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R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1441.

Examination of a Cast Steel Idler Wheel Bracket for Ram Mark III Tank.

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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Source of Material and Object of Investigation:

On June 11th, 1943, Professor J. U. MacEwan, Consultant to the Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, sent in a cast steel idler wheel bracket which had failed in service on a Ram Mark III tank. It was requested (Requisition No. 538, A.E.D.B. Lot No. 327; Report No. 106, Sec "B", Test No. 1) that the chemical composition and physical properties of the steel be checked.

Material Received:

Figure 1.

IDLER WHEEL BRACKET CASTING.
(Approximately 1/10 size).

Chemical Analysis:

Drillings taken from the casting were analysed and found to have the following chemical composition:

		Per Cent
Carbon	-	0.35
Manganese	-	0.97
Silicon	-	0.71
Phosphorus	-	0.042
Sulphur	-	0.052
Nickel	-	1.10
Chromium	-	0.80
Molybdenum	-	0.02
Vanadium	-	None detected.

Physical Tests and Heat Treatment:

Tensile and Izod tests were carried out on two specimens of the casting in the "as received" condition, and also a tensile and an Izod test on a third specimen which was water-quenched from 1650°F. and drawn at 1200°F., the bar being quenched from the draw. The following results were obtained:

(Continued on next page)

(Physical Tests and Heat Treatment, cont'd) -

	SPECIMEN NO. 1 (AS RECEIVED)	SPECIMEN NO. 2 (AS RECEIVED)	SPECIMEN NO. 3 (WATER-QUENCHED AND DRAWN)
Ultimate stress, p.s.i. -	107,000	100,700	110,300
Yield " , p.s.i. -	88,500	92,700	95,200
Elongation, per cent in 2 in. -	14.5	8.5	9.0
" " " " 1 " -		8.0*	15.0
Reduction in area, per cent -	16.5	16.1	17.9
Brinell hardness -	217	217	241
Diam. of tensile bar, inches -	0.505	0.282	0.282
Izod impact, ft./lb. -	15	16½	20

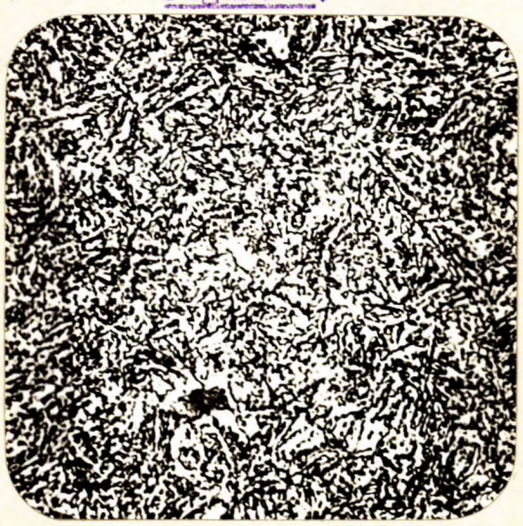
* Broke at gauge mark.

(NOTE: All fractures had coarse dendritic structures.)

Microscopic Examination:

A specimen was removed from the casting, polished, and then examined under the microscope in the unetched condition. Apart from a number of sulphide inclusions, the steel was found to be fairly clean. The steel was next etched in a solution of 4 per cent picric acid in alcohol and re-examined. Figure 2 is a photomicrograph at X1000 magnification. The structure consists of fine pearlite.

Figure 2.



X1000, etched in 4 per cent picral.

Discussion of Results:

The composition of the steel was similar to that of an SAE 3135 steel. Nickel-chromium steels of this composition are subject to temper embrittlement and should be

(Discussion of Results, cont'd) -

quenched from the draw in order to obtain the best impact properties. The steel had a coarse dendritic fracture. This probably accounted for its low Izod impact strength. The Izod values were only slightly increased by a water-quench-and-draw (quenched in water from the draw temperature) heat treatment. A high-temperature homogenizing treatment prior to quenching and drawing probably would be necessary to break up the cast dendritic structure.

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