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## An unusual gearbox pinion failure

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### ABSTRACT

Two large gearboxes were installed to power a bulk conveyor at a mine site. Upon start-up, failure of the final drive pinion occurred in one gearbox after 43 s when maximum torque was reached. The failure was unusual as fracture in the pinion was approximately at right angles to the pinion axis, in the centre of the pinion. The pinion was forged and integral with its supporting shaft. The initial suspicion was of hydrogen embrittlement, however analysis identified a pattern of inclusions in the centre of the pinion. In consequence, the cause of failure was attributed to improper control of the casting and forging processes used in the manufacture of the pinion blank.

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## 1. Introduction

Two nominally identical gearboxes were supplied to a coal mine site to drive a coal conveyor. They were driven by two separate electric motors.

When the system was started following installation it suffered catastrophic failure after 43 s. Fig. 1 shows the record of torque versus time for the two gearboxes (1 and 2). When gearbox 1 reached maximum torque, the torque on gearbox 2 had reached approximately one quarter of the maximum, and the system shut down. The final stage pinion on gearbox 1 was determined to have failed.

Fig. 2 shows the schematic arrangement of a gearbox, the darker grey indicating the final drive pinion that failed in gearbox 1, while Fig. 3 shows a drawing of the final stage pinion on the shaft driven by the 2nd stage wheel, and the dotted line indicates the approximate plane of fracture, although it was actually slightly off from being at right angles to the shaft.

Limited information was available concerning the production of the gears. During the investigation it was indicated that the two integral shafts and pinions, of which one had failed, were produced from the same billet of steel. Also, it was reported that the steel for the various ingots used was not vacuum degassed, and that the gears had been hot forged, while shafts were from continuously cast steel.

## 2. Examination of failed and unfailed gearboxes

Both gearboxes were examined, initially nondestructive testing being conducted on all components followed by metallurgical examination to determine the cause of the failure.

Views of the fracture surfaces of the final stage pinion are shown in Figs. 4 and 5 and an area where fracture might have initiated is shown in Fig. 6, based on the relatively smooth and flat geometry.

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