AN INDEPENDENT APPROACH MATTERS

REPLACE OR REPAIR?

A COMPARISON OF ACTIVITIES, ROUGH COSTS AND DOWNTIME

ANNEALING SAVES CONDEMNED CRANKSHAFT

SHIP ENGINE: Containership with MAN 6L48/60
Journal Diameter Pre-Machining: 415mm
Final Journal Diameter: 410mm
Max Hardness Pre-Annealing: ~700 HB
Max Hardness Post-Annealing: <300HB

THE REPAIR:
Goltens was called upon to inspect and perform magnaflux and hardness tests. The run out on the shaft was 0.11mm versus a maximum of 0.09mm as allowed by MAN. Hardness values were also well beyond the maker’s limits. Cracks did not penetrate below the 5mm undersize — the smallest diameter for which standard undersized bearings were available. Goltens informed the owner that the crankshaft could be saved at -5mm — despite the surface cracking, slight bend and excessive hardness resulting from the casualty — via annealing and peening of the shaft. Subsequent inspection by the engine maker confirmed the previous findings. However, since MAN does not approve of annealing and peening to reduce hardness and straighten its crankshafts, the shaft was condemned by the maker.

THE DECISION:
Goltens machined the crankshaft to -4mm to evaluate the condition of the shaft. It was determined that the hard spots did not lessen — in fact, they became worse. All of the surface cracks were removed, with the exception of a few that could be locally ground and not exceed the -5mm target. Goltens was now confident that they could salvage the crankshaft at -5mm. Due to excessive hardness on the journal and the requirement to peen the shaft to straighten it, Goltens worked closely with Germanischer Lloyd (GL) to gain approval for a slight process modification to proceed with the annealing and peening of the shaft to restore it to the required tolerances.

THE RESULT:
Final inspections were verified by both owner and class and upon installation and additional work. The engine could be restored to operation, a costly crankshaft replacement had been avoided.

CRANKSHAFT CAN BE REPAIRED
Annealing and Straightening Approved by Class

Result for customer: CLASS-APPROVED REPAIR AND OPERATIONAL ENGINE
Cost: <200K USD
DOWNTIME: 2-3 Weeks

CRANKSHAFT MUST BE REPLACED
If annealing and straightening are not approved by Maker / Class

Replacement Activities:
- Crankshaft purchase/delivery (delivery of new crankshaft often takes multiple months)
- Full disassembly of engine to remove condemned shaft (full diesel team of 5-7 men for around two weeks)
- Rigging of condemned shaft from engine room (which often requires cutting holes in hull (welders and riggers))

Result for customer: CLASS-APPROVED REPAIR AND OPERATIONAL ENGINE

CRANKSHAFT PURCHASE AND REPLACEMENT COST:
1,500K USD approximately

DOWNTIME: Multiple months

INSPECTION AND SURVEY PHASE:
The inspection results are the same but the approach pursued dictates whether the owner/insurer are going to undertake a cost and time efficient repair or be subjected to a costly and time consuming crankshaft replacement.

INSPECTION RESULTS:
- Crankshaft has surface cracks that do not penetrate below max standard undersize (ex: -5mm).
- Crankshaft has hardness above maker limits and expected to penetrate below maximum journal undersize.
- Run-out checks show bend in crankshaft beyond maker limits.

REPAIR ACTIVITIES:
- Crankshaft machining and annealing equipment shipped to site
- In-situ machinist machines cracks from surface of crankpin
- Disassembly of adjacent main bearings and pistons
- Crankshaft is annealed to reduce hardness
- Crankshaft is finish machined and polished to final diameter
- Bearings reinstalled and affected cylinders reassembled
- Engine oversized and restored to operation

Decision Point: Pursue Annealing or Replace crankshaft?

Cost:
- Crankshaft Purchase
- Replacement Cost: 1,500K USD

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