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**WATERTOWN ARSENAL  
LABORATORY**

**MEMORANDUM REPORT**

NO. WAL 710/697

Resistance of NE-3620 Steel  
in Various Conditions of Hardness to  
Perforation by Flak-Simulating Projectiles

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BY

J. F. SULLIVAN  
Asst. Engineer

**UNCLASSIFIED**

DATE 16 September 1944

**WATERTOWN ARSENAL  
WATERTOWN, MASS.**

710/697

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MEMORANDUM REPORT NO. WAL 710/697

22nd Partial Report on Problem B-8.2

16 September 1944

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Resistance of NE-8620 Steel  
in Various Conditions of Hardness to

Perforation by Flak-Simulating Projectiles

1. In response to a request of the Office, Chief of Ordnance<sup>1</sup>, a general program of development of body armor component materials is being conducted at this arsenal. As part of this program tests have recently been completed on samples of NE-8620 steel supplied by the Republic Steel Corporation.

2. Although the resistance of none of these samples to perforation by cal. .45 steel-jacketed ball projectiles was comparable with that of an equivalent weight of Hadfield manganese steel, samples tested in the as-quenched condition exhibited resistance characteristics superior to those of the tempered specimens.

3. Duplicate samples of NE 8620 steel as tempered at 900°F, 1000°F, 1100°F and 1200°F after a water quench from 1600°F were received from Republic Steel Corporation. One sample of each was tested as-received and the duplicate samples were reheated to 1600 F at this arsenal and water quenched. These samples were tested without tempering. Inasmuch as the resistance of the tempered samples to perforation by cal. .45 steel-jacketed ball projectiles was so low and in deference to a back-log of testing with the cal. .22 flak-simulating projectile, G-22, tests with the latter projectile were not made on those samples. The as-quenched specimens were tested with both projectiles. The results appear in Table I.

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1. O.O. 422.3/71(c) - Wtn 470.5/7443(c), dated 28 September 1943.
  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. Since the resistance of samples of NE-3620 either as-quenched or as tempered at various representative temperatures is so greatly lower than that of Hadfield manganese steel of equivalent weight, the further consideration of this type of steel in this gauge as a prospective component of body armor is to be discouraged. In heavier gauges there is some reason to believe that a ferritic steel such as this may afford more satisfactory resistance.

*J. F. Sullivan*

J. F. SULLIVAN  
Asst. Engineer

APPROVED:

*N. A. Matthews*

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

TABLE I

Summary of Tests Conducted at Watertown Arsenal on  
Samples of NL-8620 Steel Supplied by Republic Steel Corporation

CHEMICAL COMPOSITION

Sample No.	CHEMICAL COMPOSITION							Tempering Temperature	Ballistic Limit (F/S)			
	C	Mn	P	S	Si	Ni	Cr		Mo	Cal. .451	G-22	
	.18	.89	.019	.020	.30	.55	.50	.15				
	Act. Grains	Hardness (Rockwell C°)							Temperature	Ballistic Limit (F/S)		
A	.045"	31								900°F	486	--
B	.044"	29								1000°F	426	--
C	.044"	25								1100°F	439	--
D	.045"	19								1200°F	453	--
E	.044"	43								As quenched	548	--
F	.044"	43								As quenched	526	--
G	.044"	42								As quenched	--	1307
H	.044"	39								As quenched	--	1155
For comparison:												
	.044"	--								--	940	1660

Average Hadfield manganese steel

<sup>1</sup>Cal. .45 steel-jacketed ball projectile - 230 grains.

<sup>2</sup>Cal. .22 flak-simulating projectile - 17 grains.