WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/610

Effect of Quilting upon the Resistance to Perforation of Fiber Glass ECC-11-162

BY

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Jr. Engineer

DATE 20 April 1944

WATERTOWN ARSENAL
WATERTOWN, MASS.

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First Partial Report on Problem B-8.9

20 April 1944

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1. In response to a request from the Office, Chief of Ordnance,[1] ballistic tests have been conducted at this arsenal on fiber glass ECC-11-162 cloth submitted by Owens-Corning Fiberglas Corporation.

2. The results of these tests indicate that, on the basis of resistance to perforation per unit weight, this material compares well with 17-1/2 17½ oz. nylon duck under impact of standard cal. .45 ball ammunition but is inferior to that material under impact of the cal. .22 fragment simulating projectile, G-2. Various intervals of quilting and various combinations of this material with nylon duck failed to vary these results significantly.

3. In previous programs of testing prospective body armor components, impacts have been made with standard cal. .45 ball ammunition and with projectiles G-1-A (cal. .30, 150 grains), G-1-S (cal. .30, 34 grains) and G-2 (cal. .22, 17 grains) developed at this arsenal.[2] It is now felt that in the study of materials equivalent in weight per unit area to .050" or less of steel, firing should be restricted to that of cal. .45 ball ammunition and projectile G-2, since these two types probably reproduce the two extremes of service impact which such materials may reasonably be expected to withstand. Thus tests of this material have been so restricted. A summary of the results of these tests appears in Table I.

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1. O.O. 400.112/12514(c) - Wtn. 400.112/3061(c) dated 6 April 1944.

2. WAL Memorandum Rpt. No. 762/247(c) - "Development of Projectiles to Be Used in Testing Body Armor to Simulate Flak and 20 mm. HE Fragment", 17 Dec. 1943.
WAL Memorandum Rpt. No. 762/253(c) - "Development of Projectiles to Be Used in Testing Body Armor to Simulate Flak and 20 mm. HE Fragment", 7 Jan. 1944.

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4. Several combinations of layers of fiber glass and nylon duck, approximately equivalent in weight per unit area to Hadfield steel now being used in body armor assemblies, were tested. No combination attempted exhibited resistance characteristics superior to an equivalent weight of 17½ ounce nylon duck and as might be anticipated from such results combinations employing the larger numbers of nylon duck layers showed better resistance characteristics.

5. In an attempt to disclose the effects of various intervals of quilting a constant combination of fiber glass and nylon duck was tested in several samples which varied only as to the distance between the rows of stitching. No appreciable variation in results developed and it was decided that the interval of quilting was not critical and even an absence of quilting would probably not produce deleterious effects upon the ballistic resistance of this material.

6. As compared with the steel currently used as a body armor component (Hadfield manganese steel) this material, as well as other fabrics tested here, offers considerably less resistance to perforation by either type of projectile. Of the fabrics tested here, this material is inferior to 17½ ounce nylon duck, but superior to #8 cotton duck and to various samples of nylon and glass beltings.

7. The subject material tended to leave a slight impression on the jackets of standard cal. .45 ball ammunition which was not left by other fabrics tested. There is some reason to suspect, therefore, that the same basic substance in a form and texture similar to that of 17½ ounce nylon duck might offer superior resistance. In its present form, however, further consideration of this material as an armoring material is to be discouraged.

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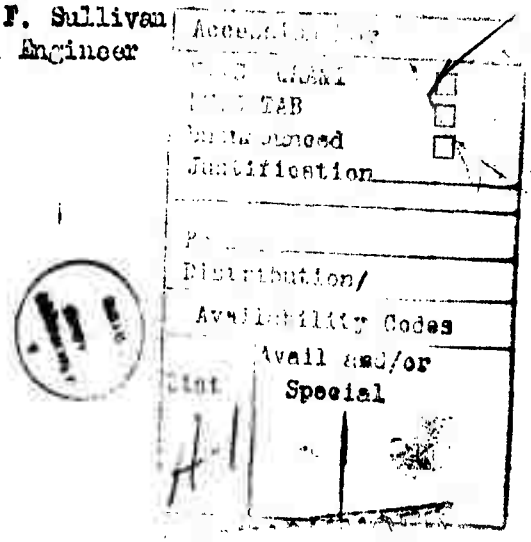

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TABLE I

Summary of Ballistic Tests Conducted at Watertown Arsenal on Various Assemblies of Fiber Glass ECC-11-162

Test Sample	Quilting Interval	Equivalent Steel Gauge	Ballistic Limit	
			C-2 (Cal. .22, 17 Grains)	Standard Cal. .45 Ball
Tautly Stretched on Rigid Wooden Frame - Back Unsupported:				
21 plies fiber glass plus 1 ply nylon duck	8"	.045"	1130	711
"	4"	.045"	1148	729
"	1"	.045"	1173	738
"	½"	.045"	1138	697
23 plies fiber glass	2"	.045"	—	710
17 plies fiber glass plus 3 plies nylon duck	2"	.045"	1208	760
23 plies fiber glass plus 1 ply nylon duck	2"	.049"	1290	-
21 plies fiber glass plus 3 plies nylon duck	2"	.053"	1335	836
12 plies nylon duck	11"	.044"	1360	750
Hadfield Manganese Steel (Average)	-	.044"	1650	925
23 plies fiber glass	2"	.045"	1189	--
23 plies fiber glass plus 1 ply nylon duck	2"	.049"	1238	--
11 plies nylon duck	11"	.040"	1360	--