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.

By
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Date 31 March 1944.

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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 re-
ceived 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 1/2" 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

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(1) O.O. 470.5/5139(r) - WM 470.5/7578(r) dated 28 October 1943.
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" 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 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. V. SULLIVAN
Jr. Engineer

APPROVED:

H. 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

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Nominal Gauge</th>
<th>Rolling Direction</th>
<th>Steel Quality</th>
<th>Fibre Fracture</th>
<th>Brinell Hardness Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>G31515</td>
<td>1/2&quot;</td>
<td>Ind.</td>
<td>B</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>H31615</td>
<td>1/2&quot;</td>
<td>Ind.</td>
<td>B</td>
<td>D</td>
<td>Ftr</td>
</tr>
<tr>
<td>H31715</td>
<td>1/2&quot;</td>
<td>Ind.</td>
<td>B</td>
<td>D</td>
<td>Ftr</td>
</tr>
<tr>
<td>H31815</td>
<td>1/2&quot;</td>
<td>Ind.</td>
<td>B</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>H31915</td>
<td>1/2&quot;</td>
<td>Ind.</td>
<td>B</td>
<td>D</td>
<td>F</td>
</tr>
<tr>
<td>H32015</td>
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<td>Ind.</td>
<td>B</td>
<td>B</td>
<td>Ftr</td>
</tr>
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<td>18742144J10</td>
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<td>B</td>
<td>B</td>
<td>F</td>
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<td>F</td>
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<td>18782153J10</td>
<td>1&quot;</td>
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<td>B</td>
<td>B</td>
<td>F</td>
</tr>
<tr>
<td>18792154J10</td>
<td>1&quot;</td>
<td>Ind.</td>
<td>B</td>
<td>B</td>
<td>F</td>
</tr>
</tbody>
</table>

1 Due to the thoroughness of cross rolling, a major rolling direction was not apparent.

2 A, B, and C according to Figure 1.

3 Numbers 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 AIS-483.
- **Fibre Fracture**: £ - Fibrous
  - Ftr - Fibrous, slight trace of crystallinity.
Method of Cutting Samples Supplied by Aberdeen

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Cut by flame.

All nicking by flame.

Cut by saw.

FIGURE 1

Location of Brinell Impressions on Cross-Sections

1/2" Plate

1" Plate

1-1/2" Plate

This edge cut by saw at Aberdeen.

FIGURE 2