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OTTAWA May 4th, 1943.

REPORT

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1402.

Investigation of NE 8620 Universal
Carrier Track Pins.

(Copy No. [illegible].)

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 Material and Object of Investigation:

On April 19th, 1943, twenty-four NE 8620 Universal Carrier track pins were received from Allied Products Limited, Detroit, Michigan, for investigation. It was requested by the Deputy Director of Inspection, Inspection Board of United Kingdom and Canada, Detroit, Michigan,[@] that these pins be given a thorough examination, since this was a new grade of steel being used by this firm for the first time.

[@] Letter dated April 17th, File No. T/10/C/1.

Specification O.A. 214:

The specification limits for the Universal Carrier track pins are:

Surface hardness	-	650 V.P.N. minimum.
Core hardness	-	24 to 32 Rockwell 'C' (optional in U.S.A.).
Case depth	-	0.012 to 0.020 inch.
Bend deflection	-	0.250-inch deflection prior to the first crack in the case.
Drop impact	-	Pins have to withstand 45 foot pounds without fracturing.

Chemical Analysis:

		As found	Specification NE 8620
		- Per	cent -
Carbon	-	0.21	0.18-0.23
Manganese	-	0.74	0.70-0.95
Silicon	-	0.22	0.20-0.35
Phosphorus	-	0.016	0.040 max.
Sulphur	-	0.020	0.040 max.
Nickel	-	0.52	0.40-0.60
Chromium	-	0.46	0.40-0.60
Molybdenum	-	0.17	0.15-0.25

Physical Tests:

A tensile specimen, 0.252 inch in diameter, was machined from the core of a pin. The elongation was taken for 1-inch gauge length.

Tensile strength	-	150,000 p.s.i.
0.1% proof stress	-	85,000 "
Elongation	-	19 per cent.
Reduction of area	-	54 "

Bend Tests:

Bend tests were carried out using the Amsler Universal testing machine. A 12-inch radius and 8-inch centres were used. An extensometer was employed to denote the deflection in inches. Table I indicates the results obtained.

(Continued on next page)

(Bend Tests, cont'd) -

Table I.

Pin No.		Deflection at first crack, in inches	Load at first crack, in pounds	Load at break, in pounds
6	-	0.420	800	1,400
7	-	0.490	850	1,400
8	-	0.230	550	1,300
9	-	0.537	850	1,325

Drop Impact Tests:

Drop impact tests were made on the pins. Six pins were tried and all passed the test. Cracks, however, were seen on the surface. Figure 1 illustrates the six pins which were tested. These have been magnafluxed to show the cracks more clearly.

Figure 1.

MAGNAFLUXED PINS AFTER IMPACT TEST.

Case Depth:

Six pins were tested for case depth, using a Brinell microscope on etched transverse microspecimens. The results were:

Inches
0.016
0.014
0.014
0.014
0.016
0.014

Hardness:

Surface hardness and core hardness of six pins are shown in Table II. The Vickers machine and a 10-kg. load were used.

Table II.

Pin No.		Surface hardness	Core hardness
1	-	715-752	322
2	-	579-634	376-417
3	-	724-762	350
4	-	743-813	401-421
5	-	599-724	323
6	-	743-847	383

Depth Hardness:

A transverse microspecimen was cut from one pin and polished. Hardness readings were taken across the face and depth-hardness curve plotted. Figure 2 illustrates this curve.

Figure 2 is on Page 5.
Text is resumed on Page 6.

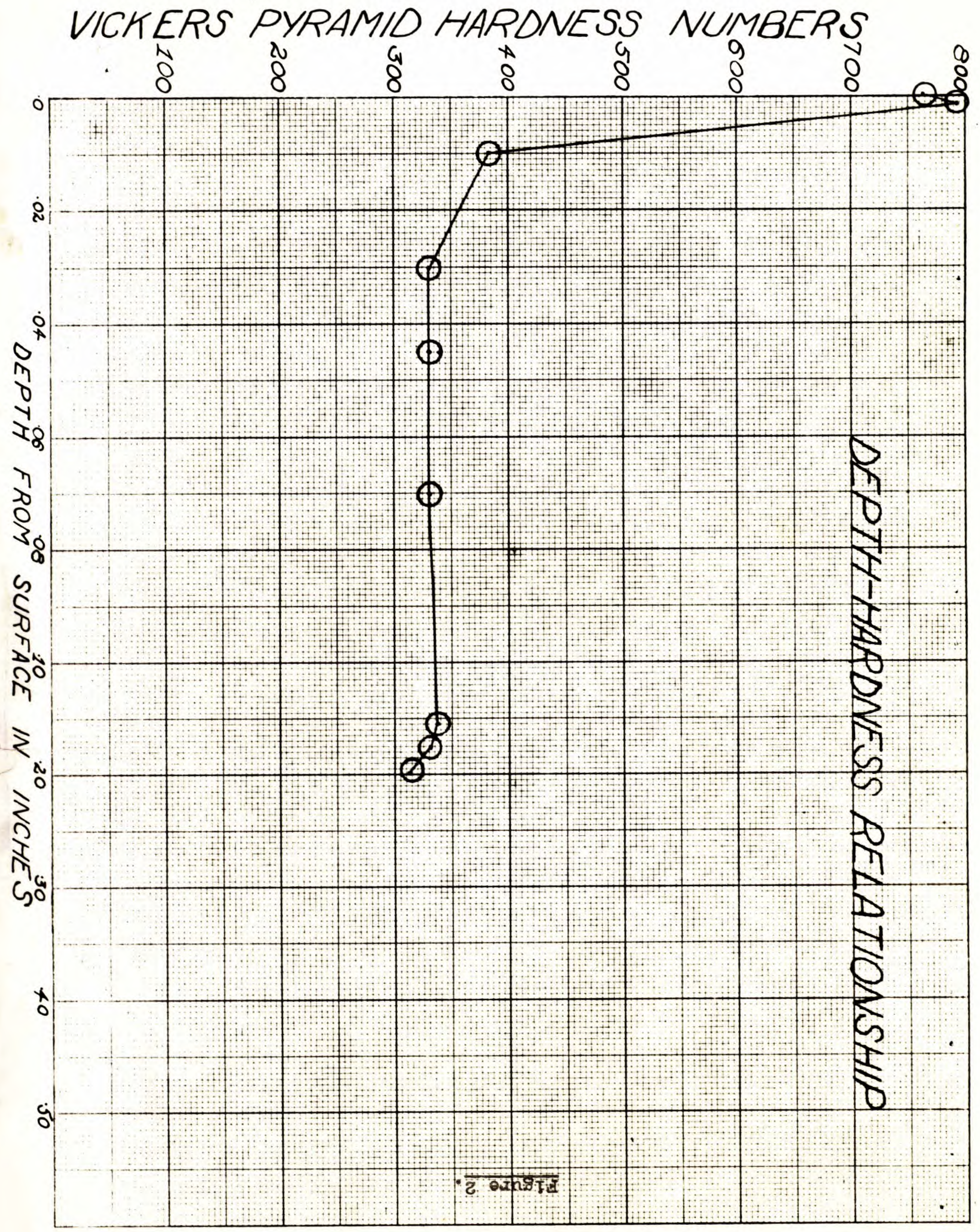

VICKERS PYRAMID HARDNESS NUMBERS
100
200
300
400
500
600
700
800
DEPTH FROM SURFACE IN INCHES
0
.02
.04
.06
.08
.10
.20
.30
.40
.50
DEPTH-HARDNESS RELATIONSHIP

Figure 2.

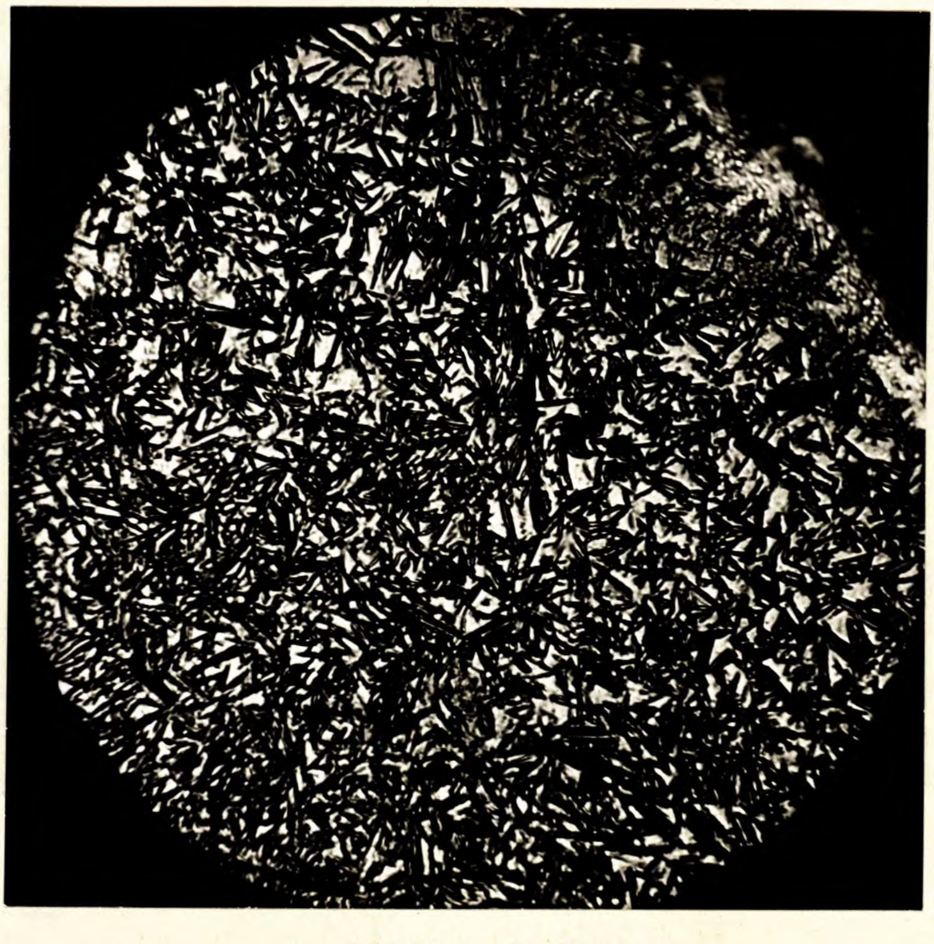
Microscopic Examination:

A transverse specimen cut from a pin was polished and then etched in 2 per cent nital. Figures 3 and 4, photomicrographs at X500 and X1000 magnification of the core and case respectively, illustrate the structure obtained. Figure 4 was taken at the surface.

Figure 3.

X500, nital etch.
CORE OF PIN.

Figure 4.



X1000, nital etch.
STRUCTURE OF CASE. - White constituent is retained austenite. Note coarsely acicular structure.

Discussion:

The chemical analysis conforms to the specification limits of NE 8620.

Excellent core physicals have been obtained.

The pins passed the bend test, showing good elasticity of the case. A load of 1300 to 1400 pounds was necessary to fracture them.

The pins passed the drop impact test. Cracks were seen on each pin after the test. This is normal, as most hard cased pins tested in these Laboratories have usually shown cracks on the surface after being subjected to the test.

Satisfactory case depth has been obtained.

The pins investigated in this report have hard cores, which are outside of the hardness limits as specified in Canada. By passing the other tests required by the specification they have shown that a satisfactory pin has been produced. It is felt that these pins should give good service.

The retained austenite and the coarsely acicular structure of the case indicate that the pins were quenched from a high temperature.

CONCLUSIONS:

1. The chemical analysis corresponds to the specification limits for NE 8620 steel.

2. Excellent core physicals have been obtained.

3. The pins passed the bend test requirements.

4. The pins passed the impact test.

5. A satisfactory case depth was obtained.

(Continued on next page)

(Conclusions, cont'd) -

6. High core hardness is evident.

7. Structure indicates quenching from a high temperature.

8. These pins should give good service.

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SLG:GHB.