Copy # 29

War 710/616

WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/616

Resistance of Various Layers of 17½ Ounce Nylon to Several Types of Small Arms Projectiles

BY

J. F. Sullivan
Jr. Engineer

DATE 22 April 1944

WATERTOWN ARSENAL
WATERTOWN, MASS.

WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT NO. WAL 710/616

Third Partial Report on Problem B-8.4

22 April 1944

Resistance of Various Layers of 17½ Ounce Nylon to Several Types of Small Arms Projectiles

1. In response to a request from the Office, Chief of Ordnance,[1] and as a result of subsequent telephonic contacts with that office, tests have been conducted at this arsenal on various multi-layered assemblies of 17½ ounce nylon duck.

2. On the basis of resistance to perforation per unit weight the subject material, layered in an assembly equal in weight per unit area to .044" of steel, is superior to all other fabrics tested at this arsenal to date (with the possible exception of Nylon parachute cloth). As compared with Hadfield manganese steel of the quality currently procurable under Specification AXS-1170, this material's ballistic limit is about 300 feet-per-second lower under impact of projectile G-2 (cal. .22, 17 grains) and about 175 feet-per-second lower under impact of standard cal. .45 ball ammunition.

3. Various numbers of layers of this material were sewed together in 12"x12" sizes and tested, stretched tautly across a wooden ballistic frame so that their backs were unsupported, 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, developed at this arsenal.[2] Similar assemblies were tested, strapped across a sawdust-filled canvas dummy, with projectiles G-1-S and G-2. The results of these tests appear in Table I.

4. The effects of layering on the resistance of this material to perforation by projectile G-1-S have been analyzed in a previous report.[3] This report lists results of similar tests with other projectiles in which it may be noted that increased layering had little effect on resistance to perforation by projectile G-1-A, but brought about expected increases in

1. O.O. 423/98(c) - Wtn. 423/161(c) dated 17 December 1943.

2. WAL Memorandum Report No. 762/247(c) and WAL Memorandum Report No. 762/253(c).

3. WAL Memorandum Report No. 710/596(c).

resistance to perforation by other projectiles. As to the effects of the method of mounting the samples, the tendency for results of the two types of test to become identical at velocities in excess of 1050 feet-per-second, exhibited in the previous report, is repeated in the tests with projectile G-2, in which limit velocities were always in excess of this figure.

5. On a weight-for-weight basis, as compared with other fabrics tested here, the ballistic limit of the subject material with cal. .45 ball ammunition (750 feet-per-second) is better than that of #8 cotton duck (395 feet-per-second) and that of Nylon parachute cloth (698 feet-per-second) and equivalent to that of the best combination of fiber-glass and itself (760 feet-per-second). With projectile G-2, its ballistic limit (1360 feet-per-second) is better than that of #8 cotton duck (883 feet-per-second) and that of fiber-glass (1189 feet-per-second) but inferior to that of Nylon parachute cloth (1467 feet-per-second). Its ballistic limits with cal. .45 ball and with projectile G-2 are, however, considerably lower than those of average Hadfield manganese steel (925 feet-per-second and 1650 feet-per-second respectively).

6. Therefore, if a fabric is to be used as a critical component of body armor assemblies, the results of these tests indicate that further consideration of 17½ ounce nylon duck is to be encouraged.

J. F. SULLIVAN
Jr. Engineer

APPROVED:

N. A. MATTHEWS
Major, Ord. Dept.
Chief, Armor Section

[redacted]

UNCLASSIFIED

TABLE I

Summary of Ballistic Tests Conducted at Watertown Arsenal on Various Multi-Layered Assemblies of 17½ Ounce Nylon Duck

Sample	Equivalent Steel Gauge	Ballistic Limits G-1-A[1]	G-1-S[2]	G-2[3]	.45[4]
Stretched tautly across a wooden ballistic frame - back unsupported:					
6 plies Nylon duck	.022"	-	790	-	-
7 plies Nylon duck	.026"	513	844	1095	-
8 plies Nylon duck	.029"	498	936	1103	-
9 plies Nylon duck	.033"	550	946	-	500
10 plies Nylon duck	.037"	545	981	1215	675
11 plies Nylon duck	.040"	567	1058	1310	704
12 plies Nylon duck	.044"	566	1105	1360	750
130 plies Nylon parachute cloth	.045"	-	-	1467	698
11 plies #8 cotton duck	.047"	-	-	-	395
17 plies fiber glass ECC-11-1b2 plus 3 plies Nylon duck	.045"	-	-	1208	760
Hadfield Manganese Steel (Average)	.044"	-	1050	1650	925

[redacted]

UNCLASSIFIED

[redacted]

TABLE I (Cont'd)

Sample	Equivalent Steel Armor	Ballistic Limits G-1-A[1]	G-1-S[2]	G-2[3]	.45[4]
Strapped on sawdust-filled canvas dummy:					
6 plies Nylon duck	.022"	-	865	-	-
7 plies Nylon duck	.026"	-	948	1064	-
8 plies Nylon duck	.029"	-	972	1081	-
9 plies Nylon duck	.033"	-	1020	-	-
10 plies Nylon duck	.037"	-	1063	1207	-
11 plies Nylon duck	.040"	-	1090	1360	-
12 plies Nylon duck	.044"	-	1102	-	-
11 plies #8 cotton duck	.047"	-	-	883	-
23 plies fiber glass ECC-11-162	.045"	-	-	1189	-

1. Cal. .30 (150 grains)
2. Cal. .30 (34 grains)
3. Cal. .22 (17 grains)
4. Standard cal. .45 ball ammunitions.

[redacted]