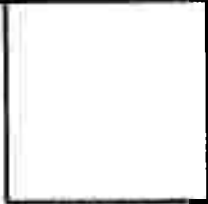


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# WATERTOWN ARSENAL LABORATORY

## MEMORANDUM REPORT

NO. WAL 710/667

Resistance of Silico-Manganese Spring Steel to  
Perforation by Fragment-Simulating Projectiles

BY

J. F. SULLIVAN  
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AD A 9 53963

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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT NO. WAL 710/667

Sixteenth Partial Report on Problem B-8,2

1 July 1944

Resistance of Silico-Manganese Spring Steel to  
Perforation by Fragment-Simulating Projectiles

1. In response to a directive from the Office, Chief of Ordnance<sup>1</sup>, the resistance of several types of light-gauge steel to perforation by fragment-simulating projectiles is being investigated at this arsenal. This memorandum reports results of tests conducted on samples of silico-manganese spring steel supplied by the Carnegie-Illinois Steel Corporation.

2. The sample tempered to 49 Rockwell "C" exhibited resistance to perforation by the cal. .22 fragment-simulating projectile, G-2<sup>2</sup>, superior to that of an equivalent weight of Hadfield manganese steel but under impact of the cal. .45 (steel-jacketed) ball projectile the resistance of a similar sample was greatly inferior to that of the Hadfield type. The resistance of samples tempered to 40/43 Rockwell "C" was considerably inferior to that of Hadfield steel under both types of attack.

3. Two groups of samples of a .60% carbon silico-manganese steel differing nominally only in tempering treatment were received from Carnegie-Illinois Steel Corporation. Two plates from each group were selected, one for testing with projectile G-2 and the other for testing with the cal. .45 ball projectile. The plates were clamped rigidly to wooden ballistic frames which allow areas 8"x8" to remain unsupported from the rear. Into the faces of these areas the impacts were directed. The results are set out in Table I.

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1. O.O. 470.1/36546 - Wtn 472.81/31530, dated 11 March 1944.

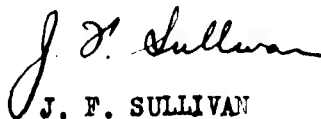
2. Watertown Arsenal Laboratory Memorandum Report No. WAL 762/253, Development of a Projectile, to Be Used in Testing Body Armor, to Simulate Fragments of a 20 mm. H.E. Projectile, 7 January 1944.

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4. Under impact of the cal. .22 fragment-simulating projectile, G-2, the resistance of sample 8-5, tempered to 49 Rockwell "C" (1760 feet-per-second), was superior to that of an equivalent weight of Hadfield manganese steel (1630 feet-per-second). Under impact of the cal. .45 ball projectile its resistance (679 feet-per-second) is greatly inferior to that of Hadfield steel of equal weight (920 feet-per-second). The resistance of the samples tempered to 40/43 Rockwell "C" (682 feet-per-second and 1170 feet-per-second, respectively) was considerably lower.

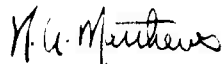
5. Although the superior resistance of the harder sample to perforation by the fragment-simulating projectile is encouraging, its decisive inferiority under impact of the cal. .45 projectile lends farther credence to the contention that in this gauge (.040" to .045") the high all-around resistance of Hadfield manganese steel is apparently unique.

6. It is therefore, considered unreasonable that search for a steel of greater overall resistance in this gauge will be productive.



J. F. SULLIVAN  
Asst. Engineer

APPROVED:



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

Table I

Summary of Penetration Tests Conducted at Watertown Arsenal on  
Samples of Silico-Manganese Spring Steel

Chemical Composition

<u>C</u>	<u>Mn</u>	<u>P</u>	<u>S</u>	<u>Si</u>
.55/.65	.70/1.00	.040 max.	.040 max.	1.80/2.20

All plates normalized, oil quenched and tempered.

<u>Sample</u>	<u>Gauge</u>	<u>Hardness</u>	<u>Ballistic Limit (F/S)</u>	
			<u>G-2<sup>1</sup></u>	<u>Cal. .45<sup>2</sup></u>
7-1	.042"	40 Rc	—	682
7-5	.043"	43 Rc	1170	-
8-1	.039"	51 Rc	—	679
8-5	.042"	49 Rc	1760	-

For Comparison:

Hadfield manganese steel (average)	.042"	88 Rb	1630	920
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<sup>1</sup>Cal. .22 fragment-simulating projectile - 17 grains.

<sup>2</sup>Cal. .45 (steel-jacketed) ball projectile - 230 grains.