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TECHNICAL REPORT LWL-CR-06S-73

MULTIPURPOSE SILICONE CUP

by

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June 1974

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Final Report

Contract No. DAAD05-73-C-0565

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)  Cup Folding cup Collapsible cup Cooking container  Drinking cup		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The R.E. Darling Company, Inc., under the direction and guidance of the US Army Land Warfare Laboratory, and funded by Contract DAAD05-73-C-0565, conducted a Research and Development program to design, develop, test and deliver Multipurpose Silicone Cups. During the course of this contract, all performance characteristics and criteria were complied with, plus other advantageous features were added to the cup. An extensive testing program verified that the Multipurpose silicone cup was suited for use under all climatic conditions and with all heat sources which (Cont on reverse)		

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BLOCK 20. ABSTRACT CON'T

would be used by the US Army personnel.

The cup is lightweight, compact, easy to clean, collapsible, strong, comfortable to hand and lips and is almost indestructible under normal use. It is a very good insulator, keeping hot food hot, or cold drinks cold. It may be used with any conventional stove, placed directly over coals or on coals, hung over an open fire, etc., for cooking or warming liquids or rations.

If properly presented to Army personnel, this cup should prove to be a valuable aid to troops while under field conditions.

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ADMINISTRATIVE DATA

1. Purpose: This final report documents the aims and objectives, results, problems encountered, solutions, conclusions and recommendations of a research and development effort to design and build multipurpose silicone rubber cups for use by the U.S. Army under worldwide field conditions.

2. References:

- a. U.S. Army LWL P/O DAAD05-73-C-0565.
- b. Statement of Work from RFQ DAAD05-73-Q-5345.
- c. U.S. Army LWL Data Item # DI-S-1800.
- d. Modification No. P00001 to referenced purchase order.

3. Specifications, Drawings and Standards:

- a. U.S. Army LWL Drawing 060056000.
- b. R.E. Darling Co., Inc. Drawing REDAR-S-30048, Revision D.
- c. REDAR-RQC-0235 - Engineering Design Test Procedure.
- d. REDAR-RTR-425 Engineering Design Test Report.
- e. MIL-STD-810B

OBJECTIVES OF RESEARCH AND DEVELOPMENT EFFORT

The R.E. Darling Co., Inc. proposed to conduct the necessary research and development work along with an extensive test program and pilot production for the development of "Multipurpose Silicone Rubber Cups" for use by Army personnel.

This cup was to surpass the present "state-of-the-art" in rubber technology, utilizing materials, molding and bonding techniques, etc., that had been developed for the United States Space Program.

The extensive test program was to verify that the cups would meet all functional requirements specified by LWL and would be suitable for use by Army personnel in all environments, utilizing whatever heat source was available.

The research and development goals as specified included the following characteristics:

Performance:

The multipurpose cup must be suitable for use in climatic and weather conditions in Categories I through VII, Army Regulation 70-38.

The multipurpose cup must be suitable for boiling water over an open flame or when placed on a hot surface (600<sup>o</sup> centigrade) such as the Yukon stove.

The handle, bail, or other device must be suitable for handling by an individual when the cup is filled with boiling water. This will include placing on or removing from a heat source and when drinking from the cup. The handle, bail, or other device should not significantly add to the total size of the cup, when the cup is not in use.

Physical:

The walls of the multipurpose cup must withstand a minimum of one-thousand (1000) flexings.

The weight of the cup will not exceed three ounces.

The multipurpose cup must have no cracks, sharp corners, or projections on the inside surface which can trap food particles.

The multipurpose cup must be easily washed and kept clean.

The multipurpose cup must be capable of folding compactly to a maximum height of one and one half inches.

Health and Safety:

The silicone rubber must be FDA approved.

The handle or holding device must not burn the user's hand or endanger him from spilled boiling water or hot food.

The bond between the aluminum base and the silicone rubber walls must not fail and separate during heating or any stage of handling by the user.

Human Factors Engineering:

The multipurpose cup design will enhance troop acceptability through improved performance, reliability and ease of maintenance.

The handle or holding device should be designed for comfortable gripping in either hand and optimum positioning for placing on or removing from a heat source.

The drinking lip should be comfortable to the mouth and should not retain an excessive amount of heat which can burn the user's lips.

Maintenance: Require no maintenance other than normal care and washing following use.

## RESULTS OF THE RESEARCH AND DEVELOPMENT EFFORT

All of the objectives listed in Objectives of Research and Development Effort were met or exceeded. Besides meeting all contractual requirements, other advantageous design features were added to the cup. Procedures for use are shown in Figure 1. These added features include:

A lid, used to keep the cup clean when carried and to keep dirt, ash, etc. out while cooking over an open fire.

A restraint strap, made of Velcro, which serves two purposes - one as a handle for the lid, and the other to keep the cup compact when closed.

Finger tabs plus an elastomer bail for ease of handling.

These extra features were added and the assembly still meets the design requirements of weight and height imposed on the cup.

Upon completion of the required test program, the cups were subjected to an entire series of supplementary tests, which were much more severe than the official tests. These tests included direct contact with live wood coals, burial in a live charcoal fire, continuous boiling tests, and destructive tests. These tests are documented in REDAR-RTR-425.

The test program has established that if the cups are heated dry, they will be ruined over a fire or heat, but if there is liquid in them when heated, they should last for many years.

## PROBLEMS ENCOUNTERED AND SOLUTIONS



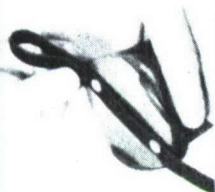

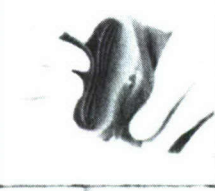
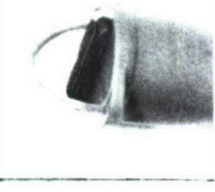
As with any research and development project, problems were encountered and had to be solved. Some of these problems and solutions are listed below:

Bond between base and silicone - problem solved by tightening mold-base tolerances, plus strict handling controls so surface did not become contaminated or touched after priming.

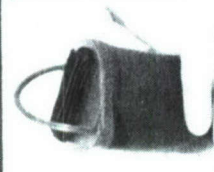
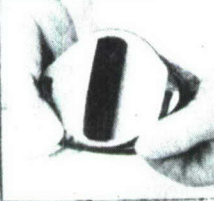
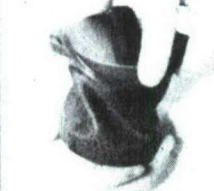
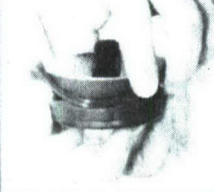



Reinforcing wire within rim - wire would shift and show through silicone lip. Solved by changing loading technique.

Lid and restraint system - Although not required by the original research and development contract, the R.E. Darling Co., Inc. engineering staff felt that a lid and restraint system were necessary to complete the cup so it would be suitable for field use. After prototyping and testing many combinations, both the U.S. Army Land Warfare Laboratory and REDAR were satisfied with the flat lid - Velcro strap combination depicted in the outline drawings of the cup in the open and folded condition, Figures 2 and 3.

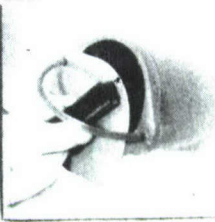
OPENING PROCEDURE



						
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COLLAPSING PROCEDURE

						
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**CAUTION**  
DO NOT HEAT WITHOUT LIQUID IN CUP



	
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**R. E. DARLING CO., INC.**  
GAITHERSBURG, MARYLAND  
TUCSON, ARIZONA

MULTIPURPOSE  
SILICONE RUBBER CUP

Figure 1. Procedures for use of Multipurpose Silicone Rubber Cup.



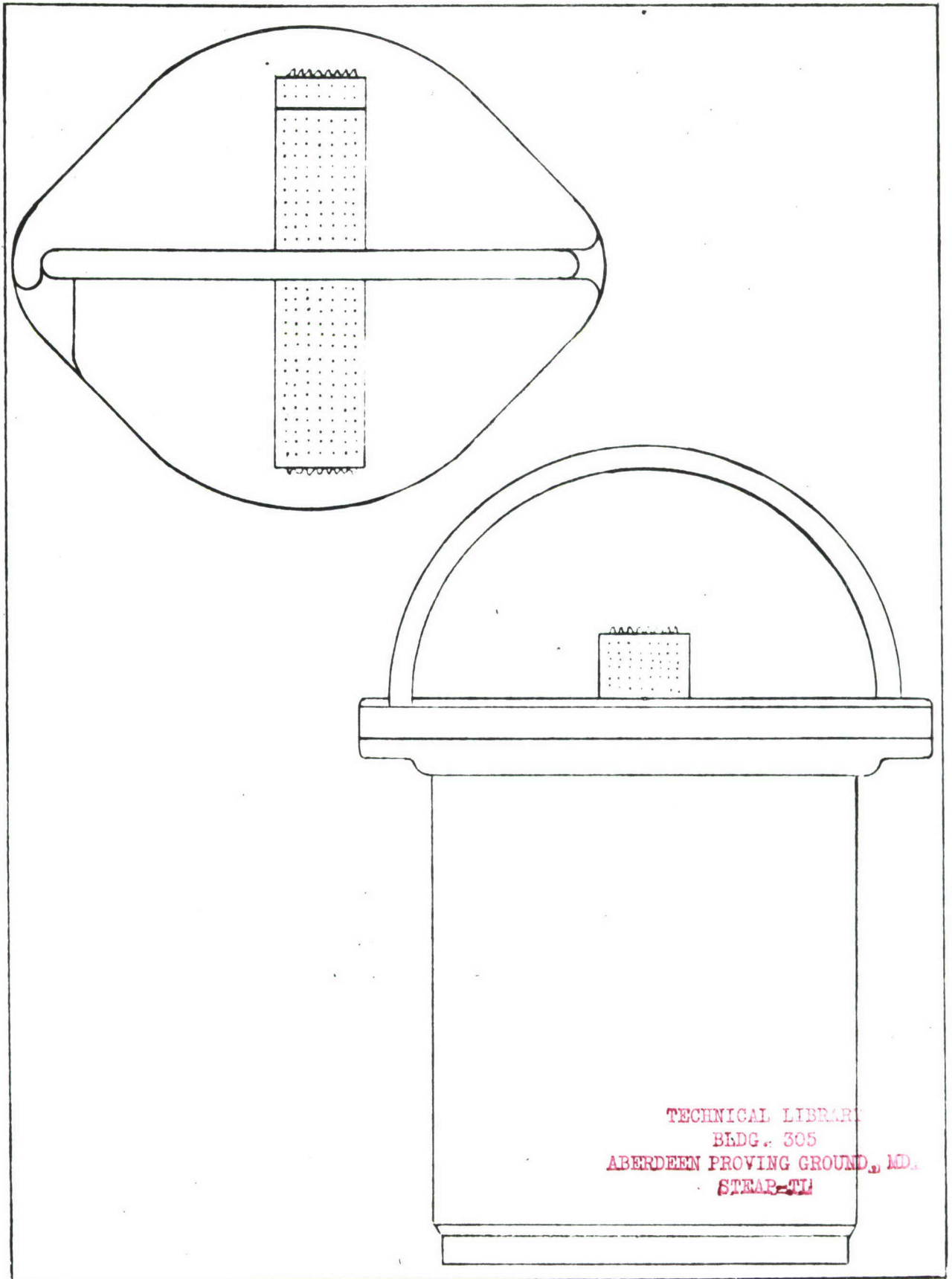


Figure 2. Multipurpose Silicone Cup (Open)

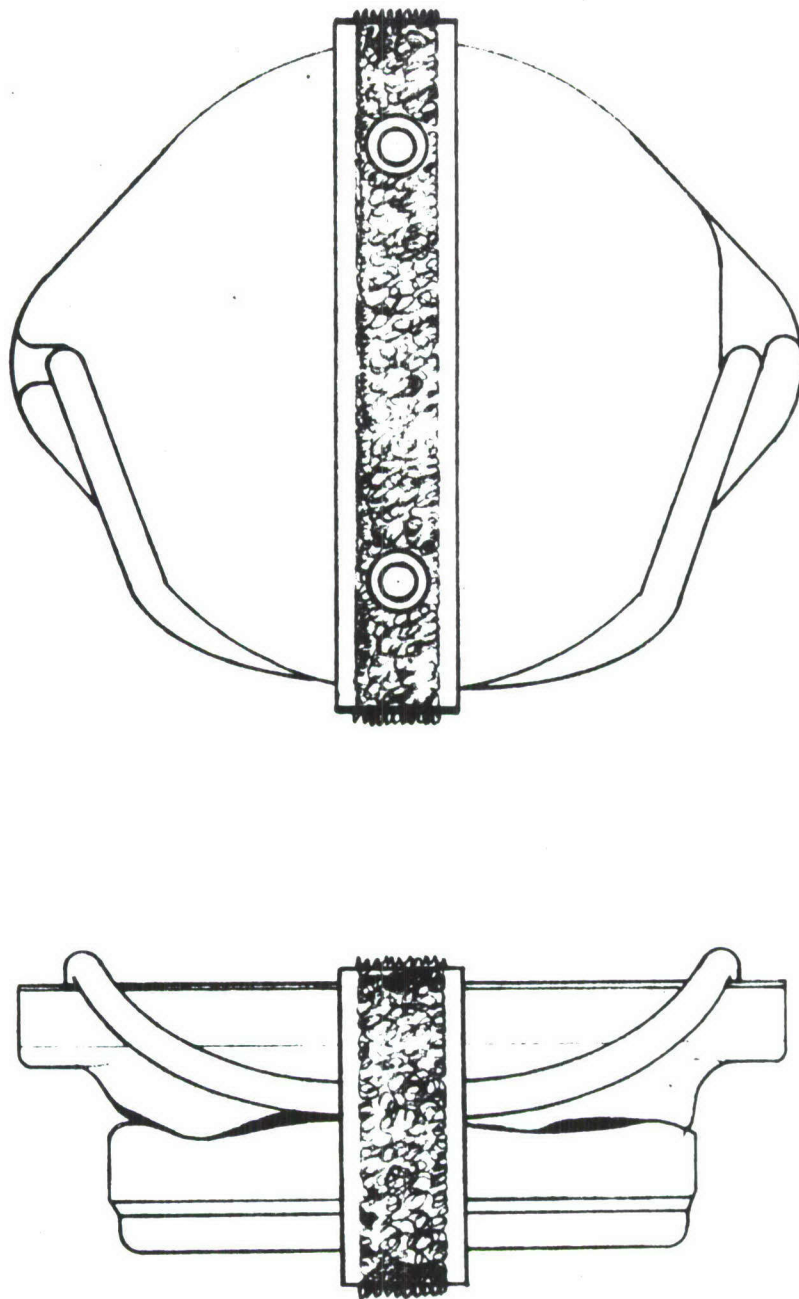


Figure 3. Multipurpose Silicone Cup (Closed)

## CONCLUSIONS

A practical cup meeting the established requirements was developed.

The technology developed on this program could be used for other items for the US Army such as a snow ice melting canteen, collapsible pressure cooker, large cooking pot, etc.

## RECOMMENDATIONS

The designated parent agency, US Army Natick Laboratories (NLABS) should review the on-going US Army Test and Evaluation Command (USATECOM) tests to establish any continuation programs. The point of contact at NLABS is Mr. A. F. Wilson, STSNL-CCP. Tests are being conducted through USATECOM Project No. 8-EI-515-000-025 at the US Army Infantry Board, US Army Tropic Test Center and the US Army Arctic Test Center.

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