O T T A W A  January 5th, 1944.

# R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1570.

## Examination of Blistered Aluminium Alloy Sheet.

(Copy No. 10.)

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Origin of Problem:

In a letter (File 902-38-19(AMAE DAI)) dated December 6th, 1943, Air Commodore A. L. Johnson, for Chief of the Air Staff, Department of National Defence for Air, Ottawa, Ontario, requested the examination of three samples of aluminium alloy sheet showing blistering on the surface.

It was stated that there is no evidence of blisters prior to annealing but that after annealing at a temperature between 650° F. and 675° F. for five minutes the defect becomes visible.

It was requested that a report be made on the possible origin and metallurgical implication of the blisters.

Description of Samples:

Three samples of D.T.D. 213 aluminium alloy sheet were submitted. Two of these samples showed blistering (see Figure 1) and the third sample showed a sliver rolling defect) and some minor blisters (see Figure 2).

Figure 1.

BLISTERED SHEET SAMPLE AS RECEIVED.
(Approximately 1½ times actual size).

Figure 2.

SLIVER ON SHEET SAMPLE AS RECEIVED.
(Approximately 1½ times actual size).

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12 cc



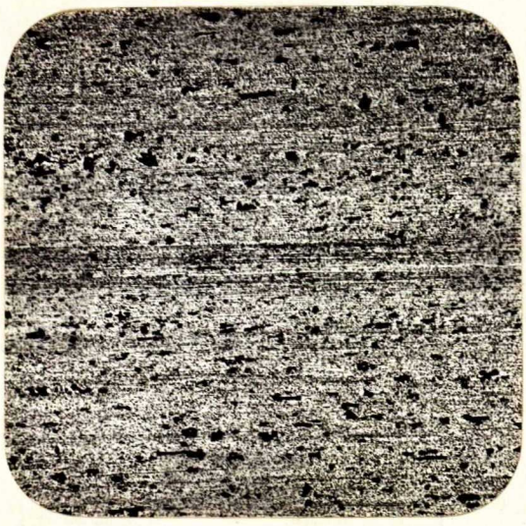
Chemical Analysis:

| | | Obtained | Specification D.T.D. 213A |
|---|---|---|---|
| | | - Per cent | |
| Manganese | - | 1.20 | 1.5 max. |
| Iron | - | 0.42 | 0.75 max. |
| Silicon | - | 0.29 | 0.6 max. |
| Magnesium | - | None detected. | - |
| Copper | - | 0.03 | 0.15 max. |
| Titanium | - | 0.01 | - |

Metallographic Examination:

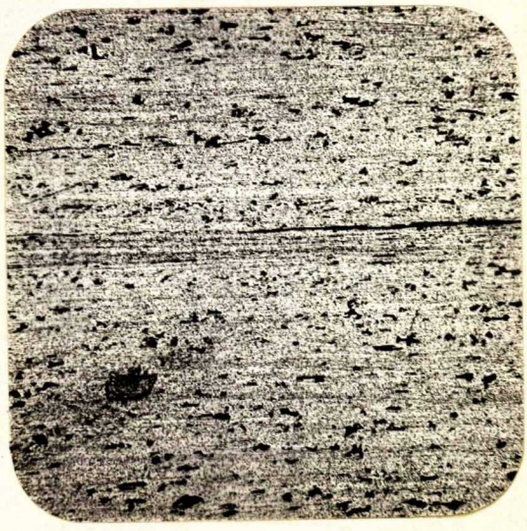
Figures 3 to 6 show the microstructure of sections of the examined sheet samples. The photomicrographs shown are taken from locations near blisters (Figures 3 and 5), or from sections cut through blisters (Figures 4 and 6).

Figure 3.



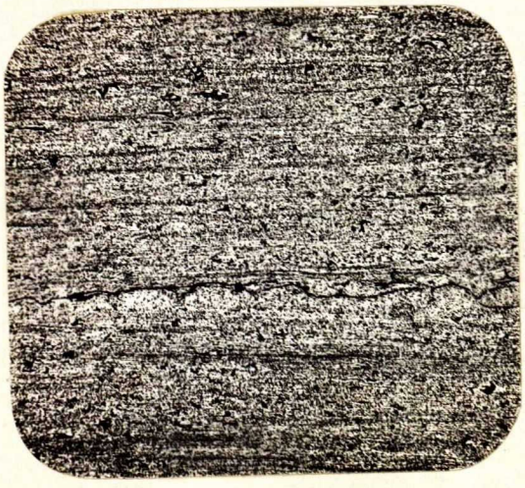
X100, Keller's etch.

Figure 4.



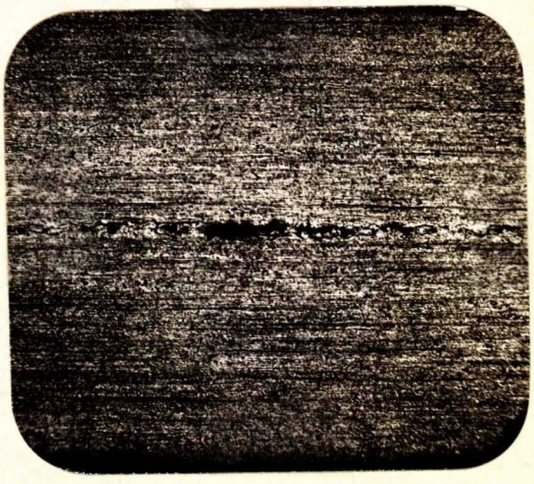
X100, Keller's etch.

Figure 5.



X100, Keller's etch.

Figure 6.



X40, Keller's etch.

MICROSTRUCTURE OF SECTION.

(Continued on next page)

(Metallographic Examination, cont'd) -

Figure 7 shows the macroscopic appearance of an etched cross-section of the examined sheet, which reveals a distinctive streak and some discontinuities.

Figure 7.

Discussion of Results:

It is known that blisters on aluminium alloys appear mostly after heat treatment. Although faulty heat treatment, e.g., overheating or heating in unfavourable atmospheres, is sometimes responsible for blistering, there are many other causes for this defect, mainly connected with the foundry practice or with the plastic deformation of the material.©

Annealing of aluminium alloy sheet at a temperature between 650° F. and 675° F., especially if the time of this annealing is only five minutes, could not be considered to be the most likely cause of blistering.

The directional discontinuities and streaks of the material (Figures 5 to 7) confirm that blistering on the examined sheets, revealed after annealing, was due to defects in the material, caused in the earlier production stages.

(Continued on next page)

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© Mr. Stokeld claims, in "The Forging of Light Alloys", published in THE JOURNAL OF THE BIRMINGHAM METALLURGICAL SOCIETY, Vol. 21, No. 4 (Dec. 1941), p 249:

(4) "... it has been said that there are at least 24 causes of blistering. Overheating is one of them, but it is often thought to be the cause when actually it is not."

(Discussion of Results, cont'd) -

The sliver (Figure 2) is a rolling defect and cannot be connected with the occurrence of blisters.

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CONCLUSION:

The blistering of the examined sheet samples which renders the material useless was not caused by the heat treating operation, but resulted from a previous production defect.

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