SAM-TR-67-114

AD 669909

BITE-SIZE FOOD IN FIGHTER AIRCRAFT

MAY J. O'HARA, Captain, USAF, BSC
JOHN E. VANDERVEEN, Ph.D.

DDC
RECEIVED
APR 1 1968
B

December 1967

USAF School of Aerospace Medicine
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas

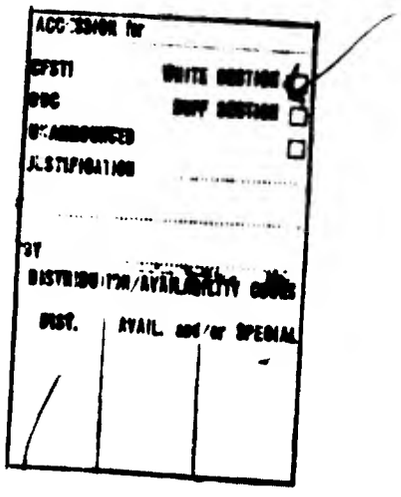
Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va. 22151

15

Qualified requesters may obtain copies of this report from DDC. Orders will be expedited if placed through the librarian or other person designated to request documents from DDC.

When U. S. Government drawings, specifications, or other data are used for any purpose other than a definitely related government procurement operation, the government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

This document has been approved for public release and sale; its distribution is unlimited.



BITE-SIZE FOOD IN FIGHTER AIRCRAFT

MAY J. O'HARA, Captain, USAF, BSC
JOHN E. VANDERVEEN, Ph.D.

FOREWORD

The research reported in this paper was conducted by personnel of the Physiology Branch, USAF School of Aerospace Medicine, under task No. 775803, with the assistance of personnel of Myrtle Beach AFB, S. C., and Edwards AFB, Calif. The work was accomplished between August 1966 and May 1967. The paper was submitted for publication on 12 October 1967.

The authors acknowledge the assistance of the following: Major David R. Jones and Captain Richard M. Thompson, who briefed the pilots of the 352d Tactical Fighter Squadron, Myrtle Beach AFB, collected the data, and returned the information to the authors; Second Lieutenant Richard P. Leifer, who assisted in making arrangements with the F-111A squadron at Edwards AFB, collected the data, and returned the information to the authors; and to Major Norman D. Heidelbaugh, who assisted with procurement of foods for the studies and coordinating with personnel at Myrtle Beach AFB.

This report has been reviewed and is approved.

GEORGE E. SCHAFER
Colonel, USAF, MC
Commander

ABSTRACT

Bite-size foods were consumed by pilots of fighter-type aircraft in two trials, and data were collected on the acceptability and ease of handling these foods. This type of feeding system offers foods that are stable without refrigeration, are easy to handle, and need no kitchen facility for preparation. Bite-size food flavors at the present time do not surpass those of conventional foods.

BITE-SIZE FOOD IN FIGHTER AIRCRAFT

I. INTRODUCTION

Bite-size foods were originally designed for in-flight feeding for extended flights of single-seated aircraft (1). These foods are easily eaten with one hand, are stable without refrigeration, require no preparation aboard the aircraft, and are more dense than in-flight meals currently available. High manufacturing costs have prohibited the evaluation of these foods in fighter aircraft. Operational flights generally have been of limited length, and food was not a consideration. Air-to-air refueling of fighter-type aircraft has increased the necessity of providing food for the pilot. These bite-size foods are now included in feeding systems in manned space missions (2, 3). The increased demand has led to new production technics and the consequent reduced costs now make the use of these foods more practical. During recent flights selected bite-size foods were evaluated for acceptability by pilots of fighter aircraft. Data on acceptability and convenience were collected and are herewith reported.

II. METHODS

Trial 1

Two meals composed of bite-size foods (table I) were supplied each F-100 pilot of the 352d Tactical Fighter Squadron to consume during a flight from Myrtle Beach AFB, S. C., to Southeast Asia. The foods were approximately ¾-in. cubes, except the bacon and chicken sandwich bites, which were slightly larger. With the exception of bacon squares, the foods had been freeze-dehydrated to insure stability. Freeze-drying removes moisture from these foods and increases their shelf life in ambient temperatures.

The foods were packaged in a modified sandwich-type polyethylene bag with a zip-lip (fig. 1). Cards with a hedonic rating scale ranging from 1 to 9 (fig. 2) were supplied in order for the pilot to indicate his preferences. Questionnaires (fig. 3) were used to obtain information on food flavors, handling qualities, quantities of food desired, and adequacy of water containers.

The water bottle was a 1-liter Nalgene plastic bottle fitted with a rubber stopper and a polyethylene tube, 10 in. long and 0.6 cm. in diameter (fig. 4). A hole was drilled through the bottle top and the rubber stopper. The polyethylene tube was inserted into the bottle and could be moved up or down to the desired level.

TABLE I

Bite-size meals for 352d Tactical Fighter Squadron, Myrtle Beach AFB

Number	Food item
	Meal I
4	Bacon squares
4	Special K with almond cubes
4	Banana cubes
4	Chocolate cubes
4	Compressed date nut cubes
	Meal II
4	Bacon squares
3	Chicken bites
4	Apricot cubes
4	Brownie cubes
4	Currants and almond cubes

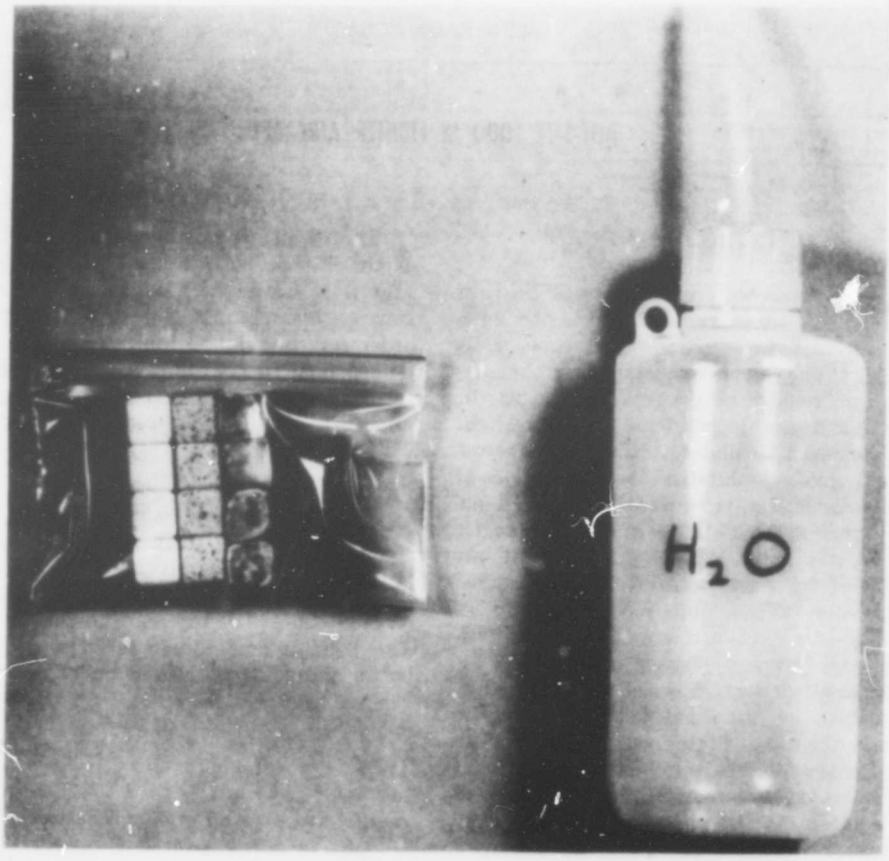


FIGURE 1

Meal I. Food bites in polyethylene bag with zip-lip and water bottle.

The authors delivered the food, rating cards, and questionnaires to Myrtle Beach AFB. The meals were packaged and the Flight Medical Officer briefed on collection of data. He, in turn, was responsible for briefing the squadron prior to the flight. The "Food Evaluation Card" and "Questionnaire on Bite-Size Feeding System" were completed at the end of each flight.

Trial 2

A second series of tests was conducted by pilots at Edwards AFB, Calif. This study was initiated because of the requirement for food on proposed long-duration flights in the F-111A.

The participating pilots were given an opportunity to sample foods from approximately 50 available flavors of bite-size foods. Each pilot recorded his preferences, and this list was used to plan menus containing acceptable foods. The meals were packaged at the USAF School of Aerospace Medicine and sent to Edwards AFB, where they were refrigerated until used. Five to six cubes of each food were

FOOD EVALUATION

NAME | DATE *(or mission time)*

Every day, please evaluate each food on the following scale. Place a check mark under the one comment that best describes how you like or dislike each food. Add any additional comments on the reverse side.

FOOD	9 LIKE EXTREMELY	8 LIKE VERY MUCH	7 LIKE MODERATELY	6 LIKE SLIGHTLY	5 NEITHER LIKE NOR DISLIKE	4 DISLIKE SLIGHTLY	3 DISLIKE MODERATELY	2 DISLIKE VERY MUCH	1 DISLIKE EXTREMELY

SAM HQ FORM FEB 66 0-212

FIGURE 2

"Food Evaluation Card" with hedonic rating.

packaged in a polyethylene bag (2½ by 6½ in.) with a zip-lip. Four to five of these packages comprised a meal.

Because of changes in flight schedules and personnel, meals were not always consumed by the pilots for whom they were planned. Some pilots, therefore, had no preflight opportunity to taste the foods. In later flights, meals were made up from available foods in an attempt to obtain evaluations for a greater number of food items.

Average flight duration, when these foods were eaten, was about 3 hours, which was considerably shorter than in trial 1. Each pilot took one meal (five packets of six cubes each) with him and a bottle of water. The "Food Evaluation Card" and the "Questionnaire on Bite-Size Feeding System" were completed at the termination of each flight.

III. RESULTS AND DISCUSSION

Trial 1

The duration of the first flight from Myrtle Beach AFB to Hickam AFB, Hawaii, was 10 hours. After several days' delay, the second flight from Hickam AFB to Guam lasted 7½ hours. These flights were of sufficient duration to warrant placing food aboard the aircraft. Regular in-flight sandwich box lunches were also placed aboard in the event the new foods were unsatisfactory. The stability of the bite-size foods was demonstrated by the fact that these foods were

packaged at Myrtle Beach AFB, with meal I eaten the next day and meal II consumed approximately a week later without any noticeable deterioration or flavor alteration.

The acceptability ratings of the bite-size foods are presented in table II. Not all foods were eaten by all pilots; all the questionnaires were not answered; some questionnaires were only partially completed. Twenty-two pilots consumed the bite-size foods on the first flight, and fourteen pilots consumed them on the second flight.

The acceptability ratings indicated that seven of the ten items, or 70% of the foods, had

QUESTIONNAIRE ON BITE-SIZE FEEDING SYSTEM

1. Handling
   - A. Was the package easy to handle?
   - B. Were you able to select the desired food items?
   - C. Was the food too large for your mouth?
   - D. Suggestions:
2. Flavor
   - A. Were any food items too sweet?
   - B. Were any food items too bland?
   - C. Was the food sticky or oily?
3. Menu Pattern
   - A. Was there enough variety?
   - B. Would you like more or less or same variety?
   - C. Did you eat the meal at one time or did you munch on it throughout the flight?
4. Water
   - A. Did you have enough water?
   - B. Is the water container easy to handle?
   - C. Suggestions:
5. Would you prefer this type feeding system to the type you have eaten on previous flights? Please comment:

FIGURE 3

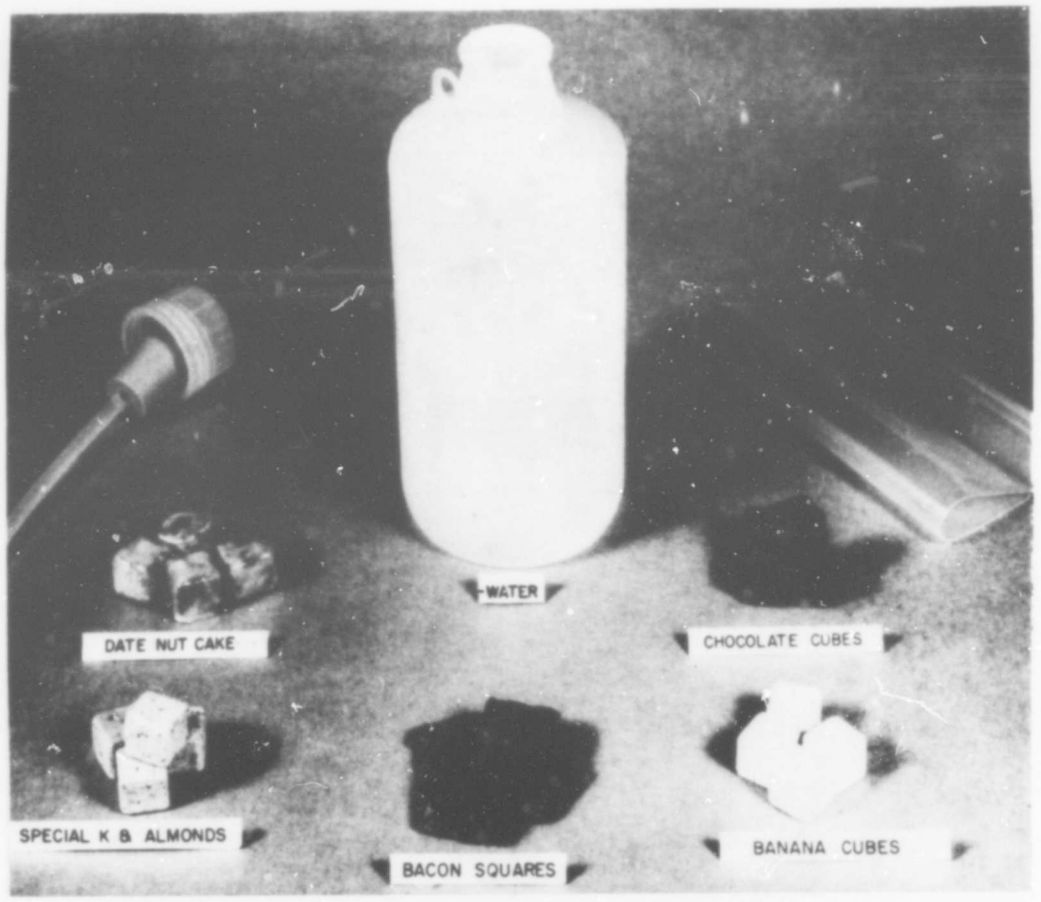


FIGURE 4

Meal I. Components of water bottle and meal.

a mean hedonic rating in the "like moderately" category. These foods were consumed only one time by the pilots, and it has been noted that the initial rating of a food does not predict future consumption (4). O'Hara et al. (5) indicated that several organoleptic experiences with a food are necessary to obtain rating consistency. Additional data on food preference would lend increased reliability to the present data.

Questionnaire data from the two meals were combined and are presented in table III. The food packages were easy for the pilots to handle, and the foods were not too large, sweet, bland, or oily. There was sufficient variety of foods consumed throughout the flight. No preference was demonstrated for this type of feeding system over the state-of-the-art in-flight sandwich box lunch; however, this was the first exposure of the pilots to this advanced concept feeding system.

The water bottles were considered by the pilots to be a definite improvement over the present system. The bottle was unbreakable,

TABLE II

Acceptability ratings of foods by pilots of 352d Tactical Fighter Squadron, Myrtle Beach AFB

Food item	Pilot																							Mean rating
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Meal I																								
Bacon squares	7	9	8	6	8	2	8	7	8	4	9	7	*	7	6	8	9	7	8	8	*	8	*	7.2
Special K with almonds	7	8	8	8	7	8	*	4	8	8	9	7	7	8	*	7	9	7	9	7	*	4	*	7.4
Banana cubes	7	8	4	8	8	6	8	7	8	7	8	7	8	8	*	7	9	7	8	7	*	6	*	7.3
Date nut cubes	7	8	7	8	7	5	8	6	8	7	9	7	8	8	*	7	9	7	6	7	*	7	*	7.3
Chocolate cubes	6	8	7	7	8	5	8	6	8	7	8	5	8	8	*	7	9	7	7	7	8	5	*	7.1
Meal II																								
Bacon squares	7	8	8	†	†	7	7	8	†	†	9	6	†	7	†	7	9	*	*	6	†	8	7	7.4
Chicken bites	3	7	2	†	†	8	6	6	†	†	8	6	†	2	†	6	8	*	*	*	†	8	*	7.4
Almond raisin cubes	5	6	4	†	†	8	6	6	†	†	8	6	†	6	†	6	8	*	*	3	†	1	*	5.6
Apricot cubes	6	5	4	†	†	3	7	4	†	†	8	6	†	6	†	6	4	*	*	*	†	3	6	5.2
Brownie cubes	5	6	6	†	†	9	8	6	†	†	8	6	†	7	†	6	8	*	*	*	†	1	*	6.3

*Did not eat the food item.

†Pilots were not part of flight.

TABLE III

Summary of data from meals I and II, Myrtle Beach AFB

Subject	Comments*	Yes	No	More	Less	Same	At one time	Munched
Handling	Package easy to handle	28	5					
	Able to select desired food	25	7					
	Food too large	4	29					
Flavor	Food too sweet	9	20					
	Food too bland	5	24					
	Food sticky or oily		29					
Menu pattern	Enough variety	26	6					
	Amount of variety			11	2	13		
	How eaten						3	28

*Additional comments: Easy to handle, serves the purpose; prefer more chewy foods; too sweet; no distinct flavor to foods; bites are good but old system adequate; make cheese-flavored bites; label contents; prefer box lunch.

and the tube allowed for easy consumption of water.

Trial 2

A summary of the food evaluation by seven pilots at Edwards AFB is shown in table IV. No trend was suggested toward acceptability. A limited number of evaluations were made of each food, and 42% (nearly half) were rated only once. Data concerning the questionnaire are presented in table V. In addition to the information presented in table V, the following comments were made:

1. Food creates thirst.
2. Package easy to place in cockpit.
3. Bacon squares melted when placed in direct sunlight.
4. Water container too large.
5. Change of pressure caused water to overflow when polyethylene tube was below water line.
6. Tube did not move easily in rubber cork.
7. If clamp is used on tube, water spurts out when removed at altitude.

One pilot expressed a preference for bite-size foods; one preferred the fresh sandwich-type lunch; and two preferred a combination of the two types of food.

TABLE IV

Food evaluations by pilots at Edwards AFB

Food	Average evaluation	Number of evaluations
Almond raisin cubes	6	1
Apricot cubes	6	3
Bacon squares	7.7	7
Beef bites	6	2
Beef sandwiches	5.5	2
Brownies	8	1
Cheese sandwiches	7	1
Cherry orange nut cake	8	1
Chicken bites	5	1
Chicken sandwiches	6	2
Chocolate cake	9	1
Chocolate cubes	8	2
Chocolate, summer	4	1
Chopped almond cubes	—	—
Cinnamon toast	7	1
Coconut cubes	6.5	2
Date fruit cake	6.6	5
Gingerbread	6.5	2
Orange cubes	3	1
Peanut butter (corn flakes)	6	2
Peanut butter with graham cracker	7	2
Peanut butter with Special K	—	—
Pineapple cubes	6.7	3
Plain toast	6.3	3
Pound cake	8	1
Strawberry cereal cubes	7	5
Toasted bread cubes	6.5	2
Walnut cubes	6	1

TABLE V

Summary of data from food testing, Edwards AFB

Subject	Yes	No
1. **Handling**		
A. Was the package easy to handle? Difficult with gloves on.	6	1
B. Were you able to select desired foods? Not in dark.	4	1
C. Was food too large for mouth?	—	7
2. **Flavor**		
A. Were food items too sweet? Strawberry cereal, slightly tart; almond raisin cube, slightly sweet.	1	5
B. Were food items too bland? Peanut butter with graham cracker, bland; date fruit cake, bland.	2	5
C. Was food sticky or oily? Bacon, too salty.	—	7
3. **Menu pattern**		
A. Was there enough variety?	5	1
B. Would you like more variety—	1	4
or less variety?	—	—
C. Did you eat meal at one time—	3	—
or throughout flight?	4	—
4. **Water**		
A. Did you have enough water?	4	—
B. Was the container easy to handle?	3	2

IV. CONCLUSION

The stability and convenience of the bite-size foods have been evaluated in two trials. At the present time, conventional foods possess flavors and textures that are more acceptable. Advantages of bite-size foods include convenience in handling, stability, and easier storage because of the reduced size and weight. The food requires no special handling, and meals are quickly packaged from commercially available foods. No kitchen facility for food preparation is necessary, thus eliminating the need for labor and equipment. Foods can be purchased in cans for later menu makeup or as preplanned packaged meals.

REFERENCES

1. Welbourn, J. High performance aircraft feeding. Activities Report 17(1):14 (1965).
2. Klicka, M. V., H. A. Hollender, and P. A. LaChance. Foods for astronauts. J. Amer. Diet. Ass. 51:238 (1967).
3. LaChance, P. A., and C. A. Berry. Luncheon in space. Nutr. Today 2(2):2 (1967).
4. Heidelbaugh, N. D., J. E. Vanderveen, M. V. Klicka, and M. J. O'Hara. Study of man during a 56-day exposure to an oxygen-helium atmosphere at 258 mm. Hg total pressure. VIII. Observations on feeding bite-size foods. Aerospace Med. 37:583 (1966).
5. O'Hara, M. J., R. E. Chapin, N. D. Heidelbaugh, and J. E. Vanderveen. Aerospace feeding: Acceptability of bite-size and dehydrated foods. J. Amer. Diet. Ass. 51:246 (1967).

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY (Corporate author)

USAF School of Aerospace Medicine
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas

2a REPORT SECURITY CLASSIFICATION
Unclassified

2b GROUP

3 REPORT TITLE

BITE-SIZE FOOD IN FIGHTER AIRCRAFT

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final report Aug. 1966 - May 1967

5 AUTHOR(S) (Last name, first name, initial)

May J. O'Hara, Captain, USAF, BSC
John E. Vanderveen

6 REPORT DATE	7a TOTAL NO OF PAGES	7b NO OF REFS
December 1967	8	5

8a CONTRACT OR GRANT NO.	9a ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO	SAM-TR-67-114
c Task No. 775803	9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d	

10 AVAILABILITY/LIMITATION NOTICES

This document has been approved for public release and sale; its distribution is unlimited.

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
	USAF School of Aerospace Medicine Aerospace Medical Division (AFSC) Brooks Air Force Base, Texas

13 ABSTRACT

Bite-size foods were consumed by pilots of fighter-type aircraft in two trials, and data were collected on the acceptability and ease of handling these foods. This type of feeding system offers foods that are stable without refrigeration, are easy to handle, and need no kitchen facility for preparation. Bite-size food flavors at the present time do not surpass those of conventional foods.

DD FORM 1 JAN 64 1473

Unclassified

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Nutrition and metabolism Bite-size foods Aerospace feeding system Food for use in space						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2*a*. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2*b*. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7*a*. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7*b*. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8*a*. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8*b*, 8*c*, & 8*d*. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9*a*. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9*b*. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through _____."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through _____."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through _____."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

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

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.

GPO 886-551