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DISCUSSION

T. W. Fazekas[2]

The authors have prepared a thorough and logical report of their experimental method and results. They are to be particularly commended for their meticulous experimental technique as exemplified by the correlation study performed using mechanical measurements, wall-mounted proximity probes, and the end-gap technique.

An analytical model was used to estimate film thickness for each of the two ring profiles that were tested. The test of the paper refers to "analytical expressions" by which the profiles were approximated, but these expressions were not stated. Since the production ring that was tested was a grooved ring, it is comparable to two narrow sliding bearings. Did the expression used for analytical modeling of this ring in any way allow for the double pressure profile that would be present in such a ring? More detail on the analytical modeling of both rings would be helpful in understanding the comparison of analytical and experimental results.

The cylinder liner used in the test apparatus contained porting. Was use of a liner without ports considered so that this extraneous variable could be removed?

The influence of gas pressure on film thickness would also be an interesting consideration, though it is probably beyond the scope of this initial work. What impact is expected due to gas pressure, and is any further work planned using a closed cylinder chamber?

The statement is made in the test that, "....further work is needed to relate the ring film thickness to frictional loss." Is such work planned?

Again, I extend my congratulations and thanks to the authors for their interesting paper. Their film thickness measurement technique appears to be a worthwhile tool for relative evaluation of piston ring designs and for improving the understanding of the variables which affect piston ring function.

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Authors' Closure

The theoretical model used in this analysis was developed at General Motors Research Laboratories by Rhode, [10, 11]. Detailed treatment of the mathematical solution of Reynolds equation, as it applies to piston ring lubrication can be found in the latter reference. The "analytical expressions" describe the geometric surface of the nominal ring face, whether it be parabolic, circular, flat, tapered, etc. Although each ring may be unique, profile traces shown in Figure 4 facilitate analytical description of face geometries. The only requirement in developing an expression for $h_1(x)$, is that it be non-negative and vanish at least at one point over the width of the ring.

Unfortunately, the grooved production ring does not develop a double pressure profile due to the relatively small leading edge radii (at the groove). The resultant pressure profile is generated over one land, depending upon the direction of motion. Although the oil film would be continuous, the pressure distribution diminishes within the groove region to that on the other side of the ring, or zero, in this case.

An unported liner was also studied during the program and it showed a more symmetric film thickness than did the ported liner. The data for the ported liner was chosen for presentation because it was felt that the dramatic influence of the ports enhanced the demonstration of the experimental technique.

A continuation of the program to include several ring designs in pressurized and fired cylinders has been planned, as has a combined film thickness/frictional loss study. However, at the present time, such a program remains in the planning stages.

Additional References

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