File

FILE COPY

O T T A W A February 5th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1351.

Investigation of a Scout Car Bolt.

(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

O T T A W A February 5th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1351.

Investigation of a Scout Car Bolt.

Origin of Material and Object of Investigation:

On January 29th, 1943, Dr. C. W. Drury, Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted a Scout Car Bolt for examination.

It was reported that these bolts were failing in shear. It was not stated whether failures were occurring near the head or at the threaded portion or whether the shear was longitudinal or transverse.

Heat Treatment:

The Canadian manufacturer producing the bolts reported that he was using SAE 1035 steel with the following heat treatment:

Heated in cyanide at 1600° F. for 30 minutes, then oil quenched.

Chemical Analysis:

Drillings were taken from the core and a carbon analysis was made to check whether SAE 1035 steel was used. The result was:

Carbon, 0.35 per cent.

Macro-Etch Examination:

The bolt was cut longitudinally. A macro-etch, using 1:1 HCl, revealed regular flow lines, indicating that the heading operation was satisfactory.

Hardness Survey:

Hardness readings were taken on the face of a transverse section. The Vickers machine and a 10-kilogram load were used. The hardness varied from 209 in the centre to 233 at about 0.010 inch from the surface. The surface reading was 429.

Depth of Case:

The depth of case was measured on the microscope and was found to vary from 0.002 - 0.0035 inch. Figure 2, a photomicrograph taken at X350 magnification, shows a section of the case approximately 0.003 inch in depth (including transition zone).

(Continued on next page)

Grain Size:

A McQuaid-Ehn grain size test was carried out and was found to be 1-3.

Microscopic Examination:

A transverse section was polished and examined under the microscope. The unetched steel was fairly clean. The specimen was etched in 2 per cent nital and re-examined. Figure 1, taken at X750, shows the structure of the core.

Figure 1.

X750, nital etch.

CORE OF BOLT.

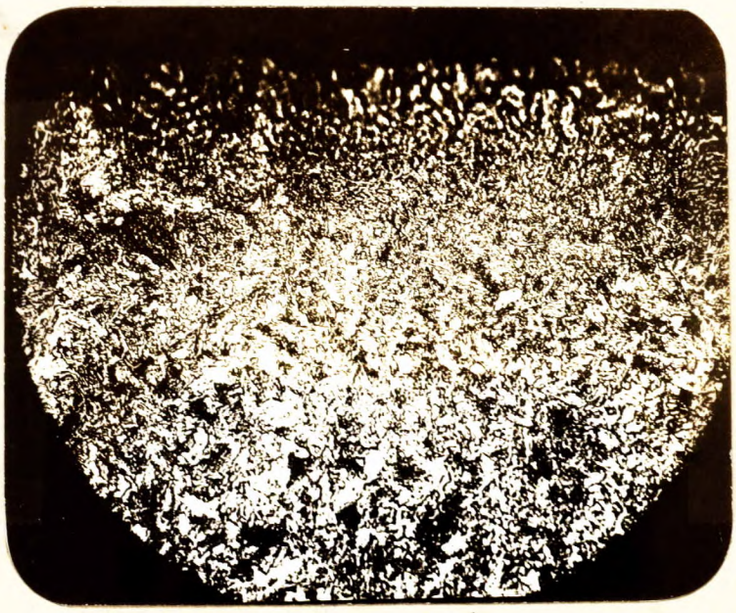
(Note ferrite and lamellar pearlite).

—

(Continued on next page)

(Microscopic Examination, cont'd) -

Figure 2.



X350, nital etch.

CASE OF BOLT.

—

Discussion:

Shear stress is proportional to the Brinell hardness. If the bolt is not subjected to impact, then the higher the surface hardness the greater is the resistance to shear. It must be remembered, however, if impact is present, that high hardness means notch sensitivity and low impact resistance.

It has been suggested[b] that a fine-grained SAE 1035 steel, water quenched, should be employed for bolts over

---

[b] THE IRON AGE, June 9, 1938.

(Discussion, cont'd) -

7/16 inch in diameter. The diameter of this bolt is 10/16 inch; it is coarse-grained and has been oil quenched; it has been cyanided in order to obtain the hardness. Quite possibly, therefore, a much better bolt would be obtained if the above suggestion were followed, namely, a water quench and a draw without cyaniding.

If the head of the bolt is subject to wear or shear, then selective cyaniding of that part may be carried out, followed by a water quench and a draw.

Conclusions:

1. The steel is SAE 1035.

2. The heading operation has been satisfactorily carried out.

3. The depth of case obtained is shallow.

4. A coarse-grained steel was used.

Recommendations:

1. A fine-grained SAE 1035 steel could be tried in the quenched-and-drawn condition.

2. If the head is subject to wear, a selective cyaniding of a fine-grained SAE 1035 steel, followed by water quench and a draw, should give good results.

oooooooooooo
oooooo
oo

SLG:GHB.