# FINAL ENGINEERING REPORT OF THE

# E61R4 AND E133R3 ~~(C)~~

James F. Hall
Meyer Chertoff

Work completed September 1955



CHEMICAL CORPS RESEARCH AND DEVELOPMENT COMMAND
BIOLOGICAL WARFARE LABORATORIES
MUNITIONS DEVELOPMENT DIVISION
Fort Detrick, Frederick, Maryland

Published March 1956

Rupture diaphragm, 0.0179 in. thickness, cold-rolled steel (26-ga)

Lamination length, 2.9 in. (subsequently changed to 2.7 in. to avoid interference in cluster)

Over-all length, 7.33 in.

Powder chamber volume*, 7.35 ml (0.45 $in^3$)

(U) A contract for fabrication of50,000 completely assembled E61R4 bomblets was awarded to Industrial Wire Cloth Products Company, Wayne, Michigan. Various studies involving rupture-diaphragm modifications were conducted with the production bomblets to improve the closure and to direct the combustion gases in such a manner as to utilize a greater portion of the available energy in breaking up the liquid fill into the desired particle size range.

(U) In addition to seam welding of the closure cup to the casing, other methods, including spot welding, mechanical double-seaming, projection welding, alloy injection, and adhesives, were investigated and/or attempted to increase the comparatively slow production rate of the seam welder.

(U) The closure cup was spot-welded to the casing at 4 points, 90° apart, prior to an overlapping series of spot welds applied by a seam welder around the entire circumference. Eight E61R4 bomblet assemblies with closures made in this manner were subjected to a Freon leak test wherein Freon-12, by means of a suitable adapter arrangement, was introduced at 20 psig into the agent cavity of the bomb. A General Electric Type H Halogen Leak Detector was used to detect the presence of gas that had escaped through leaks. It was found that only 2 of the 8 assemblies did not leak. Since such a high leak rate was objectionable from the biological point of view, the spot-welding technique was dropped from further consideration.

(U) As a result of a consultation with representatives of the metal container industry, it was deemed inadvisable to develop a mechanical double-seaming method for effecting a closure. It was their opinion that, since the E61R4 design used a thin closure cup and a rather thick casing wall, cracking or splitting of the rigid casing would almost certainly occur. However, it was pointed out that a single seam could possibly be obtained at a high production rate if the casing were necked in and provided with a flange at the end, over which a closure cup with an extended

*The chamber volume is about 10 percent less than that giving the best aerosol results, because of the necessity for wall strength and the desirability of the smallest possible powder cavity, as indicated by test results.

2. (U) The E61R4 bomblet design is adaptable to mass production.

3. (U) The E34R4 fuze design is adaptable to mass production.

4. ~~(S)~~ The E61R4/E34R3 combination is an aerodynamically stable munition. Production versions are expected to meet the required performance levels.

G. RECOMMENDATIONS

1. ~~(C)~~ It is recommended that the E61R4 bomblet/E34R4 fuze combination in the E133R2 cluster be produced and tested in a Final Engineering Program to determine the suitability of the munition.

2. ~~(C)~~ It is recommended that the E61R4 bomblet be tested with various candidate agents.*

3. ~~(C)~~ It is recommended that tests be run to determine the compatibility of the agent and the agent container in storage at various temperatures.

## III. FINAL ENGINEERING ~~(S)~~

A. INTRODUCTION

~~(C)~~ The Final Engineering Phase of the development of the $\frac{1}{2}$-lb Bomb, Biological, E61R4, (Figure 40) was started with the procurement of the E61R4 bomblet body in early 1952. The contractor was the Industrial Wire Cloth Products Company of Wayne, Michigan. The contract was for the production of approximately 50,000 E61R4 bodies.

(U) Final engineering production of the fuze for the E61R4 bomblet was not started until the Fall of 1953. Thus, there was considerable overlapping of the Development and Final Engineering Phases.

(U) The Final Engineering Phase of this program, for reporting purposes, began when a final prototype for each component had been developed. Thus, this portion of the report covers the E133 cluster containing E61R4 bomblets consisting of the E61R4 bomblet body, the E34R4 fuze, the E36 ignition cartridge, and the E11 container.

*Subsequent to the completion of the Development Engineering Phase, the decision was made to develop the E61R4 bomblet for use with agent N.

C. FINAL ENGINEERING PROGRAM AND TESTING

(U) The Final Engineering Program consists of the procurement, production, and testing required for the Final Engineering Phase of the munition development (Appendix B). Each component of the munition will be discussed as a unit. The chronological development of the components of the E61R4 and the E133R3 is shown in Figures 51 and 52.

1. E61R4 Bomblet Body

a. Procurement and Production

(U) The final prototype E61R4 body, as described in Part II, is a modified version of the bomblet produced by Victor Electric Co. Using this modification, Engineering Agency, Army Chemical Center, made drawings and specifications for trial procurement of approximately 50,000 bodies. The industrial Wire Cloth Products Company of Wayne, Michigan, was awarded a contract to manufacture 52,500 E61R4 bodies in early 1952. This procurement was handled by the Chemical Corps Materiel Command.

(C) The Industrial procurement proceeded with a minimum of production difficulties. Some difficulty was encountered at the start of manufacture in brazing the rupture diaphragm, casing, and adapter together to form a biological seal. This was quickly overcome by changing the assembly slightly. (The specifications have been revised recently to require a leak test of the body with Freon gas and a halogen leak detector.) It was also found in this procurement that the tail of the casing could be oval and still pass the existing inspection gages. On welding the circular closure cup into these oval cases after filling, it was difficult to get a leakproof seal because of the differences in fit around the circumference. An air gage was designed to check ovality and tolerance to overcome this difficulty. The first tests of bodies from this procurement were made in July 1952.

(U) Since many of the Industrial bodies were used up in the fuze development program in 1952 and 1953, it became necessary in the Fall of 1953 to replenish the supply for use in the Final Engineering Test Program. A subsequent procurement of 50,000 E61R4 bodies was placed with Shwayder Brothers, Inc, of Denver, Colorado, by Pine Bluff Arsenal Procurement Office in September 1953. The first shipment of these was received by Camp Detrick in December 1953. A new production difficulty arose during this procurement with the advent of Freon leak detection as a standard technique at Camp Detrick. Leak-testing of these bodies showed a high incidence of Freon leakage through the casing wall, which appeared to be porous. An examination of the production techniques used by Shwayder led to a change in production techniques wherein the drawing temperatures were controlled and annealing between certain drawing steps was made. This served to correct the problem, and the latter part of the production produced leak-free bodies. The Shwayder contract was completed in April 1954.