O T T A W A June 5th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1238.

Examination of Tinned Steel Retaining Pins.

(Copy No. 22)

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 June 1st, 1942, via the National Research Council, Ottawa, two tinned steel retaining pins were received from Lieut. J. R. Millard, Research Liaison Officer, Department of National Defence (Naval Service), Ottawa, Ontario. These pins had failed and were forwarded for test by the Superintendent of Boom Defence. It was requested (Lieutenant Millard's letter dated May 28th, File No. N.S. 835-7-47) that they be examined

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

in order to determine, if possible, the cause of fracture.

These pins are made in accordance with Specification D.N.C./M./S. W.11 (Schedule 94) - SPECIFICATION FOR IRON CHAIN CABLES, MOORING CHAINS AND ASSOCIATED ARTICLES. It is stated in Section V of these specifications that "the pins shall be made by turning down bars without subjecting them to heat treatment."

It is stated, in Section VI of these specifications, under the heading "Pin Steel - Quality of Material," that "the pins are to be made from bars of "40" carbon steel (hardened and tempered) manufactured in accordance with British Standard Specification 2 S. 76 (March, 1937), Section 3, (S.76--B. Bars for Machining)."

This is interpreted by this Department to mean that the bar stock from which these pins are to be machined is to:

(1) Meet the chemical specifications of BSS 2S. 76;

(2) Be heat treated in accordance with BSS 2S. 76 before machining; and

(3) Meet the physical specifications of BSS 2S. 76.

After the pins are machined out of this bar stock they are to receive no further heat treatment.

Chemical Analysis:

The chemical analysis of the steel in the pins submitted is compared in the following tabulation with the specified BSS 2 S. 76:

(Continued on next page)

(Chemical Analysis, cont'd) -

	- Per cent -	
	BSS 2 S. 76	Obtained
Carbon	0.35-0.45	0.68
Manganese	1.20 max.	0.87
Silicon	0.30 "	0.24
Sulphur	0.05 "	0.014
Phosphorus	0.05 "	0.023
Nickel	1.0 max. (optional)	Nil.
Chromium	-	Trace.

Physical Tests:

The physical specifications of BSS 2 S. 76 are as follows:

Ultimate tensile strength, tons per sq. in.	-	40-50
Elongation, per cent	-	22 min.
Izod Impact, foot pounds	-	35 min.
Brinell hardness number	-	174-223

The pins, as received, had a Vickers hardness number of 729, which corresponds to a Brinell hardness number of 606.

The heat treatment outlined in BSS 2S. 76 is as follows:

Oil or water quench from 850° C.
Temper at 500° to 650° C.

One of the pins was heat treated, as follows:

Oil quench from 1575° F. (857° C.)
Temper at 1100° F. (593° C.)

The following physical properties were obtained:

Ultimate tensile strength, tons per sq. in.	-	72
Elongation, per cent	-	20
Izod impact, foot pounds	-	30
Brinell hardness number	-	331

Discussion of Results:

In view of the higher carbon steel being used, it would be necessary to temper at a higher temperature (say, 1200° F. or 650° C.) to meet the elongation, izod and Brinell hardness number. It is probable, however, that the ultimate tensile strength would still be exceeded.

Obviously these pins have been heat treated after machining and the heat treatment has consisted of quenching only.

Conclusions:

1. The pins broke because they were too hard.

2. The chemical analysis of the steel was not in accordance with specifications.

3. The pins were heat treated after machining, in violation of specifications.

Recommendations:

1. Should a higher ultimate tensile strength than 50 tons per square inch be permissible, the present steel could be used with a suitable alteration of the heat treatment.

2. In the absence of any standard hardness testers a file could be used to pick out any hard pins.

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