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# R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1428.

## Examination of Steel Wire from a Three-Core Naval Cable.

(Copy No. 6.)

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Source of Material and Object of Investigation:

On June 5th, 1943, a sample of steel wire five inches in length was received, for analysis, from A/Lieut. Commander J. R. Millard, Senior Technician Technical Division, Department of National Defence (Naval Service), Ottawa, Ontario. Information was given in an accompanying letter (N.S. 1038-16-3, dated June 3rd, 1943) to the effect that the wire is used for armouring each core of a three-core cable which forms the electrical supply to minesweeping apparatus which is immersed in salt water. It was stated that this sample had been found to have the required properties of resistance to salt water corrosion and to flexing of the cable.

Request was made for an analysis and for suggestions as to a possible Canadian substitute.

Size of Wire:

The diameter of the wire received was 0.036 inch (No. 20 Standard Wire Gauge).

Spectrographic Analysis:

A qualitative spectrographic analysis was made on a sample of the wire. The following elements were found, in approximate order of quantity:

1. Iron.
2. Zinc.
3. Manganese.
4. Nickel, titanium, copper, and boron(?).
5. Silicon, magnesium, chromium, aluminium.

A moving-plate spectrographic analysis was also carried out and the outer coating was identified as zinc. Some indication of concentration of copper in the zinc coating was noted, but owing to the small quantity of the sample this could not be considered conclusive.

Chemical Analysis:

A carbon determination was carried out on an 0.9-gram sample by the combustion method and 0.50 per cent carbon was found to be present.

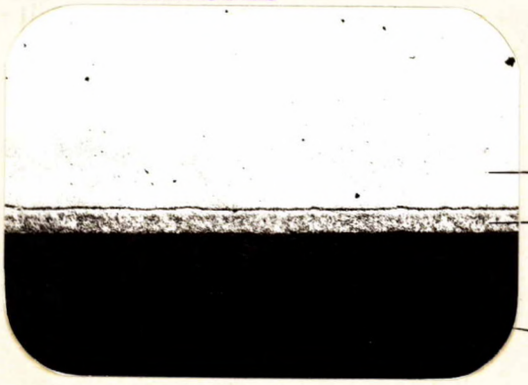
Microscopic Examination:

A sample of the wire was mounted in bakelite, polished, and examined in the unetched condition under the microscope. Figure 1 is a photomicrograph, at X100 magnification, showing the structure of the unetched material. The specimen was then etched in a solution of 4 per cent picric acid in alcohol and re-examined. Figure 2 is a photomicrograph, at X100 magnification, showing the etched structure of the material. The outer white layer is zinc. The white etching constituent of the steel wire is ferrite and the dark etching constituent is the fine pearlite phase. It was observed that the surface of the wire is badly decarburized and that the constituents are elongated. Figure 3 is a photomicrograph, at X100

(Microscopic Examination, cont'd) -

magnification, showing a full cross-section of the wire.

Figure 1.




X100, unetched.

STRUCTURE OF UNETCHED MATERIAL.

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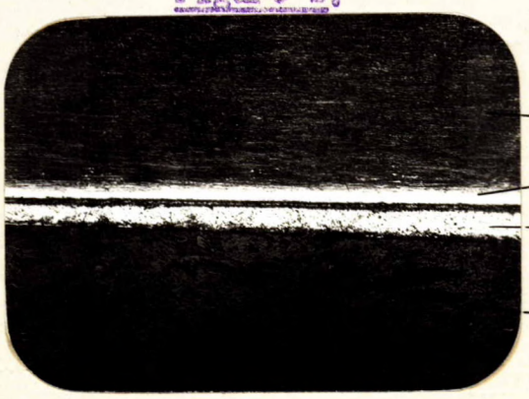
Figure 2.




X100, etched in 4 per cent picral.

STRUCTURE OF ETCHED MATERIAL.

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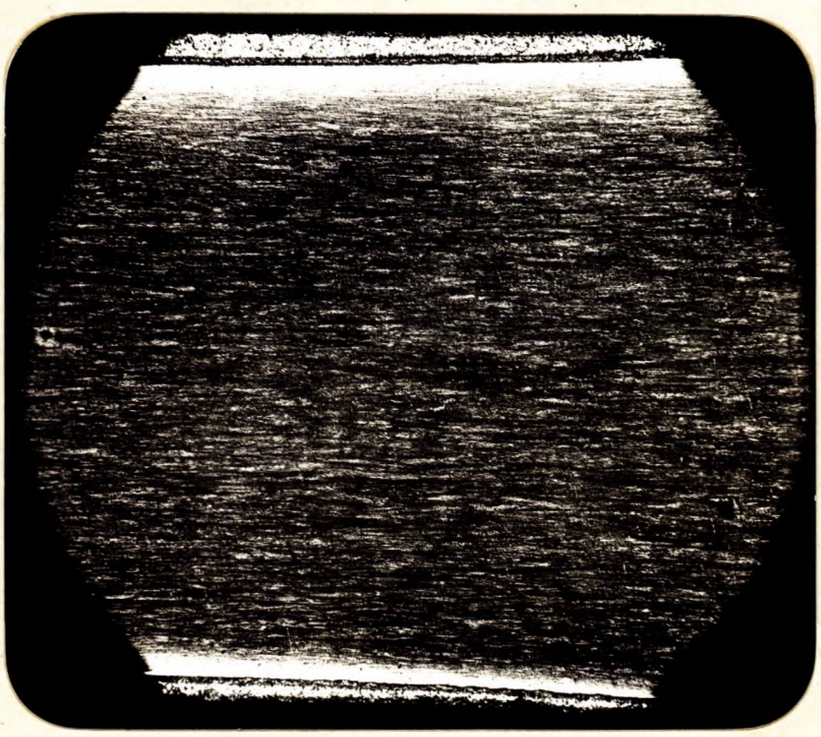
(Microscopic Examination, cont'd) -

Figure 3.



X100, etched in 4 per cent picral.
FULL CROSS-SECTION OF WIRE.

Discussion of Results:

The sample of wire examined was found to have the composition of a plain carbon steel. It was not possible to carry out a check carbon determination as the amount of material available was too small. The carbon was determined on a 0.9-gram sample from which the coating had not been removed. The carbon content, therefore, is probably somewhat higher than that found by the combustion method. The coating on the wire was identified as zinc. The elongation of constituents showed that the wire was cold drawn.

Regarding Possible Canadian
Substitute for this Wire:

Any reputable Canadian wire manufacturer should be able to supply an equivalent product.

Conclusion:

It is concluded from the above examination that the wire was made from a plain carbon steel which was cold drawn and coated with zinc.

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