizeable decrease in average rating for beefsteak in menu 3 when consumed cold. The difference between hot and cold mean ratings for the potato patty in menu 5 is also of a sizeable magnitude.

d. The general preference for the 12 menus of the standard ration indicates a need to improve individual components of the experimental ration. The averages for the 3 experimental menus and most components were, however, at a satisfactory level of acceptability when consumed hot or cold. Possible exceptions to this were the bread roll, potato patty and milk. Overall, the menus and components are considered to essentially meet the requirements of the Military Characteristics in this respect.

e. Food consumption percentages generally substantiate the average ratings shown in Table I. The percentages are extremely high for both rations, but those for the standard ration are somewhat higher. With regard to the experimental items, only two foods show consumption figures below 90 percent. One of these, the bread roll, also received a low average rating (5.53). The relatively low consumption of this item further attests to its low acceptability.

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

2.3.1 OBJECTIVE

To determine that menus of the Meal, Ready-to-Eat provide an adequate quantity of food for one man for one meal, all meals to be essentially equivalent in nutrition so that any 3 meals will constitute a ration. To determine that the Meal, Ready-to-Eat conforms to nutritional requirements.

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 experimental and standard rations. These data were obtained to determine if the quantity of food in experimental menus was adequate

from the standpoint of satiety. Pertinent information regarding the extent to which the experimental menus meet the requirements for nutritional adequacy was obtained by letter from the Food Division of the U.S. Army Natick Laboratories. See Appendix E.

2.3.3 RESULTS

2.3.3.1 Quantitative Adequacy of Menus.

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?" is 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	
	No.	Percent	No.	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.

2.3.3.2 Nutritional Adequacy of Menus.

U.S. Army Natick Laboratories has determined (Appendix E) that the three prototype meals are essentially equivalent in nutrition so that experimental menus 2, 3 and 5 can be interchanged and any three constitute a ration. Through laboratory tests conducted at Natick it has also been determined that the three experimental meals are essentially

equivalent in caloric and protein content, each supplying approximately one-third of requirements prescribed by AR 40-5 for a ration. Nutritive data are now being obtained on these meals. When data are complete, the vitamin and mineral adequacy of the meals for fortification will be determined.

2.3.4 ANALYSIS

2.3.4.1 Quantitative Adequacy.

a. The fact that a larger number of individuals considered the experimental meals to be less filling than the standard meals was partly caused by the relatively low acceptability and low consumption of major foods in the experimental meals, including the bread roll. (Tables I and II.) Failure of many individuals to eat the bread also resulted in low consumption of such items as military spread, peanut butter and jelly. Voluntary comments of participants showed the existence of a feeling that from the standpoint of satiety the experimental meal components were not as substantial as the standard items.

b. Another factor which probably influenced the opinions of individuals as to the adequacy of the quantity of food was the difficulties experienced in using the carton-stove to prepare the experimental meals. (See paragraph 2.6.3a.) Difficulty in setting up and operating the stove resulted in instances of inadequate, or partial preparation of foods.

2.4 ACCEPTABILITY FOR CONSUMPTION OVER A ONE-WEEK PERIOD (MC 20b)

Only three menus of the experimental ration were available for engineering testing. Three additional menus (Nos. 1, 4 and 6) were undergoing engineer design testing at the same time. However, the number and variety of menus available were not considered sufficient to determine whether the Meal, Ready-to-Eat can be consumed as a sole diet over a period of one week. At the present time the experimental ration does not meet this Military Characteristic.

2.5 EXTENT FOOD PREPARATION AND RECONSTITUTION REQUIRED (MC 20e)

2.5.1 OBJECTIVE

To determine whether preparation, other than opening packages, is required and whether water is required for preparation of other than drinks.

2.5.2 METHOD

Components of each menu, other than drinks, were examined to determine whether they would normally and logically be consumed without any preparation. Food ratings obtained for menus and components of the experimental ration when all foods were consumed cold and when dehydrated foods were consumed either dry, or rehydrated with cold canteen water, were also considered in determining the need for food preparation, and water required for preparing other than drinks.

2.5.3 RESULTS

Examination of individual components in the three menus showed 3 meat items - bacon, beefsteak and barbecued beef - which would normally be consumed hot if the tactical situation allows for preparation. Thus in such situations the amount of preparation done would exceed that specified in MC 20e. Average hedonic scale ratings for these foods when consumed cold, however, showed all 3 to be acceptable without preparation. This performance is considered satisfactory to meet the requirements of the MC that no preparation of food other than drinks be necessary. The 3 menus also include 4 dehydrated items - pears, peaches, strawberries and a potato patty. If given a choice the individual soldier would probably prefer to reconstitute these items prior to consumption. Thus in such situations these items would produce a requirement for water over and above that required for the reconstitution of drinks included in the meals. The additional water required per meal, however, is negligible in that it does not exceed more than a few ounces. Also if necessary, these dehydrated foods can be consumed dry.

2.5.4 ANALYSIS

Not applicable.

2.6 SUITABILITY OF EXPENDABLE HEATING DEVICE (CARTON STOVE) (MC 20h)

2.6.1 OBJECTIVE

To determine the suitability of the expendable combination carton-stove (Figure 4) provided with each menu of the Meal, Ready-to-Eat for use by the soldier in the preparation of food components. To determine the thermal efficiency of the stove.

2.6.2 METHOD

Carton-stoves provided with the meals were used by personnel of three Engineer Companies (paragraph 2.2.2) to heat necessary water and certain foods over a 4-day period at Camp A.P. Hill, Virginia. Participants were observed in order 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 fiber-board stoves caught fire was likewise noted. The thermal efficiency of the carton stove in heating both water and a single flexibly packaged food (beefsteak) was also determined under controlled conditions at Fort Lee. (Figures 4 and 5).

2.6.3 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, (Appendix D-2) but were of little aid to the soldier who found the construction of the stove to be extremely complex and consequently 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 it 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 problem 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 D-3. It is recognized that fire and safety hazards also exist when heating the Meal, Combat 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 D-2. 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.

e. The proposed approach of using the stove to heat ration components by the "double boiler" method (Appendix D-2) 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 assurance of non-toxicity of the inner surface of the stove, the food

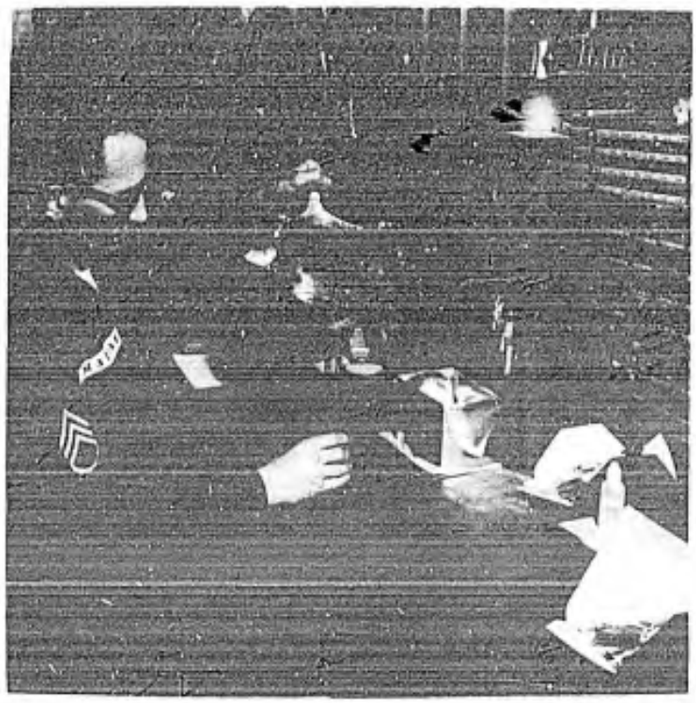

Figure 4.
Measurement of water prior to pouring in assembled carton-stove.

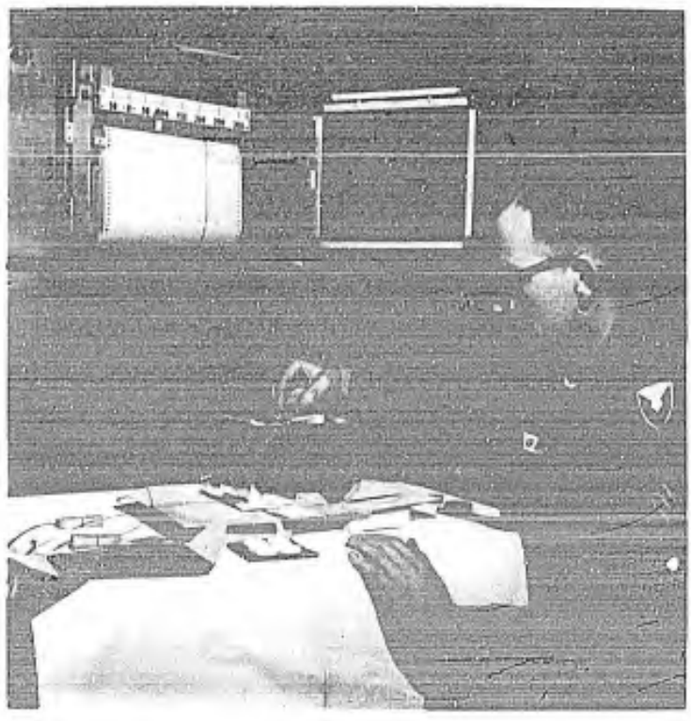

Figure 5.
Thermocouple is placed in water prior to ignition of trioxane fuel bar. Top of stove is covered prior to use.

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NEGATIVE 53, 54

Thermal Efficiency of Carton-Stove

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

packages, and glue used with these packages. Recorded observations as to preparation time for experimental meals prepared outdoors showed an average preparation time of approximately 32.2 minutes. Eighteen individual preparation times observed ranged from 18 to 45 minutes.

f. The thermal efficiency of the carton-stove in heating both water and flexibly packaged beefsteak in accordance with the printed instructions (Appendix D-2) was accomplished during 8 indoor trials. The specific heat of beefsteak was obtained from results of a previous test (2) and was computed using a Bomb Calorimeter. Table IV shows thermal efficiency values obtained for the carton-stove when heating water. Table V shows similar values obtained when heating flexibly packaged steak. Ambient temperature during these trials was approximately 77°F. while relative humidity was 21.5 percent.

g. 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.

2.6.4 ANALYSIS

Not applicable.

2.7 OVERALL COMMAND AND TROOP ACCEPTABILITY

2.7.1 OBJECTIVE

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

2.7.2 METHOD

After 2 days' experience with each ration, officers and key NCO's in each of the 3 participating companies at Camp A.P. Hill were asked to compare the experimental meals with the standard meals as to effects of their use on the ability to accomplish the unit mission, and their 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.

2.7.3 RESULTS

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

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	

b. The average rating, and distribution of individual ratings of enlisted personnel regarding the overall suitability of the two rations for use by the soldier are shown in Table VII.

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.

2.7.4 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 the 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 standard meals 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 ration 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 inflammable stoves. The number of different containers in the experimental meal was 5 or 6, counting the accessory pack as a single item. All of these containers were flexible packages, many of which were oversized (paragraph 2.1.3.1d) and difficult to handle during preparation and consumption of the meals.

2.8 AVAILABILITY OF ACCESSORIES (MC's 20f and g)

2.8.1 OBJECTIVE

To determine whether the experimental meals include all accessories necessary for consumption except canteen, canteen cup, and water. To determine whether an accessory packet is provided which contains cigarettes, matches, toilet paper, chewing gum, and rifle cleaning patches.

2.8.2 METHOD

The Meal, Ready-to-Eat menus were examined to determine conformance to the above.

2.8.3 RESULTS

All three menus were found to be complete with respect to accessories necessary for consumption, and completeness of the accessory packet. With further regard to consumption of the meals, participants at Camp A.P. Hill were asked if they had any particular difficulty in

eating directly from the flexible packages. Responses obtained showed that 76 had no difficulty while 72 stated that they did. When asked to explain, 42 individuals said that the plastic spoon provided with each meal was too short for use with the packages. This particular problem is not considered to be of major significance, even though the difficulty cited did occur when attempting to eat from the heat processed food package. This package, without the fiberboard cover, measures approximately 7 x 4 1/2 inches and is opened across the short end. While attempting to eat from the package with a 5-inch spoon created a problem for many, it was not of paramount importance to more than half of individuals questioned.

2.8.4 ANALYSIS

Not applicable.

2.9 HANDLING, TRANSPORTATION AND STORAGE CAPABILITY, AND LEGIBILITY OF CASE MARKINGS (MC's 21b and c)

2.9.1 OBJECTIVE

To determine the capability of cases and meals to withstand military handling during transportation and storage prior to use, legibility of case markings during such handling, and the ease of opening cases, meals and packages.

2.9.2 METHOD

a. A total of 500 cases of the Meal, Ready-to-Eat were initially shipped by motor freight from Chicago to Fort Lee during December 1963. Cases were off-loaded and stacked approximately 10 high in a heated warehouse. Approximately 230 cases were loaded in a covered 2 1/2-ton truck and shipped approximately 75 miles to Camp A.P. Hill during February 1964. Rations were off-loaded and stacked in an unheated warehouse. They were issued to troops for use over a 4-day period. Forty additional cases were shipped by military truck from Fort Lee to Camp Pickett during February, a distance of some 40 miles. The rations were off-loaded and stacked on the ground in a tent until used by troops. An additional 56 cases were loaded at Fort Lee and transported by truck a distance of some 100 miles to Fort Story, Virginia. Rations were off-loaded and stored in tents on the ground until used for

troop acceptability tests. Meal cases were examined after each shipment to determine the occurrence of any failures, and to determine if markings on cases and meal cartons remained legible.

b. Information as to ease of opening cases and meals was obtained by observation and questionnaires during test operations at Camp A.P. Hill, Fort Story, Camp Pickett and Fort Lee, Virginia, during which troops handled, prepared and consumed the test meals.

2.9.3 RESULTS

a. Examination of all meal cases after initial shipment from Chicago to Fort Lee, and after subsequent storage, handling and shipment, showed no damage of any significance to any of the meal cases, cartons or components. In addition, all case markings remained legible throughout the series of transportation, storage and handling operations performed.

b. Observations obtained during the troop phases of the test at Camp A.P. Hill, Fort Story, Camp Pickett and Fort Lee showed that participants had no major difficulty opening either the ration cases or meal cartons. Individuals were questioned regarding ease or difficulty in opening the flexibly packaged components in the individual meal cartons. Responses to this question were as follows:

Packages were:	No. Responses	Percent
Very easy to open	49)	62
Slightly easy to open	43)	
Slightly difficult to open	40	27
Very difficult to open	17	11

c. All of the flexibly packaged components in the meals possessed a V-shaped indentation along one edge to facilitate opening of the package. (Figure 6). There was considerable orientation prior to the test during which the method of opening was described and illustrated to participants. In spite of this a sizeable number of individuals considered the packages difficult to open to some extent. Since the packages were usually easy to open once the V-shaped tear area was located,

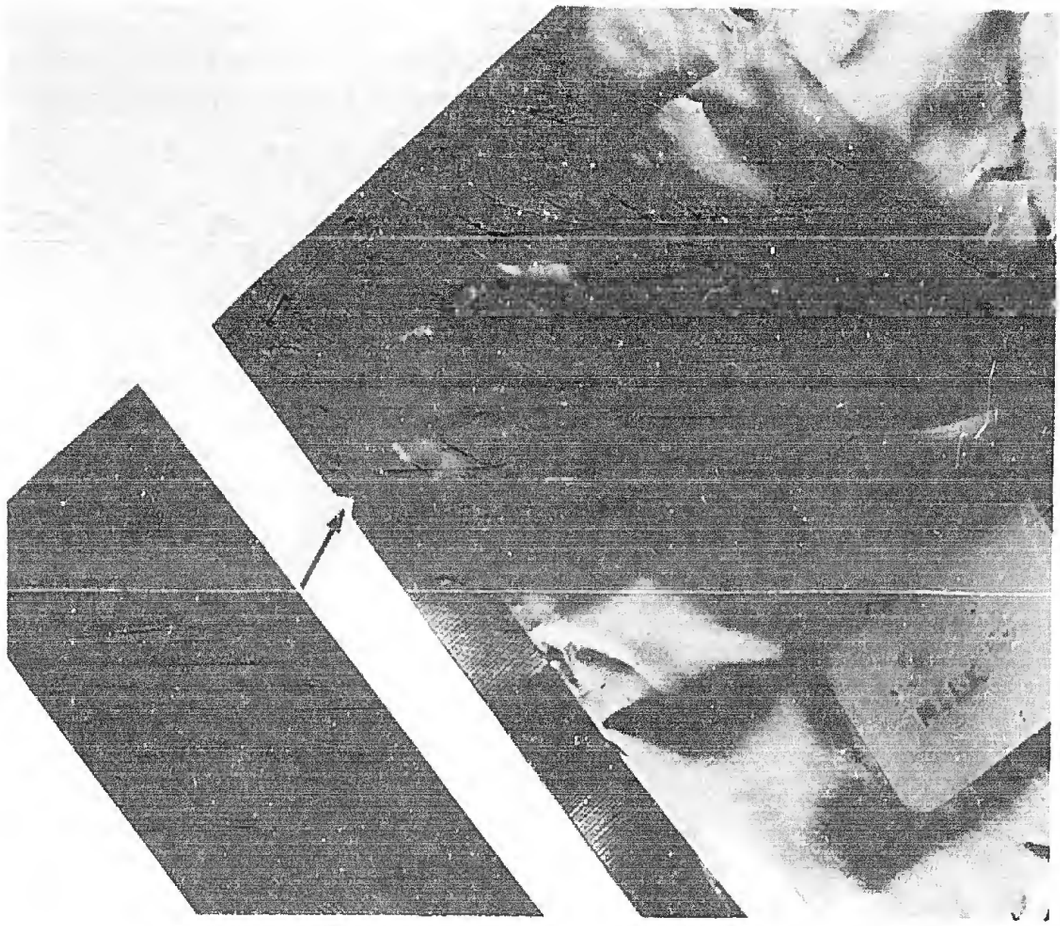

Figure 6. Milk package showing V indentation to facilitate opening.

it is believed that most of the difficulty encountered can be eliminated simply by making the "V" at the point of initial opening slightly larger. This would make it easier to see, and more sensitive to the touch in those situations where visibility is restricted.

2.9.4 ANALYSIS

Not applicable.

2.10 RESISTANCE TO WATER, INSECTS AND RODENTS, AND STORAGE CAPABILITY OF MEALS (MC's 21a and e)

2.10.1 OBJECTIVE

To determine resistance of meal cases and packages to water, insects and rodents, and the ability of meals to withstand a minimum of two years' storage without refrigeration and without spoilage or detrimental decrease in nutritional value or palatability.

2.10.2 METHOD

Information as to the long-term storage capabilities and resistance of meal cases and packages to water, insects and rodents was obtained from the U.S. Army Natick Laboratories. See Appendix E.

2.10.3 RESULTS

a. Natick Laboratories has determined that the cases and packages of the Meal, Ready-to-Eat are resistant to water and non-boring types of insects. Resistance of cases to rodents is equivalent to that of cases for present standard rations. The resistance of meal packages to rodents is unknown and is expected to be partial.

b. Storage studies conducted at Natick on the experimental meal components indicate that menus 2, 3 and 5 of the Meal, Ready-to-Eat will meet the 2 years' storage requirement. Additional stability studies are planned on the meals provided for this test and will be conducted on additional components of the meals as they are developed.

2.10.4 ANALYSIS

Not applicable.

2.11 DURABILITY OF COMPONENT PACKAGES UNDER ACCELERATED USE CONDITIONS

2.11.1 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 D-4).

2.11.2 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. (Figures 7 and 8.) All six menus of the experimental ration were evaluated in this manner. Results reported here, however, are for foods included only in menus 2, 3, and 5, and those which are common to all 6 menus. Results for 1, 4 and 6 are reported separately in Technical Report 8-3-7400-05K covering the Engineer Design test of the Meal, Ready-to-Eat, Individual.

2.11.3 RESULTS

Table VIII shows a summary of damages incurred by component packages of menus 2, 3, and 5 during 3 traversals of the course obstacles. 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.

2.11.4 ANALYSIS

a. While the pound cake and bread roll both show evidence of crushing, the dehydrated foods show the greatest frequency of damage in this respect. The contents of approximately one-third of the potato patties, peaches, and strawberry packages carried over the wear course obstacles were crushed in varying degrees after 3 traversals. It is of

Figure 7.
Enlisted men with meal components dispersed in pockets slide down stone embankment.

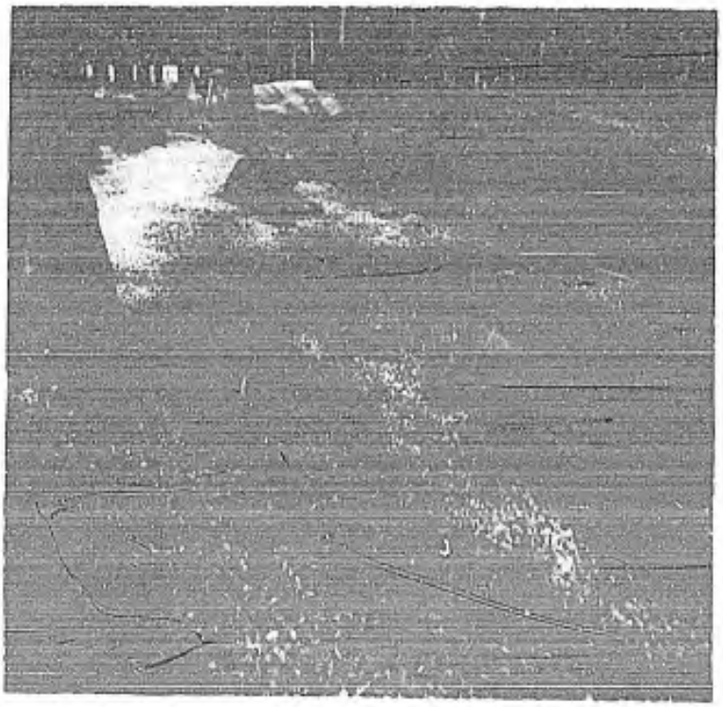

Figure 8.
Traversing gravel crawl.

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TEST 8-3-7400-04K

NEGATIVE 43, 39

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 2, 3, and 5)

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)
Beefsteak	3	30		1	1	
Beef w/Barbecue Sauce	5	30		2	1	
Beans w/Tomato Sauce	2	30			1	
Bacon	2	30		1	1	
Pound Cake	3	30	6	4		
Bread Roll	2,3,5	90	15			
Accessory Packs	2,3,5	90		6	3	
Military Spread	5	30			2	2
Peanut Butter	2	30			1	6
Potato Patty	5	30	10	7		1
Peaches	3	30	11	2		2
Strawberries	5	30	12		3	
Pears	2	30	5			
Milk	5	30			3	
Orange Juice	2	30		2		1
Pineapple Juice	3	30		1		1
Carton-Stove	2,3,5	90*				

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

interest that the dehydrated pears suffered little as a result of crushing. While this product did break apart it was not as brittle as either the strawberries or peaches. The pears generally remained in bite size chunks, while in many instances the peaches and strawberries were found to be pulverized.

b. Both the wet and dry food packages sustained pinhole damage due mainly to sand abrasion. The potato patties, however, show a relatively high frequency of pinholing caused by both sand abrasion and the rough texture of the product per se, which makes the package more susceptible to such damage.

c. With regard to punctures or tears in the package wall or seals, wet food items such as beefsteak, barbecued beef and beans, show only one failure each. All of these were of such a minor nature that the package contents for the most part remained intact. As shown in the last column of Table VIII, only the peanut butter showed a relatively high frequency of severe damage. Six, or 1/5 of the packages carried, were sufficiently damaged that their contents were, for practical purposes, lost.

d. Overall, the performance of the foods in the accelerated wear test was excellent. Treatment given these items during 3 traversals of the course obstacles is considerably more harsh than any comparable type of 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 dehydrated 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.

2.12 AIR DELIVERY EVALUATION (MC 22b and c)

2.12.1 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.

2.12.2 METHOD

a. A total of 27 cases of the Meal, Ready-to-Eat was rigged for air delivery by qualified personnel of a QM Aerial Support Company. 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. Heavy straps secured the bundles which rested on 3 layers of 4-inch paperboard honeycomb. A small 68-inch pilot parachute 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. This altitude would be used when dropping men and rations simultaneously.

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. A mechanical knife cut the straps after the bundles were ejected and the meal cases landed individually. One hundred feet is the altitude at which rations will normally be delivered without parachute.

2.12.3 RESULTS

a. There were no packages with major leakage during the high velocity drop in which 16 of each menu were dropped from an altitude of 500 feet. There were also 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 of each meal dropped free fall at an altitude of 100 feet, only three foods showed evidence of major damage. These were beans with tomato sauce (menu 2) with 4 failures; peanut butter (menu 2) with 2 failures; and barbecued beef (menu 5) with 6 major 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. There was also a total of 10 bean,, peanut butter and beef packages which showed minor leakage. Most of the contents of these packages were intact and were therefore considered usable.

2.12.4 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 and this was during the free fall drop. Barbecued beef showed the highest number of failures. Approximately 27 percent of these items showed major failures during the free fall drop, while similar percentages for the beans with tomato sauce and peanut butter were 18 and 9 percent, respectively. Overall the aerial 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 higher when using the free fall delivery method.

2.13 SAFE STORAGE AND TRANSIT CONDITIONS (MC 24: TC 2c)

2.13.1 OBJECTIVES

a. To determine whether all food components in the Meal, Ready-to-Eat will withstand at least 6 months storage at 100°F. without significant loss of nutritional adequacy, edibility, acceptability and utility.

b. To determine whether foods 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 2 hours per day, and as low as -65°F. without significant loss of nutritional adequacy, acceptability and utility.

c. To determine whether the Meal, Ready-to-Eat will meet the air transit condition set forth in paragraph 7.1d, AR 705-15.

2.13.2 METHOD

The U.S. Army Natick Laboratories provided the FEA with information by letter (Appendix E) pertaining to MC 24 and TC 2c.

2.13.3 RESULTS

a. The developer of the Meal, Ready-to-Eat concurred in MC 24 at the time of coordination on the grounds that AR 705-15 would be revised to include requirements attainable for packaged rations. The requirement set forth in subparagraph 7.1a is considered unrealistic for food and it is doubtful that the Meal, Ready-to-Eat or any other ration based on existing technology can meet it. Effort in this respect is being directed by Natick Laboratories to enable this ration to meet the storage conditions delineated in paragraph 2c of the approved TC's. (Reference objectives a and b above.)

b. Experience of the U.S. Army Natick Laboratories with previous flexibly packaged foods indicates that the Meal, Ready-to-Eat will probably meet the air transit conditions set forth in paragraph 7.1d, AR 705-15 (objective c above). Tests will be conducted in the future to determine this. As an indication of meeting these conditions, the FEA subjected one each of menus 1 through 6 of the experimental ration to a vacuum of 28.5 inches of mercury for 15 minutes (Figure 9). This was the approximate equivalent of flying at an altitude of 69,000 feet. While there was moderate to extreme distension of the meal cartons and packages placed in the vacuum chamber, there were no failures of any kind after 15 minutes of exposure. This brief experiment indicates that the meal cartons and individual food packages are more than satisfactory from the standpoint of safe air transit conditions. The regulation specifies that the rations will be capable of air transport at an altitude of 40,000 feet.

2.13.4 ANALYSIS

Not applicable.

2.14 CBR AND ATOMIC REQUIREMENTS (MC 25)

2.14.1 OBJECTIVE

To determine whether cases and packages of the Meal, Ready-to-Eat, Individual, are as resistant to CBR and atomic effects as the standard Meal, Combat, Individual.

2.14.2 METHOD

The U.S. Army Natick Laboratories provided the FEA with information by letter pertaining to MC 25. See Appendix E.

2.14.3 RESULTS

U.S. Army Natick Laboratories has informed the QM R&E FEA that testing of flexibly packaged foods conducted to date indicates that packaging materials used for the Meal, Ready-to-Eat, Individual, will meet this requirement. Testing in this respect has not been completed.

2.14.4 ANALYSIS

Not applicable.

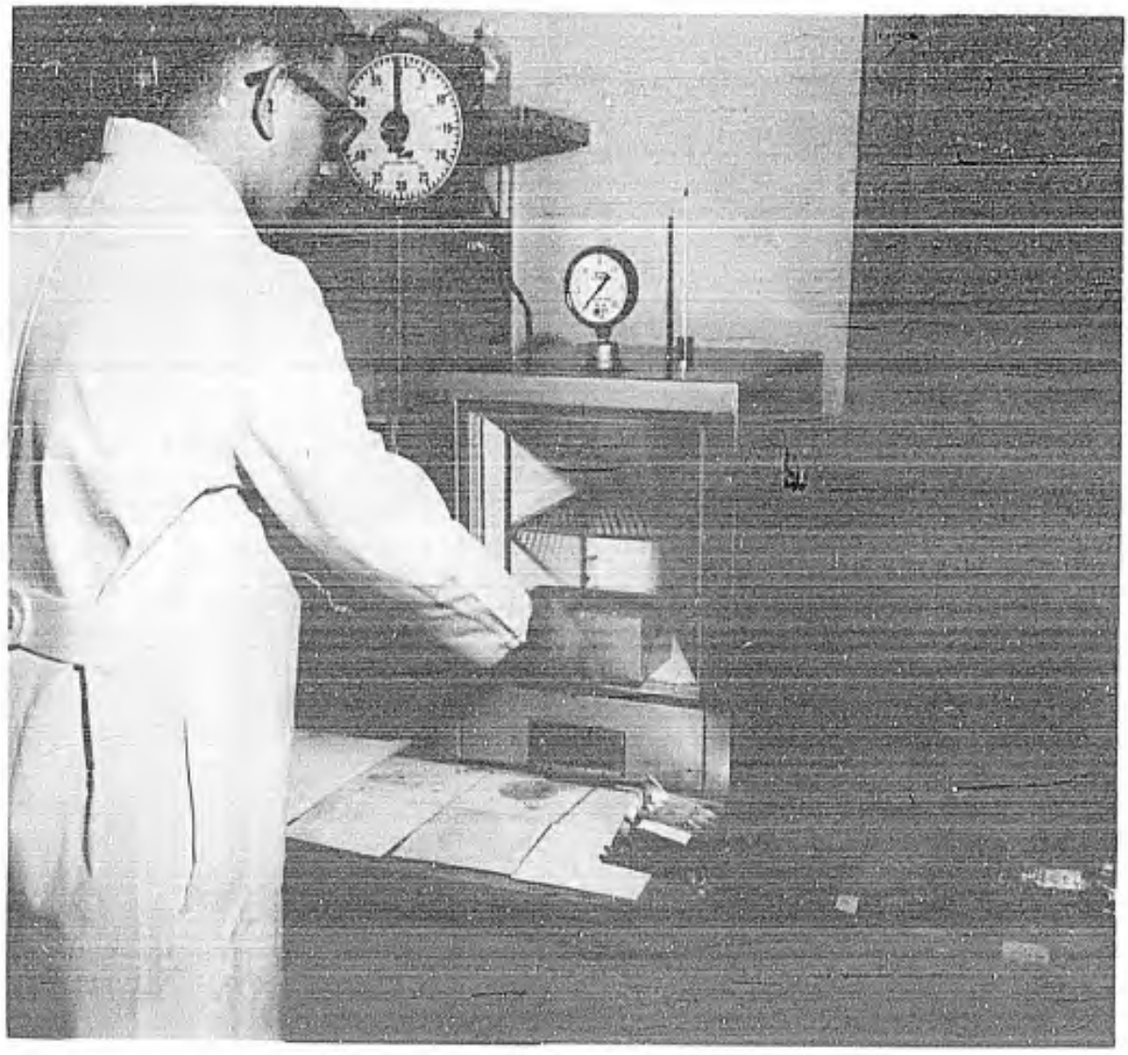

Figure 9. Placing Meal, Ready-to-Eat Menu in vacuum chamber.

SECTION 3 - APPENDICES

Appendix A - Test Directive

Appendix B - Military and Technical Characteristics

Appendix C - Deficiencies and Shortcomings

Appendix D - Test Data

Appendix E - Letter, U.S. Army Natick Laboratories

Appendix F - Distribution

APPENDIX A (1)

U.S. ARMY NATICK LABORATORIES
NATICK, MASSACHUSETTS

IN REPLY REFER TO
AMXRE-F

13 December 1963

SUBJECT: NLABS 64014, Engineering Test of Meal, Ready-to-Eat, Individual

TO: Commanding General
US 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).

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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, numbers 2, 3 and 5 (Inclosure 2) of the Meal, Ready-to-Eat are ready for test against most of the approved military characteristics (Inclosure 3). Fully packaged, these menus include a wide variety of components, including both wet-pack and dehydrated items. Each menu contains at least one dehydrated item, which can be eaten either dry or reconstituted with cold water.

3. Objectives

a. To determine the operational performance characteristics of three prototype Meal, Ready-to-Eat, Individual menus in relation to paragraphs 19, 20a (first part only), 20d through 20h, 21a through 21d, 22 and 23 of approved military characteristics (Inclosure 3). Information on paragraphs 20a (second part), 20b, 20c, 21e and 24 will be provided to QM R&E Field Evaluation Agency by the U. S. Army Natick Laboratories.

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 items and the menu combinations, recognizing that the variety of test menus is limited and therefore will not allow compliance with MC - 20b at this time. Testing against this requirement is expected to be accomplished when a minimum of 12 menus are available for test.

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.

c. Information on the utility of the Meal, Ready-to-Eat, and users' 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) Insofar as possible, issue Meal, Ready-to-Eat, to one or more companies (approximately 200 men) three times a day for 2 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 the restriction that any given individual will not duplicate menus within one day.

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(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.

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

(d) Issue menus randomly to both groups.

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 64015, Engineering Design Test of Meal, Ready-to-Eat, Individual.

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b. Experimental Meal, Ready-to-Eat, will be furnished by Food Division, US Army Natick Laboratories. Shipment is presently scheduled for on or 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.

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

g. Command Schedule requires initiation of test by the end of 3rd Quarter FY 1964.

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

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.

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 marking 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 (8)

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. H uman 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 at 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.

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 lightweight 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.

APPENDIX C

DEFICIENCIES AND SHORTCOMINGS

1. DEFICIENCIES

Deficiency	Suggested Corrective Action	Remarks
The carton-stove is difficult to assemble, ignites and burns easily, and is a safety hazard to personnel and property.	Eliminate stove feature of meal carton. Use soldier's canteen cup as a stove for necessary preparation of meal components. If this is not practicable, redesign carton-stove to correct cited deficiency.	See Par. 2.6.3

2. SHORTCOMINGS

Shortcoming	Suggested Corrective Action	Remarks
a. There is excess packaging material primarily in the length of some flexible packages.	Reduce length of certain packages by 1 to 2 inches as appropriate; or reduce and standardize package sizes.	See Par. 2.1.3.1d
b. All menus exceed 1 pound weight limitation. Average deviation is 6 ounces.	Reduce weight and volume, if possible, by eliminating excess packaging material.	See Par. 2.1.3.2a
c. Quantitative adequacy of Meal Ready-to-Eat menus is less than that of Meal, Combat menus.	Improve satiety characteristics of menus wherever possible.	See Par. 2.3.4.1

APPENDIX D (1)

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

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

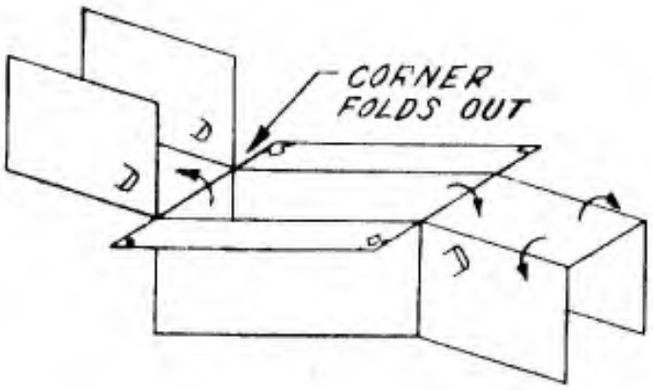

Figure 1

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

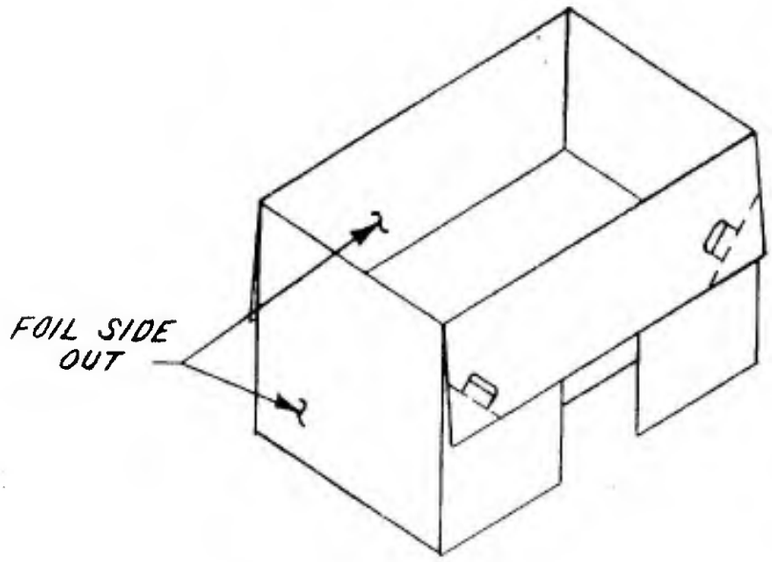

Figure 2

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

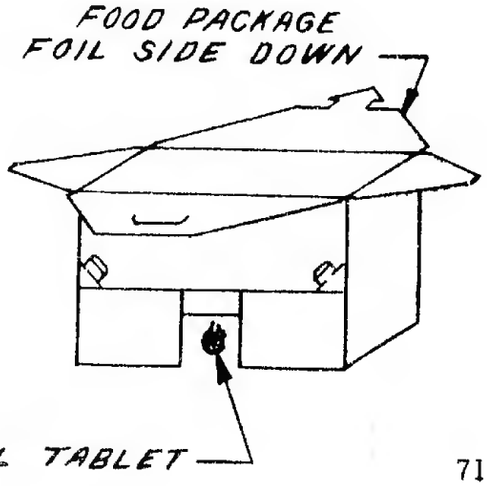

Figure 3

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 D - 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 D-4

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 E (1)

U.S. ARMY NATICK LABORATORIES

NATICK, MASSACHUSETTS

IN REPLY REFER TO

AMXRE-FPC

- 5 MAR 1964

SUBJECT: TECOM Project 8-3-7400-04, Engineering Test of Meal, Ready-to-Eat, Individual (NLABS 64014)

TO: Commanding Officer
Headquarters
Quartermaster Research and Engineering
Field Evaluation Agency
Fort Lee, Virginia 23801

Reference is made to paragraph 2, letter from your Headquarters, subject as above, dated 6 February 1964, STEFA-FC. The following information is furnished in response thereto:

a. Second sentence, MC 20a - The three prototype meals provided for subject test are essentially equivalent in nutrition so that these three meals can constitute a ration.

b. MC 20c - See below, under TC 2a.

c. TC 2a - These Laboratories have determined that the three experimental meals are essentially equivalent in caloric and protein content, each supplying approximately one-third of requirements prescribed by AR 40-5 for a ration. Nutritive data are being obtained on the meals as procured for subject test; when the data are complete, the vitamin and mineral adequacy of the meals and need for fortification will be determined.

d. MC 20b - A minimum of 12 meals is being designed to meet this requirement. It is not believed that the three prototypes furnished for subject test will, by themselves, provide sufficient variety to be acceptable for consumption as a sole diet for one week.

e. MC 21a - Cases and packaging are resistant to water and to non-boring types of insects. Resistance of cases to rodents is equivalent to that of cases for present standard rations. Resistance of packages to rodents is unknown and is expected to be partial.

f. MC 21e - Storage studies on experimental components indicate that the three meals will meet this requirement. Additional stability studies are planned on the meals as procured for subject test and will be conducted on additional components and meals as they are developed.

AMXRE-FPC

- 5 MAR 1964

SUBJECT: TECOM Project 8-3-7400-04, Engineering Test of Meal, Ready-to-Eat, Individual (NLABS 64014)

g. TC 1c - See above, under MC 21e.

h. MC 24 - The developer concurred in this MC at the time of coordination on the grounds that AR 705-15 would be revised to include requirements attainable for packaged rations. The requirement set forth in subparagraph 7.1a is considered unrealistic for food and it is doubtful that the Meal, Ready-to-Eat, Individual or any other ration based on existing technology can meet it. Effort in this respect is being directed to enable this ration to meet the storage conditions delineated in paragraph 2c of the approved TC's. Experience with previous flexibly packaged food items indicates that the Meal, Ready-to-Eat will probably meet the air transit conditions set forth in paragraph 7.1d, AR 705-15 and tests will be conducted to confirm this.

i. MC 25 - Although testing of flexible packages is not completed, results indicate that packaging materials used for the Meal, Ready-to-Eat, Individual will meet this requirement.

FOR THE COMMANDER:

Gerald C. MacDonald

JAMES H. FLANAGAN
Deputy Scientific Director
for Engineering

APPENDIX F (1)

DISTRIBUTION LIST

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AD Accession No.

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An engineering 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 if menus 2, 3 and 5 of the meal are suitable for service test. Experimental and standard menus were evaluated under both normal and accelerated use conditions to obtain measures of such factors as troop acceptability and utility of meals and components; durability of packaging; suitability of the carton-stove; air delivery factors; and safety.

It is concluded that menus 2, 3 and 5 of the Meal, Ready-to-Eat are suitable for service test, provided that shortcomings

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2. Rations
3. Stove, Carton
4. Heating device, Expendable
I. Burt, Thomas B.
II. Title
III. TECOM Project No. 8-3-7400-04K
IV. Food Logistics System, Simplified

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It is recommended that menus 2, 3 and 5 of the Meal, Ready-to-Eat, Individual be considered suitable for service test upon correction of the cited shortcomings, and that the carton-stove be eliminated entirely or be redesigned. Consideration should be given to delaying any service testing of the experimental meal until after all menus proposed for the ration have been engineering tested.

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

FINAL REPORT OF ENGINEERING TEST OF MEAL, READY-TO-EAT, INDIVIDUAL, by Thomas B. Burt, May 1964. 81p. -tables, -illus., -graphs, 6 Appendices p49-81. (TECOM 8-3-7400-04K) 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 engineering 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 if menus 2, 3 and 5 of the meal are suitable for service test. Experimental and standard menus were evaluated under both normal and accelerated use conditions to obtain measures of such factors as troop acceptability and utility of meals and components; durability of packaging; suitability of the carton-stove; air delivery factors; and safety.

It is concluded that menus 2, 3 and 5 of the Meal, Ready-to-Eat are suitable for service test, provided that shortcomings

UNCLASSIFIED

1. Meal, Ready-to-Eat, Individual
2. Rations
3. Stove, Carton
4. Heating device, Expendable

I. Burt, Thomas B.
II. Title
III. TECOM Project No. 8-3-7400-04K
IV. Food Logistics System, Simplified

AD Accession No.

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