



Review

Failure of a motor vessel's crankshaft 1968



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ABSTRACT

In July 1968 the Swedish motor vessel “MV Stureholm” traveled from Sweden across the North Atlantic with destination to the American gulf harbours. MV Stureholm was a freighter with 9700 tdw build in 1957 by a German shipyard. About 100 nautical miles north of the peninsula Yucatan the 9,000 HP diesel engine failed as a consequence of fatigue failure of the crankshaft. The ship was disabled and had to be towed to Veracruz, Mexico. The Swedish shipowning company decided to perform a temporary repair in Veracruz by welding the fatigue crack. Towing the motor vessel back to Sweden would have been too expensive.

Back in Sweden the damaged but repaired crankshaft was dismantled from the engine and inspected by surveyors. The result was that a fatigue crack had initiated from a subsurface solidification (hot) crack. The latter was formed during the solidification of the casting process. Before delivering the casted crankshaft to the engine manufacturer this crack was repaired by a so called “weld for fabrication”, which is a common procedure for large casted components. Unfortunately the repair weld was not appropriate in such a manner that the hot crack was only welded on its surface for a depth of 10 mm, the entire crack depth however was about 30 mm.

The shipowning company evaluated its amount of financial loss to 266,000 USD and filed a complaint at the German regional court in Düsseldorf against the German engine's manufacturer. The defendant contradicted the thesis of the Swedish surveyor, and the court of law entrusted (Federal Institute for Material's Research an Testing, a non commercial sovereign institute) BAM to carry out an independent survey report.

BAM survey report, predominantly based on metallographic analyses, stated the Swedish conclusions as applicable and moreover confirmed the results of the fracture mechanics based crack propagation calculations which are explaining a very slow crack propagation and a fast final failure even after more than 10^8 load cycles.

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1. Introduction

1.1. Historical background

MV Stureholm, see Fig. 1, was a 9700 tdw cargo ship built by a German shipyard and commissioned on October 7th in 1957. It operated under the Swedish flag and it was also used for schooling of sailors and therefore especially thorough maintenance and service was performed. The freighter was equipped with a t7 cylinder two stroke 9000 HP diesel engine with 120 rpm, built by a German manufacturer. Maximum speed was 17 kn. The engine's data are taken from the original court files. However, different declarations are to be found in internet.

1.2. Description of failure event

On 5th of July 1968 the freighter was travelling from Europe to Mexico and the American gulf harbors, carrying packaged goods. About 100 sm (nautical miles) north of the peninsula Yucatan in the Caribbean Sea unexpected engine sounds could be heard. The sound was located coming from the fourth engine crankcase which was also knocking strongly. The travelling speed was reduced and the engine stopped and then the fourth crankcase was examined, however no failure could be detected. Injection nozzles and pump were replaced and then travelling with slow speed was continued. The sound and knocking of the engine did not stop so the adjacent crankcase of the third cylinder was inspected.

A failure in one web of the assembled crankshaft made from cast steel became apparent, see Fig. 2. Surprisingly the engine had run for nearly 12 h with this broken crankshaft. Due to this, the original fracture surfaces were partly destroyed with the consequence that the clearance at their edges was about 30 mm. Fortunately, neither the stand nor the bearings were

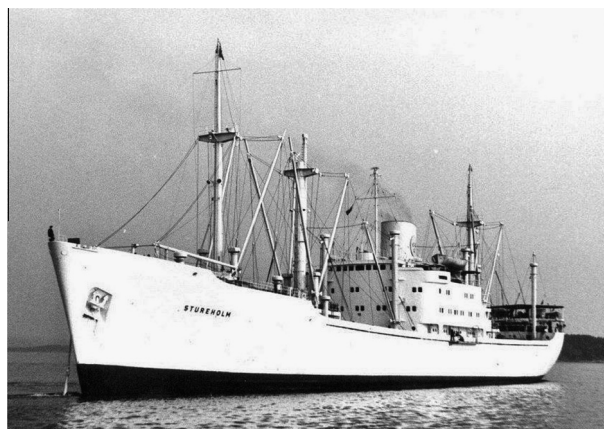


Fig. 1. View of MV Stureholm.

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