

CHAPTER 8

RECOMMENDATIONS

1. To implement “no-oil” hot tests on the production line of an engine manufacturing facility, on a permanent basis, this study would have to be expanded to include small four-stroke, horizontal shaft engines also. A study of horizontal engines might bring up new concerns that might have to be addressed differently. For example, semi-automatic equipment is currently used on the production line to pre-treat both horizontal and vertical engines. It appears only natural that any changes in such equipment / procedures that are made to carry out “no-oil” tests, for vertical shaft engines, would have to be relevant for all engines manufactured at that facility.
2. Further exhaustive testing should be carried out on the four-stroke minimum bearing clearance engines using the lubricants that have exhibited superior tribological properties, to ultimately select the lubricant(s) to be tested on the production line. At least three tests each on the TVS, LEV and VLV series engines are recommended for each lubricant.
3. Wear of the connecting rod bushing has to be quantified to better evaluate the efficacy of the lubricants in preventing scuffing at this interface (which has proved to be the critical one in the tests). Though the photographs of the connecting rod bushing were taken

prior to and after each test to visually evaluate scuffing at that interface, it might be worthwhile to cut-up the bushing into several small pieces after the test and take their surface profile on the alpha step 500 profilometer. A few unused bushings have to be subjected to this routine to act as a reference.

For this purpose, a small, light vice could be made (probably out of aluminum) to hold the bushing pieces for obtaining its surface profile. Furthermore, the stylus on the alpha step 500 profilometer has to be checked periodically for wear of/damage to the stylus tip. This could be achieved by periodically measuring the worn track on a reference specimen by using the same customized 'recipe' (or program - saved on the profilometer). Considerable deviation of the wear track results from the previous would indicate either a worn stylus tip or damage to the same.

4. Photomacrographs and SEM photographs of pertinent interfaces have to be taken to further assist in evaluating the scuffing that has occurred and to better compare the components of one test to another.
5. The design of the T-11 pin-on-disk device is suitable to carry tests only for lubricants with the same or similar viscosity and tackiness. It would be absurd to try to compare the tribological properties of fluids such as hexadecane and monoester on this machine as they

are subjected to a centrifugal force that leaves very little lubricant at the pin-disk interface. The stark difference in the viscosity of these lubricants coupled with their difference in tackiness would leave more amount of the monoester at the interface than the former, even when subjected to this centrifugal force.

6. Based on the impressive performance of the formulated lubricants on small four-stroke engines, they could now be tested on multi-cylinder automotive engines. In addition to the interfaces that the lubricants were used to pre-treat in this study, there exist several areas such as the valve train and power train where these specially formulated lubricants could be effective. A study of such potential areas has to be carried out.