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December 20th, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1135.

Examination of an Aluminium Alloy
Rudder Tube.

(Copy No. 10.)

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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 Problem:

In a letter dated December 10th, 1941, Group Captain A. L. Johnson, for Chief of the Air Staff, Department of National Defence (Air Services), Ottawa, Ontario, requested an examination of a broken Stranraer rudder tube. The tube was received on December 11th.

It was stated that the cause of the failure was

(Origin of Problem, cont'd) -

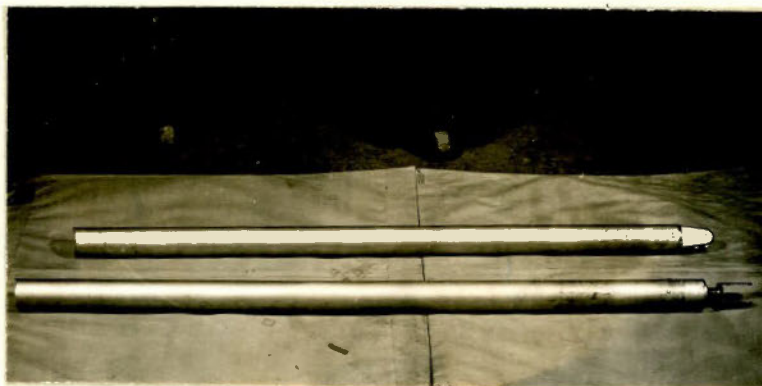
indeterminate from a visual examination. The material should conform to the specification 4 T.4. (Dural). It was requested that the parts delivered be tested for strength and hardness and then analysed metallurgically.

Nature of Sample:

Two pieces of aluminium alloy tube, outside diameter $1\frac{1}{2}$ inches and thickness 0.040 inch, were submitted.

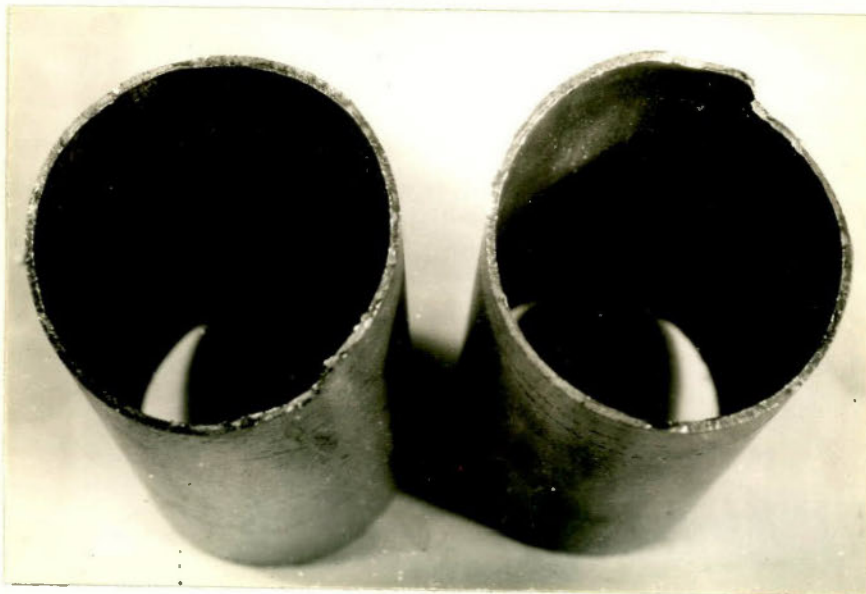
Figure 1 shows the parts as received. Figure 2 shows the character of the fracture.

Figure 1.



(Approx. 1/10 size).
PARTS AS RECEIVED.

Figure 2.



(Approximately 4/3 size).
FRACTURE AS RECEIVED.

Chemical Analysis:

	<u>Examined</u> <u>part</u>	<u>Specification</u> <u>4 T.4.</u>
	(Per cent)	
Copper	- 4.35	3.5-4.5
Magnesium	- 0.66	0.4-0.7
Manganese	- 0.59	0.4-0.7
Silicon	- 0.43	0.7 max.
Iron	- 0.40	0.7 max.
Titanium	- 0.01	0.3 max.

Physical Tests:

Tensile Test -

Two specimens, one from each side of the break, were tested. The following results were obtained:

	<u>Specimen</u> <u>No. 1</u>	<u>Specimen</u> <u>No. 2</u>	<u>Specification</u> <u>4 T.4.</u>
0.1 per cent proof stress, p.s.i.	40,000	40,000	40,000 min.
Ultimate tensile strength, p.s.i.	61,000	64,000	58,000 min.
Elongation, per cent in 2 inches	21	20	8 min.

Hardness -

110 Vickers Hardness Number.

Micro-Examination:

Figures 3 and 4 show the microstructure of the material adjacent to the break. The photomicrographs indicate that this tubing had a structure normal for this type of aluminium alloy.

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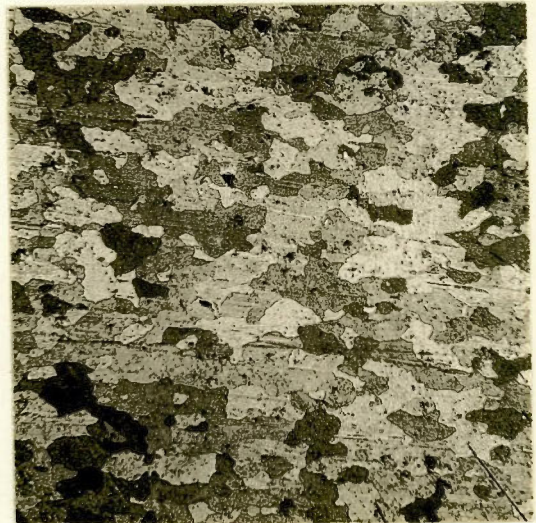
(Micro-Examination, cont'd) -

Figure 3.



X100, unetched.

Figure 4.



X100, etched with Keller's reagent.®

Discussion of Results:

The fracture of the tubing shows no indication of failure due to fatigue.

The chemical composition and the results of the physical tests conform closely to the specification 4 T.4. except that the 0.1 per cent proof stress is marginal.

Conclusion:

The examination shows that the material is satisfactory; the failure is not due to any defect of its quality.

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JWM:PES.

® HF, 1 per cent; HCl, 1.5 per cent; HNO₃, 2.5 per cent, and H₂O, 95 per cent.

