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O T T A W A September 30th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1505.

Examination of Canadian Dry Pin Track Shoes
from Hull Iron and Steel Foundries Limited
and Electric Steels Limited.

(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 August 23rd, 1943, the Division of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted Requisition No. 580, AEDB Lot No. 368, covering four austenitic manganese steel Canadian Dry Pin track shoes. Two of the shoes had been produced by the Hull Iron and Steel Foundries Limited, Hull, Quebec, and two by Electric Steels Limited, Cap-de-la-Madeleine, Quebec.

For the purpose of comparison, complete metallurgical examinations were requested.

Chemical Analysis:

Results of chemical analyses made on drillings taken through surfaces from which the decarburization had been removed by grinding were as follows:

	HULL IRON AND STEEL		ELECTRIC STEELS	
	No. 1	No. 2	No. 3	No. 4
	- Percent -			
Carbon -	0.99	1.01	1.04	1.10
Manganese -	12.42	11.36	12.30	12.30
Silicon -	0.44	0.56	0.51	0.51
Sulphur -	0.019	0.015	0.006	0.004
Phosphorus -	0.037	0.035	0.068	0.067
Chromium -	0.05	0.07	0.22	0.22

Hardness:

Impressions were made on thick sections of the shoes, using the Brinell hardness machine with loads of 500, 1,000, 2,000 and 3,000 kilograms. The diameters of the impressions were measured using the Brinell microscope. The results of the measurements, as well as the Brinell hardness number with the 3,000-kilogram load, are recorded in Table 1.

TABLE I.

SHOE NO.	DIAMETER OF IMPRESSION, MILLIMETERS: Brinell loads, kilograms - 500	1,000	2,000	3,000	B.H.N. (3,000-kg. load)
Hull Iron and Steel No. 1.	2.0	2.6	3.5	4.1	217
Hull Iron and Steel No. 2.	1.9	2.55	3.6	4.2	207
Electric Steels No. 3.	2.0	2.7	3.5	4.15	212
Electric Steels No. 4.	1.9	2.7	3.5	4.2	207

Micro-Examination

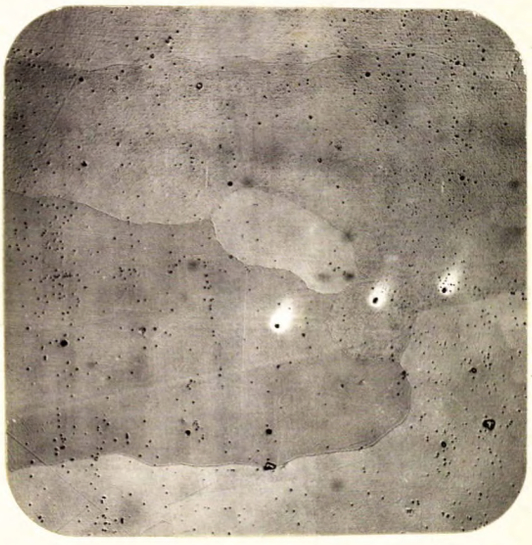
Micro-specimens were cut from thick and thin sections of each shoe, polished, etched in 2 per cent nital, and examined under the microscope. No abnormal conditions were observed. Figure 1 shows the structure in the thick section of a Hull Iron and Steel shoe, while Figure 2 shows that of an Electric Steels shoe. Both photomicrographs are at 100 magnifications.

Figure 1.

X100, nital etch.

STRUCTURE OF HULL IRON AND STEEL SHOE.

Figure 2.



X100, nital etch.

STRUCTURE OF ELECTRIC STEELS SHOE.

Discussion:

The chemical analyses show that the steels of both producers conform to specification. It is probable that the two shoes from Electric Steels are from the same heat while those of Hull Iron and Steel are from different heats.

The only marked difference in the analyses is in the amounts of chromium in the steel. Hull Iron and Steel shoes contain 0.05 to 0.07 per cent, while those of Electric Steels contain 0.22 per cent. It seems very unlikely that this amount of chromium has been added to the Electric Steels

(Discussion, cont'd) -

shoes purposely; rather, it seems much more probable that the chromium has been introduced into the steel in the scrap. If the latter is the case, a lack of violent oxidation in the steelmaking is indicated. If the steel is melted "soft" the chromium should be reduced to a low value. The low chromium values in the Hull Iron and Steel shoes indicate that the constituent metal has been violently oxidized in the steelmaking operation, as the scrap undoubtedly would contain a certain amount of chromium.

No difference in malleability was observed when the diameters of Brinell impressions made with varying loads were measured. The diameters were found to be similar for each load no matter what shoe was tested. The Brinell hardnesses of the shoes of each producer were normal, those of Hull Iron and Steel varying from 207 to 217 B.H.N. and those of Electric Steels varying from 207 to 212 B.H.N.

The metallographic examination did not show any difference in the steels of the two producers. No free carbides were observed in either the thick or thin sections, indicating a proper heat treatment process. Figures 1 and 2, showing the structures in the thick sections, indicate that the grain sizes of the two steels are similar.

CONCLUSIONS:

1. The chemical analyses show that the steels of both Hull Iron and Steel and Electric Steels conform to specification.

2. The chromium content of the steel from Electric Steels is higher than that of the steel from Hull Iron and Steel. If this is due to the introduction of chromium in the scrap, the lack of violent oxidation is indicated in the

(Conclusions, cont'd) -

steelmaking at Electric Steels.

3. There is no difference in the malleability of the steels from the two producers as measured by means of the Brinell hardness tester.

4. The microstructures of the steels are similar.

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