O T T A W A May 7th, 1942.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1215.

Examination of Track Bonding Clips.

(Copy No. 15.)

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:

In a letter dated April 30th, 1942, Major J. E. Raney, Director of Signals Design Branch, Department of Munitions and Supply, Ottawa, Ontario, requested an examination of some track bonding clips, used for the dispersion of ground static in the cruiser tanks. The clips function as connectors between the various track parts, which otherwise would be insulated by the rubber treads. It was stated that the only information available on these clips is that they are to be made of phosphor bronze, .032 inch thick, with a Rockwell hardness of from B 92 to 96.5.

It was requested that the submitted clips (four in number, received on May 1st, 1942) be tested to determine whether they meet these requirements.

(Origin of Problem, cont'd) -

It was said that a large number of these bonding clips are breaking under service conditions and advice was solicited on more suitable materials which might give greater expectancy of service life.

Chemical Analysis:

	As Received	Specification S.A.E. No. 77, Grade A.
	- Per cent -	
Copper -	94.86	Remainder
Tin -	4.66	3.80 - 5.80
Phosphorus -	0.09	0.03 - 0.35
Lead -	0.02	max., 0.05
Manganese -	0.20	-
Iron -	None detected.	max., 0.10
Zinc -	" "	max., 0.30
Silicon -	" "	-
Cu + Sn + P -	99.61	min., 99.50

Hardness Tests:

Hardnesses were determined by the Vickers method, using a 5-kilogram load. The obtained hardness numbers, as converted to the Rockwell Scale B, were:

B 92 - B 94.

Incidentally, for material of this thickness faulty results would be obtained should the Rockwell B method be used directly.

Micro-Examination:

The microstructure of the material was found to be typical for cold phosphor-bronze strips.

Discussion of Results:

The chemical analysis, hardness tests, and micro-examination show that the material used meets the required specifications. They show no defects.

Due to the high hardness specified for these phosphor-

(Discussion of Results, cont'd) -

bronze clips, the material requires severe cold working, which causes internal stresses and thereby increases susceptibility to cracking.

Alternative Materials:

The best material suitable for this purpose would be beryllium-copper alloy*, which, in addition to possessing higher electrical conductivity, higher hardness and higher tensile strength, also is more ductile.

In case that copper-beryllium strips are not available, which seems very likely, two other alternatives are suggested below:

1. If a non-magnetic material is necessary, the most suitable non-ferrous material is copper-silicon alloy*, which has lower electrical conductivity than phosphor bronze but possesses similar mechanical properties and has the further advantage of not containing any tin.

2. If ferrous materials can be used, the following steels should give good service:

(a) Silicon-manganese steel (S.A.E. No. 9250).

(b) Chromium-silicon steel (approx., C - 0.50-0.60%, Si - 1.50-1.60%, Cr - 0.60-0.80%).

(c) Chromium-vanadium steel (S.A.E. No. 6150).

The use of the steel first mentioned (a) is especially advantageous at the present time, as it contains no strategic alloys.

The best combination of fatigue strength and ductility is obtained by heat treating these steels to a Rockwell 'C' hardness of 44 to 46.

(Continued on next page)

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*The only known Canadian manufacturer of these materials is the Anaconda American Brass Co. Ltd., New Toronto, Ontario.

(Alternative Materials, cont'd) -

The fatigue properties of parts made from these steels would be further improved by shot blasting.

Conclusions:

The clips submitted for testing show that they were made from sound material which meets the required specifications.

To avoid failures in service it is recommended that consideration should be given to the use of copper-beryllium alloy strips, or, in case of difficulties in procurement, copper-silicon or one of the above-mentioned steels. Indeed, as the circuit depends on the conductivity of a steel pin, there would seem to be no advantage in using the lower strength copper-alloys.

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