

FILE COPY

O T T A W A

December 23rd, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1136.

Examination of Aluminium Alloy Forgings.

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Department of National Defence  
Air Service

IN REPLY PLEASE QUOTE

FILE NO. 902-14-58  
(AMAE DAI)

4-3-5

Ottawa, Canada, December 10, 1941

Jan

Mr. C.S. Parsons,  
Chief, Division of Metallic Minerals,  
Bureau of Mines,  
552 Booth Street,  
Ottawa, Ontario.

Metallic Minerals Division  
BUREAU OF MINES  
DEC 12 1941  
RECEIVED  
OTTAWA, CANADA.

Canadian Jacobs Anson Part No. R.81414, Material 17ST

Dear Sir:

There has been delivered to your division by Flight Lieutenant A.J. Smith, personally, two of the above referred to article.

The parts show a peculiar strain streak after anodizing, which suggests inclusions. Please make the necessary investigation and inform us immediately on your findings.

Yours truly,

*A.L. Johnson*  
(A.L. Johnson),  
Group Captain,  
for Chief of the Air Staff.

1136



Refer: Our  
File No. 8-3.

552 Booth Street,  
Ottawa, Ontario,  
February 24, 1942.

Flight Lieutenant Allan J. Smith,  
Aeronautical Engineering Services,  
Room 716, Jackson Bldg.,  
Ottawa, Ontario.

Re: 902-33-1 (AMAEDAI)

Dear Sir:

In reply to your verbal inquiry February 24th, 1942 regarding a written request from J. S. Roper for Officer Commanding, No. 11 (Tech) Detachment, R. C. A. F., Montreal, Quebec, their file 1214-2-1, requesting information on the location of section of forgings shown in photomicrographs, Figures 3-6 in Report of Ore Dressing and Metallurgical Laboratories; Investigation No. 1136 - Examination of Aluminium Alloy Forgings, these photomicrographs were taken from a sample cut from the forging shown on the left side of Figures 1 and 2. The exact location of the micro specimen was about 5 mm. in from the right edge of the forging on the stain line showed Figure 1, left side. All microphotographs included in the report are from this specimen. Specimens from other locations were examined microscopically but not photographed as the microstructure of these and of the defect showed practically the same characteristics.

Yours very truly,

For C. S. Parsons,  
Chief of Division.

NCM/JG

C O P Y

ROYAL CANADIAN AIR FORCE

Our File 1214-2-1.  
Ref. Your 902-33-1 (AMAE-DAI)

Montreal, Que., February 6, 1942.

The Secretary,  
Department of National Defence for Air  
Ottawa, Ont.

Report of the Ore Dressing and Metallurgical Laboratories; Investigation  
No. 1136 Examination of Aluminum Alloy Forgings.

1. Please advise location of section of forgings, from which photomicrographs shown in Figures 3 - 6 are taken.

J. S. Roper  
for Officer Commanding,  
No. 11 (Tech) Detachment, RCAF.,  
Montreal, Que..

BUREAU OF MINES  
DIVISION OF METALLIC MINERALS  
—  
ORE DRESSING AND  
METALLURGICAL LABORATORIES



CANADA  
DEPARTMENT  
OF  
MINES AND RESOURCES  
MINES AND GEOLOGY BRANCH

O T T A W A

December 23rd, 1941.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1136.

Examination of Aluminium Alloy Forgings.

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 the examination of two aluminium alloy forgings (Canadian Jacobs Anson Part No. R.81414, Material 17ST), which showed a peculiar strain streak after anodizing,



(Origin of Problem, cont'd) -

suggesting inclusions.

The two forgings were submitted on December 11th, 1941.

The nature of the defect is shown in Figures 1 and 2 below:

Figure 1.

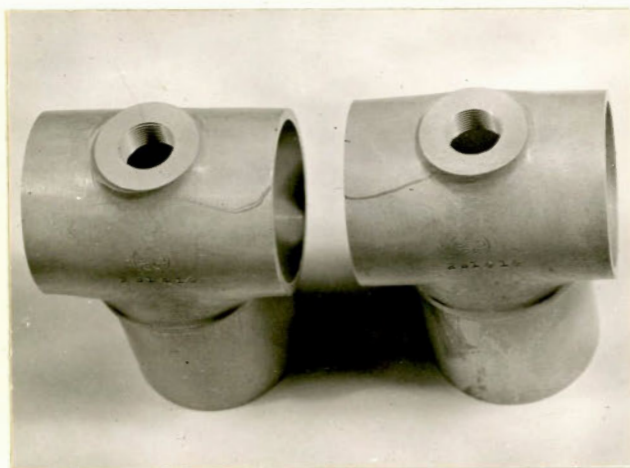
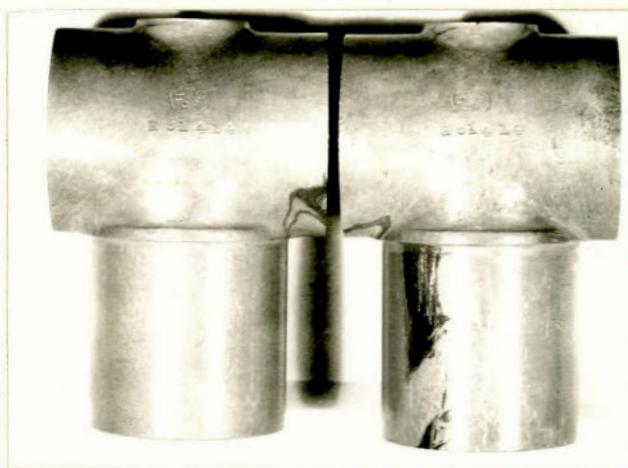


Figure 2.



Approximately 2/3 size.

Approximately 2/3 size.

PARTS AS RECEIVED.

Chemical Analysis:

	<u>Examined Forging</u>	<u>Specification D.T.D. 150A.</u>
Copper, per cent -	4.41	3.5-4.5
Magnesium, per cent -	0.59	0.4-0.8
Manganese, " -	0.61	0.4-0.7
Silicon, " -	0.33	0.7 max.
Iron, " -	0.43	0.7 max.
Titanium, " -	0.01	0.3 max.

Physical Tests:

Hardness - 110 V.H.N.



Micro-Examination:

Figures 3 to 6 show strings of pronounced segregation of heavy compounds (Cu, Mn, Fe) in the base alloy.

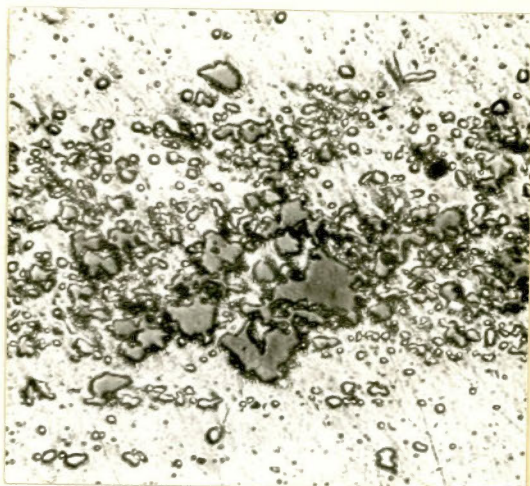
Figure 7 shows the structure of the "sound" material, normal for this type of alloy.

Figure 3.



X100, unetched.

Figure 4.



X250, unetched.

Figure 5.



X100, etched with Keller's reagent.®

Figure 6.



X250, etched with Keller's reagent.®

(Continued on next page)

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® HF, 1 per cent; HCl, 1.5 per cent; HNO<sub>3</sub>, 2.5 per cent; and H<sub>2</sub>O, 95 per cent.



(Micro-Examination, cont'd) -

Figure 7.



X100, etched with  
Keller's reagent.⊕

⊕ HF, 1 per cent; HCl, 1.5 per cent; HNO<sub>3</sub>,  
2.5 per cent; and H<sub>2</sub>O, 95 per cent.

Discussion of Results:

The chemical composition and the hardness tests show that the material conforms closely to the specifications for a 17ST aluminium alloy.

The micro-examination shows that the stain visible on the surface after anodizing was due to pronounced segregation of heavy compounds (Cu, Mn, Fe) in the aluminium alloy.

This kind of segregation in duralumin-type alloys may originate from the following causes:

1. Inverse segregation on the surface of the ingot followed by improper surface preparation prior to



(Discussion of Results, cont'd) -

the forging process.

2. Local segregation in the ingot derived from the heading process.
3. In the case of forgings made from extruded material, segregation could also result from improper surface preparation of the billet followed by extruding without "sleeve" (skin shell) or by leaving too small butt ends in the press.

Conclusions:

The stain on the surface of the examined forgings was caused by segregations in the alloy.

This type of defect seriously impairs the uniformity (strength and ductility) of the metal.

Parts with such defects are not recommended for use in aircraft construction.

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JWM:PES.

