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Crankshaft Journal Finish - Oil Seal and Bearing

No matter how good quality a crankshaft seal is, improper grinding and/or polishing of crankshaft seal journals can result in oil seal leakage. Seal journals should be polished similar to bearing journals. Bearing journals on highly loaded crankshafts such as diesel engines or high performance racing engines often require surface finishes better than 0.25 µm Ra (10 µ Ra). Sealing surfaces typically require a surface finish of 0.25 - 0.50 µm Ra (10 - 20 µ Ra). The maximum permissible lead angle is 0 ± 0.05° and the most acceptable method for obtaining this surface characteristic is plunge grinding, check the surface afterwards for any type of nicks or burrs, and **do not** polish the shaft before installing the seal. If only linishing the shaft, extreme care must be taken to avoid introducing a spiral pattern or lead while polishing seal journals.

To test for the presence of a spiral pattern on the seal journals, support the shaft between centres or in Vee blocks so that it can be rotated slowly by hand. Prepare a 200 to 250 mm length of thin string (e.g. 0.23 mm extra strong quilting thread) by tying a 12 mm or larger hex nut to each end. Drape the string over the sealing journal with the weights hanging on each side of the shaft to hold the string tight. Slowly rotate the crankshaft (approximately 60 rpm) in the direction of engine rotation (generally clockwise when looking from the front). If the string moves toward the nearest end of the shaft, this indicates that shaft rotation will pull oil in the same direction during engine operation causing leakage. If the string stays where it was originally placed or moves toward the bearing journal, oil will not be forced past the seal. To correct for improper spiral, check the relationship of the polishing belt to the axis of the shaft. The polishing belt should be positioned at exactly 90 degrees to the shaft centerline to prevent creating a spiral pattern.

The 0.25 - 0.50 µm Ra surface roughness ensures that the rubber skin from the sealing lip is worn away (breaking the seal in) and a lubricating film remains to protect the seal lip from further wear. The seal may not break-in properly if the surface were any smoother, while a rougher finish may cause excessive wear of the lip before the protective lubricating film develops. In either case there is a chance of leakage. The seal lip usually breaks-in in less than an hour after initial engine operation and a wear track starts to develop. The width of the wear track stabilises within 100 hours and varies from 0.25 to 1.00 mm in width. The seal lip wears very little during the life of the seal, but it smooths and burnishes the shaft surfaces in the wear track. Newer 'microprofile' design seals result in narrower wear tracks of 0.075 - 0.150 mm. They also tend to last longer because their radial force is about half of the older, more common design.

The oil temperature at the lip area (wear track) can be as much as 38°C higher than the engine oil temperature for NBR (Nitrile Butadiene Rubber) and Polyacrylate Rubber seals, but is only 8°C higher for Silicon seals. The increase in lip temperature for FPM (Fluroelastomer) materials, such as Viton™, is higher than Silicon but less than Polyacrylate Rubber. This additional temperature can convert the oil to resin, which causes carbon to build up in the helix of the seal. As carbon builds, the helix loses its effectiveness and leakage occurs. Radial lip seals will function satisfactorily on steel, cast iron or ductile/nodular/malleable iron shafts. Under light to normal operating conditions, the section of the shaft contacted by the sealing lip should be hardened to a minimum 30HRC. Under normal to heavy operating conditions a minimum hardness of 45 HRC is recommended to prevent nicks, scratches, and dents.