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METALLURGICAL EXAMINATION OF WORN SNUBBING CASTER SUPPORT SHAFT

by

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PHYSICAL METALLURGY DIVISION

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C.M. Webster* and R.D. McDonald**

SUMMARY

A worn snubbing caster support shaft was examined to determine if it had been made to the manufacturing specifications.

It was found that the shaft did not comply with the chemical or heat treatment requirements. The variation from the chemical specification was slight and not considered serious in this application. The failure of the shaft, however, was attributed to an improper case-hardening heat treatment.

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INTRODUCTION

On April 15, 1964, Mr. J.W. Moody, Superintendent of the Research and Development Division, Engineering Branch, Post Office Department, Ottawa, submitted a worn snubbing caster support shaft which had been removed from their experimental, semi-automated processing equipment at Winnipeg, Manitoba.

Subsequent to our discussion with Mr. Moody a letter was received on April 16, 1964 (ref: Canada Post Office 37-80-62-17), from Mr. J.N. Craig, Director, Engineering Branch, requesting that a metallurgical examination be carried out on the shaft to determine whether it had been manufactured to specification. The manufacturing specifications outlined in the letter called for EN32B steel, case-hardened to 700 VPN (60 R_c) minumum hardness.

VISUAL EXAMINATION

The snubbing shaft shown in Figure 1 was 7 in. long and 1 in. in diameter. Wear to a depth of 0.085 in. had occurred on one side of the shaft. The wear began 1 in. in from one end and extended for a distance of 2-1/4 in. along the shaft.

CHEMICAL ANALYSES

Chemical analyses were carried out on drillings taken from the shaft. The results are shown in Table 1, and the chemical specification for Grade EN32B steel is included for comparison.

TABLE 1

Chemical Composition (Per Cent)

Element	Shaft*	Spec. EN32B
Carbon	0.15	0.10 - 0.18
Manganese	0.49	0.70 - 1.10
Sulphur	0.040	0.070 max
Phosphorous	0.024	0.050 max
Silicon	0.07	0.050 - 0.35

The chemical composition of the shaft corresponds to an SAE 1015 grade of steel.

* - Steel Control Laboratory Report #507.

SURFACE HARDNESS DETERMINATIONS

Surface hardness determinations showed a uniform hardness of Rockwell "B" 84-85 over the entire length of the shaft.

METALLOGRAPHIC EXAMINATION

A specimen was cut from the worn region of the shaft, so that the worn and unworn surfaces could be examined microscopically. The microstructure, shown in Figure 2, resembles that which is developed by a normalizing treatment. There was no evidence that a case carburizing or hardening treatment had been carried out on this shaft.

DISCUSSION

The chemical analyses showed that the manganese a[redacted] does not comply with the specifications. This does not appear to be important in this instance, although the higher manganese would be expected to provide a stronger and tougher core material. However, the lack of wear resistance is preeminent in this failure and is attributed to the lack of a case-hardening treatment. The grade of steel indicated by the composition is a case-hardenable grade and, with a correctly case-hardened surface, should have prevented the failure.

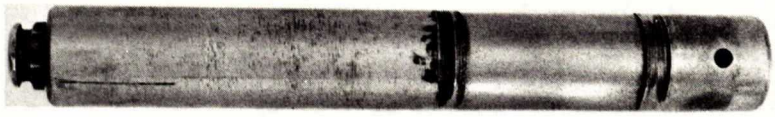
CONCLUSION

1. The steel supplied did not meet the chemical specification for grade EN32B steel.

2. The surface of the shaft had not been carburized and hardened as required by the manufacturing specifications.

3. The shafting material used would not have failed in this manner if it had been correctly case-hardened.

CMW: RDM:ac



(Approx. 1/2 actual size)
Figure 1. Snubbing shaft as-received showing worn area.

(a)
Etched 2% nital - X100

(b)
Etched 2% nital - X100

Figure 2. (a) Unworn surface not carburized
(b) Worn surface showing worked metal.