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March 16th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1368.

Investigation of a Broken Valentine
Tank Track Pin.

(Copy No. 13.)

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 February 27th, 1943, Dr. C. W. Drury, Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted a broken track pin for investigation. The requisition received, No. 511, AEDB Lot No. 192, reported that this pin had been produced from SAE 5115 bar stock and had failed in a Campbell, Wyent and Cannon Ice track link after 102 miles of service.

Macro Examination:

The pin failed at a point about three inches from the headed end. The fracture indicated a sudden failure and showed a coarsely granular structure. Figure 1 illustrates the fractured surface of the pin.

Figure 1.



FRACTURED SURFACE OF PIN.

(Approximately 3X magnification).

Chemical Analysis:

Drillings were taken from the core for chemical

analysis:

	<u>As Found</u>	<u>SAE 3115</u>
	<u>- Per cent -</u>	
Carbon	- 0.12	0.10-0.20
Manganese	- 0.48	0.30-0.60
Silicon	- 0.25	0.15 min.
Chromium	- Trace.	0.45-0.75
Nickel	- 1.81	1.00-1.50
Phosphorus	- 0.027	0.040 max.
Sulphur	- 0.028	0.050 max.

(Continued on next page)

(Chemical Analysis, cont'd) -

The British specification for track pins is BSS 5005/102, with the following limits:

	Per cent
Carbon	0.15 max.
Manganese	0.60 max.
Silicon	0.30 max.
Sulphur	0.05 max.
Phosphorus	0.05 max.
Nickel	1.50-2.25
Chromium	0.30 max.

Physical Properties:

A 0.505-inch-diameter tensile test specimen was taken from the core of the pin.

Tensile strength	-	81,750 p.s.i.
Yield	"	57,500 p.s.i.
Elongation in 2 inches	-	33.5 per cent.
Reduction of area	-	72 "

Grain Size:

A McQuaid-Ehn test was carried out on a specimen taken from the pin. The grain size was 5-6.

Depth Hardness:

A transverse specimen was cut from the pin. Hardness readings were taken across the polished face, using the Vickers machine and a 10-kilogram load. The results were:

Distance from the Surface, in inches	V.P.N.
0.350	228
0.290	232
0.210	233
0.180	233
0.140	254
0.060	283
0.025	333
0.008	642
Surface	752

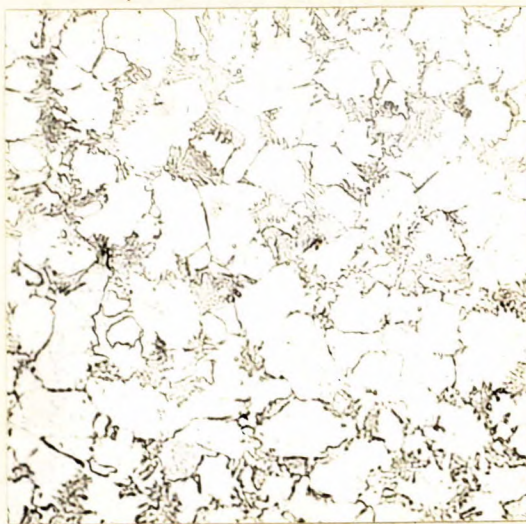
Depth of Case:

The depth of case was measured, using the Brinell microscope. It was 0.023 inch (measured from surface to first point of colour change, i.e., black to grey).

Microscopic Examination:

Transverse and longitudinal microspecimens were cut from the pins. They were polished and then examined, in the unetched state, under the microscope. The steel was not free from inclusions--some silicates were evident and a small number of oxides. Specimens etched indicated the structure of the core and case shown in Figures 2 and 3 taken at X500 and X1000 magnifications respectively.

Figure 2.

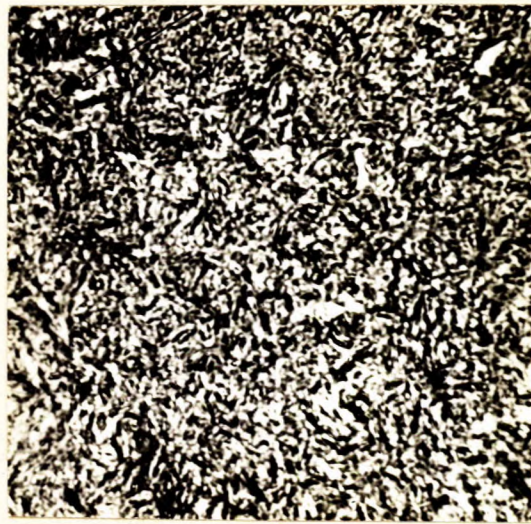


X500, nital etch.

CORE OF PIN.

(Mainly ferrite-white constituent).

Figure 3.



X1000, nital etch.

CASE OF PIN.

Tempered
martensite.

Discussion:

The steel used for this pin corresponds to BSS 5005/102 rather than with SAE 3115 stated in the requisition.

The appearance of the fracture indicates that the pin broke instantaneously. This would suggest failure by

(Discussion, cont'd) -

impact. Metallurgically, this pin appears to be satisfactory and is not significantly different from the regular production pins which have given satisfactory service in the past. It is possible that the failure was due to some subsurface crack incurred either in the rolling or quenching operation. It is not possible, however, to prove this.

CONCLUSIONS:

1. NO METALLURGICAL CAUSE FOR FAILURE COULD BE FOUND.
2. The pin broke 3 inches from the headed end. This is the point at which Valentine pin failures usually occur.
3. The grain size was 5-6 McQuaid-Ehn.
4. The steel conformed to the specification limits of BSS 5005/102.
5. The case depth of 0.023 inch was satisfactory.

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SLG:GHB.