O T T A W A February 10th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1159.

Investigation of Disintegration of Manganese Steel Roll Shell.

(Copy No. 5.)

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 January 31st, 1942, a piece of manganese steel from a roll shell casting that disintegrated completely on quenching was received from Mr. W. S. White, Superintendent, Sorel Steel Foundries, Sorel, Quebec. In his letter of January 29th, Mr. White requested a chemical analysis and also a reason for this unruly performance.

Chemical Analysis:

The chemical analysis is given below, compared with the A.S.T.M. specification A-128-33:

	Sorel Manganese Steel, per cent	A. S. T. M. Spec. A-128-33, per cent
Carbon	0.99	1.0 - 1.4
Manganese	11.38	10.0 Min.
Silicon	0.85	
Phosphorus	0.056	0.10 Max.
Sulphur	0.008	0.05 Max.

Physical Examination:

A Vickers hardness value of 210 (Brinell 209) was obtained.

Micro-Examination:

Nothing unusual was found on microscopic examination. The steel was fully austenitic. No carbides were found. There was only a normal amount of oxide and sulphide inclusions. No peculiar phenomenon was found worth photographing.

Discussion:

All examinations indicate that the furnace practice is good and the quenching temperature is in the correct range. The slightly higher hardness value (210, compared to a normal of 190) indicates, if anything, only a slight amount of cold work very likely caused by the disintegration.

It is possible that this casting contained microscopic cracks before it was quenched. These cracks could have been created either in the casting process or in the heating prior to quenching.

No information is given regarding design. If the casting possesses sharp changes in contour or section, internal stresses will be induced on solidification and it will also be susceptible to both heating and quenching stresses on heat-treatment.

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(Discussion, cont'd) -

The core may possess too high a hot strength, thereby creating high internal stresses in the casting.

The casting may be heated too quickly or introduced into too hot a heat-treating furnace.

All these conditions are possible factors that might contribute to the formation of microscopic cracks at the grain boundaries. If the metal possessed many of these cracks before quenching it is quite possible that it could not withstand the shock of quenching and would therefore disintegrate.

Conclusions:

The sample submitted possessed the proper analysis and structure, indicating that melting practice was good and the quenching temperature correct.

Recommendations:

The following conditions might be investigated as possible sources of trouble:

1. Design of casting.
2. Hot strength of core and moulding sand.
3. Gating system.
4. Any other means of minimizing casting stresses such as external chills, knocking out core (if any), etc.
5. Rate and condition of heating to quenching temperature.

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