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O T T A W A July 20th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1455.

Examination of Cast and Welded Ram Tank Return Idlers.

(Copy No. 10.)

Bureau of Mines
Division of Metallic
Minerals

Ore Dressing
and Metallurgical
Laboratories

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Ram Tank Return Idlers.

Origin of Material and Object of Investigation:

On May 19th, 1943, eight rollers (return idlers) from a Ram Tank track suspension assembly were received from the Army Engineering Design Branch of the Department of Munitions and Supply, for examination.

The work was covered by A.E.D.B. Requisition No. 460, dated May 17th, 1943, at 11 Jordan Street, Toronto, Ontario, and signed by Dr. C. W. Drury, Director of Metallurgy, Army Engineering Design Branch. It was designated Report No. 8, Section D, Test 6, Request No. C-27.

The rollers submitted were identified as follows:

(Continued on next page)

(Origin of Material and Object of Investigation, cont'd) -

A.E.D.B. Lot No.		Remarks
453A	-	1 Roller, Meehanite A, unmachined.
453B	-	1 Roller, Meehanite B, unmachined.
452A	-	1 Roller, Meehanite A, machined by Otis-Fensom.
452B	-	1 Roller, Meehanite B, machined by Otis-Fensom.
458A	-	1 Roller, Meehanite A, machined by Montreal Locomotive Works.
458B	-	1 Roller, Meehanite B, machined by Montreal Locomotive Works.
602	-	2 Rollers, Old Type, with Improved Welding.

The material was supplied by Mr. A. M. Bain, of the Army Engineering Design Branch, who obtained the castings from the Otis-Fensom Elevator Company Limited, Montreal, Quebec.

The following work was requested:

1. X-ray examination of sample Lots Nos. 453A and 453B.
2. X-ray examination of one of Lot No. 602 to check weld and joint.
3. Visual examination of surfaces of Lots Nos. 458A and 458B to determine if any surface defects are present or whether any defects after machining have been filled by welding, etc.
4. Determination of the physical properties of the Meehanite metals marked A and B in order to obtain information that would facilitate the writing of the specification.
5. Any chemical analyses which are considered necessary by the Ore Dressing and Metallurgical Laboratory.
6. Determination of the weights of welded and cast rollers.

The object of the work was to check on the soundness of the Meehanite castings and to determine whether the two grades of Meehanite supplied differed significantly.

X-Ray Examination of Lots Nos. 452A, 452B, 453A, 453B, 458A, and 458B:

All these rollers were sent to the National Research Council (Ottawa) for X-ray examination. Indications of unsoundness were observed only in Lots Nos. 458A and 452B. These areas were on the same side as the oil holes. A sectioning at these areas revealed blowholes, as shown in Figures 1 and 2. By their position with relation to the parting line on the casting it is indicated that these blowholes occurred in the cope side of the casting.

X-Ray Examination of Lot No. 602:

Both rollers of Lot No. 602 were sent to the National Research Council for examination. This examination did not reveal any welding defects.

Visual Examination of Cast Surfaces:

The cast surface of the Meehanite rollers was reasonably smooth and free from any gross irregularities.

Mechanical Properties:

Test bars were prepared from Lots Nos. 458A, 453A, 458B, and 453B. The ultimate tensile strengths and Brinell hardness numbers obtained are recorded in Table I below. The The standard A.S.T.M. test bar, size A, was used.

TABLE I. - Mechanical Properties.

	A.E.D.B. Lot No.			
	458A	453A	458B	453B
Ultimate tensile strength, p.s.i. -	51,000	38,870@	41,200	35,200@
Brinell hardness number -	197	197	187	179

@ Average of three tests.

These two grades of Meehanite are expected to possess the following tensile properties:

Process B, Meehanite - 45,000 p.s.i., minimum.
Process A, Meehanite - 50,000 p.s.i., minimum.

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Chemical Analysis:

Samples for chemical analysis were obtained from the same castings that the test bars were cut from. These results are given in Table II.

TABLE II. - Chemical Analysis.

	Lot No. 458A	Lot No. 453A	Lot No. 458B	Lot No. 453B
	- Per cent -			
Total carbon -	2.80	2.95	3.04	2.87
Silicon -	1.31	1.49	1.43	1.77
Manganese -	0.70	0.74	0.87	1.15
Sulphur -	0.10	0.099	0.094	0.086
Phosphorus -	0.064	0.074	0.082	0.084
Nickel -	0.12	0.08	0.12	0.09
Chromium -	Not detected.	Not detected.	Not detected.	Not detected.
Molybdenum -	0.02	Not detected.	Not detected.	Not detected.
Copper -	0.09	0.09	0.08	0.09

Weights:

The two steel rollers weighed 45 pounds each, while the weights of the machined cast rollers ranged from 68½ pounds to 72 pounds each. The "as cast" weight of these castings was about 80 pounds each. Views of the cross-section of the welded and cast rollers respectively are shown in Figures 3 and 4. The outer wall of the welded steel roller is 5/16" thick, while that of the cast iron roller is 3/4" thick with a reinforcing rib around the middle.

Microscopic Examination:

Sections from the ends of the tensile bars were prepared for the microscope. Photomicrographs to show the graphite arrangement are shown in Figures 5, 6, 7, and 8. The microstructure of the graphite has been evaluated according to the tentative practice recommended by the American Society for Testing Materials, A.S.T.M. designation A-247-41T. These evaluations are given in Table III.

(Continued on next page)

(Microscopic Examination, cont'd) -

Table III. - Graphite Evaluation.

A.E.D.B. Lot No.	Figure No.	Graphite Size	Graphite Type
458-A	5	5	A
453-A	6	4	A
458-B	7	4	A
458-A	8	3	A

The etched structure, showing the pearlite, is given in Figures 9, 10, 11, and 12. There are no massive areas of ferrite in this iron.

Discussion and Recommendations:

It is clear, from their position and type, that the defects found in these castings originate in the moulding or core-making practice. However, if the present design of casting is retained, defects of this size should have little effect on the roller performance.

In spite of the fact that the chemical analysis is what might be expected in a metal of this type, the tensile strengths are very erratic and low, indicating that the manufacturing process for the metal is not yet under complete control.

In view of the difficulties and hazards inherent in the melting, processing and casting of high test cast iron, it is recommended that, for the time being, castings obtained from this source be accepted if they comply with A.S.T.M. Specification A-48-41 for Class No. 40. This is actually a better grade of iron than that supplied in at least two of the sample rollers submitted. It is recommended that no chemical specification be set on this material.

It is also recommended that as soon as this foundry

(Continued on next page)

(Discussion and Recommendations, cont'd) -

demonstrates its ability to consistently produce the higher process of Meehanite in castings reasonably free from blowholes, a change in design of the rollers be considered, reducing the outer wall of the roller to ½-inch thickness. When this is done the material specification should be advanced to at least Class No. 45. In the lighter section this should be equivalent to a Class 50 C.I.

Conclusions:

1. Under present conditions of manufacture there is a doubtful difference between the Meehanite "B" and Meehanite "A" supplied.

2. Metallurgical examination indicates that some irregularities exist in the control of the manufacturing process.

3. Blowholes in the cope side of some of the castings indicate that there is room for improvement in moulding sand and core sand control.

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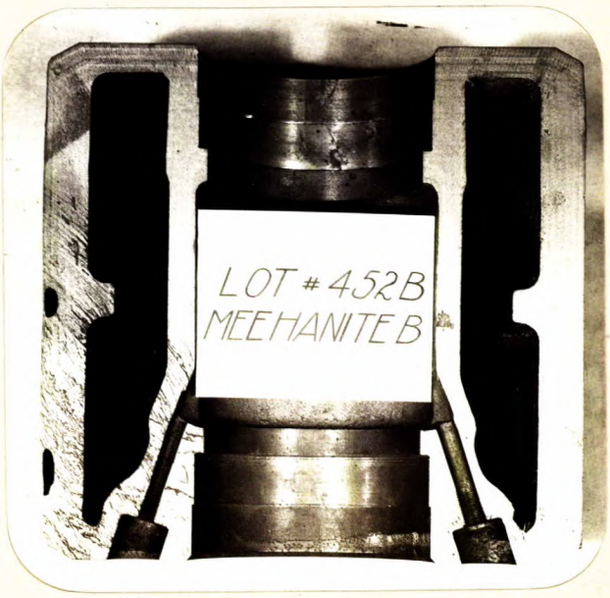
HVK:PES.

Figure 1.

Figure 2.



SECTIONS OF ROLLERS, SHOWING BLOWHOLES.

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Figure 3.

SECTION AND GENERAL VIEW OF A CAST ROLLER.
(Approximately ¼ actual size).

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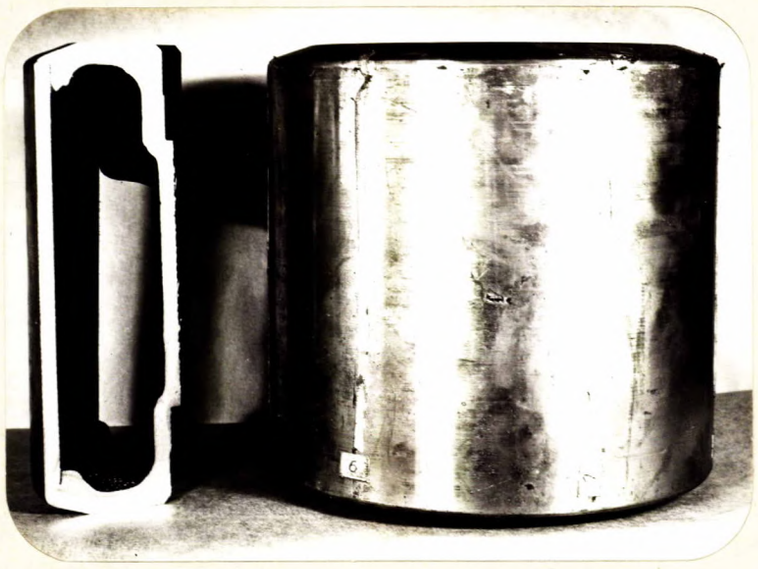
Figure 4.



SECTION AND GENERAL VIEW OF A WELDED STEEL ROLLER.
(Approximately ¼ actual size).

Figure 5.

X100, unetched.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 458A,
SHOWING GRAPHITE.

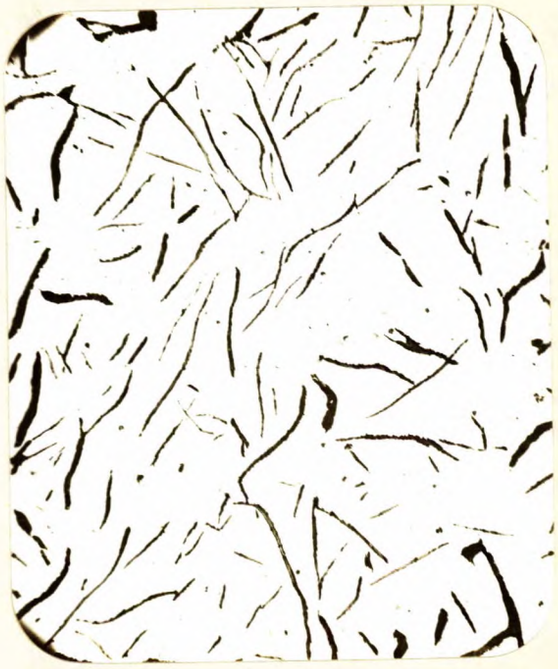
Figure 6.

X100, unetched.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 453A,
SHOWING GRAPHITE.

Figure 7.

X100, unetched.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 458B,
SHOWING GRAPHITE.

Figure 8.



X100, unetched.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 453B,
SHOWING GRAPHITE.

Figure 9.

X500, picral etch.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 458A.

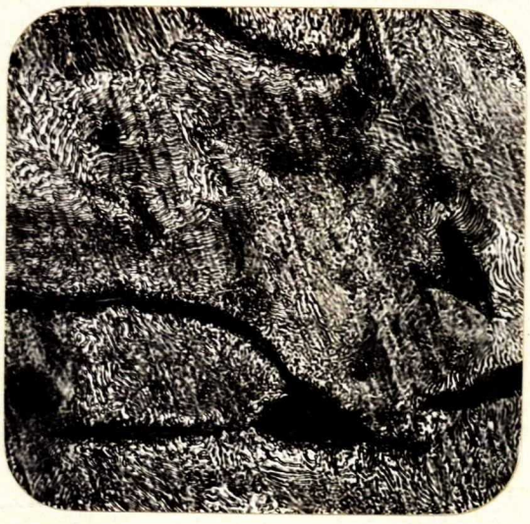
Figure 10.

X500, picral etch.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 453A.

Figure 11.

X500, picral etch.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 453B.

Figure 12.



X500, picral etch.
PHOTOMICROGRAPH,
A.E.D.B. LOT NO. 453B.

HVK:PES.