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O T T A W A September 20th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1497.

An Examination of Recarburized End Connectors, No. C-55592.

(Copy No. 10.)

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 Request and Object of Investigation:

Fourteen end connectors No. C-55592 (A.E.D.B. Lot No. 649), made of N.E. 9445 steel which had been decarburized to a depth of 0.05 inch in the original heat treatment and had subsequently been recarburized, machined, and heat-treated, together with one end connector No. C-55592 forging (A.E.D.B. Lot No. 650) which had been recarburized but not machined or heat-treated, were received from the Army Engineering Design Branch, Department of Munitions and Supply, Toronto, Ontario, on August 31st, 1943.

On Department of Munitions and Supply Requisition No. 710, Report No. 13, Test No. 40, dated August 30th, the following information was requested:

1. Microscopic examination of the recarburized surface to determine the structure of the recarburized, decarburized and normal structure of the end connector.

2. What properties would be affected by the recarburizing treatment.

Macroscopic Examination:

Figure 1 is a photograph (about 2/5 natural size) showing the unmachined forging. This was taken after part of the ear was cut away for examination. Figure 2 is a photograph of a finished end connector. Note where the machining has occurred.

Microscopic Examination:

Figure 3 is a photomicrograph, at X30 magnification, showing the structure under the recarburized surface of the unmachined, unheat-treated forging.

Figure 4 is a photomicrograph, at X30 magnification, showing the structure under the recarburized surface after the end connector has been fully machined and heat-treated.

It will be noted that there are three zones in Figure 3. Just under the surface, in Zone 1, there is no ferrite; then there is an intermediate zone of finely divided ferrite and pearlite; and, finally, in Zone 3 there is the normalized structure of the normal N.E. 9445 steel.

The bottom of Zone 2 is about 0.05 inch below the surface, which corresponds to the depth of the original decarburization. Comparing Zone 2 with Zone 3, it would appear that the carbon content of Zone 2 is no lower than that of Zone 3. This is evidence that all traces of decarburization have been eliminated. However, from the appearance of the structure of Zone 1 it is evident that a true high-carbon case has now been created.

The structure of this case after complete heat treatment is shown in Figure 5, at a magnification of 500 diameters, and the normal structure of the heat-treated steel is shown in Figure 6, also at 500 diameters. There is nothing unusual in these structures.

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Mechanical Tests:

A hardness survey of the metal below the recarburized surface was made on a sample taken from one of the finished end connectors. The results are shown in the chart, Figure 7.

Discussion of Results; Conclusions:

From the examinations conducted it is evident that all traces of decarburization have been removed. Where the original forged surface remains on the finished end connector, there is actually a case, created by recarburizing. This case penetrates to a depth of 0.04 inch and has a hardness of 460-470 Vickers hardness number. It is not considered that this case will be detrimental to the performance of these parts.

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HVK:GHB.

Figure 1.

PHOTOGRAPH OF END CONNECTOR FORGING, ABOUT 2/5 ACTUAL SIZE.

Note portion has been removed from ear for examination.

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Figure 2.

PHOTOGRAPH OF FINISHED END CONNECTOR, ABOUT 2/5 ACTUAL SIZE.

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Figure 3.

X30, picral etch.

PHOTOMICROGRAPH SHOWING STRUCTURE IN RECARBURIZED METAL BEFORE HEAT TREATMENT. Note the presence of three distinct zones.

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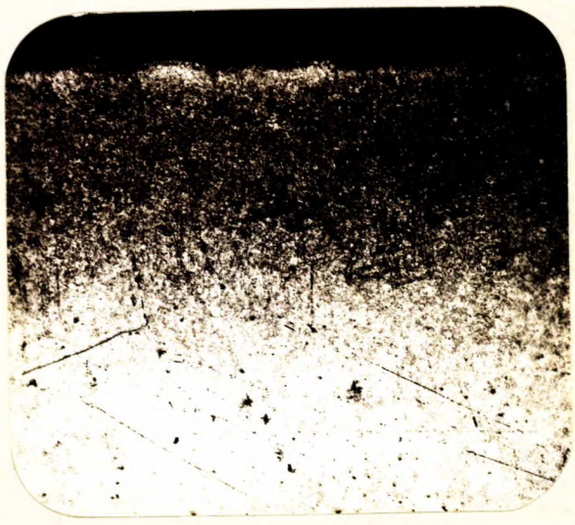
Figure 4.



X30, picral etch.

PHOTOMICROGRAPH SHOWING STRUCTURE IN RECARBURIZED METAL AFTER HEAT TREATMENT.

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Figure 5.

X500, picral etch.

PHOTOMICROGRAPH SHOWING STRUCTURE IN RECARBURIZED CASE AFTER HEAT TREATMENT.

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Figure 6.

X500, picral etch.

PHOTOMICROGRAPH SHOWING NORMAL STRUCTURE OF HEAT-TREATED N.E. 9445 STEEL IN END CONNECTORS.

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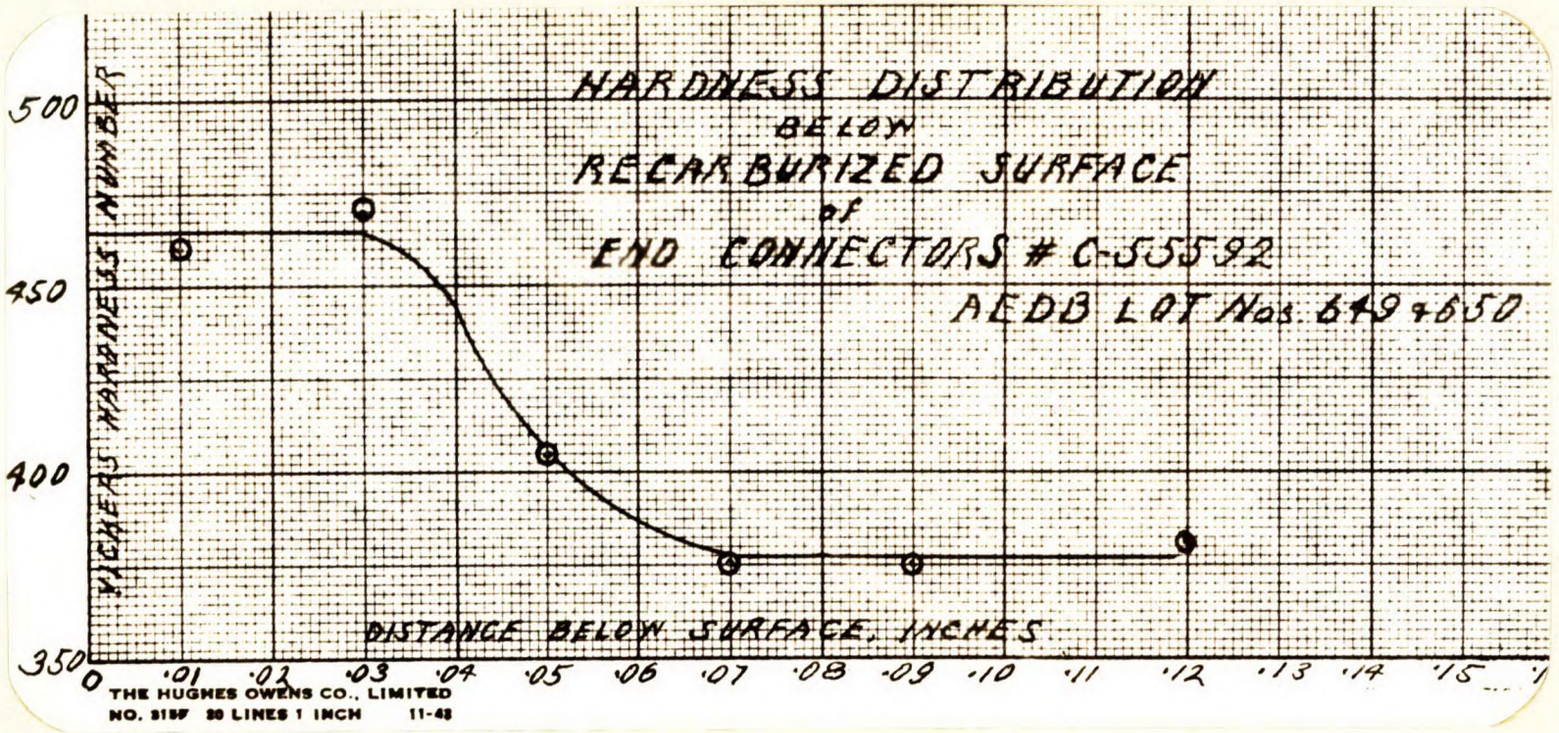
Figure 7.



HARDNESS SURVEY CHART.