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January 18th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1573.

An Investigation on the Recarburizing of  
Decarburized End Connectors.

(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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REPORT

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ORE DRESSING AND METALLURGICAL LABORATORIES.

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An Investigation on the Recarburizing of  
Decarburized End Connectors.

Origin of Request and Object of Investigation:

On November 2nd, 1943, Dr. C. W. Drury, Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Toronto, Ontario, forwarded to these Laboratories one dozen decarburized end connectors. In an accompanying requisition (No. 733, AEDEB Lot No. 824, Report No. 13, Test 400), he requested that these end connectors be recarburized to give a recarburized layer of 0.50 per cent carbon.

Method of Recarburizing:

The method used for recarburizing the end connectors was taken from O.S.R.D. Report No. 1842 (Serial No. M-145), "Final Report on Improvement of Low Alloy Armour Steel, Part III - Control of Carbon in Carburized Zone of Face-Hardened Armour" written by C. H. Lorig, G. P. Krumlauf, P. C. Rosenthal and G. K. Manning.

The conclusion of the above report stated: "The maximum carbon content of a carburized case may be lowered by adding a silicon-bearing material and chloride to the carburizer. The effect of the combined additions is much greater than can be attributed to simple dilution."

This conclusion was reached after many experiments made with different mixtures of silicon-bearing material and chlorides. The results obtained with a 0.20 per cent carbon alloy steel were presented graphically, and the composition of the mixture used in the present investigation was selected from one curve which seemed to fit the requirements of the actual recarburizing.

This mixture was made in the following proportions:

8 per cent molasses-water binder (i.e., one part foundry molasses and four parts water);

20 per cent ferrosilicon (50 per cent silicon--ground to -200 mesh);

4 per cent nickelous chloride (commercial grade); and

68 per cent Houghton's Quicklight "A" carburizing compound.

The nickelous chloride was first dissolved in the molasses-water binder and this solution was added to the previously dried and mixed ferrosilicon and carburizing compound. The carburizing temperature was 1700° F., and carburizing times of 12, 20, and 28 hours were used.

Method of Sampling:

Every precaution was taken to get representative chemical samples.

The layers were removed from the flat portion of the end connectors. The end connectors were cut to fit tightly in the milling machine holder. The decarburized edges along the milled surface were removed. The piece was then leveled and the samples taken.

Results:<sup>o</sup>

Depth of layer, inches	Carbon Content, Per Cent				
	DECARBURIZED, i.e., "As Received"	RECARBURIZED			
		12 hours	20 hours	28 hours	
0.015	0.05	0.31	0.42	0.58	
0.025	0.04	0.33	0.38	0.57	
0.035	0.03	0.29	0.37	0.55	
0.045	0.10	0.23	0.35	0.54	
0.055	0.18	0.23	0.35	0.51	
0.065	0.20	0.24	0.34	0.50	
0.075	0.25	-	0.35	0.49	
0.085	0.26	-	0.37	0.49	
0.095	0.28	-	0.37	0.49	
0.105	0.29	-	0.37	0.48	
0.125	0.32	-	-	-	

<sup>o</sup> These results are also charted (see Page 5).

The carbon content of the end connectors was 0.41 per cent.

Discussion of Results:

The present investigation has shown that the depth of decarburization on the end connectors is much in excess of 0.05 inch. By extrapolating the curve No. 1 on the chart, it is seen that the depth of decarburization amounts to nearly 0.19 inch.

The method used to recarburize the end connectors definitely leads to acceptable results. The recarburizing times of 12 and 20 hours are too short, while 28 hours is excessive. An intermediate recarburizing time of 24 hours

(Discussion of Results, cont'd) -

would probably give the desired results.

This investigation has not confirmed the conclusion of the above report, that the carburizing time did not affect the maximum carbon content in the extreme layer. The only difference between the mixtures used was in the nickelous chloride. While the O.S.R.D. investigators used a C.P. nickelous chloride, a commercial grade (one-third as expensive) was used for the present experiment.

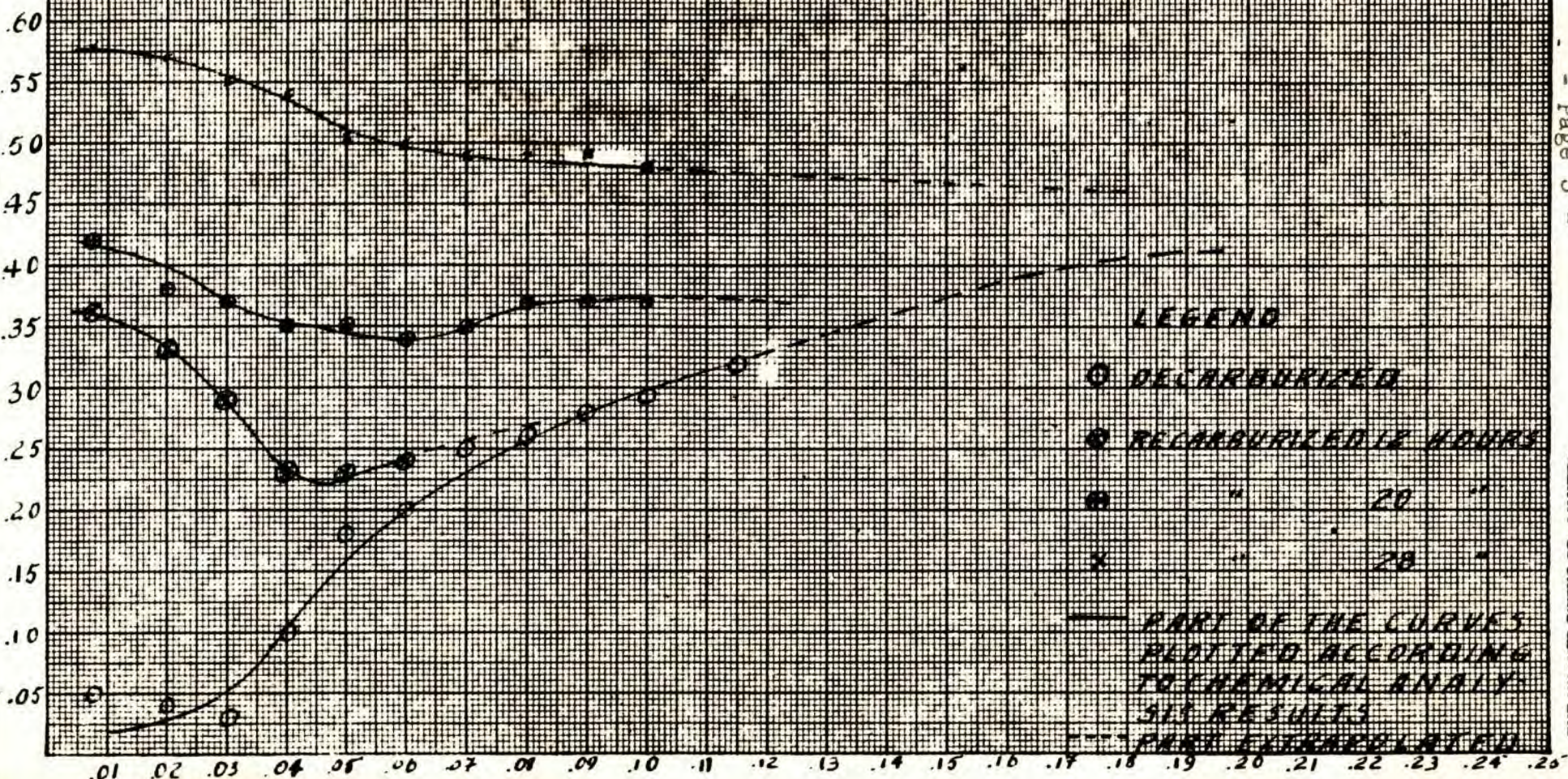
However, the maximum carbon content found in the present case, even with an excessive carburizing time, is not much beyond the specified limit of 0.5 per cent.

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AD:LB.

(Note: Page 5, following,  
is a chart)

# DEPTH-CARBON CONTENT RELATIONSHIP ON DECARBURIZED AND RECARBURIZED END CONNECTORS



**LEGEND**

- DECARBURIZED
- RECARBURIZED 12 HOURS
- " " 20 "
- × " " 28 "
- PART OF THE CURVES PLOTTED ACCORDING TO CHEMICAL ANALYSIS RESULTS
- - - PART EXTRAPOLATED