

This document was produced
by scanning the original publication.

Ce document est le produit d'une
numérisation par balayage
de la publication originale.

Dr. J. Conroy

~~INDUSTRIAL CONFIDENTIAL~~

**Declassified
Déclassifié**

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 65-84

**EXAMINATION OF 33S ALUMINUM ALLOY
EXTRUSION BILLET SAMPLES**

by

W. A. POLLARD

PHYSICAL METALLURGY DIVISION

COPY NO. 6

OCTOBER 22, 1965

IR 65-84

*46888974
01-7988974*

Declassified
Déclassifié
Industrial Confidential

Mines Branch Investigation Report IR 65-84

EXAMINATION OF 33S ALUMINUM ALLOY EXTRUSION

BILLET SAMPLES

by

W.A. Pollard*

SUMMARY OF RESULTS

The poor extrudability of one billet examined was found to be most probably caused by the presence of small, hard inclusions thought to be gamma alumina. A "good" billet of the same alloy was found to have fewer of these inclusions.

* Senior Scientific Officer, Non-Ferrous Metals Section, Physical Metallurgy Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

A sample of 33S (5% Si) aluminum alloy extrusion billet (8 in. diameter) was received from Mr. M. W. Martinson of Canadian British Aluminium Company Limited on September, 1965. In discussion, it was learned that the billet from which the sample slice had been taken had been difficult to extrude and it was requested that the reason for this be found.

METALLOGRAPHIC EXAMINATION

The whole cross section of the poor billet was etched in an attempt to reveal any inhomogeneities of macro-structure. However, the grain size was reasonably uniform and no features were observed which would seem likely to have caused the poor extrudability.

Longitudinal and transverse sections were taken from various points on the diameters of the cross sections from the two billets and were mounted and polished for metallographic examination.

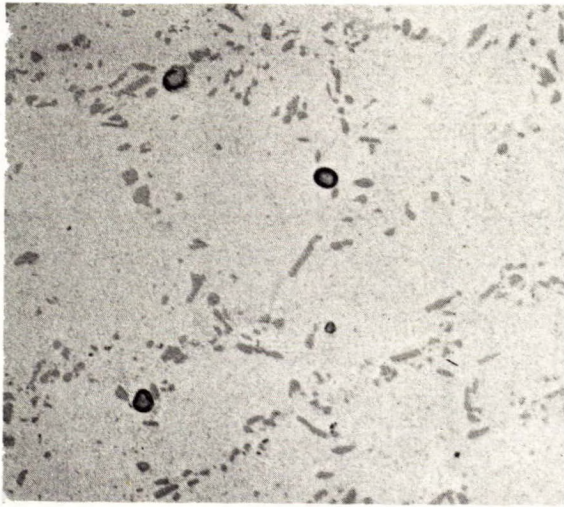
In both cases the structures of the alloy consisted of primary α -aluminum dendrites in a eutectic made of aluminum, silicon and a constituent presumably containing iron. (See Figures 1 and 2). In the sections from the first billet sample (difficult to extrude) the eutectic silicon particles were somewhat finer and more rounded than those in the second sample (satisfactory extrudability). It is thought that this difference in structure may be attributable to the homogenizing heat treatment which was stated to have been given to the first billet; the second billet presumably received no such treatment or a less effective one.

In most sections of both billets small particles of a very hard substance were observed. However, these were very numerous in two sections from the "poor" billet and were much less widely observed in the "good" billet. Typical micrographs showing inclusions are given in Figures 1 and 3.

DISCUSSION AND CONCLUSIONS

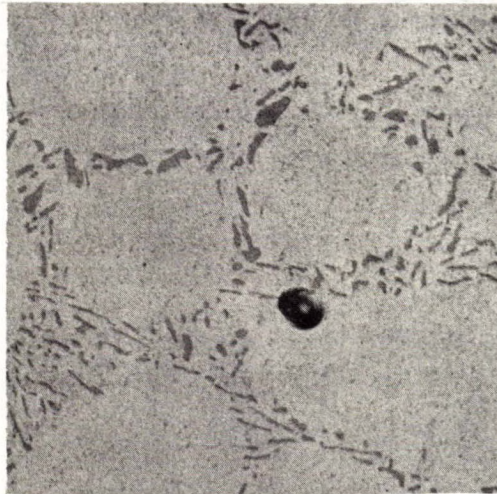
Metallographic examination of the two billet sections has shown that the most likely cause of the poor extrusion behaviour of the first billet was the presence of high concentrations of hard particles. The appearance of the particles suggests that they consist of "gamma alumina". In a previous study it was shown that such inclusions were the most probable cause of poor machinability in aluminum alloy die castings. In the periodical "Foseco Foundry Practice" for February 1961 published by Foundry Services, (Canada) Ltd., an article entitled "Hard Spots in Aluminum Castings" describes these inclusions and states that although the nature and mode of formation of gamma alumina is not completely understood, many investigators "have established that excessive disturbance of the molten metal, incorrect fluxing practice, the melting of oxidized scrap material and failure to clean out furnaces regularly are all contributory causes".

It seems probable that this type of inclusion would also have an adverse effect on extrudability as a result of their abrasive effect at the die and also, possibly, on local reduction of plasticity of the metal.



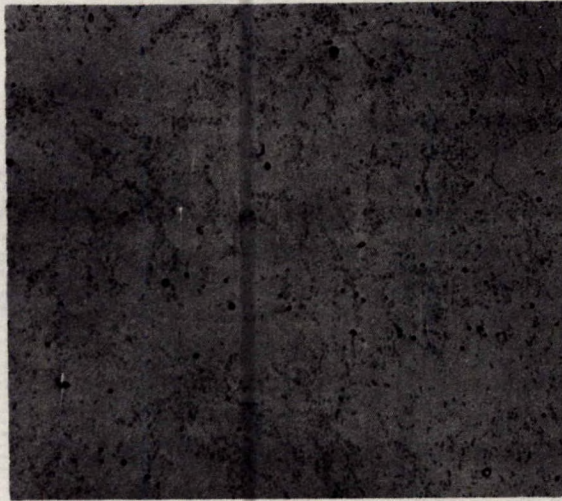
X500

Figure 1. Section from "poor" billet showing general structure and several hard particles. (Unetched)



X500

Figure 2. Section from good billet showing general structure. Note eutectic particles are less rounded than in Figure 1. One hard particle is also shown. (Unetched)



X100

Figure 3. Section from "poor" billet showing dense concentration of hard particles.