O T T A W A October 3rd, 1940.

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ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 903.

Examination of an Austenitic Manganese Steel Casting.

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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CANADA
DEPARTMENT
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Origin of Material and Object of Investigation:

On September 24th, 1940, Mr. R. Rivest, Assistant Sales Manager, Joliette Steel Limited, Joliette, Quebec, sent in for examination a section of a Symons Cone Crusher bowl liner. It was stated that the liner had been giving excellent service until the lug broke. This failure made it necessary to scrap the entire casting. Since there was no apparent reason for the break, it was requested that a full examination be made

in order to determine, if possible, the reason for this break.

Macro-Examination:

The casting as received appeared to be made of sound metal. There also was no evidence of any imperfection where the break of the lug occurred.

Chemical Analysis:

Drillings were taken for chemical analysis from a freshly ground surface of the casting and the following results were obtained:

Carbon, per cent	Manganese, per cent	Silicon, per cent	Phosphorus, per cent	Sulphur, per cent
1.20	12.40	0.57	0.064	0.015

Micro-Examination:

A sample for micro-examination was taken from the outer edge of the casting. It was not possible to take a specimen from the lug, due to the size of the casting and the limits of the cut-off equipment.

Figure 1, a photomicrograph at X100 magnification of the steel in the unetched condition, shows a fairly large number of inclusions and also a number of intercrystalline markings along the surface of the casting. These intercrystalline markings were examined under the microscope at high magnification and appeared to be filled with iron oxide. The steel was etched in a 2 per cent nitric acid solution in alcohol and re-examined. Figure 2 is a photomicrograph at X100 magnification of the etched material. The structure consists of medium-sized grains of austenite. There was no significant amount of free carbide present.

Discussion of Results:

The chemical analysis of the steel shows that the composition is within the limits of the A.S.T.M. specification for austenitic manganese steel. The appearance of the casting indicated that moulding conditions were quite satisfactory. The steel had a fairly high inclusion content but apart from this the steel seems to have been properly made.

The medium size of the austenitic grains indicates that the steel was poured at the proper temperature. The absence of free carbides within and along the grain boundaries shows that the steel was properly heat treated. The intercrystalline markings at the outer surface may have been formed in service but their uniform thickness and the apparent presence of oxides in the markings more probably indicate that they were formed as a result of overheating during the heat treatment operation. The absence of these markings from the body of the steel indicates that the burning was superficial. It is, however, quite likely that the burning may have been more pronounced in the thinner lug section. A steel which has been burnt to the extent shown in the photomicrograph (Figure 2) cannot be restored by any subsequent heat treatment.

Conclusions:

The investigation indicates that the surface of the casting was burnt in the heat treating operation. It is probable that the burning may have been responsible for the lug breakage.

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NBB:PES.

Figure 1.

X100.

Unetched.

Figure 2.

X100.

Etched in 2 per cent Nital.

NBB:PES.