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August 17th, 1944.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1702.

Metallurgical Examination of Tracked Jeep Pins.

REPRODUCED FROM THE ORIGINAL BY THE NATIONAL ARCHIVES

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Origin of Material and Object of Investigation:

On July 3rd, 1944, the Detroit office of the Inspection Board of the United Kingdom and Canada requested (letter, File No. 50028 Can 217) a metallurgical examination of ten (10) Tracked Jeep pins. It was stated that the pins were made from SAE 9265 steel oil-quenched from 1625° F. and tempered to Rockwell 'C' 48 \pm 2. After heat treatment they had been straightened, centreless-ground, and Parco Lubrized.

Parco Lubrizing Process:

The Parco Lubrizing process produces an even black finish on the pins. Standard practice for Parco Lubrizing usually produces a coating (of from 0.0002 to 0.001 inch in thickness) which consists of an admixture of iron and manganese phosphate. The coating acts as a rust inhibitor but its chief function is to absorb and retain lubricant. After treatment, the parts or components being processed are dipped in soluble oil to which colloidal graphite is sometimes added.

Chemical Analysis:

One pin was softened and analysed. The analysis was as follows:

TABLE I.

		As Determined - Per Cent -	NE 9262 Specification
Carbon	-	0.52	0.55-0.60
Manganese	-	0.74	0.70-0.90
Phosphorus	-	0.018	0.040 max.
Sulphur	-	0.036	0.040 max.
Silicon	-	2.02	1.80-2.20
Chromium	-	0.28	0.25-0.40
Molybdenum	-	Trace.	---

Hardness Measurements:

Rockwell 'C' readings were made on the surface of five pins, both with and without the Parco Lubrite coating. The averages are listed in Table II.

TABLE II.

Pin No.	Average Rockwell 'C' Hardness *	
	With Coating	Without Coating
1	45	45.5
2	44	46.5
3	44.5	44
4	44	45
5	51	50

* The figures listed are the averages of five readings.

Rockwell 'C' readings were taken on transverse sections

(Hardness Measurements, cont'd) -

of all pins. The averages of three core readings are listed in Table III.

TABLE III.

<u>Pin No.</u>	<u>Hardness, Rockwell 'C'</u>
1	49
2	50
3	51
4	51
5	56
6	56
7	54.5
8	53
9	51.5
10	53

Hardness surveys were made on one transverse section (from Pin No. 3) with both Tukon and Vickers hardness testers, using 500-gram and 10-kilogram loads respectively. Results are shown in Table IV.

TABLE IV.

<u>TUKON SURVEY</u>		<u>VICKERS SURVEY</u>	
<u>Distance from :</u>	<u>:</u>	<u>Distance from :</u>	<u>:</u>
<u>edge, mm.</u>	<u>: Knoop</u>	<u>edge, mm.</u>	<u>: V.P.N.</u>
0.2	: 506	0.4	: 503
0.4	: 567	0.9	: 514
0.6	: 543	1.7	: 525
0.8	: 572	2.4	: 525
1.0	: 567	3.0	: 514
1.2	: 581	3.8	: 554
1.4	: 587	4.4	: 542
2.4	: 562	5.0	: 530
2.9	: 558	5.9	: 536
3.4	: 561	6.8	: 530

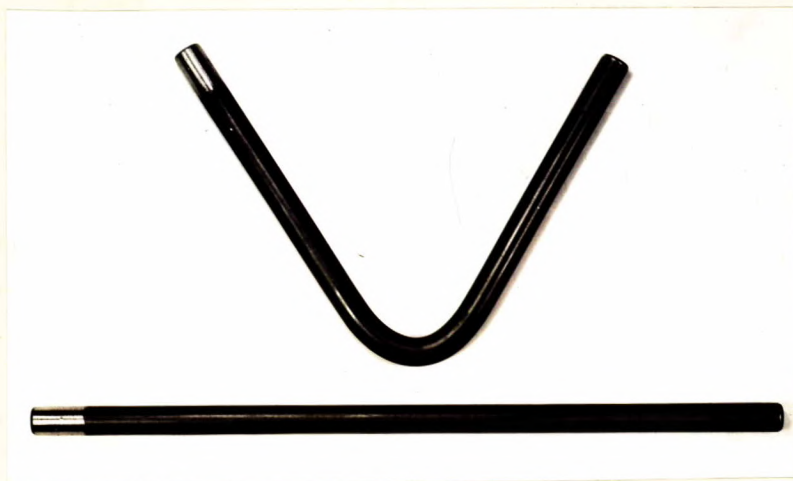
Physical Tests:

Two pins were subjected to a bend test on the Amstler Universal machine, using 4-inch centres and a $\frac{1}{2}$ -inch-radius block. Pin No. 1 did not break. It is shown in Figure 1.

(Continued on next page)

(Physical Tests, cont'd) -

Figure 1.



PIN NO. 1.

Deflection: 2.16 inches at
2,150 pounds.

The second pin, Pin No. 5, withstood 2,530 pounds before breaking. Total deflection in the two cases was:

<u>Pin No.</u>		<u>Core Hardness, Rockwell 'C'</u>	<u>Deflection, inches</u>	<u>Load, pounds</u>	<u>Remarks</u>
1	-	49	2.16	2,150	Unbroken.
5	-	56	1.33	2,530	Broken.

All the remaining pins were then subjected to an impact test on the C.D.P. drop impact machine, using 4-inch centres. The impact was increased from 50 foot-pounds to 400 foot-pounds, in 50 foot-pound increments. None of the pins broke. Results are shown in Table V.

TABLE V.

<u>Pin No.</u>		<u>Impact, foot-pounds</u>	<u>Deflection, inches</u>
2	-	50	5/16
3	-	100	11/16
4	-	150	7/8
6	-	200	15/16
7	-	250	15/16
8	-	300	15/16
9	-	350	31/32
10	-	400	1

(Micro-Examination:

There was no evidence of banding in the pins examined.

The structure was tempered martensite, as shown in Figure 2.

Figure 2.



X1000, nital etch.

TEMPERED MARTENSITE STRUCTURE.

Discussion:

The steel used in the pins resembled NE 9262, with a somewhat lower carbon content. Recently some trouble has been encountered with the precipitation of graphite in SAE 9255 pins. The addition of chromium (as in SAE 9262) would aid in the solution of the graphite.

The effect of Parco Lubrizing on pin performance can only be judged by field tests.

The higher hardness of Pins Nos. 5 and 6 might be caused by improper tempering. It appears that the producer was trying to control his draw temperature to produce the proper surface hardness.

Conclusions:

1. From the tests conducted, the pins appear to have excellent physical properties although the hardness is apparently out of control.
2. The pins are satisfactory metallurgically and chemically, even though they are NE 9262 steel rather than the SAE 9265 specified.

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