

INTEROFFICE MEMORANDUM

SUBJECT DIESEL CRANKSHAFT FILLETS,  
PEENING

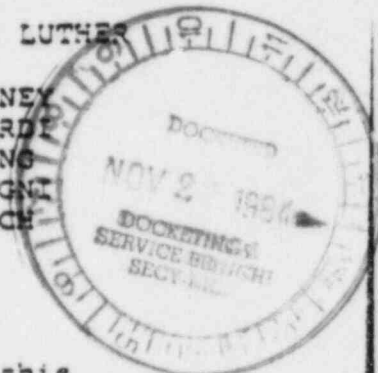
TO D. E. ELLIS

LOG NO. 11600.37

DATE SEPTEMBER 20, 1983

FROM GARY V. LUTHER

CC M. KEARNEY  
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FILE



Preliminary analysis performed by FaAA (as of this date) finds that the lower 1/3 of the reentry fillet at the crankshaft pin junction is the most critical area with respect to crankshaft failure. The reasons given are:

- (1) High stress at loading (the crankshaft may be near a harmonic at its loaded running speed.
- (2) A residual stress (determined by x-ray diffraction) at the fillets caused apparently by machining.
- (3) Surface finish at the fillets. Although the finish does not appear to be rough to the naked eye (or by feel), I have seen scanning electron microscope photographs of cracks in initial stages of propagation. The cracks appear to be initiating at one of the radially machined "valleys" of the fillet.

In order to reduce the residual tensile stresses at the fillet (and also to reduce the degree of valley alignment with the primary tensile stress planes), we have specified peening to be performed (at TDI).

However, review of the as-received cranks found that they were inadequately peened at locations of interest (to FaAA) e.g. the lower 1/3 of the fillet. FaAA recommended that the peening be redone by a "Metal Improvement Co.", specialists in controlled peening.

MIC already performs peening to crankshaft fillets for other diesel manufacturers.

MIC's equipment was transported to the site and the peening was performed in a building erected to house the crankshaft.

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MIC reported that the fatigue life of a properly peened crankshaft can be increased by 100% by proper peening.

#### QC Checks - Peening

100% peening is defined as areas where the surface is totally dimpled. They have invented a "peenscan method" to verify 100% peened surfaces. The process utilizes an ultraviolet solution (the process is somewhat similar to a UV magnaflux check) which the UV sensitive solution is applied to the area to be peened. 100% peening is defined by a total removal of the ultraviolet sensitive solution. An ultraviolet light is used to verify its removal.

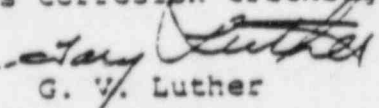
#### MIC-GL - Conversations

I questioned the MIC engineer on repeening previously peened surfaces and his reply was that peening typically becomes detrimental to fatigue life only if the peening abrades a critical section. He also stated that their equipment is designed for accessibility and control and that their operators are experienced enough so that abrasion of peened sections is not a problem.

Attached is a sample of MIC's shot; you will note its uniformly round geometry which is much "better" than commercial cleaning shot. The tape which the shot is attached to is similar to duct tape and is used for masking areas specified as not to be peened.

Overall, I was impressed with the company's control and expertise. The company essentially wrote MIL-S-13165 (which we invoked on the crankshaft). MIL-S-13165 is much more definitive overall in the peening process than any SAE specification I have seen. I requested that they send a product brochure to Boston describing their processes and any data they have concerning the beneficial effects for other applications.

Other applications they cited may be reduction of residual stress on turbine shafts, and reduction of residual tensile stresses where stress corrosion cracking is a concern.

  
G. V. Luther

P.S. The new crankshafts reentry fillet geometry is much better than the old one.