OTTAWA April 16th, 1942.

REPORT

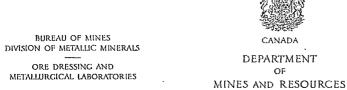
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Investigation No. 1204.

Examination of Superheater Tubes.

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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:

- \underline{l} . 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 pyrmetric 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:

		Found	Specified (Per Cen	National Tube Co.
Carbon	€	0.12	O.15 max.	0.12
Menganese	tra and	0.45	0.30 min.	0.47
Silicon	eu	0.12	O.lo max.	0.11
Phosphorus	ຄາ	0.008	£D.	ಜಾ
Sulpbur	42	0.024	er>	150
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Physical Properties:		Sample No. 1.	Sample No. 2.	Sample No. 3.
Ultimate stress, p.s.i. Yield stress, p.s.i.		52,800 30,000	52,500 29,400	52,000 29,100
Elongation, per cent in 2 inches	477	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:

Wall Thickness, in Inches.						
Location:-	Outer Radius	: Side	0	Inner Radius	11011(4) 0	Side
		(t D	0	A CAMPAGE CONTRACTOR AND A SECUNDARY CONTRACTOR OF THE PARTY OF THE PA	Đ đ	4114
	0,134	:0.129	0	0.127	3	0.132
	0.143	:0.132	0	0,122	٥	0.132
	0.142	:0.129	0	0.122	80	0.133
	0.142	:0,128	ů,	0,123	9	0.132
	0.143	:0.127	3	0.123	9	0.133
	0.133	:0.134	0	0.128	9	0.131
	Christian Street Colonial and St. H. Spilling (Shirty Street Associations)	inan tak maniparinan dia a ()	0 ?	स्थापन मान्य स्थान क्षांत्र स्थान	**************************************	derpartamental fraça est

			in Inches.
Location:-	From Outer to In	mer :	The state of the s
	Radius	o October de la company de la Company de la company de la	Side to side
		3	
	1.127	n o	1,126
	1.147	o o	1,095
	1.145	c s	1,086
	1.143		1.085
	1,143		1.086
	1,132	8	1,123
	en Ettivische verzig reifver gestellte der springen gelvender men der Gerenbehannt als der verzigen. In der	O O O	Rifficients at greatheigh eight mateurarage of the proceduration and attails

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, contid) -

not affected the carbon content of the steel.

The results of the physical tests are quite uniform. The ultimate strength and elengation 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.

MBU;GHB.