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**MARINE CORPS
LANDING FORCE DEVELOPMENT CENTER
MARINE CORPS SCHOOLS
QUANTICO, VIRGINIA**

(NAVMC—QUANTICO)



Polyethylene Canteen, final report

PROJECT NO. _____
42-58-01K

CONDUCTED BY

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MARINE CORPS EQUIPMENT BOARD

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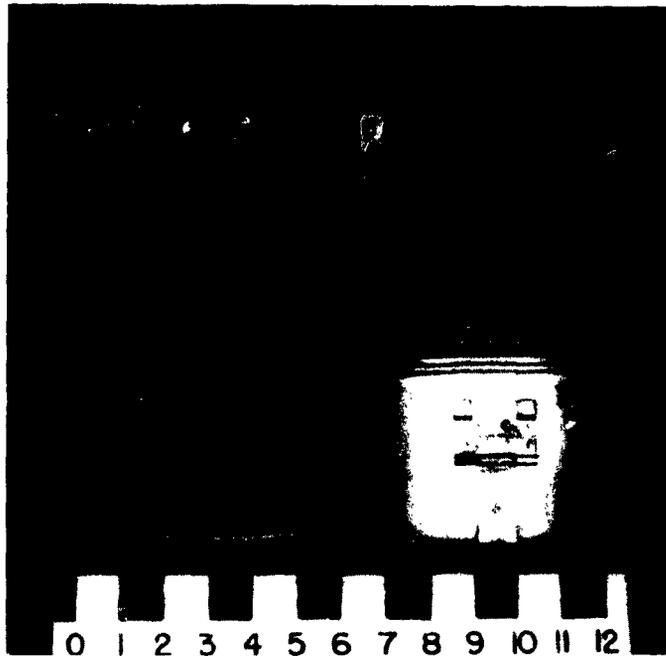
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42-58-01K

CLASSIFICATION: Unclassified

PROJECT NO.: 42-58-01K

SUBJECT: Polyethylene Canteen; Final Report of



ABSTRACT

1. Two models of an experimental polyethylene canteen (high and low density) were tested in the Fleet Marine Force to determine their suitability for Marine Corps use.
2. The test items are considered not suitable for Marine Corps use.
3. It is recommended that:
 - a. The Department of the Army be requested to develop a plastic canteen (with cup) as a suitable replacement for the standard corrosion resistant steel (CRS) canteen.
 - b. The Marine Corps participate in the testing of any future canteens (including the X58A) being considered by the Army for adoption.
 - c. The Marine Corps utilize the present CRS canteen with cup until a suitable replacement has been developed.

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REFERENCE: (a) CO, US Naval Medical Field Research Laboratory
ltr Ser. 302 of 17 Apr 1957 to CMC w/ends
(b) CMC ltr AO4D-es/2 of 9 Sep 1957 to CMCS (CMCLFDA)
(c) CMCLFDA NavSpdLtr 46/4E/VDK:vlg over 42-58-01K
of 31 Jul 1961 to CMC

1. INTRODUCTION

a. Purpose

To test two types of experimental polyethylene canteens (high and low density) in comparison with the standard corrosion resistant steel (CRS) canteen to determine the most suitable canteen for Marine Corps use.

b. Background

Reference (a) requested that 500 polyethylene canteens of non-standard design be procured for field testing for the purpose of advancing the overall program of body armor and load carrying systems.

Reference (b) approved this request for an evaluation of the polyethylene canteen to be conducted in conjunction with field tests of body armor and load carrying systems, not only to ensure the compatibility of the polyethylene canteen with improved body armor and load carrying systems, but to determine its suitability as a replacement for the present CRS canteen.

As a result of reference (b) prototype polyethylene canteens were procured incorporating decreased profile and contoured to fit the body.

Initial evaluation of the prototype low density polyethylene canteens procured determined that the plastic canteen cap was improperly designed and would "pop-off" the canteen when pressure was applied to the side of the canteen. Subsequent modification of the canteen cap resulted in the elimination of this defect.

Further testing of these canteens revealed that the low density polyethylene canteen retained the flavor of previously held liquids,

the cap could not be properly tightened to prevent leakage of liquid, the canteen changed color to light blue after being exposed to sunlight for 7-10 days, and in some cases the canteens split along the seams.

Additional color fast polyethylene canteens of improved design, including both high density and low density (epoxy lined), with low density polyethylene modified caps, were then procured for further testing.

A troop test of these canteens in the Fleet Marine Force was scheduled for the period 15 October - 31 December 1960, in conjunction with a troop test of experimental man load carrying systems; however the test of the canteens had to be postponed due to manufacturing difficulties and resultant non-delivery of the canteens on schedule.

During the period of 1 April - 30 June 1961 a troop test within the Fleet Marine Force of 175 low density epoxy lined polyethylene canteens and 175 high density polyethylene canteens of improved design, including 500 low density polyethylene modified caps and 350 specially designed carriers, was conducted. This report contains the results of this test.

It is to be noted that the U. S. Army Quartermaster Research and Engineering Center at Natick, Massachusetts completed extensive engineering tests on the X58A plastic canteen (Canadian) early in 1961 and found that it appeared to fulfill Army requirements.

The X58A canteen was service tested on a limited scale by the U. S. Army in operation SWAMP FOX during the period approximately 1 August - 30 September 1961 and from advance information it appears that this item was satisfactory. It is believed that the X58A canteen should be tested by the FMF prior to consideration for adoption by the Marine Corps.

Reference (c) reported on the results of a user preference test of the Aluminum Canteen versus the Corrosion Resistant Steel (CRS) Canteen. The CRS canteen and cup was recommended to be retained as standard for the Marine Corps.

c. Description

(1) Test Canteen A

A low density polyethylene epoxy-lined canteen, with low density cap, which weighs 5 ounces, has a capacity of 960cc (slightly more than a quart), and is pliable, hereinafter referred to as test canteen A.

(2) Test Canteen B

A high density polyethylene canteen, with low density cap, which weighs 5 ounces, has a capacity of 960cc (slightly more than a quart), and is rigid, hereinafter referred to as test canteen B.

(3) Control Canteen

The standard canteen, water, corrosion resistant steel (CRS) which weighs 10 ounces has a capacity of 950cc (approximately a quart) hereinafter referred to as the control canteen.

2. DISCUSSION

The test results are summarized as follows:

a. Test No. 1 - Physical Characteristics

The test and control canteens conformed essentially to the physical characteristics indicated in paragraph 1.c. of this report.

b. Test No. 2 - Compatibility with Desired Characteristics

The test canteens did not prove to be compatible with all Desired Characteristics. The caps were easily broken, the caps were found to leak when not secured unusually tight, the canteens themselves do not resist the effects of an open flame.

c. Test No. 3 - User Acceptability

Test personnel preferred the control canteen for field use in hot-wet and temperate climates because of its ruggedness and reliability.

d. Test No. 4 - Suitability for Marine Corps Use

(1) The test canteens, in their present design, are not considered suitable for Marine Corps use as replacements for the standard CRS canteen.

(2) The caps of both test canteens were found to leak unless secured unusually tight. Frequently caps split while being tightened to the degree required to prevent leakage.

(3) When worn filled on the belt, several of the canteen caps would not withstand body pressure when the wearer was in a reclining or sitting position.

(4) The caps of both test canteens broke easily in use and also split open while in storage when screwed on the canteen.

(5) Both test canteens are compatible with the standard load carrying system except that a special cover had to be fabricated for attachment. It is to be noted that the polyethylene canteens tested do not utilize a cup.

3. CONCLUSIONS

a. Neither test canteen A or B, in its present design, is considered suitable for Marine Corps use as replacement for the standard CRS canteen.

b. The caps leak or are easily broken.

c. The canteen is unable to withstand the effects of an open flame.

d. Some canteens are unable to withstand body pressures when filled.

e. Low density polyethylene canteens and/or caps cannot be sterilized for sanitation reasons in an autoclave at 250° Fahrenheit; they melt. High density polyethylene canteens are apparently not affected. However, both low density and high density polyethylene canteens may be sterilized in boiling water, without any ill effects.

f. The test canteens do offer advantages over the standard corrosion resistant steel canteen in the following areas:

(1) Cost - Estimated less than .25¢ per canteen in quantity production as compared with the cost of the standard CRS canteen and cup (\$1.92).

(2) Weight - Approximately 5 ounces as compared to the 10 ounce weight of the standard CRS canteen.

(3) Manufacture - Relatively simple to manufacture from non-strategic materials.

(4) Other Factors - They do not rattle or clink. They do not reflect light, and are producible in a variety of colors. They possess decreased profile and are contoured to fit the body.

g. It is not considered desirable to modify either of the test canteens to make them suitable for Marine Corps use.

4. RECOMMENDATIONS

a. It is recommended that:

(1) The test canteens be considered unsuitable for Marine Corps use.

(2) No modifications be made to either of the test canteens to make them suitable for Marine Corps use since there is no indication from the field that such modification would make either of the test canteens wholly acceptable.

(3) Consideration be given to no further development effort by the Marine Corps on polyethylene canteens.

(4) The Department of the Army be requested to develop a plastic canteen (with cup) as a suitable replacement for the standard CRS canteen.

(5) The standard CRS canteen (with cup) be retained for Marine Corps use until a satisfactory replacement is developed by the Department of the Army and proven suitable for Marine Corps use through tests in the FMF.

(6) The test canteens be disposed of in the best interests of the government.

(7) That Project No. 42-58-01K be terminated.

Submitted by:

C. A. LASTER
Colonel, U. S. Marine Corps
President, Marine Corps Equipment Board

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Brigadier General, U. S. Marine Corps
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Copy to:
Distribution List (Annex B)

DETAILS OF TEST

1. Test No. 1 - Physical Characteristics

a. Purpose

To verify the physical characteristics of the test and control canteens indicated in paragraph 1.c. of this report.

b. Method

The testing unit examined and measured the test and control canteens to determine if they conformed to the physical characteristics indicated in paragraph 1.c. of this report.

c. Results

An analysis of the results obtained disclosed that the test and control canteens conformed essentially to the physical characteristics indicated in paragraph 1.c. of this report.

2. Test No. 2 - Compatibility with Desired Characteristics

a. Purpose

To determine if the test and control canteens are compatible with Desired Characteristics.

b. Method

The test and control canteens were subjected to the criteria of the applicable requirements of the Desired Characteristics.

c. Results

The test canteens generally proved to be compatible with all Desired Characteristics except that the caps were easily broken, were found to leak when not tightly secured, and the canteens themselves do not resist the effects of an open flame. A recapitulation follows:

| <u>Desired Characteristics</u> | <u>Remarks</u> |
|---|--|
| (1) Climatic Conditions: (a) For use: Shall be capable of a satisfactory performance at ambient temperatures ranging from -40° to 125° F without any deleterious effects to the canteen. | (a) The test and control items perform satisfactorily at ambient temperatures of -25° to 100 F without any deleterious effect. |

Desired Characteristics (Cont'd)

(b) For Storage: Shall be capable of storage at ambient temperatures ranging from -40°F for periods of at least three days duration, to 160°F for periods as long as four hours per day, without any deleterious effects to the canteen.

(2) Functional Requirements

(a) Shall be capable of being integrally attached to an integrated body armor carrying system, or with cover, to the current load carrying system in such a manner as to eliminate bouncing, shifting, rattling and excessive profile.

(b) Shall be readily fabricated, commensurate with other characteristics, of an inexpensive, non-critical plastic.

(c) Shall be easy to clean and shall be reusable.

(d) Shall have an opening sufficiently large to facilitate rapid filling with liquids.

(e) Shall survive a 32 foot free fall when filled with water without losing any liquid.

Remarks (Cont'd)

(b) The test and control items were stored at ambient temperatures of 40°F for a period of three days, to 120°F for a period of four hours daily, without any deleterious effects.

(a) The test and control items were not tested with an integrated body armor load carrying system. The test items bounced and shifted, the control item bounced, shifted and rattled when attached to the standard load carrying system.

(b) The test items met this requirement. This requirement is not applicable to the control item.

(c) The test and control items met this requirement satisfactorily.

(d) The test items can be readily filled directly from 5 gallon water cans, and spigots on water trailers and Lister Bags without undue loss of liquid. The control item's opening is not sufficiently large to facilitate rapid filling with liquids from 5 gallon water cans.

(e) The test items met this requirement satisfactorily. The control item failed to meet this requirement.

Desired Characteristics (Cont'd)

Remarks (Cont'd)

(f) Shall not be unitized with the canteen cup.

(f) The test items cannot be carried with the standard canteen cup in any cover. The control item is normally carried with the standard canteen cup in the same carrier.

(g) Shall have a cap or stopper capable of being firmly secured to prevent any loss of liquid and easily removed under the climatic conditions for use.

(g) The test items failed this requirement. The control item met this requirement satisfactorily.

(3) Size, Shape and Weight Limitations:

(a) Size: Shall have a capacity of one liquid quart, plus or minus two fluid ounces with the maximum dimensions of eight inches by six inches by two inches.

(a) The test and control items met the capacity criteria, but exceeded the two inch dimension.

(b) Shape: Shall have a minimum dimensional bulk commensurate with its capacity and conform with the contours of the human body.

(b) The test and control items met this criteria.

(c) Weight: Shall weigh not more than seven ounces when empty.

(c) The test items weigh two ounces less and the control item weighs three ounces more than the weight limit.

(4) Portability:

(a) By individual: Shall be inherent in the equipment.

(a) The test and control items met this criteria.

(5) Life Expectancy:

(a) In use: Shall withstand combat usage for not less than 90 days with a minimum of maintenance and replacement; and yet may be disposed of after one filling without undue cost.

(a) The test and control items met this criteria, except that the control item costs too much (\$1.92) to be disposed of after one filling.

(b) In storage: Shall have a minimum life expectancy of one year under field storage conditions.

(b) The test items failed this requirement, the caps split open around the edge. The control item met this requirement.

Desired Characteristics (Cont'd)

Remarks (Cont'd)

(6) Proofing:

(a) In use and storage:
Shall be resistant to the effects
of fungus, mildew, saltwater, insect
and fire.

(a) The low density test
item met this criteria, except
that they do not resist the
effects of an open flame and
melt at approximately 220°F.
The high density was not affected.
The control item met this require-
ment, except that the control
item's cap is not resistant to
the effects of an open flame, and
the control item's chain is not
resistant to the corrosive effects
of saltwater after normal usage.

(7) Camouflage:

(a) Shall conform to
standard camouflage practice.

(a) The test items met this
criteria. The control item
failed this criteria due to the
reflectance of light from its
metallic surface.

(8) ABC Protection:

(a) Shall be compatible
with requirements for ABC protection.

(a) The test and control
items can be sterilized by
boiling.

(9) Effects upon the Human Body:

(a) Shall be made of an inert
plastic which is non-toxic, impermeable,
does not impair the palatability of
nor impart toxicity to the beverages
held and suffers no deleterious effects
from heated beverages or water purification
tablets.

(a) The test and control
items met this requirement
satisfactorily.

3. Test No. 3 - User Acceptability

a. Purpose

To determine the user acceptability of the test and control items.

b. Method

Prior to commencement of the test, Test Personnel Data Forms and Questionnaires were issued to all test personnel. At the completion of the testing period the Test Personnel Data Forms and Questionnaires were completed, analyzed and inconsistencies evaluated by the test unit project officer through interviews with test personnel.

c. Results

Test personnel preferred the control canteen for field use in hot-wet, cold-wet and temperate climates because of its ruggedness and reliability.

4. Test No. 4 - Suitability for Marine Corps Use

a. Purpose

To determine the suitability of the test and control canteens for Marine Corps use.

b. Method

From an analysis of results obtained in Tests No. 1 through No. 3 it was determined which canteen is most suitable for Marine Corps use.

c. Results

(1) The test canteens, in their present design, are not considered suitable for Marine Corps use as replacements for the standard CRS canteen.

(2) The caps of both test canteens were found to leak when not secured unusually tight.

(3) Several of the canteen caps of both test canteens would not withstand body pressure, when filled. Some canteen caps would leak as a result of body pressure when the canteen was filled or partially filled with water.

(4) The caps of both test canteens broke easily in use and also split open while in storage when screwed on the canteen.

(5) Both test canteens are compatible with the standard load carrying system except that a special cover had to be fabricated for attachment. It is to be noted that the polyethylene canteens tested do not utilize a cup.

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