O T T A W A April 6th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1198.

An Examination of Three Hull Iron and Steel Foundries Towing Hooks.

(Copy No. 6 .)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Origin of Material and Object of Investigation:

On March 14th, 1942, under Requisition No. O.T. 170, Mr. H. L. Lexier, of the Inspection Board of the United Kingdom and Canada, 58 Lyon Street, Ottawa, Ontario, sent in three towing hooks for examination. These hooks were reported to have been made by the Hull Iron and Steel Foundries Limited, Hull, Quebec.

Chemical Analysis:

		Per cent
Carbon	-	0.22
Manganese	-	0.81
Silicon	-	0.38
Phosphorus	-	0.037
Sulphur	-	0.018
Nickel	-	0.10
Chromium	-	Nil.

X-Ray Examination:

Mr. W. A. Morrison, of the National Research Council, Ottawa, carried out an X-ray examination on the three hooks. The films show the presence of a cavity in each of the three hooks. Two of these are at identical spots at the base of the hook, toward one side, and the third is also at the base of the hook but toward the opposite side.

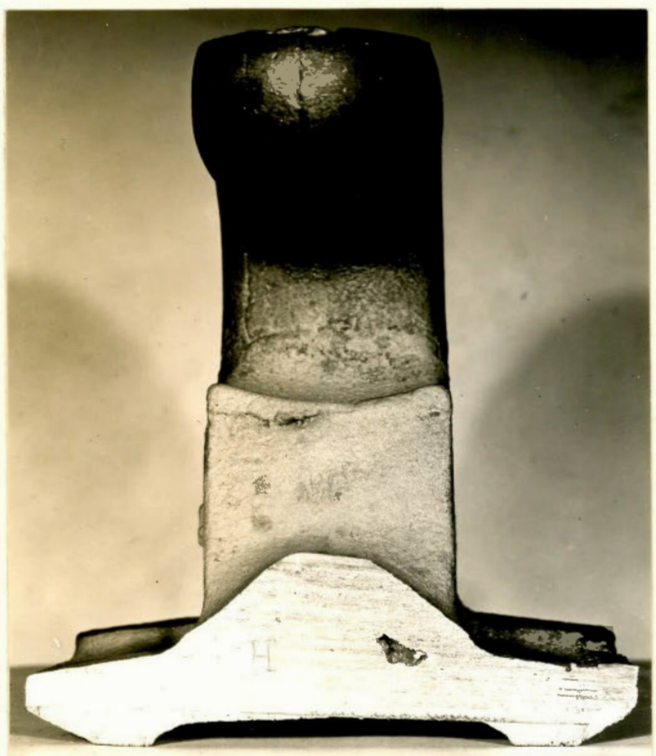
Two of the hooks were cut open in order to expose the cavities. These are shown in Figures 1 and 2.

Figure 1.

NOTE CAVITY AT THE BASE OF THE HOOK.

(X-Ray Examination, cont'd) -

Figure 2.



CAVITY AT BASE OF SECOND HOOK.

Physical Tests:

A tensile test specimen, diameter 0.282 inch, was cut from the base of a hook for physical testing on the Baldwin-Southwark testing machine. The results obtained are as follows:

Yield strength, p.s.i.	-	46,400
Tensile strength, p.s.i.	-	70,700
Elongation, per cent in 1 inch	-	28
Reduction of area, per cent	-	49.5

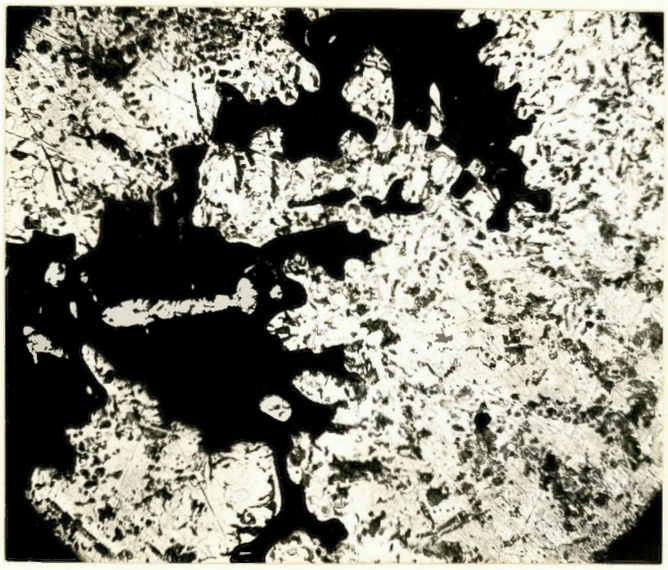
Hardness Tests:

Hardness tests were carried out on the Vickers hardness testing machine, using a 50-kilogram load. An average of 144 was obtained.

Microscopic Examination:

A section including the cavity shown in Figure 1 was polished and then examined under the microscope. A photomicrograph was taken of the edge of the cavity at X100 magnification. This is illustrated in Figure 3 below:

Figure 3.



X100, nital etch.

NOTE DENDRITIC STRUCTURE, INDICATING SHRINKAGE.

Discussion:

The specification requires:

Tensile strength	-	78,000 to 90,000 p.s.i.
Yield strength	-	40,000 p.s.i. minimum.

The producer has not met the tensile strength lower limit. A slightly harder material than 144 V.P.N. should be sought, as this would raise the tensile to meet the specification.

The X-rays revealed cavities in all three hooks. By the general contours of the holes (Figures 1 and 2) and the dendritic structure shown in the photomicrograph (Figure 3), these cavities are due to shrinkage.

(Continued on next page)

(Discussion, cont'd) -

Although the strength of the hooks would be slightly reduced by the presence of cavities, in this case this is not considered a serious defect. Elimination of the cavities can be effected, however, by a change in the casting technique, such as:

(1) Gating, so as to supply hot liquid metal under pressure to the section while it is solidifying,

or

(2) Using metal chills in the mould so as to move the shrinkage to a point where Method (1) may be applied more easily. Since internal chills are not allowed by the specification the chills used in this case would be of the external type.

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Conclusions:

1. A slightly harder material is required in order to meet the tensile strength demanded by the specification. In the case of producers of railroad castings, it would facilitate total production in the plant if the tensile required for the hooks were lowered to 70,000 pounds per square inch. It is felt that if hooks having 70,000 p.s.i. tensile strength are

(Conclusions, cont'd) -

found to be satisfactory in the field a change in specification to this tensile strength should be made.

2. The castings reveal flaws. These flaws are shrinkage cavities. Although these reduce the strength of the casting somewhat, in the case of these hooks they do not constitute a serious defect.

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