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O T T A W A

August 26th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1486.

Examination of Aluminium Alloy Rivets Suspected  
of Having Been Incorrectly Heat-Treated.

(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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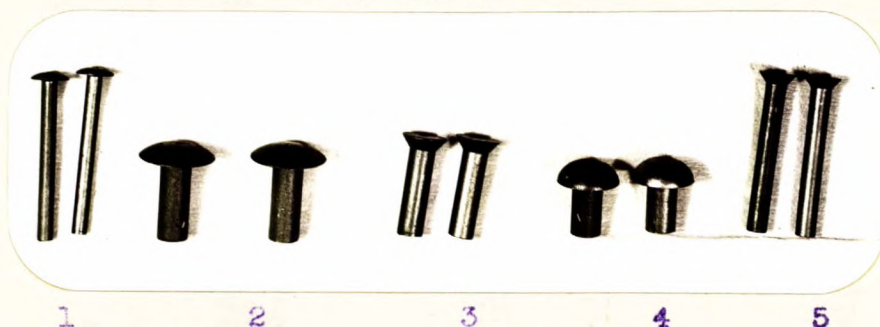
Origin of Samples and Object of Investigation:

On August 20th, 1943, a letter (File No. 902-38-1  
AMAE DAL) was received from Air Commodore A. L. Johnson,  
for Chief of Air Staff, Department of National Defence,  
Air Service, Ottawa, Ontario, covering a box of rivets  
earlier delivered to these Laboratories. This box,  
marked "Steel Company of Canada, indicating correct finish  
and colour," contained a number of each of five different  
sizes of rivets and also one other rivet of an unmatched  
size. It was requested that an investigation be carried  
out to determine whether these rivets had been correctly  
heat-treated.

Physical Examination:

The five different sizes of rivets received are shown, approximately to size, in Figure 1.

Figure 1.



( X 7/8 actual size).

The dimensions of the odd-sized rivet were: overall length, 0.580 inch; head diameter, 0.377 inch; and body diameter, 0.1565 inch.

Longitudinal sections from two of each of the five types of rivets, as well as from the odd rivet, were mounted in bakelite and polished.

Hardness readings, using the Vickers method, with a 10-kilogram load, were taken on the bodies of the rivets. Results were (refer to Figure 1 for identification of types):

	Average Vickers Hardness Number					
	Type 1	Type 2	Type 3	Type 4	Type 5	Odd Rivet
1st sample	- 75.4	70.7	71.0	76.9	68.1	71.9
2nd sample	- 71.0	70.0	61.7	57.1	72.7	
3rd sample	=			49.9		

Microscopic Examination:

The rivets discussed under "Physical Examination" were polished and etched with Keller's reagent (1 per cent HF + 1.5 per cent HCl + 2.5 per cent HNO<sub>3</sub> + 95 per cent H<sub>2</sub>O).

Figures 2, 3 and 4 are photomicrographs, at 100

(Microscopic Examination, cont'd) -

diameters, of the three samples of Type 4. Sample 2, of Type 3, has a microstructure that appears to be about intermediate between those shown in Figures 3 and 4. Figure 4 is representative of the microstructure of all other samples. All photomicrographs were taken from the bodies of the rivets.

Figure 2.



X100, Keller's etch.  
SAMPLE 3, TYPE 4 RIVET.

Figure 3.



X100, Keller's etch.  
SAMPLE 2, TYPE 4 RIVET.

Figure 4.



X100, Keller's etch.  
SAMPLE 1, TYPE 4 RIVET.

Discussion of Results:

Hardness tests showed that three rivets of Types 3 and 4 (see Figure 1) were considerably softer than any of the others examined. However, because of the small number examined, the fact that soft rivets were found only in these two types does not eliminate the possibility of their occurrence in other types.

Consideration of the variances in hardness and microstructure among Type 3 and 4 rivets leads to the conclusion that rivets in this group may have had three different kinds of heat treatment. The structure (Figure 2) and hardness of the Sample 3, Type 4 rivet would seem to indicate that this rivet had not been solution heat-treated. The Sample 2, Type 3 rivet and the Sample 2, Type 4 rivet (Figure 3) may have been solution heat-treated but, in any case, it is evident, from the large amount of undissolved constituent present and the lower hardness, that either the temperature of the solution heat treatment was not sufficiently high or the parts were not held long enough at the correct temperature. The remainder (the great majority) of the rivets examined, had, however, evidently been given a satisfactory heat treatment.

The acceptance or rejection of these rivets would seem to depend upon the importance of the difference in physical properties of rivets heat-treated to 68-76 V.H.N. in one case and to 49-61 V.H.N. in the other.

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