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O T T A W A November 23rd, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1538.

Examination of a Broken High Strength Brass Cap Square.

(Copy No. 10.)

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Origin of Problem:

On November 12th, 1943, under Materials Division Analysis Requisition No. O.T. 4101, Mr. H. H. Scotland, Inspector of Materials, Inspection Board of United Kingdom and Canada, Ottawa, Ontario, submitted for examination a broken cap square made supposedly from High Strength Bronze 45. One side of the form had been brazed.

In the accompanying request letter (File No. 12/4/6), it was stated that High Strength Bronze 45 is listed under "Vickers Standard Materials" with the following properties:

Composition	=	Copper, 57-60; Zinc, 35-40 per cent.
Ultimate tensile strength	=	45 tons/sq.in. (100,800 p.s.i.).
Yield strength	=	28 tons/sq.in. (62,720 p.s.i.).
Elongation in 2 inches	=	12 per cent.

It was requested that the chemical composition be checked and that an opinion on the quality of the material be expressed.

Chemical Analysis:

		Per cent
Copper	-	64.28
Zinc	-	27.03 (by difference).
Manganese	-	1.88
Aluminium	-	5.26
Iron	-	1.46
Silicon	-	0.04
Lead	-	0.03
Phosphorus	-	0.022
Tin	-	None detected.
Nickel	-	None detected.

Mechanical Properties:

Tensile Test -

A tensile test specimen (diameter, 0.282 inch) was cut out from the examined sample and the following results were obtained:

Ultimate tensile strength p.s.i.	-	111,300 (50 tons/sq.in.).
Yield strength, p.s.i.	-	74,200 (33 tons/sq.in.).
Elongation in 1 inch, per cent	-	14.

Hardness Tests -

Rockwell 'B' scale	-	93.5-95.
Vickers, 30-kg. load	-	225-236.

Metallographic Examination:

The fracture appeared to be duplex in nature, being oxidized in part and untarnished in part. As a rule such a fracture indicates a fatigue failure. In this instance, however, such characteristics cannot be distinguished with certainty, because the fracture was exposed for a considerable period before examination and, consequently, corrosion may be incidental.

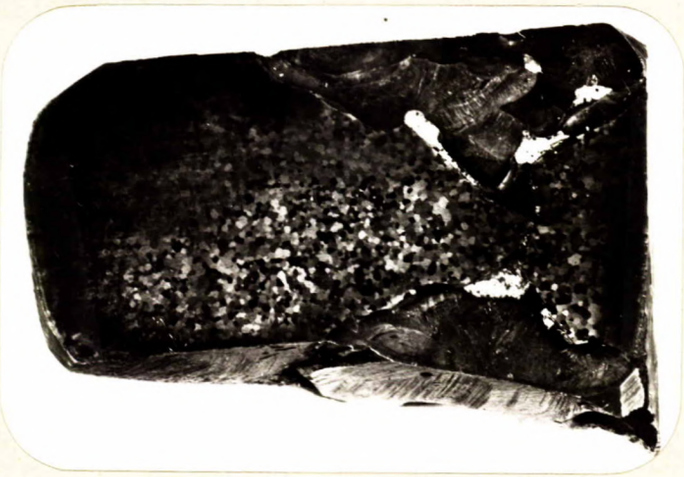
Macroscopic examination of the brazed part reveals a

(Metallographic Examination, cont'd) -

very poor joining of the previously broken parts (see Figure 1).

It should be observed that the "Vickers Standard Materials" specification states the following for this material: "NOT TO BE SOLDERED."

Figure 1.



$FeCl_3$ etch.
BRAZED JOINT AT FORMER BREAK.
(Approximately twice actual size).

Microscopic examination of the material adjoining the actual fracture showed structure normal for a β-type manganese bronze (Figure 2). The microstructure of the brazed joint is shown in Figure 3.

(Continued on next page)

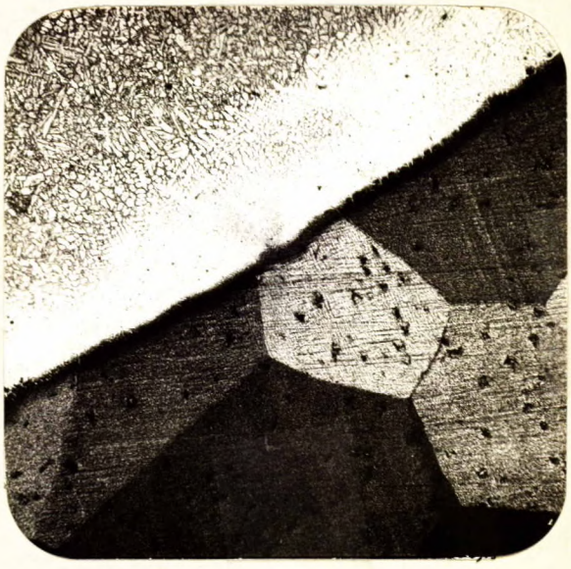
(Metallographic Examination, cont'd) -

Figure 2.

X100, $FeCl_3$ etch.

STRUCTURE CLOSE TO THE FRACTURE.

Figure 3.



X100, $FeCl_3$ etch.

BRAZED JOINT.

CONCLUSIONS:

The examination revealed no metallurgical defects in the material.

The previous fracture and the duplex type of the actual fracture indicate that the failure was due either to mechanical overstressing or to improper design of this part.

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