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O T T A W A

December 15th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1556.

Examination of a Broken Manganese Bronze Casting.

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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 and Object of Investigation:

In a letter (File No. 11-11-5-1) dated October 27th, 1943, Mr. I. M. Banham, British Admiralty Technical Mission, Ottawa, Ontario, requested the examination of a small sample broken from a defective intensifier casting for 4-inch gun mountings.

Additional information was given in the letter, and also in an accompanying copy of a report on a visit to the Canadian Bronze Co., Montreal, Quebec, to the effect that the contractors, Trenton Industries, report that considerable rejections have taken place due to castings breaking out when sweating in steel adaptors, and a portion of a casting so failing was broken from the opposite end of the casting and

(Origin of Problem and Object of Investigation, cont'd) -

forwarded to Ottawa.

It was stated that no heat or solder had been applied to this part of the casting. The material is reputed to be high-strength manganese bronze, with mechanical properties in the following range:

Ultimate tensile strength, p.s.i.	-	75,000-90,000.
Yield strength, p.s.i.	-	40,000-50,000.
Elongation in 2 inches, per cent	-	15-25.

It was requested that chemical analysis of the submitted sample be carried out and that general remarks concerning this sample, especially the "silvery" crystalline break, be given.

In the attached copy of a report on a visit to the Canadian Bronze Co., Montreal, Que., the opinion of Mr. H. J. Roast, Metallurgist, on the faulty casting was quoted. He stated that the fracture of the casting with the appearance of poorly mixed metal, showing considerable silvery patches, was due to an attempt being made to fill a blow-hole with solder. The metal being porous and slaggy, the solder had run causing the silvery appearance. Mr. Roast and Mr. J. Moore, Foundry Superintendent, further stated that they had never seen this appearance in a fractured manganese bronze casting and that it was extremely unlikely to occur due to zinc mixing so readily.

Chemical Analysis:

		<u>Per cent</u>
Copper	-	59.55
Zinc	-	34.00
Manganese	-	2.14
Aluminium	-	2.80
Iron	-	1.08
Tin	-	0.25
Lead	-	Trace.
Nickel	-	None detected.
Silicon	-	None detected.

Spectrographic Examination:

Some single crystals of silverish surface were removed from the fracture and examined spectrographically with the following results (only qualitative):

Main compounds:	Cu, Zn
Minor " :	Fe, Mn
Strong traces :	Al, Sn
Traces:	Pb, Si
Faint traces:	Ag, Ca, Mg

Metallographic Examination:

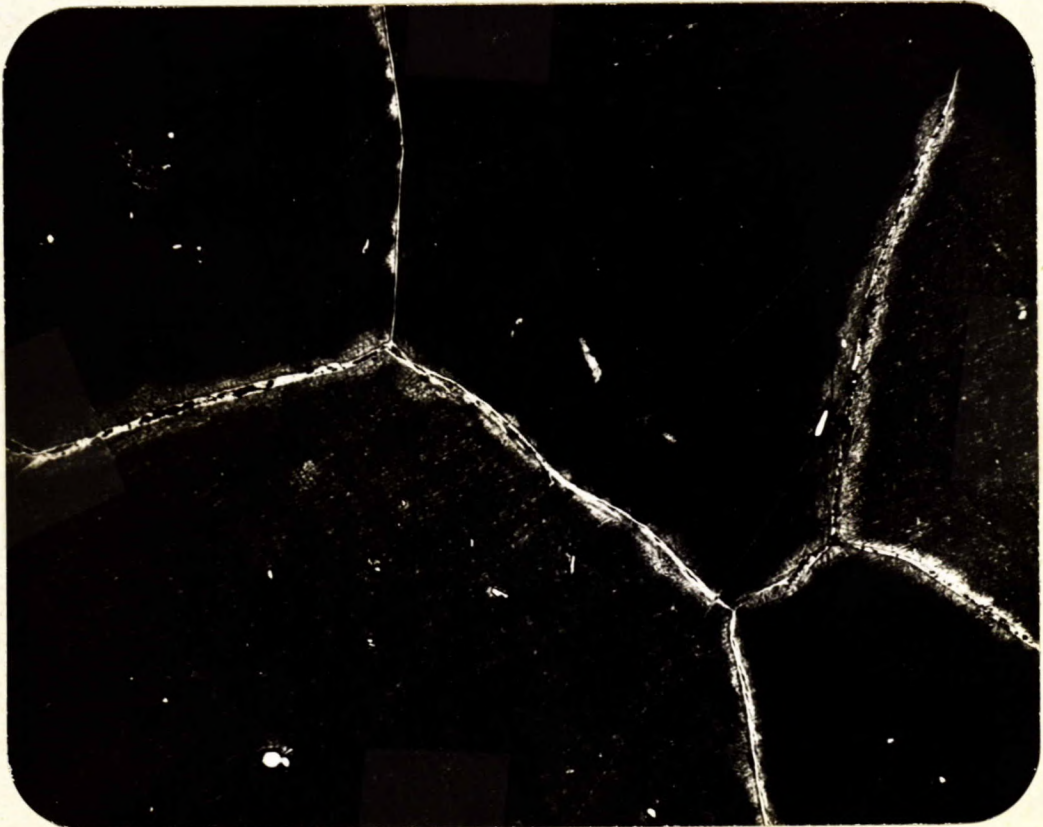
The fracture of the sample shows the presence of a whitish tinge on its large granular facets.

Microscopic examination of the region adjoining the fracture revealed intergranular films penetrating from the surface and diminishing inwards.

Figure 1 shows such a film on the grain boundaries. Figure 2 shows segregations in the grains.

Generally, the sample shows a microstructure typical for β -brass of simple polyhedral structure.

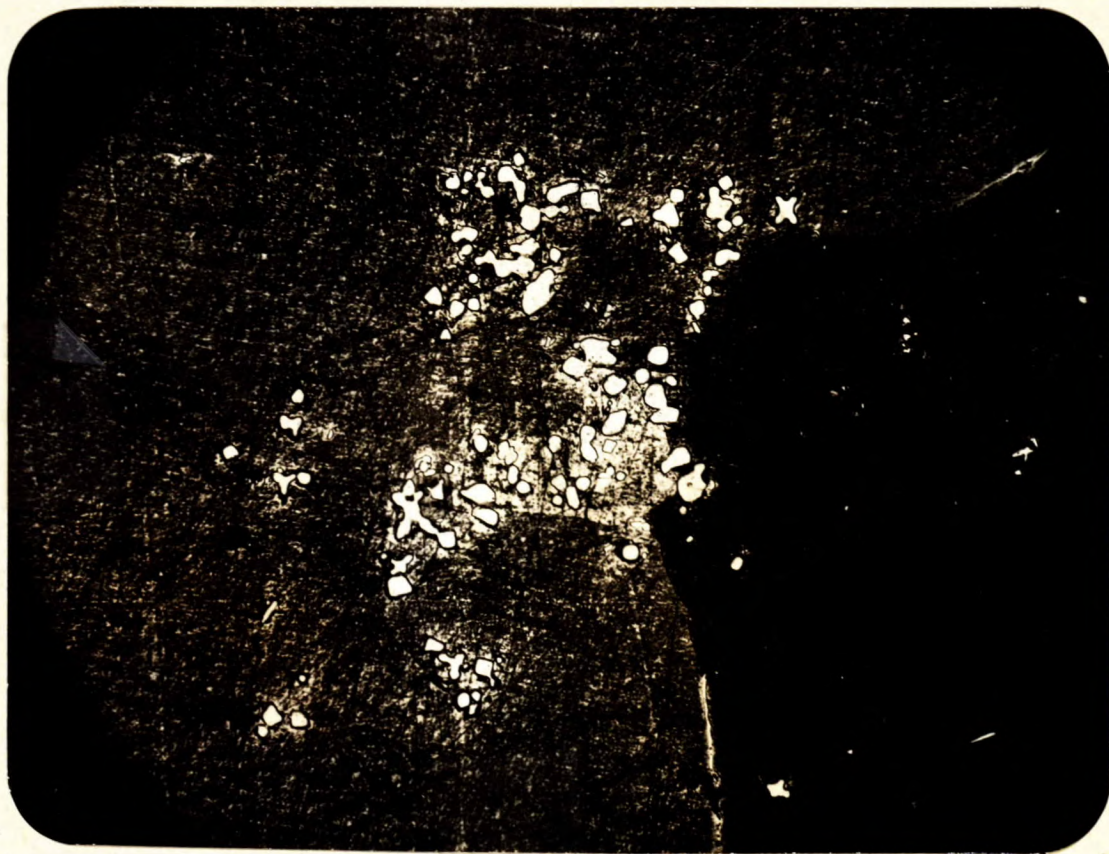
Figure 1.



X250, FeCl₃ etch.

(Metallographic Examination, cont'd) -

Figure 2.



X250, FeCl₃ etch.

Discussion of Results:

The chemical analysis and the microscopic examination show that the submitted sample is a typical β -phase manganese bronze casting.

The qualitative spectrographic examination gave no definite results, so far as the determining of the constituents of the surface film of the break was concerned. It showed the average composition of the material, because probably the whitish film on the surface of the crystals was very thin.

Microscopic evidence of intergranular films penetrating from the surface of the fracture and disappearing farther inside, would indicate that a fluid metal, e.g., a solder,

(Discussion of Results, cont'd) -

penetrated between the crystals of the manganese bronze casting.

A very similar failure is described by J. H. S. Dickenson in an article, "Note on a Failure of Manganese-Bronze," in the Journal of the Institute of Metals, vol. 24 (1920), pp. 315-332.

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JWM:GHB.