

O T T A W A

April 16th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1204.

Examination of Superheater Tubes.

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BUREAU OF MINES
DIVISION OF METALLIC MINERALS
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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 April 9th, 1942, Lieut. Commander C. E. Olive, Department of National Defence (Naval Service), Ottawa, Ontario, sent in six pieces of superheater tube for examination. It was requested that the ultimate strength and the elongation of the three straight tubes be determined and that a survey be made of the wall thickness of the three bent pieces. A report on the general quality of the material also was requested.

Condition of Tubes:

The letter requesting the work gave the following information concerning these tubes:

1. The tubes had been inspected and passed in accordance with U. S. Navy Specification 44-T-3 (INT).
2. The tubes were bent cold in a bending machine by the Superheater Company Limited, at Sherbrooke, Quebec.
3. After bending they were annealed. However, no pyrometric control was used during the annealing cycle. The tubes were heated to a cherry red colour in an open oil-fired furnace and allowed to cool slowly under a covering of sand.
4. After bending, they were successfully tested under a hydrostatic pressure of 2500 pounds per square inch.

Chemical Analysis:

One of the tubes was sampled in a milling machine for chemical analysis and the following results were obtained:

	<u>Found</u>	<u>Specified</u>	<u>National Tube Co.</u>
	<u>- (P E R C E N T) -</u>		
Carbon	- 0.12	0.15 max.	0.12
Manganese	- 0.45	0.30 min.	0.47
Silicon	- 0.12	0.10 max.	0.11
Phosphorus	- 0.008	-	-
Sulphur	- 0.024	-	-

Physical Properties:

	<u>Sample</u>	<u>Sample</u>	<u>Sample</u>
	<u>No. 1.</u>	<u>No. 2.</u>	<u>No. 3.</u>
Ultimate stress, p.s.i.	- 52,800	52,500	52,000
Yield stress, p.s.i.	- 30,000	29,400	29,100
Elongation, per cent in 2 inches	- 51.0	52.0	52.0

Dimensions of Bent Tubing:

Four measurements were taken on each end of the three bent specimens submitted. The following results were obtained:

Location:-	Wall Thickness, in Inches.			
	Outer Radius	Side	Inner Radius	Side
	0.134	: 0.129	: 0.127	: 0.132
	0.143	: 0.132	: 0.122	: 0.132
	0.142	: 0.129	: 0.122	: 0.133
	0.142	: 0.128	: 0.123	: 0.132
	0.143	: 0.127	: 0.123	: 0.133
	0.133	: 0.134	: 0.128	: 0.131

Location:-	Outside Diameter, in Inches.	
	From Outer to Inner Radius	Side to side
	1.127	: 1.126
	1.147	: 1.095
	1.145	: 1.086
	1.143	: 1.085
	1.143	: 1.086
	1.132	: 1.123

Microscopic Examination:

A section of the tubing was mounted in bakelite and given a metallographic polish. The steel was then etched in a solution of 2 per cent nitric acid in alcohol and examined under the microscope. The structure was found to be normal for low carbon steel. No decarburization of the steel was observed.

Discussion of Results:

The results of chemical analysis reported by the National Tube Company were checked and found to be correct. These results are within the limits of the specification 44-T-3 (INT).

No decarburized areas were observed in the steel, which would indicate that the annealing heat treatment had

(Discussion of Results, cont'd) -

not affected the carbon content of the steel.

The results of the physical tests are quite uniform. The ultimate strength and elongation are above the minimum orders specified (47,040 p.s.i. and 27 per cent respectively) for cold finish seamless steel tubes for boilers, superheaters, etc.

The bending operation showed an increase and a decrease of approximately 0.010 inch from the nominal thickness at the inner and outer radii respectively.

Conclusion:

The results of the above tests indicate that the tubing is satisfactory.

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