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W. A. Laboratory
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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/596

Resistance to Perforation by 34-Grain Fragment-Simulating Projectile G-1-S of Various Numbers of Layers of 17-1/2 Oz. Nylon Duck

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J. F. SULLIVAN

Jr. Engineer

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DATE 17 March 1944

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Watertown Arsenal Laboratory

Memorandum Report No. WAL 710/596

First Partial Report on Problem B-8.4

17 March 1944

Resistance to Perforation by 34-Grain Fragment-Simulating Projectile G-1-8 of Various Numbers of Layers of 17-1/2 Oz. Nylon Duck

1. In response to a request from the Office, Chief of Ordnance, (1) various numbers of layers of 17-1/2 oz. nylon duck have been tested with the 34-grain fragment-simulating projectile developed at this arsenal. ~~(2)~~

2. In accordance with instructions the ballistic limits of several plies of this material, as affixed to a dummy, were determined. In addition similar plies of this material mounted rigidly on a wooden ballistic frame were tested with the same projectile. The results of each series of tests appear in Table I in company with the estimated ballistic limits of good Hadfield manganese steel of equivalent weight per square foot. These values have also been plotted in Figure 1.

3. Examination of this figure discloses that at lower limit velocities a given ply of this material, mounted loosely, so that it may react freely to impact, offers resistance superior to that of the same ply, mounted rigidly, so that its reaction to impact is impeded. As limit velocity increases, however, this superiority decreases until a 12-ply combination, loosely mounted, enjoys no superiority over a rigidly mounted combination of the same thickness. This diminution of superiority as velocity increases is doubtless attributable to the fact that at lower velocity the time consumed in perforation is such as allows a loosely mounted material a measure of reaction before complete perforation, whereas as velocity increases and the time expended in perforation consequently decreases a lesser degree of reaction can take place prior to failure until, at a critical velocity, the permitted reaction of the loosely mounted combination and that of the rigidly mounted combination apparently equalizes and the resultant resistance of both is virtually identical.

4. From Figure 1 it also appears that in thickness less than about 13-ply a given weight of the subject material affords resistance to perforation by a 34-grain fragment-simulating projectile G-1-8 superior to that of an equivalent weight of steel. In thicknesses greater than 13-ply, however, it is suspected that an equal weight of steel will provide the greater resistance to attack with this type of projectile. A current lack of projectiles precludes a more complete investigation of this problem at this time.

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(1) O.O. 423/98 (c); Wtn. 423/161 (c). (2) WAL 752/247 (c).

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5. Further experimentation with different types of projectiles is contemplated and will be reported as soon as results become available.

J. F. SULLIVAN
Jr. Engineer

APPROVED:

N. A. MATTHEWS
Major, Ordnance Dept.

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TABLE I

Comparison of Ballistic Limits of Various Numbers of Layers of 17-1/2 Ounce Nylon Duck, as Rigidly Mounted, and as Loosely Mounted, with Those of Hadfield Manganese Steel of Equivalent Weight.

Number of Layers	Equivalent Stell Thickness	Ballistic Limit with 34 - Grain Fragment Simulating Projectile G-1-S		
		Rigid	Loose	Steel of Equivalent Weight
6	.022	790	865	—
7		844	948	—
8		938	972	—
9	.033	946	1020	—
10		981	1063	—
11		1058	1090	880
12	.044	1105	1102	1020

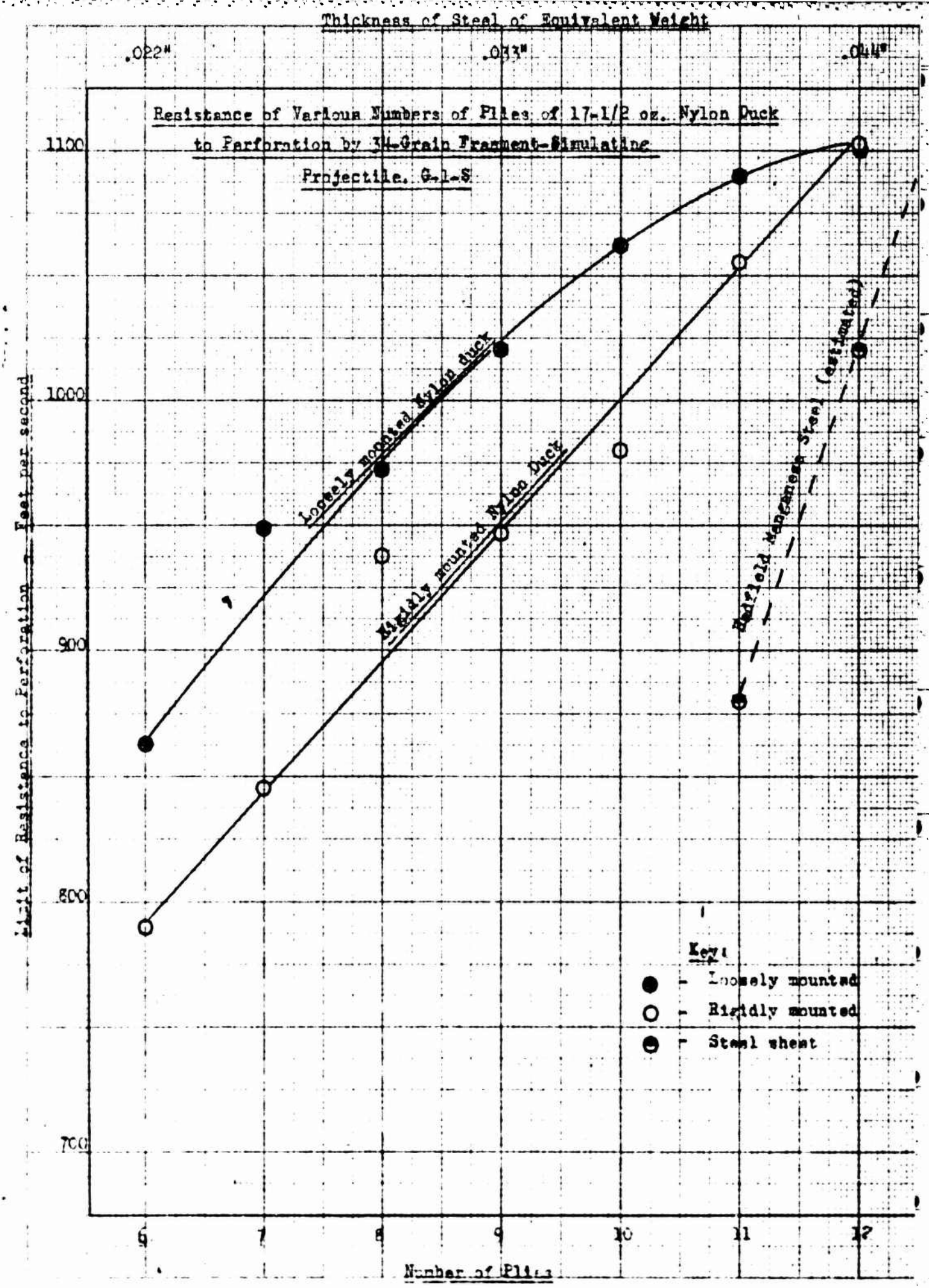
Thickness of Steel of Equivalent Weight
.022"
.033"
.044"
Resistance of Various Numbers of Plies of 17-1/2 oz. Nylon Duck
to Perforation by 34-Grain Fragment-Simulating
Projectile, G-1-S
1100
1000
900
800
700
Limit of Resistance to Perforation - Feet per second
Loosely mounted Nylon duck
Rigidly mounted Nylon Duck
Hadfield Manganese Steel (estimated)
Key:
- Loosely mounted
- Rigidly mounted
- Steel sheet
6
7
8
9
10
11
12
Number of Plies

FIGURE 1