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REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1985.

Investigation of Cracked Manganese Steel Casting.

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(Copy No. 6 .)

Bureau of Mines
Division of Metallic Minerals

Physical Metallurgy Research Laboratories

CANADA

DEPARTMENT
OF
MINES AND RESOURCES

Mines and Geology Branch

OTTAWA January 8, 1946.

REPORT

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ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1985.

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Origin of Request and Object of Investigation:

On December 5, 1945, a letter was received from Mr. W. K. MacLeod, President, Lynn MacLeod Metallurgy Limited, Thetford Mines, Quebec, requesting that an examination be made to determine, if possible, the cause of cracking in a certain manganese steel casting. Samples of cracked castings were submitted for investigation.

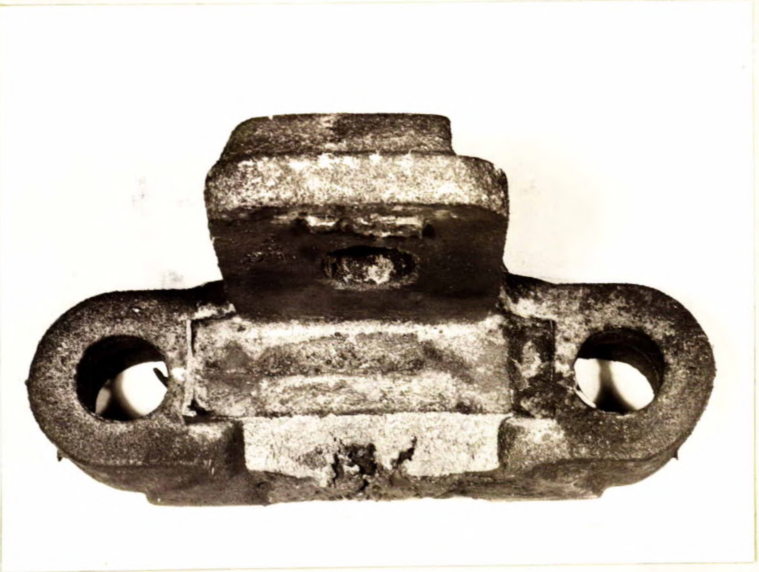
Interim Report:

After visual examination of the specimens, a letter was written to Mr. MacLeod on December 15, giving some tentative conclusions.

Description of Specimens:

Figure 1 shows one of the castings submitted.

Figure 1.



CRACKED MANGANESE STEEL CASTING.

(Approximately 1/4 actual size).

The casting as shown consists of a fairly heavy base with two lugs. One lug has broken off, showing a shrinkage cavity in the fractured surface. It was noted that a connecting bar had joined the two lugs together. This bar was cut off when the casting was cleaned.

Chemical Analysis:

		Per Cent
Carbon	-	1.41
Manganese	-	12.42
Chromium	-	0.26
Silicon	-	0.77
Sulphur	-	Trace.
Phosphorus	-	0.073

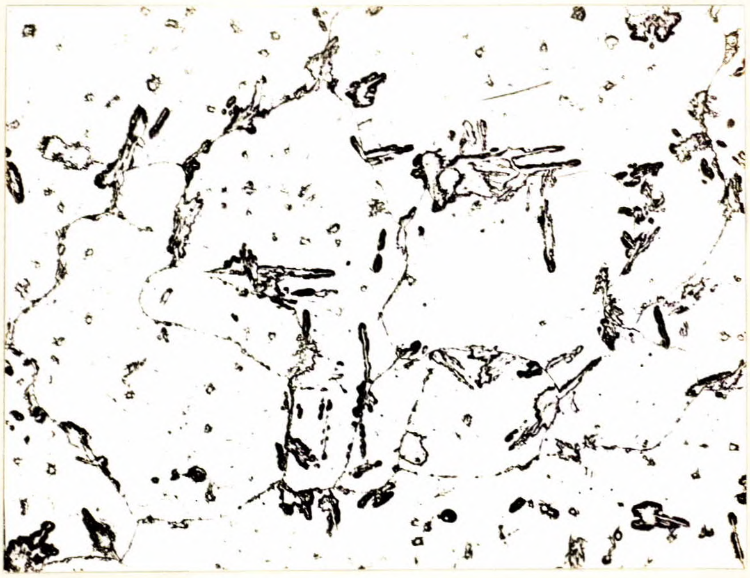
Mechanical Tests:

Four Charpy impact specimens were prepared from the casting as received, in the unheat-treated condition. The results obtained were, respectively, 11, 13, 16 and 12 foot pounds.

Micro-Examination:

Figures 2 and 3, at X30 magnification, show the as-cast and the heat-treated structures of the casting submitted.

Figure 2.



X50, nital etch.

AS CAST STRUCTURE.

Note the coarse grain size and grain boundary carbides.

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Figure 3.

X50, nital etch.

HEAT-TREATED STRUCTURE.

Note the coarse grain and the cracks around grain boundaries.

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DISCUSSION:

1. The carbon content of the casting examined is high, although within normal commercial limits.

2. The high carbon would tend to make the as-cast metal more brittle, by formation of carbides, and it would be more difficult to avoid cracking.

3. The as-cast metal has an impact strength of 13 foot pounds. With careful handling, it should be possible to cast this metal free from cracks.

4. In Figure 1, a view of the fractured surface shows that the fracture is not oxidized, indicating that the crack occurred when the casting was cold. A shrinkage area also appears in the fracture.

5. A change in gating and risering is necessary to avoid the shrinkage in the casting.

6. Strains are set up in the casting as it cools. These strains, when imposed on a high carbon metal, result in the cracking observed.

7. The following are suggested as possible causes for strain. No definite conclusion can be reached due to the scant evidence at hand; however, it may be worth while to follow up these possibilities.

(a) Excessively large grain size indicates high casting temperature. The casting may have been poured too hot.

(b) The casting may have been shaken out too soon.

(c) Cores may have been too hard.

(d) While being cut off, the connecting bar between the two lugs may have expanded and forced the lugs apart.

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