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O T T A W A March 17th, 1943.

R E P O R T

of the

ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1369.

Investigation of Canadian Acme Screw and
Gear Universal Carrier Track Pins.

(Copy No. 13.)

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 February 16th, 1943, under Requisition No. 382, A.E.D.B. Lot No. 419, Report 9 Section A Test 21, Dr. C. W. Drury, Director of Metallurgy, Army Engineering Design Branch, Department of Munitions and Supply, Ottawa, Ontario, submitted twelve Universal carrier track pins for examination. It was reported that these were representative of 4,800 SAE 2115 pins, produced by Canadian Acme Screw and Gear Ltd., Toronto, Ontario, that were rejected by the Ford Motor Company of Canada because of failure to comply with the specified impact test of 45 foot-pounds.

Specification for Universal Carrier Cased Pins:

Core Hardness - 250 to 315 V.P.N.

Depth of Case - 0.012 to 0.020 inch in thickness.

The depth of case to be measured as from the surface of the pin to the point of colour change after the pin has been etched.

Bend -

The pin must give a minimum deflection of 0.25 inch without the case cracking.

Impact Resistance -

Pins should withstand a force of 45 foot-pounds.

Grain Size -

The steel should be 6-8 McQuaid-Ehn grain size.

Chemical Analysis:

Drillings were taken from the core of one pin and a complete analysis was made.

	As found	SAE 2115
	Per cent	
Carbon	0.10	0.10-0.20
Manganese	0.41	0.30-0.60
Silicon	0.26	0.15 min.
Sulphur	0.016	0.050 max.
Phosphorus	0.008	0.040 max.
Chromium	0.05	0.30 max. optional.
Nickel	1.57	1.25-1.75

0.003 inch was ground off the case of one pin and this material was analysed for nitrogen content. This was found to be 0.028 per cent.

Physical Properties:

A 0.252-inch-diameter tensile specimen was taken from the core of a pin and pulled on the Baldwin-Southwark tensile testing machine.

(Continued on next page)

(Physical Properties, cont'd) -

Tensile strength, p.s.i.	=	99,600
0.1 per cent proof stress, p.s.i.	=	61,200
Elongation in 1 inch, per cent	=	22
Reduction of area, per cent	=	66
Rockwell "B" hardness	=	93.5

Bend Tests:

Two pins were subjected to the specified bend test. The Amsler Universal machine was used and an extensometer was attached to denote when the 0.250-inch deflection was reached. Both pins passed this test and withstood up to 1,250 pounds pressure without breaking in two.

Impact Tests:

Four of the twelve pins were subjected to the specified impact test and one failed. A pin which had been water-quenched in these laboratories was also tested and it broke. Table I shows core hardness (taken on Vickers machine, 10-kg. load) and case depth of the pins subjected to the impact test.

Table I.

Condition of Pin	Core Hardness, V.P.N.	Case Depth, in inches	Impact Test Results
As received	264	0.016	Passed.
As received	331	0.032	Failed.
As received	232	0.020	Passed.
As received	262	0.020	Passed.
Re-heat treated*	193	0.016	Passed.
Re-heat treated**	227	0.016	Passed.
Re-heat treated**	283	0.030	Failed

* Heated in neutral atmosphere to 1600° F. and oil quenched.

** Heated in neutral atmosphere to 1600° F., water quenched, and given a stress-relieve draw at 300° F.

The carbon content of the 331 V.P.N. pin above was 0.11 per cent. A pin having 240 core hardness was found to have 0.085 per cent carbon.

Grain Size:

The McQuaid-Ehn grain size was 7-8.

Microscopic Examination:

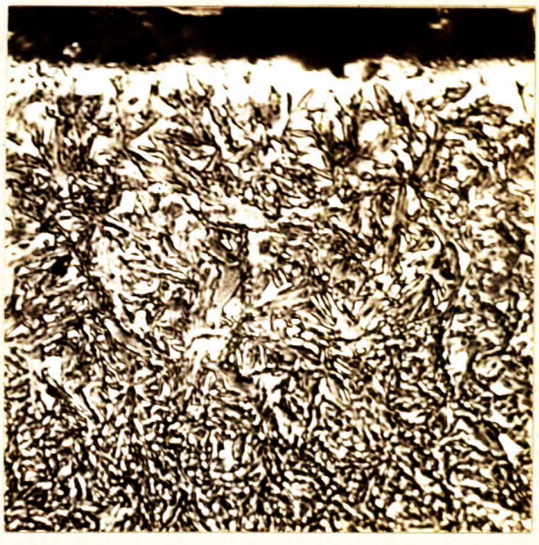
A transverse microspecimen was cut from a pin and examined under the microscope. The unetched specimen showed that the steel was quite clean. The nital-etched specimen showed the structures of the case and core shown below in Figures 1 and 2.

Figure 1.

X500, nital etch.

CORE OF PIN.

Figure 2.



X1000, nital etch.

CASE OF PIN.

Discussion:

The steel conforms to the limits set by the specification for SAE 2115 steel. The carbon content is at the lower limit. Analysis of three different pins indicates that the carbon varies from 0.085 to 0.11 per cent for this heat of steel.

The core hardnesses of the pins varied from 230 to 331 V.P.N. It was thought that the firm was not getting the

(Discussion, cont'd) -

maximum core hardness possible on a water quench, perhaps due to quenching from below the upper critical temperature. A piece taken from one of the pins was water-quenched from 1600° F., and gave 396 V.P.N. (10-kg. load). Another pin when subjected to the same treatment gave only 283 V.P.N. This indicates that it is not always possible to obtain the high result shown above; in fact, the high hardness may be unusual and due to this pin's having some characteristic difference. Unfortunately, not enough of the high-hardness pin was available for carbon and chromium determinations.

One out of four 'as received' pins failed on impact. This pin had 0.032-inch case depth and 331 V.P.N. core hardness. The re-heat treated, water-quenched pin which failed in impact had 0.030-inch case depth.

The pins passed the bend test minimum deflection of 0.250 inch.

The white fringe at the surface of the pins is a characteristic of those produced by this firm. It is felt that this may be retained austenite. The nitrogen content of the case is normal for cyanided cases.

CONCLUSIONS:

1. Some of the pins fail the specified

   (a) impact test,
   (b) case depth,
   (c) core hardness.

2. The two pins which failed the impact test had thick cases.

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(Conclusions, cont'd) -

3. Core hardnesses varied from 230 to 331 V.P.N. on the eight pins tested.

4. The two pins tested for bend deflection were satisfactory.

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SLG:GHB.