O T T A W A September 20th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1094.

Examination of Superheater Steel Tubes For Class "O" Destroyers.

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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Source of Material and Object of Investigation:

On September 18th, 1941, Comm. (E) J. W. Keohane, Naval Stores, Department of National Defence, Ottawa, Ontario, sent in two samples of steel tubing for examination. The tubing was stated to have been manufactured by Page Hersey Tubes Limited, Welland, Ontario, for the superheaters of Class "C" destroyers. One of the tubes had failed to pass the flattening test specification while the other had passed. The failed and passed tubes will be referred to in this report as Nos. 1 and 2, respectively.

Macro-Examination:

The surface of the failed tubing was not as smooth as that of the tubing which had passed the flattening test. The thickness of the No. 2 tubing was 0.005 inch less than the No. 1 tubing.

Chemical Analysis:

Sample No.		Carbon, per cent	Manganese, per cent
1	-	0.08	0.40
2	-	0.11	0.43

Hardness Tests:

Hardnesses were determined by the Vickers method, using a 5-kilogram load.

Sample No.		Vickers Hardness Number.
1	-	115
2	-	150

Microscopic Examination:

Samples cut transversely and longitudinally from each tube were mounted in bakelite and given a metallographic polish. Both steels were etched in a solution of 2 per cent nitric acid in alcohol. Figures 1 and 2 are photomicrographs, at X200 magnification, of Tubes Nos. 1 and 2 respectively. The structure of both steels consists of small ferrite grains and small areas of pearlite. The photomicrographs show the relative surface condition of the two samples.

Temper Test:

The specification for Cold Finish Seamless Steel Tubes, For Boilers, Superheaters, Oil Fuel Heaters and Pressure Feed Heaters, Etc., calls for a temper test, stating that strips cut from the tubes, flattened, heated to 730° C. and

(Temper Test, cont'd) -

cooled in water at 80° F. are to stand being doubled over a radius of half an inch.

The bend test was carried out on a sample of each tubing immediately after quenching and also after standing at room temperature for 18 hours.

In the test carried out immediately after quenching both tubes passed the bend test but when tested after standing the No. 1 tube failed and the No. 2 tube passed the test.

Discussion of Results:

The surface of Tube No. 1 was rougher than that of Tube No. 2. These surface conditions are illustrated in Figures 1 and 2, photomicrographs of Tubes Nos. 1 and 2 respectively. The structure of both steels is normal for low carbon steels.

The embrittlement encountered in the temper test may be due to differences in section. However, it may indicate that the steel is subject to quench aging. Steels that age after quenching are also usually subject to strain aging and it is important for this particular application that a steel should not strain age as this lowers the ductility and impact properties. With the small amount of material available for examination no dogmatic statement with respect to aging embrittlement can be made. This can be checked on properly heat-treated, full-size, tensile test specimens.

(Concluded on next page)

Conclusions:

The surface imperfections of Tubing No. 1 may be due to rolled-in scale or to faults in the die. The apparent failure of the steel to pass the temper test indicates that the steel may be defective. Additional tests would have to be made to substantiate this.

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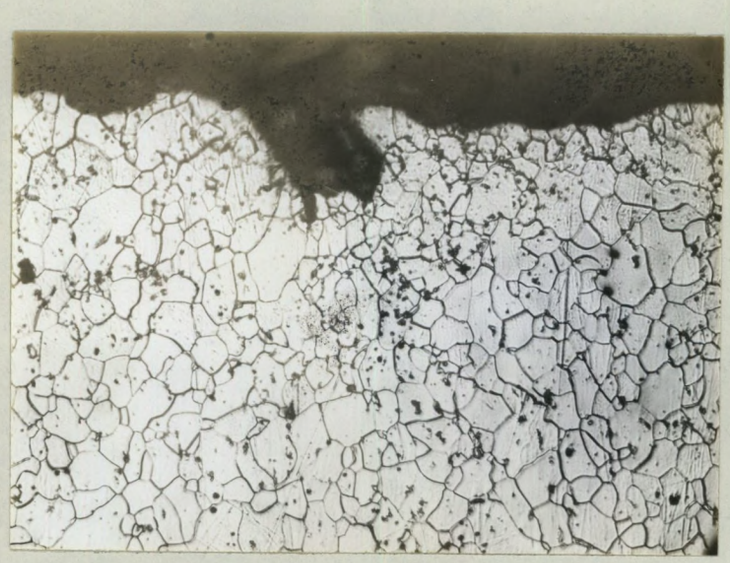
Figure 1.



X100, etched in 2 per cent nital.

TUBING NO. 1.

Figure 2.

X100, etched in 2 per cent nital.

TUBING NO. 2.

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