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RESTRICTED ARMOR SECTION

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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/516

AD-A-39971

Resistance of Various Numbers of Plies of
.020" Aluminum Alloy Sheets to Perforation by
Fragment-Simulating Projectiles

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BY

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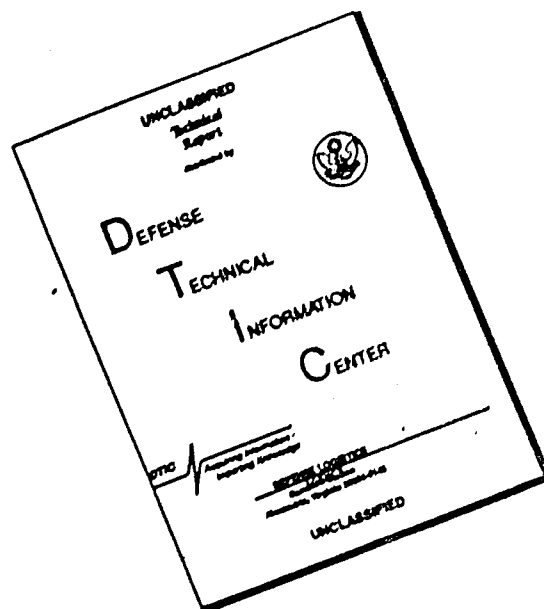
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MEMORANDUM REPORT NO. WAL 710/516

19th Partial Report on Problem B-8.2

29 August 1944

Resistance of Various Numbers of Plies of
.020" Aluminum Alloy Sheets to Perforation by
Fragment-Simulating Projectiles

1. At the request of the Office, Chief of Ordnance¹, ballistic tests have recently been conducted at this arsenal on various numbers of plies of .020" aluminum alloy sheets.

2. The resistance of single sheets of this material was so low as to be indeterminable by the test methods employed. The resistance of six plies of this material to perforation by cal. .45 ball projectiles (steel-jacketed) was about equal to that of solid pieces of aluminum alloy previously tested, whereas the resistance to perforation by the 17 grain fragment-simulator, G-2², of a similar combination was somewhat inferior to that of solid pieces of equivalent weight. *caliber* *Superior*

3. Various numbers of plies of .020" aluminum alloy sheet were rigidly clamped to a wooden frame and impacted fairly in unsupported areas, with the cal. .45 steel jacketed projectile and with the cal. .22 fragment simulating projectile, G-2. The results of these tests are set forth in Table I.

4. Because of the extreme thinness of these samples the resistance of a single sheet to perforation by the projectiles used could not be evaluated. Since it was necessary, therefore, to fire at more than a single thickness, it was decided to clamp the several plies closely together rather than to allow the introduction of the many variables to be expected from spacing. The resistance of a variety of numbers of plies sufficient to cover the ordinary velocity ranges of the projectiles was determined.

5. It is interesting to note that the resistance of six plies of this material to perforation by the cal. .45 steel-jacketed ball projectile is about the same as that of an equivalent weight of similar material in a single thickness^{3,4}, while, under impact of the cal. .22 fragment-simulator, G-2,

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1. O.O. 400.112/8724(r) - Wtn 400.112/3147(r).
 2. WAL Report No. 762/253(c).
 3. WAL Report No. 710/636.
 4. WAL Report No. 710/657.

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the resistance of the plied assembly was superior to that of a solid piece of the same weight-per-unit-area. This latter superiority of divided armor over solid armor is attributable to the fact that the solid pieces invariably fail in shear when impacted with this projectile, whereas, under such circumstances the discontinuities of material characteristic of the laminated assembly arrest the propagation of shear failure and the resultant resistance of such an assembly tends to be greater than that of solid material. Ordinarily, however, in the absence of a shear failure of the solid material, a divided armor assembly exhibits less resistance than an equivalent weight of solid material.

6. The resistance of the subject material, however, is so low as to eliminate it from consideration as a potential body armor material.

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TABLE I

Summary of Ballistic Tests Conducted at Watertown Arsenal
on Various Numbers of Plies of .020" Aluminum Alloy Sheet

<u>No. Plies</u>	<u>Equivalent Steel Gauge</u>	<u>Ballistic Limit (F/S)</u>	
		<u>Cal. .451</u>	<u>Q-22</u>
4	.029"	398	692
5	.036"	569	-
6	.043"	703	927
7	.050"	796	-
8	.057"	908	1175
9	.064"	1044	--
10	.071"	--	1313
12	.086"	--	1590
<u>For Comparison</u>			
Aluminum Alloy (Ave.)	.044"	748	827
Hadfield Manganese Steel (Ave.)	.044"	940	1660

1. Cal. .45 steel-jacketed ball projectile - 230 grains.
2. Cal. .22 fragment-simulating projectile - 17 grains.



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ABSTRACT:

Ballistic tests were conducted on various numbers of plies of .020-in. aluminum alloy sheets. The resistance of single sheets of this material was so low that it was not able to be determined by the test methods used. The resistance of six plies of the material to perforation by cal. 0.45 ball projectiles (steel jacketed) was about equal to that of solid pieces of aluminum alloy previously tested. The resistance to perforation by the 17 grain fragment-simulator, G-2, of a similar combination was somewhat superior to that of solid pieces of equivalent weight. Ordinarily, however, a divided armor assembly exhibits less resistance than an equivalent weight of solid material. However, the resistance of the aluminum is so low as to eliminate it from consideration as a potential body armor.

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