O T T A W A February 13th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1164.

Examination of Tracer Body Tubes (Tracer No. 12).

(Copy No. 6.)

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 Examination:

On February 9th, 1942, under Requisition No. O.T. 97, Mr. H. H. Scotland, of the Inspection Board of the United Kingdom and Canada, 58 Lyon Street, Ottawa, Ontario, submitted three tracer body tubes (Tracer No. 12) which had been cadmium plated. These articles are made from S.A.E. 1112 steel. Mr. Scotland's letter stated that these parts showed cracks longitudinally

(Origin of Material and Object of Examination, cont'd) -

between the pencil marks on them. We were requested to examine them microscopically and express an opinion.

Macroscopic Examination:

The parts were carefully examined as received and also subjected to magnaflux inspection. No cracks were detected. However, faint "ghost lines" were seen under the plating.

The parts were next subjected to hot macro-etching in 50 per cent hydrochloric acid. Figure 1 depicts the results. There would appear to be seams or bands of material subject to preferential attack by acid.

Chemical Analysis:

A sample of this steel was analysed. The results are compared with S.A.E. Specifications 1112 and X1112 in Table 1.

Table 1.

Chemical Analysis.

	Sample	S.A.E. Specification 1112, per cent	S.A.E. Specification X1112, per cent
Carbon	-	0.08 - 0.16	0.08 - 0.16
Manganese	0.83	0.60 - 0.90	0.60 - 0.90
Phosphorus	0.123	0.09 - 0.13	0.09 - 0.13
Sulphur	0.325	0.10 - 0.20	0.20 - 0.30

Physical Testing:

Two rings were cut from the small end of one of the tubes, below the internal threads. One of these rings was normalized at 1650° F. for 20 minutes. Both were squeezed in a vise until cracks appeared. The results are shown in Figures 2 and 3.

Microscopic Examination:

Two longitudinal specimens were prepared for microscopic examination. One was examined in the condition as received and one was normalized at 1650° F.

Figure 4 shows the characteristic structure existing in the material in the condition submitted for examination. Note that it is composed of wide bands of ferrite containing numerous sulphide inclusions and much narrower bands of the normal ferrite-pearlite structure.

Figure 5 shows that the normalizing treatment has broken up the banded structure.

Both Figure 4 and Figure 5 are photomicrographs at 100 diameters, etched in 4 per cent picral.

Discussion:

Apparently the "ghost lines" that gave rise to the supposition of cracks were caused by some preferential plating action due to the banded microstructure of the metal. This banded structure would also be the cause of the appearance after macro-etching.

The case of a similar steel is described in "Steels for the User", by R. T. Rolfe, on pages 78 to 79.© This deals with a steel of the following chemical analysis:

		Per cent
Carbon	-	0.20
Silicon	-	0.014
Sulphur	-	0.256
Phosphorus	-	0.135
Manganese	-	0.79

As received, the Izod impact value was 6.6 foot pounds. Microscopic examination revealed a banded structure. The statement is made: "From the view-point of mechanical

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(Discussion, cont'd) -

quality, such a structure is thoroughly undesirable."

This material was subsequently normalized and an izod impact value of 60.5 foot pounds obtained. Again the author states: "No objection can be raised as to the quality of the normalized material, of which the izod value has been much increased."

The benefits of this normalizing treatment are quite evident in Figures 2 and 3. Figures 4 and 5 show how the structure is improved. There does not appear to be any undue segregation of the sulphides.

The chemical analysis reveals that the sulphur is high, even for S.A.E. steel X1112. Such a steel of course would not normally be used where high service imports were likely.

Conclusions:

1. There does not appear to be any undue sulphur segregation.

2. The sulphur content is higher than that allowed for by S.A.E. Specification X1112 in the sample analysed.

3. As received, the material possessed a banded structure due to cold working.

4. There were no cracks in the parts submitted.

Recommendations:

If the service requirements of these parts are even moderately severe, performance could be improved by normalizing at 1650° F. for 20 minutes.

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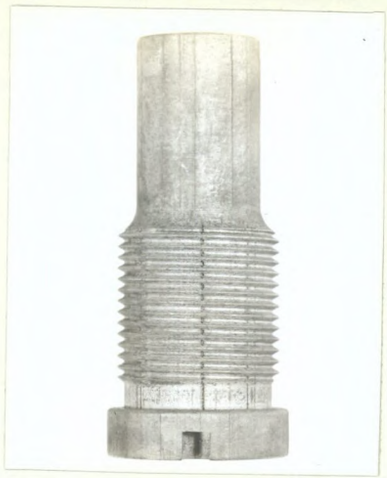
HVK:GHB.

Figure 1.



Hot etched in 50% HCl.
(Natural size).

Figure 2.

RESULTS OF SQUEEZE TEST,
BEFORE NORMALIZING.
(Natural size).

Figure 3.

RESULTS OF SQUEEZE TEST,
AFTER NORMALIZING AT 1650° F.
(Natural size).

Figure 4.

X100, picral etch.
MICROSTRUCTURE AS RECEIVED.

Figure 5.

X100, picral etch.
MICROSTRUCTURE AFTER NORMALIZING.

HVK:GHB.