# Renewing a Crankshaft After Engine Over Speed.

This describes the replacement of the crankshaft on a 9 cylinder MAN L58/64 engine (580mm bore, 640mm stroke) after the engine over sped and bent the crankshaft.

The over speed occurred as a result of a combination of factors from which lessons should be learned. The fuel rack operating arm became detached from the governor control arm because the nut securing it had vibrated loose and eventually fallen off. (see photo opposite).

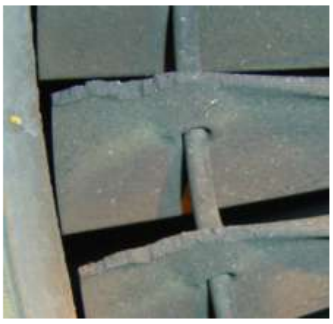
Normally, if this engine over speeds for any reason (sudden declutching whilst on load etc), then at 15% over speed the electronic part of the governor receives a minimum fuel signal and at the same time a signal causes the hydraulic actuator power cylinder to drain, both of which should zero the fuel racks. Of course, because the governor had become disconnected, although they operated, neither had any effect.

To comply with class rules there is also a secondary shut down, independent of the governor. On this engine it consisted of a valve operated by a solenoid from the engine control system or by a pushbuttons located on the valve side, the governor, and remotely in the control room. Operation of this valve allows air at 30 bar from the start air system to operate a piston which will zero the fuel racks..

When the governor linkage became disconnected, the engine fuel pumps delivered maximum fuel. The engine speed began to rise, from a normal 428rpm to 491 (15% above) At this speed the clutch disengaged, but the trips did not operate. Because the load came off the engine as the clutch disengaged, the engine speed increased further out of control. Manual operation of the trip button in the control room had no effect. After about 40 seconds, the engine finally stalled, probably due to failure of, and damage to the valve control gear. It is estimated that it reached a speed of between 850 and 900RPM before it stalled. Fortunately, no parts became detached during the over speed and no one was injured.

The reason that the independent shut down did not operate was that although the valve received the signal, it had not been correctly installed. The valve is the same type as is used to initiate the air start sequence, and it is the blanking off, or opening of ports using plugs which determine the function of the valve. This valve, which was a replacement for the original, had been set up as a start valve, and therefore did not operate. Testing of the over speed shut downs was done by simulation. The engine was run at normal speed and then by pressing a test button, the over speed set point was reduced by 15% and the control system shut the engine down. There was no independent test of the secondary system, so although the engine was shutting down from the governor, the zeroing of the fuel racks by the pneumatic cylinder was not tested.

Although the engine was in one piece, on further investigation the crankshaft was found to be bent and it had suffered damage and cracking on some of the bottom journals which had overheated, causing excessive hardness. The valve gear on all the units was damaged, the rocker box covers holed, and the turbocharger blading had been damaged.



The Crankshaft along with all damaged parts were going to have to be replaced. It was decided to do the job without taking the vessel out of service as the engine was one of a multi engine installation, although lifting of the engine for removal and replacement of the crankshaft would be done whilst the vessel was alongside.

The cylinder heads were taken off, pistons, conrods, and liners withdrawn, crankshaft counterweights, the exhaust sections, turbocharger, air cooler, air manifold, flywheel and vibration damper were removed. All but three main bearing caps were lowered into the crankpit, and all pipework and electrical connections disconnected. The holding down bolts were removed.

**Engine Stripped down**

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The Crankshaft was supported from chainblocks mounted on plates secured to the cylinder head studs as shown opposite. The remaining bearing caps were removed and lowered into the crankpit.

The lift of the engine frame then began. The engine was initially raised on jacking bolts and the first jacks inserted. As the photos show the jacking was done in stages.

The Crankshaft was then lifted out of the engine room. This was a tricky operation which involved enlarging a hatch and removing pipework. There was literally only a few mm to spare. The new crankshaft which had been delivered by lorry from MAN B&W to the quayside was lowered down in a similar manner and slid into the engine.

The engine was then reassembled, alignment checked, and after all checks and tests, started and followed a running in procedure. The whole process had taken 40 days from the overspeed. After commissioning the engine entered service.

However, a few days later the engine had to be taken out of service again due to a high oil mist alarm. Following this all liners were renewed and it was during this time that it was discovered that the camshaft hardness had been affected by the overspeed and in fact suffered damage. This meant sections of the camshaft had to be replaced, but that's another story.....