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WATERTOWN ARSENAL LABORATORY

MEMORANDUM REPORT

NO. WAL 710/602

Preliminary Metallurgical Examination of Twelve (12) Samples
of Rolled Homogeneous Armor to be Fired During the
1943-44 Cold Test Program.

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BY
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DATE 31 March 1944.

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Watertown Arsenal Laboratory

Memorandum Report No. WAL 710/602

Fifth Partial Report on Problem B-12.1

31 March 1944

Preliminary Metallurgical Examination of Twelve (12) Samples

of Rolled Homogeneous Armor to Be Fired during the

1943-44 Cold Test Program

1. In accordance with a directive from the Office, Chief of Ordnance, (1) twelve (12) samples of rolled homogeneous armor were received from the Ordnance Research Center for metallurgical examinations preliminary to their being fired as part of the 1943-44 Cold Test Program.

2. These samples had been cut at Aberdeen Proving Ground from ballistic test samples in sections approximately 4"x36"xT (the thickness of the ballistic test plate). From these samples, sections for metallurgical examinations have been cut at this arsenal according to Figure 1.

3. Section A (8"x4"xT) was used to determine steel quality in the direction parallel to the 36" edge of the original ballistic plate. All such samples were nicked in 3/8" on each side and broken uniformly slowly by means of a steam forge press. The results are listed in Table I, in the column marked "A".

4. Section B (8"x4"xT) was used to determine the response of the ballistic plates to heat treatment. All samples were nicked in 1 1/2" on each side and broken uniformly fast on a steam forge hammer. The results are listed in Table I, in column "B".

5. In order to determine steel quality and response to heat treatment as indicated by a fracture in the opposite direction, Section C (4"x3"xT) was cut and all such samples were nicked in 3/4" to provide a fracture surface suitable to the dual purpose of the test. These samples were broken uniformly slowly in a steam forge press. The results of these

(1) O.O. 470.5/5139(r) - Wtn 470.5/7578(r) dated 28 October 1943.

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ratings for steel quality and fibre are shown in Table I, in the two columns marked "C".

6. Section D was prepared by Blanchard grinding for a Brinell hardness traverse according to Figure 2. (Although this report does not cover $1\frac{1}{2}$ " plates, this figure includes them, since traverse patterns have been standardized for this program). The individual readings of the traverse and their average is set out in Table I. One surface of each sample was also Blanchard ground and three Brinell impressions made. Their average also appears in Table I.

7. In previous reports on this program the orientation of the section with respect to the major direction of rolling has been determined by inspection of the fracture. In this group of plates, however, the cross-rolling has been so thorough that directional indications have been virtually eliminated and no estimate can be made of the direction of major rolling. The steel from which both groups of plates were produced is apparently of superior quality.

8. Five out of six of the $\frac{1}{2}$ " samples showed an extremely laminated condition in approximately the same location in each section, as cut at Aberdeen. In other areas of the section, virtual absence of lamination was apparent. This poor condition occurred approximately in the center of the section as received and would seem to indicate a constant malpractice either as regards ingot design or as regards cropping procedure. The ballistic test plates may be expected to show variable results in different areas of impact.

9. The results of metallurgical results of further groups of samples will be reported as they become available.

J. F. SULLIVAN
Jr. Engineer

APPROVED:

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

TABLE I

Summary of Metallurgical Examinations Conducted Prior to Ballistic Testing

of 12 Samples of Rolled Homogeneous Plate to be Fired

During the 1943-44 Cold Test Program

Sample No.	Nominal Gauge	Rolling Direction ¹	Steel Quality ²		Fibre Fracture ²	Brinell Hardness Number ³				
			A	B		Cross Section			Surface Ave.	
						1	2	3		4
GH1515	1/2"	Ind.	B	D	F	363	363	363	363	384
HH1615	1/2"	Ind.	B	D	F _{tr}	363	363	375	375	359
IH1715	1/2"	Ind.	B	D	F _{tr}	352	352	352	352	359
JH1815	1/2"	Ind.	B	D	F	363	363	363	375	371
KH1915	1/2"	Ind.	B	D	F	363	363	352	352	375
LH2015	1/2"	Ind.	B	B	F _{tr}	352	352	352	363	371
1874H149J10	1"	Ind.	B	B	F	293	321	321	321	311
1875H150J10	1"	Ind.	B	B	F	311	321	321	321	321
1876H151J10	1"	Ind.	B	B	F	321	321	321	321	321
1877H152J10	1"	Ind.	B	B	F	331	331	331	331	324
1878H153J10	1"	Ind.	B	B	F	331	341	341	331	328
1879H154J10	1"	Ind.	B	B	F	311	331	331	331	321

¹Due to the thoroughness of cross rolling, a major rolling direction was not apparent.²A, B, and C according to Figure 1.³Numbers indicate position of Brinell impression on cross section (Figure 2). Surface value is average of three readings.

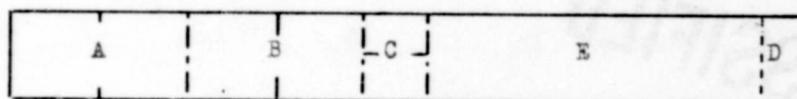
Explanation of ratings:

Steel Quality: A to E according to Specification AISI-488.

Fibre Fracture: F - Fibrous

F_{tr} - Fibrous, slight trace of crystallinity.

Method of Cutting Samples Supplied by Aberdeen



----- Cut by flame . All nicking by flame.
----- Cut by saw.

FIGURE 1

Location of Brinell Impressions on Cross-Sections

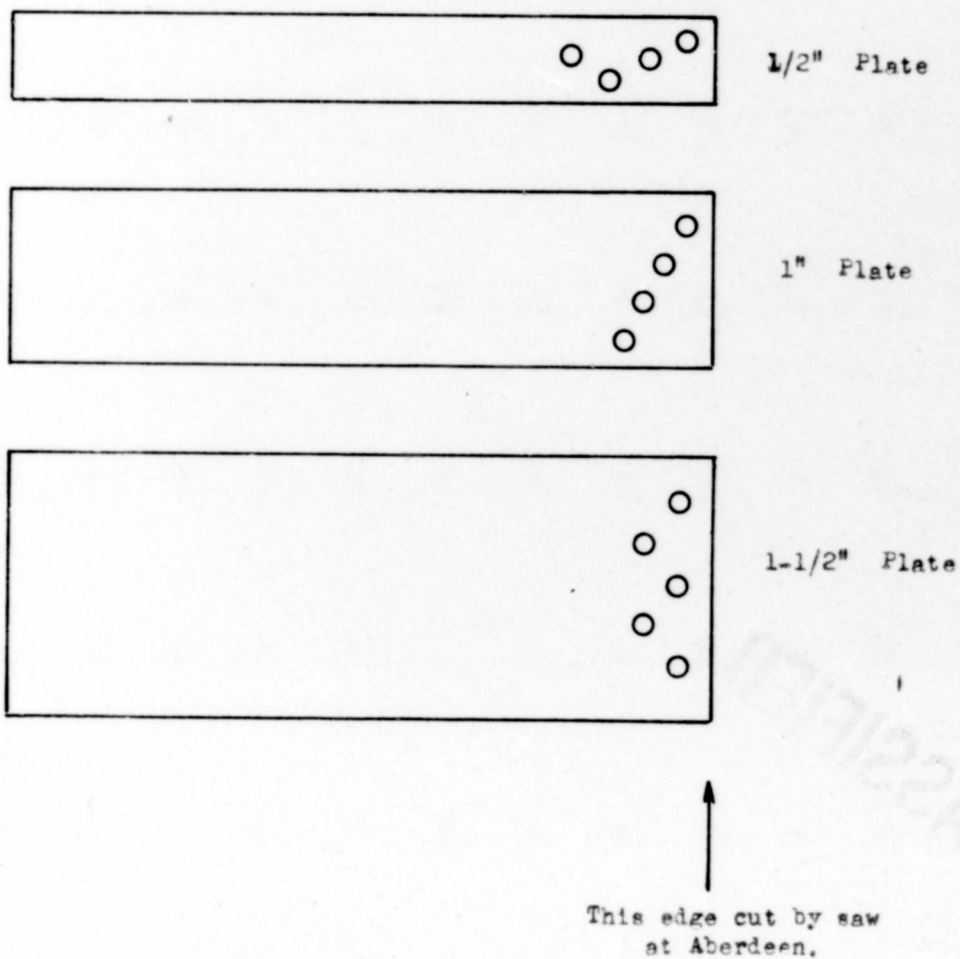


FIGURE 2