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O T T A W A October 9th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1314.

(M. and S. No. 7/B/2).

Investigation of a Cracked Valentine Tank Track Link.

(Copy No. 15.)

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 October 3rd, 1942, under Requisition No. 7B-2, A.E.D.B. Lot No. 100, Dr. C. W. Drury, Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, 24 Adelaide Street East, Toronto, Ontario, submitted a steel track shoe for metallurgical examination. It was stated that this part was received from the Experimental Wing, Canadian Armoured Corps, Camp Borden, Ontario. The link had travelled 1,407 miles and had developed a crack in the centre lug. The shoe was reported to have been manufactured at Campbell, Wyant and Cannon, Muskegon, Mich., from Ford No. 4 steel.

Chemical Analysis:

	As Found	Specification, Ford No. 4.
	- Per cent -	
Carbon -	0.46	0.33 - 0.40
Manganese -	0.80	0.70 - 0.90
Silicon -	0.33	0.15 - 0.40
Copper -	0.54	0.50 - 0.60

Physical Properties:

The physical properties specified are as follows:

Tensile strength -	135,000 p.s.i.
Yield point -	120,000 "
Elongation in 2 inches -	8 per cent.
Reduction of area -	20 "
Brinell hardness -	286 - 302.

Five micro-tensile specimens were cut from various parts of the casting and tested on a tensometer. The following results are the averages obtained:

Tensile strength -	136,000 p.s.i.
Yield point -	123,000 "
Elongation (total length of microspecimen) -	11 per cent
Reduction of area -	19 "
Brinell -	269.

A notched standard izod impact specimen was cut from the link. The impact strength was found to be 11 foot pounds.

Microscopic Examination:

A microspecimen was cut from the link and polished. It was examined in the unetched and nital-etched states. The unetched specimen showed the steel to be quite clean. Figure 1 at X500 magnification, taken of the etched specimen, indicates a uniform structure.

(Continued on next page)

(Microscopic Examination, cont'd) -

Figure 1.

X500, nital etch.

STRUCTURE OF THE LINK.

Discussion:

The low impact strength of 11 foot pounds is the most probable cause of the cracking in the eyehole wall. The chemical analysis shows that the carbon value is well in excess of the upper limit of the specification. This would result in low impact strength. From mechanical property charts*, it can be seen that for water-quenched carbon steels drawn to the same hardness the impact strength of an SAE 1045 steel is much lower than that of an SAE 1035;

e.g., SAE 1045 - Brinell 269 - Izod 44 foot pounds.
SAE 1035 - " 269 - " 69 " "

Thus, a difference in 0.10 per cent carbon in an ordinary carbon steel has resulted in a drop of 25 foot pounds in the impact strength.

(Continued on next page)

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* Nickel Alloy Steels - International Nickel Co. Inc., New York, N.Y.

(Discussion, cont'd) -

It is recollected that the same difficulty was experienced at one time with the Universal Carrier links made out of Ford No. 4 steel; high carbon was found to be the reason for failure.

CONCLUSIONS:

1. The steel has a low impact strength.

2. The high carbon content is the most probable cause for the low impact strength.

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SLG:GHB.