O T T A W A July 16th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1262.

Examination of Welded Steel Tubing (Lot No. 208).

(Copy No. 10.)

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 June 23rd, 1942, Mr. K. S. Rawlins, Assistant Chief Inspector, Materials, British Air Commission, 1785 Massachusetts Avenue, Washington, D. C., submitted eleven samples of welded steel tubing for examination. It was stated (letter reference: TC/69722) that some of the tubes were in the "as welded" condition and that some had been cold-drawn after welding. Some of the tubes were of stainless steel but the majority were said to be molybdenum-chromium steels of SAE X4130

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

composition. It was requested that the tubes be identified by measuring the outside diameter and the gauge thickness. In addition, a chemical analysis and a microscopic examination of each tube were requested. The tubes will be referred to in this report as Nos. 1 to 11.

Measurements of Tubes Received:

No.	Outside diameter, in inches	Gauge, in inches
1	0.992	0.065
2	1.020	0.085
3	0.630	0.042
4	0.629	0.042
5	0.502	0.041
6	0.503	0.041
7	0.376	0.034
8	0.376	0.034
9	0.375	0.016
10	0.260	0.032
11	0.260	0.031

Chemical Analysis:

Tube No.	Carbon, per cent	Chromium, per cent	Molybdenum per cent	Nickel, per cent
1	0.03	18.26	Trace	10.38
2	0.34	0.91	0.22	0.21
3	0.34	1.07	0.22	0.57
4	0.34	1.08	0.21	0.55
5	0.32	0.91	0.20	0.20
6	0.32	0.91	0.20	0.21
7	0.32	0.90	0.20	0.21
8	0.32	0.90	0.20	0.20
9	N.D.	17.95	0.10	9.30
10	N.D.	0.87	0.20	0.20
11	N.D.	0.84	0.20	0.20

Note: N.D. - not determined.

Microscopic Examination:

Specimens were cut from each tube and polished in the usual manner on emery papers up to 0000. The steels were then polished electrolytically in an electrolyte solution of 20 per cent perchloric acid and 80 per cent glacial acetic acid. The polishing required 75 seconds at 50 volts. After washing in water and alcohol and drying, the molybdenum-chromium steels were etched in a solution of 4 per cent picric acid in alcohol, while the two stainless steels, Nos. 1 and 9, were etched in the following solution; 1 part HNO_3, 3 parts HCl, 2 parts glycerin, and 1 part H_2O_2. Figures 1 and 9 show, at X250 magnification, the structure of the parent metal of the stainless steel tubes Nos. 1 and 9. Figures 2, 3, 4, 5, 6, 7, 8, 10 and 11 show, at X1000 magnification, the structure of the parent metal of the molybdenum-chromium SAE X4130 steel tubes, while Figures 12, 13 and 14 show, at X100 magnification, the structure of the weld metal of Tubes 2, 4 and 11.

Discussion of Results:

The outside diameter and gauge thickness of the metal in each tube were found to be quite uniform. The chemical analysis showed that Tubes Nos. 1 and 9 were made of low carbon 18-8 stainless steel, whereas the other tubes were made of molybdenum-chromium steel of SAE X4130 composition. The etched structure of the steel of the tubes at the weld after cold drawing was observed to be identical with the etched structure of the parent metal. A deep macro etch was required before any evidence of the weld in the drawn tubes was visible.

Conclusion:

From their uniformity of dimensions, chemical analysis, and microstructure, it can be concluded that the tubes were properly made.

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Figure 1.

~~X100~~ X250.
No. 1 Tube.
(Stainless Steel)

Figure 2.

X1000.
No. 2 Tube.

Figure 3.

X1000.
No. 3 Tube.

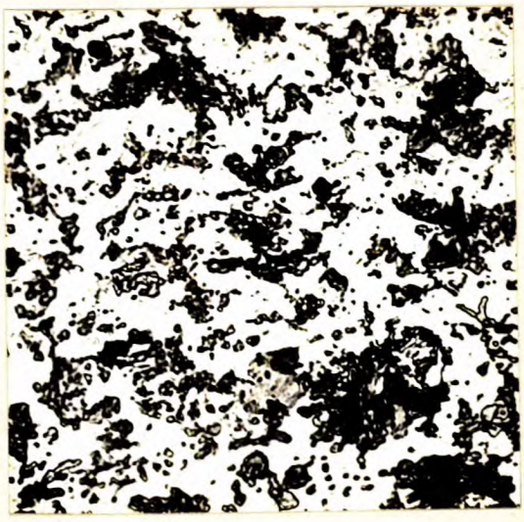
Figure 4.

X1000.
No. 4 Tube.

Figure 5.

X1000.
No. 5 Tube.

Figure 6.

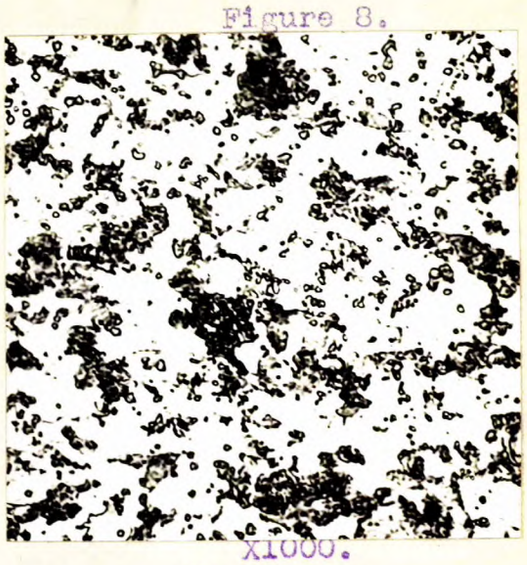


X1000.
No. 6 Tube.

Figure 7.

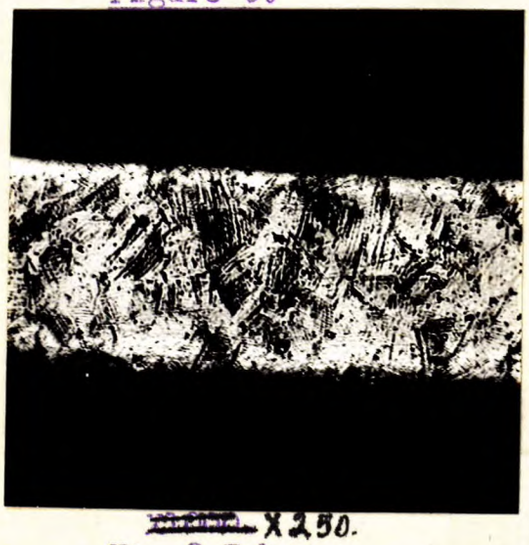
X1000.
No. 7 Tube.

Figure 8.



X1000.
No. 8 Tube.

Figure 9.



X250.
No. 9 Tube.
(Stainless Steel)

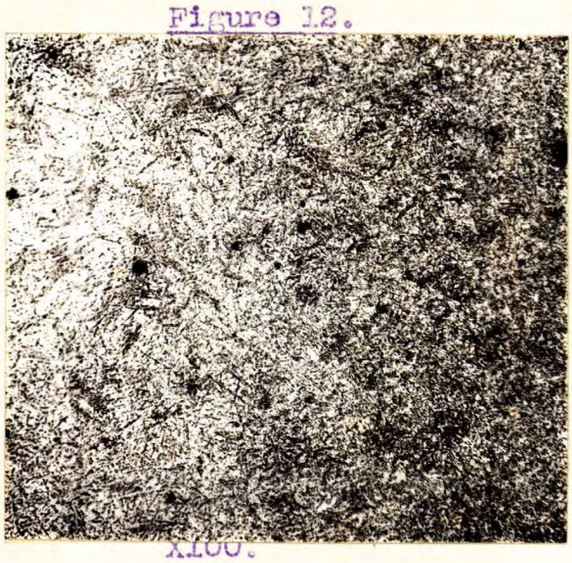
Figure 10.

X1000.
No. 10 Tube.

Figure 11.

X1000.
No. 11 Tube.

Figure 12.



X100.

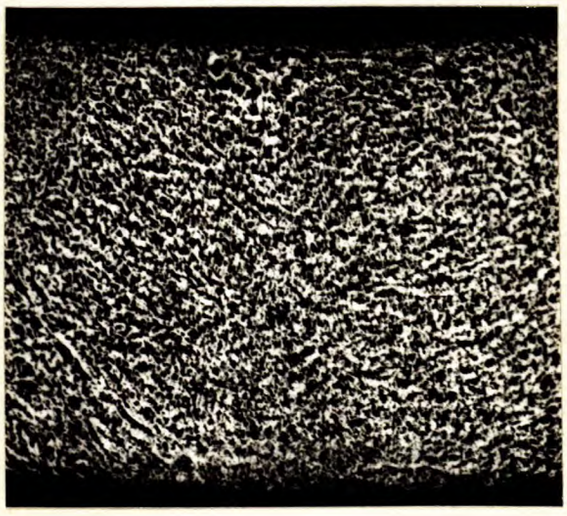
No. 2 Tube.

Figure 13.

X100.

No. 4 Tube.

Figure 14.



X100.

No. 11 Tube.

NBB:PES.