

FILE COPY

O T T A W A

March 21st, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1188.

Examination of 8-Inch Howitzer Recuperator Pintle.

=====

(Copy No. 7.)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS
—
ORE DRESSING AND
METALLURGICAL LABORATORIES



CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

O T T A W A March 21st, 1942.

R E P O R T
of the
ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1188.

Examination of 8-Inch Howitzer Recuperator Pintle.

=====

Origin of Request and Object of Investigation:

On March 7th, 1942, Mr. R. Boulton of the Inspection Board of the United Kingdom and Canada, 58 Lyon Street, Ottawa, Ontario, submitted a broken 8-inch howitzer recuperator pintle for examination. Chemical analysis, longitudinal tensile tests, and izod tests were requested. It was also requested that an expression of opinion be made as to the quality of the steel

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

and the present thermal condition. This work is authorized by Analysis Requisition O.T. 152.

Macro-Examination:

Figure 1 is a photograph of the pintle as received by the Bureau of Mines.

Figure 2 is a cross-section of the pintle macro-etched in a hot aqueous solution of 38 per cent HCl, 12 per cent H₂SO₄.

Chemical Analysis:

The chemical analysis of this steel is as follows:

	<u>Per cent</u>
Carbon	- 0.44
Manganese	- 0.65
Silicon	- 0.24
Phosphorus	- 0.037
Sulphur	- 0.041
Nickel	- Trace

Physical Testing:

The results obtained from the physical tests are given in Table I.

Table I.

Physical Properties of Metal in 8-Inch Howitzer Pintle.

	<u>Longitudinal</u>	<u>Transverse</u>
Ultimate tensile strength, p.s.i.	- 122,000	117,000
Yield strength, p.s.i.	- 61,000	61,000
Elongation, per cent	- 24	20
Reduction in area, per cent	- 38.4	29
Izod impact strength, foot pounds	- 8	6.3
Brinell hardness number	-	166

Microscopic Inspection:

A longitudinal and a transverse specimen were prepared for microscopic examination.

Figure 3 is a photomicrograph of the longitudinal structure taken at a magnification of 100 diameters. Note that the direction of the forging lines is indicated by the elongation of the sulphide particles. There is also evidence of some banding.

Figure 4 is a photomicrograph of the transverse structure taken at a magnification of 100 diameters.

Figure 5 is a photomicrograph taken at a magnification of 1,000 diameters to show the structure of the pearlite.

For all these photomicrographs the structure was developed by etching with an alcoholic solution of 4 per cent picral.

Discussion of Results:

The macrograph would give the impression that this part is cut out of a forged billet. This would also be indicated by the photomicrographs.

The fact that the metal failed in service is probably best explained by its low izod impact value. The reason for this could be the rather coarse structure as revealed by Figures 3 and 4.

The structure of the pearlite, as revealed in Figure 5, is characteristic of steel that has been cooled slowly through the critical range.

Coupling the information obtained from Figures 3 and 4, at 100 diameters, and Figure 5, at 1,000 diameters, it is possible that the most recent thermal history of this steel has been a slow cool from a temperature well above

(Discussion of Results, cont'd) -

the AR_3 temperature. This could have been accomplished either by a high temperature anneal or by forging at a very high temperature followed by cooling either in a furnace or some insulating medium to prevent fast cooling.

Conclusion:

1. The 8-inch howitzer pintle submitted failed due to the low impact strength of the material. This low impact strength can be attributed to the coarse structure of the metal.

2. This microstructure is characteristic of metal that has been slowly cooled from a temperature well above the upper critical point through the critical range.

oooooooooooo
oooooo
oo

HVK:GHB.

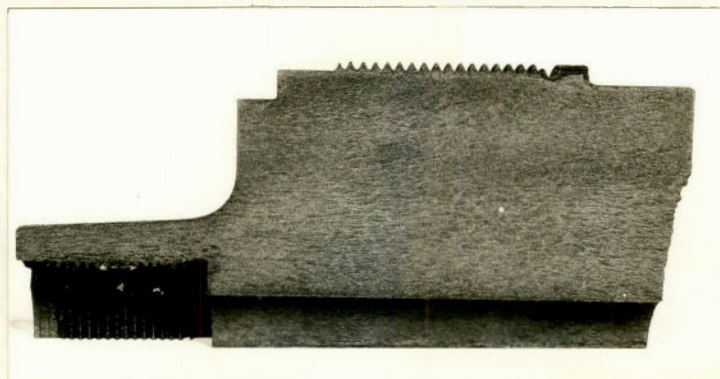
Figure 1.



PHOTOGRAPH OF FRACTURED 8-INCH
HOWITZER GUN PINTLE.

(Approx. $\frac{1}{4}$ size).

Figure 2.



PHOTOGRAPH OF MACRO-ETCHED SECTION
OF 8-INCH HOWITZER GUN PINTLE.

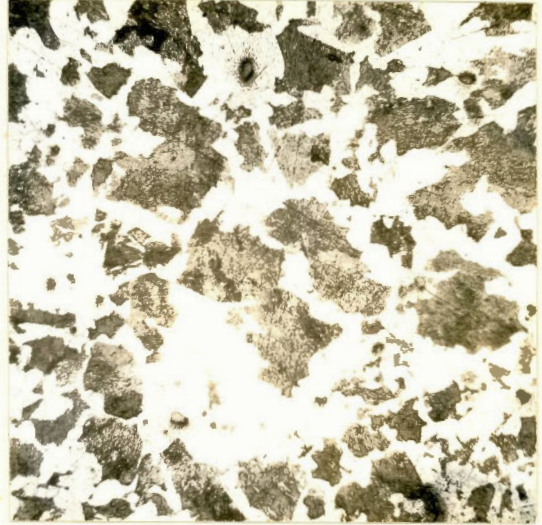
(Approx. $\frac{1}{2}$ size).

Figure 3.



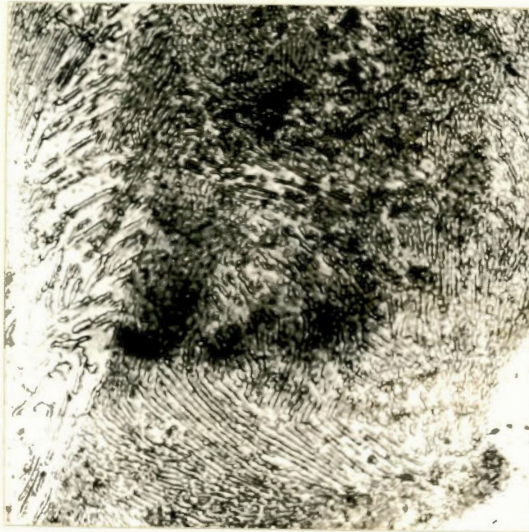
X100, picral etch.
PHOTOMICROGRAPH OF
LONGITUDINAL SECTION.

Figure 4.



X100, picral etch.
PHOTOMICROGRAPH OF
TRANSVERSE SECTION.

Figure 5.



X1000, picral etch.
PEARLITIC STRUCTURE.

HVK:GHB.

GOVT. OF CANADA

GOVT. OF CANADA