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January 26, 1945.

## R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1784.

Microscopic Examination of Twenty-Two Samples of  
Austenitic Manganese Steel.

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(Copy No. 6.)

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Microscopic Examination of Twenty-Two Samples of  
Austenitic Manganese Steel.

Origin of Request and Object of Investigation:

In connection with an investigation of austenitic manganese steel samples requested by the Sorel Steel Foundries Limited, Sorel, Quebec, a second lot, of twenty-two (22) samples, was received from this company on January 15, 1945. The samples are marked by numbers 51 to 70 inclusive, 72, and 73.†

The Sorel Steel Foundries Limited requested only a microscopic examination of these samples and photomicrographs of those which have a normal austenitic microstructure. No further investigation of the mechanical properties was required.

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† The microscopic examination of the first lot, Specimens Nos. 36 to 50, is reported in O.D.M.L. Investigation No. 1778, dated January 17, 1945.

Microscopic Examination:

Examination of suitably prepared microspecimens showed that the microstructure of the twenty-two samples could be classified into three groups, as follows:

- A. Samples numbered 52, 53, 54, 55, 56, 57, 59, 60, 62, 64, 65, 67 and 68, which had a normal austenitic microstructure with no evidence of free carbides.

Photomicrographs of these microstructures, at X100 magnification, are shown in Figures 1 to 13, inclusive.

- B. Samples numbered 51, 63, 70 and 73, in which microstructures occasional small particles of free carbide are present at the austenitic grain boundaries (see Figure 14).

When these specimens are examined at lower magnification, such as 100 diameters, the structure appears to be normally austenitic. Particles of free carbide are only observed at magnifications of 1000 or higher. Since the particles are very small and do not form a continuous film about the grain boundaries, the microstructure may be considered satisfactory but is indicative of marginal heat treatment.

Photomicrographs of these microstructures, at X100 magnification, are shown in Figures 15 to 18.

- C. Samples numbered 58, 61, 66, 69 and 72, in which microstructures relatively large particles of free carbide were present, both in and at the boundaries of the austenite grains (see Figures 19 and 20).

The samples in this group have not a normal austenitic microstructure, because of either improper heat treatment or improper chemical composition.

Summary:

Twenty-two samples of austenitic manganese steel were examined.

1. Specimens Nos. 52, 53, 54, 55, 56, 57, 59, 60, 62, 64, 65, 67 and 68 have a normal austenitic microstructure.

2. Specimens Nos. 51, 63, 70 and 73 have an austenitic microstructure which may be considered satisfactory, but occasional particles of free carbide at the grain boundaries indicate marginal heat-treating practice.

3. Specimens Nos. 58, 61, 66, 69 and 72 do not have a normal austenitic microstructure.

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IHM:GHB.

Figure 1.



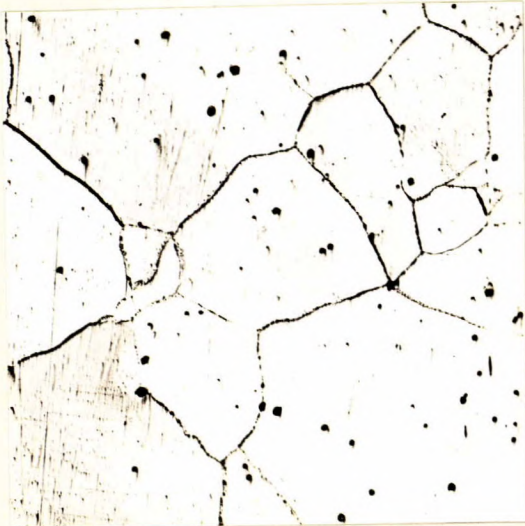
SAMPLE NO. 52.

Figure 2.



SAMPLE NO. 53.

Figure 3.



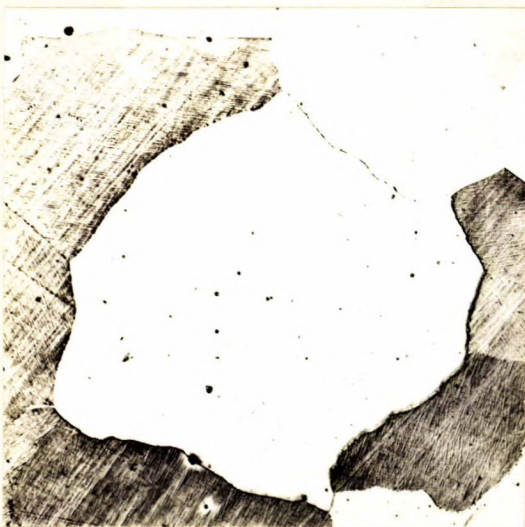
SAMPLE NO. 54.

Figure 4.



SAMPLE NO. 55.

Figure 5.



SAMPLE NO. 56.

Figure 6.



SAMPLE NO. 57.

All of above photomicrographs at X100,  
etched in 2 per cent nital.

Figure 7.



SAMPLE NO. 59.

Figure 8.



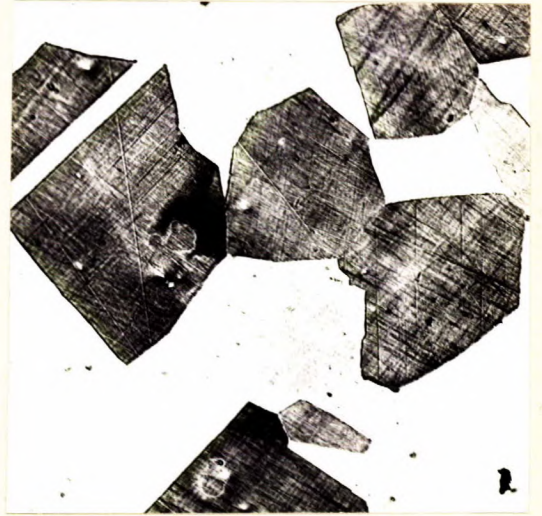
SAMPLE NO. 60.

Figure 9.



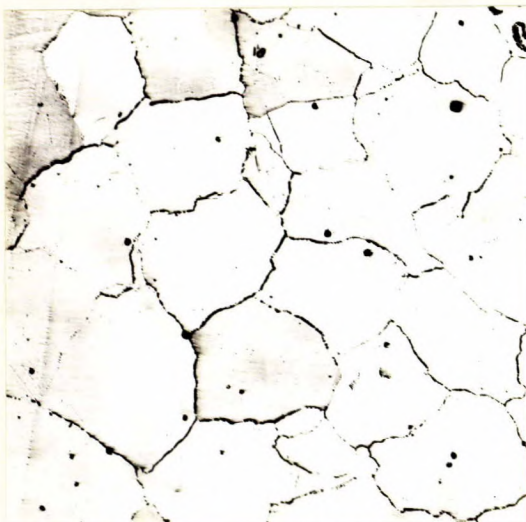
SAMPLE NO. 62.

Figure 10.



SAMPLE NO. 64.

Figure 11.



SAMPLE NO. 65.

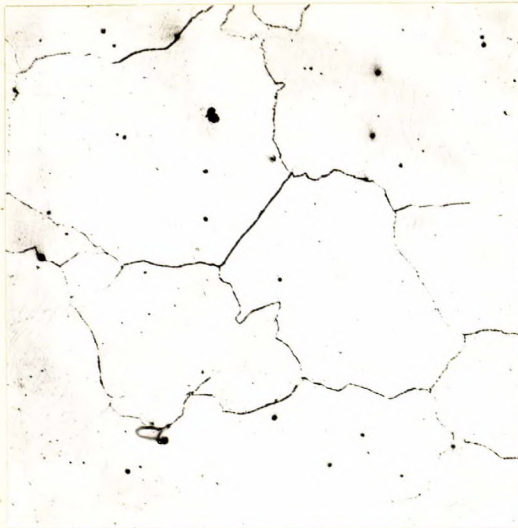
Figure 12.



SAMPLE NO. 67.

All of above photomicrographs at X100,  
etched in 2 per cent nital.

Figure 13.

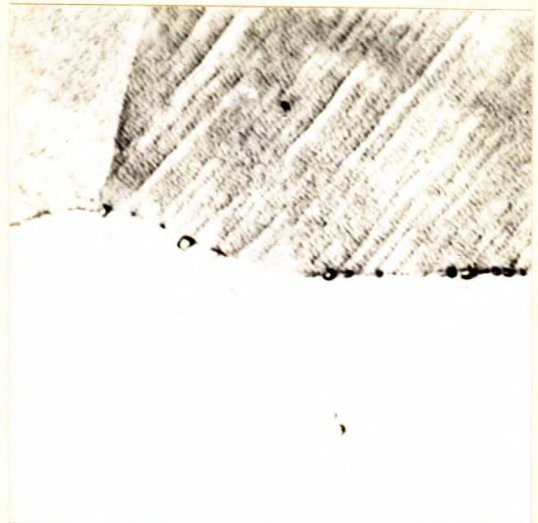


X100, etched in 2  
per cent nital.

SAMPLE NO. 68.

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Figure 14.



X1000, etched in 2  
per cent nital.

SAMPLE NO. 51.

Small globular carbides at  
austenitic grain boundaries.

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Figure 15.



X100, etched in 2  
per cent nital.

SAMPLE NO. 51.

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Figure 16.



X100, etched in 2  
per cent nital.

SAMPLE NO. 63.

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Figure 17.

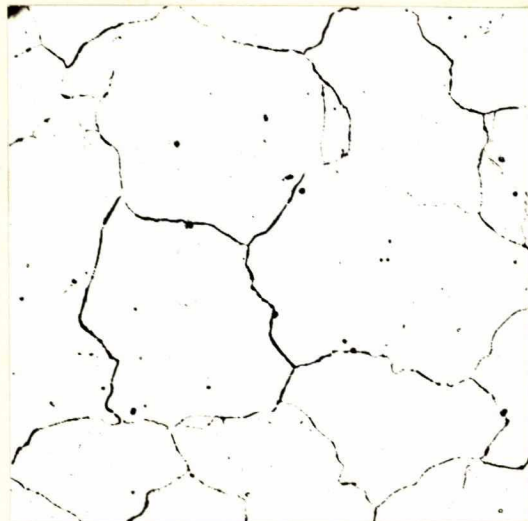


X100, etched in 2 per cent nital.

SAMPLE NO. 70.

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Figure 18.

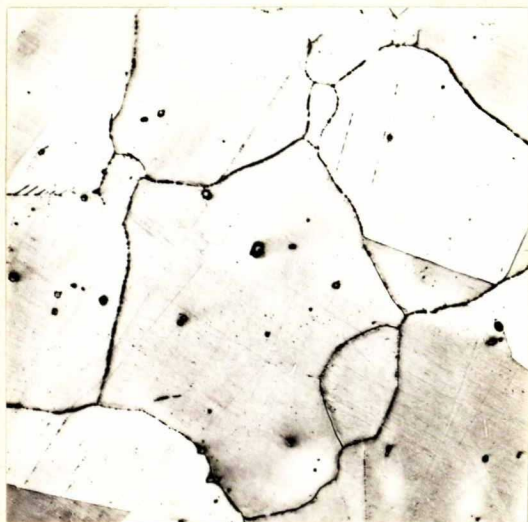


X100, etched in 2 per cent nital.

SAMPLE NO. 73.

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Figure 19.



X100, etched in 2 per cent nital.

SAMPLE NO. 66.

Note relatively large globular carbides in austenite grains.

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Figure 20.



X500, etched in 2 per cent nital.

SAMPLE NO. 72.

Typical arrangement of carbides found at all grain boundaries.

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Micrograph showing a network of dark lines representing grain boundaries. Small, dark, circular spots (carbides) are concentrated along the grain boundaries, illustrating a typical arrangement of carbides.