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O T T A W A October 14th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1720.

Metallurgical Examination of CTL 875 Coupling.

(Copy No. 10)

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Origin of Material and Object of Investigation:

On July 3rd, 1944, one CTL 875 coupling was submitted by Professor J. U. MacEwan, of the Division of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario. The covering Requisition No. 652 (A.E.D.B. Lot No. 545, Report No. 9, Section "D", Test No. 5) called for a metallurgical investigation of the steel in the coupling.

The material specified was BSS 5005/502 steel heat-treated to Brinell 444 to 555. NE 8640 steel was specified

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

as alternate material.

The coupling is shown in Figure 1.

Figure 1.

CTL 875 COUPLING.

(Approximately 2/3 full size).

Chemical Analysis:

Chemical analysis proved the metal to be NE 8640 steel. The use of NE 8640 effects a considerable saving in both nickel and chromium, since the specification for BSS 5005/502 calls for 3.75 to 4.75 per cent nickel and 1.00 to 1.50 per cent chromium.

	As Determined	Specification NE 8640
	- Per Cent -	
Carbon -	0.43	0.38-0.43
Manganese -	0.75	0.75-1.00
Silicon -	0.33	0.20-0.35
Sulphur -	0.018	0.040 max.
Phosphorus -	0.016	0.040 max.
Chromium -	0.40	0.40-0.60
Nickel -	0.43	0.40-0.70
Molybdenum -	0.16	0.15-0.25

Hardness Surveys:

A full-length quadrant was cut from the coupling and hardness readings (using a 10-kg. load on the Vickers hardness machine) were taken at various points along one cross-section of the wall. The hardness was below 444 Brinell in many spots, particularly on the thread teeth. However, there was no sign of decarburization (as determined microscopically after an anneal in lead).

Successively higher drawing temperatures were used on one sample in an attempt to determine the temperature at which the coupling had been drawn. From this it appears that the drawing temperature used was between 700° F. and 800° F.

Micro-Examination:

The structure was tempered martensite (see Figure 2).

Figure 2.

X250, nital etch.

Small particles of what was apparently spheroidized cementite were observed throughout the structure.

A sample was given the McQuaid-Ehn grain size test. The

(Micro-Examination, cont'd) -

resultant structure is shown in Figure 3.

Figure 3.

X100, nital etch.
STRUCTURE AFTER McQUAID-EHN TEST.
Grain size, 6½.

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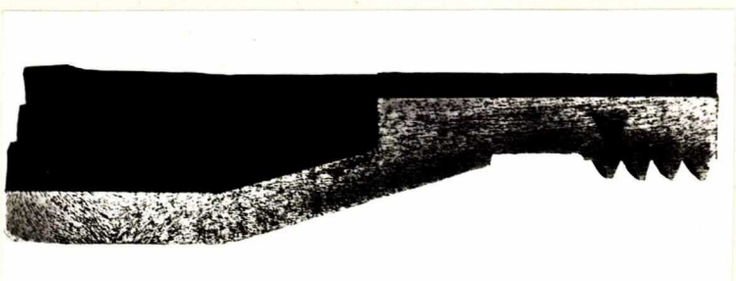
One section from the coupling was then macro-etched with 25 per cent sulphuric acid for 16 hours. This showed up the fibrous structure, and also revealed the presence of quenching cracks (see Figures 4 and 5).

Figure 4.



25 per cent H_2SO_4 etch.
FIBROUS STRUCTURE OF COUPLING.
(Approximately full size).

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(Continued on next page)

Figure 5.

25 per cent H_2SO_4 etch.

QUENCHING CRACKS IN COUPLING.

(Approximately full size).

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Discussion:

Since this part has given no trouble in service as yet, no defects in the structure, hardness, etc., were expected.

The alloy was within the specifications for NE 8640 steel, although manganese, chromium, nickel and molybdenum were on the low side.

The uneven hardness of the sample was thought to be due possibly to the fact that the part, which had probably been spheroidized before final heat treating, had not been given a sufficiently long soak at the austenitizing temperature. As a result, a percentage of the carbides did not go into solution, with a consequent loss in hardenability. The presence of carbides in the martensite background would support this view. There was no decarburization.

The fibre structure of the sample showed that the piece had been forged and had undergone a heading operation at the thick end.

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