O T T A W A May 4th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1212.

Examination of Ford Towing Hooks.

(Copy No. 10.)

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 April 22nd, 1942, under Requisitions O.T. 317 and 318, the Inspection Board of the United Kingdom and Canada, 58 Lyon Street, Ottawa, Ontario, submitted two towing hooks for examination. These had been produced by the Ford Motor Company of Canada Limited, Windsor, Ontario.

Chemical Analysis:

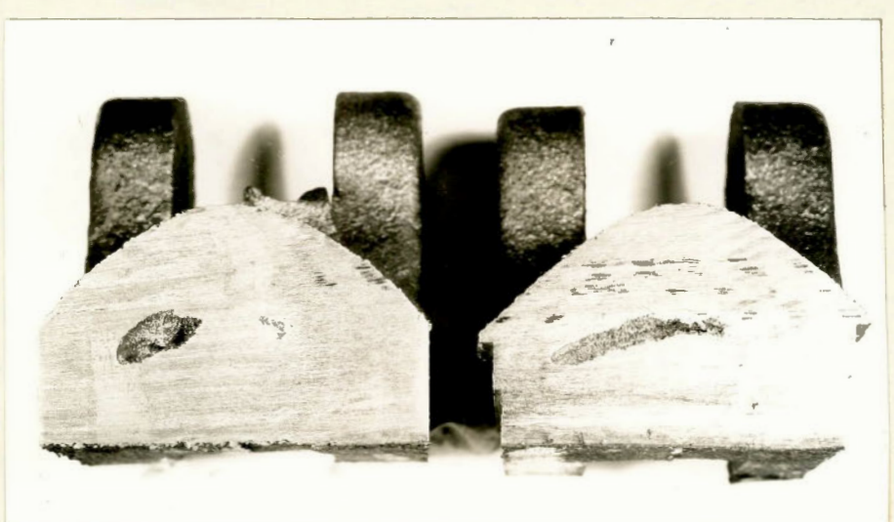
No. 1.		Per cent
Carbon	-	0.46
Manganese	-	0.75
Silicon	-	0.37
Phosphorus	-	0.041
Sulphur	-	0.039
Copper	-	0.16

No. 2.		
Carbon	-	0.41
Manganese	-	0.88
Silicon	-	0.50
Phosphorus	-	0.040
Sulphur	-	0.044
Copper	-	0.16

X-Ray Examination:

Mr. W. A. Morrison, of the National Research Council, Ottawa, carried out an X-ray examination on the two hooks. The films showed the presence of a cavity at the base of the hook in approximately the same place for both hooks. Figure 1 shows the exposed cavities in both hooks. The X-rays also indicate the presence of a number of other shrink or slag defects throughout the hooks.

Figure 1.



Note Cavities at the Base of Hooks.

Hardness Tests:

Hardness tests were carried out on the Vickers hardness testing machine, using a 50-kilogram load.

No. 1. - 244 V.P.N.
No. 2. - 246 V.P.N.

Physical Tests:

A tensile test specimen, diameter 0.282 inch, was cut from the base of the hooks. The results obtained are as follows:

No. 1.

Tensile strength - 104,400 p.s.i.
Yield - 68,800 p.s.i.
Reduction of area = 13.5 per cent.
Elongation in 1 inch = 12.0 per cent.

The tensile test specimen broke outside the middle third of the one-inch gauge length.

No. 2.

Tensile strength - 104,800 p.s.i.
Yield - 81,600 p.s.i.

The test specimen broke outside the middle third of the one-inch gauge length.

In order to determine the cause for the tensile specimens breaking at the above-mentioned point, microsections were cut from the tensile specimens 1/16 inch from the break. These were polished and then examined under the microscope. Shrinkage cavities were observed as shown in Figure 2, a photomicrograph taken of the unetched specimen at X100 magnification.

(Continued on next page)

(Physical Tests, cont'd) -

Figure 2.

X100, unetched.

Note Shrinkage Cavities.

Bend Tests:

Bend test specimens, $4\frac{1}{2}$ inches in length and $\frac{1}{4}$ inch square, were subjected to continuous pressure under a $\frac{1}{2}$-inch radius. The Amsler Universal testing machine was used. The bend specimens of both hooks failed to reach the minimum specification limit of 90° bend before cracking.

Discussion:

The specification requires:

Tensile strength, p.s.i. - 78,000 to 90,000.
Yield strength, p.s.i. - 40,000.
Elongation = 15 per cent min.

The producer has obtained a considerably greater tensile strength than is required by specification. It is felt that some sacrifice of toughness should be made in order to obtain greater ductility, as elongation is below specification. It may be that the elongation would have been greater than the specified 15 per cent minimum if the test specimen had

(Discussion, cont'd) -

broken at a point nearer to its centre. Under service conditions a more ductile material would provide a greater margin of safety.

The X-rays revealed the castings to be of an inferior quality, since there were a number of shrink or slag defects present, also the two large shrinkage cavities shown in Figure 1.

Elimination of the shrinkage cavities can be effected by a change in the casting technique, such as gating, so as to supply hot liquid metal under pressure to the section while it is solidifying, or using external metal chills to facilitate the above.

Conclusions:

1. A slightly softer, more ductile material would be more satisfactory for the service conditions of the hook.

2. The castings revealed flaws. These should be eliminated as they reduce the strength of the casting.

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SLG:GHB.