

AD-A954 290

WATERTOWN ARSENAL
WATERTOWN, MASS.

UNCLASSIFIED
Copy # 2a



WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/625

A+1-126230

Resistance to Light-Gauge (.045" to .048")

Armor Submitted by National Armor Company
to Perforation by Small Arms Projectiles

DTIC FILE COPY

BY

J. F. SULLIVAN
Jr. Engineer

DECLASSIFIED
DOD DIR 5400.9

This document has been approved
for public release and sale; its
distribution is unlimited.

DTIC
SELECTED

DEC 18 1984

UNCLASSIFIED

A

DATE 15 May 1944

WATERTOWN ARSENAL
WATERTOWN, MASS.

UNCLASSIFIED

RESTRICTED

Watertown Arsenal Laboratory

Memorandum Report No. WAL 710/625

Fifth Partial Report on Problem B-8.2

15 May 1944

Resistance to Light-Gauge (.045" to .048")

Armor Submitted by National Armor Company

to Perforation by Small Arms Projectiles

WAS

1. In accordance with a request from the Office, Chief of Ordnance, a program of development of improved body armor components is in progress at this arsenal. In conjunction with this program tests have recently been conducted on twelve light-gauge steel sheets furnished by the National Armor Company.

2. The resistance of these samples to perforation by standard caliber .45 ball ammunition (steel jacketed) was consistently appreciably inferior to that of average Hadfield manganese steel currently being used in body armor assemblies. Under impact of the caliber .22 fragment simulating projectile, G-2², two hard (46 Rc and 47 Rc) samples compared favorably with the Hadfield steel whereas a harder (48 Rc) sample was considerably inferior. Under impact of projectile G-1-S³ only the 46 Rc sample compared favorably with Hadfield steel. ←

3. Samples were clamped rigidly to a wooden ballistic frame which allows an 8"x8" area of the back of the plate to be unsupported and were impacted with projectiles G-1-S, G-2 and with standard caliber .45 ball ammunition (steel jacketed). The results of these tests are shown in Table I.

1. O.O. 422.3/71(c), Wtn 470.5/7443(c) dated 28 September 1943.
2. VAL Memorandum Report No. 762/253(c) - "Development of a Projectile, to Be Used in Testing Body Armor, Simulate Fragments of a 20 mm. H.E. Projectile" - 7 January 1944.
3. WAL Memorandum Report No. 762/247(c) - "Development of Projectiles to Be Used in Testing Body Armor to Simulate Flak and 20 mm. H.E. Fragment" - 17 December 1943.

UNCLASSIFIED

4. Under impact of standard caliber .45 ball ammunition the resistance of the best of these samples (866 feet-per-second) was appreciably inferior to that of run-of-the-mill Hadfield manganese steel (950 feet-per-second). Although this specimen was the hardest (48 Rc) of the samples tested there was apparently no correlation between resistance to this type projectile and plate hardness.

5. Under impact of projectile G-1-S, the resistance of only one sample (1042 feet-per-second) compared favorably with that of Hadfield steel (1050 feet-per-second). Here also there was apparently no correlation between resistance and hardness.

6. Under impact of projectile G-2, the caliber .22 fragment simulator, the resistance of two hard plates (46 Rc and 47 Rc) compared favorably with the Hadfield type (1670 feet-per-second and 1690 feet-per-second compared with 1675 feet-per-second), whereas that of a harder plate (48 Rc) was considerably inferior (1380 feet-per-second).

7. Analysis of the tests with projectile G-2 discloses some correlation between resistance to perforation and hardness (as shown in Figure 1) but there are glaring exceptions to the trend. Furthermore, the resistance of Hadfield manganese steel is very high while its hardness is very low (88 Rockwell "B"). It is therefore contended that some other physical property, probably elongation prior to necking, may be much more significant than hardness. With this in mind samples of various types of steels are being prepared for tensile tests at this arsenal. The results will be made known as soon as sufficient data have been compiled.

J. F. Sullivan
J. F. SULLIVAN
Jr. Engineer

APPROVED:

N. A. Matthews

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



Approved for	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

-2-
~~RESTRICTED~~

UNCLASSIFIED

UNANNOUNCED

TABLE I

Summary of Ballistic Tests Conducted at Watertown Arsenal Laboratory

on Twelve Light-Gauge (.045" to .048") Steel Sheets Submitted by

National Armor Company

<u>Sample</u>	<u>Gauge</u>	<u>W.A. Hard- ness</u>	<u>G-1-A¹</u>	<u>G-1-S²</u>	<u>G-2³</u>	<u>.45⁴</u>
1	.048"	35 Rc	--	933	1425	782
2	.048"	29 Rc	--	928	1488	782
3	.047"	47 Rc	--	978	1690	792
4	.047"	32 Rc	--	932	1340	820
5	.046"	30 Rc	--	914	1307	733
6	.046"	37 Rc	395	916	1398	798
7	.047"	48 Rc	--	958	1380	866
8	.046"	35 Rc	400	896	1385	642
9	.045"	41 Rc	--	1004	1629	797
10	.045"	46 Rc	--	1042	1670	750
11	.048"	34 Rc	--	1019	1588	777
12	.047"	33 Rc	--	923	1560	751

For Comparison:

"Hadfield Manganese Steel"	.045"	88 Rb	--	1050	1675	950
----------------------------------	-------	-------	----	------	------	-----

¹Cal. .30 fragment-simulating, 150 grains

²Cal. .30 fragment-simulating, 34 grains

³Cal. .22 fragment-simulating, 17 grains

³Cal. .45 ball ammunition (steel jacketed)

1700

1620

1540

1460

1380

BALLISTIC LIMIT - F/S

Correlation between Ballistic Limit
with Projectile 9-2 and Rockwell 'C' Hard-
ness of Twelve (.047") Steel Plates
Submitted by National Armor Company

30

34

38

42

46

50

RC

FIGURE 1

