

Target: Lip Seals

Thirty-eight million rubber lip seals are produced for industrial use in the United States each year. At least half of them, nineteen million, are probably misapplied and should not be installed in industrial rotating equipment.

According to their manufacturers, even the best lip seals have a median life to failure of only 1,844 hours or 77 days of operation. Half last longer than that and half last less than the mean time hours to leakage. More than 90% of them will quit sealing within the first 3,000 hours of operation.

After that, they either groove the shaft or burn to a crisp at the point of contact with the rotating shaft. Why, then, are they applied to protect rotating equipment that is designed to run uninterrupted for five years and bearings that are rated for much longer than that? **figure 1**

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Table 1 - The Effect of Water on Rolling Contact Fatigue Life in Lubricating Oils				
Base Oil Description	Water Content of Wet Oil	Fatigue Life Reduction, Percent	Test Equipment and Hertzian Stress	Author(s) (Reference)
Base Mineral Oil Dried	0.002%	48	Rolling 4-Ball	Grunberg & Scott
Over Sodium	0.014%	54	8.60 GPa (1.25 x 10 ⁶ psi)	1960 (1)
	3.0%	78		
	6.0%	83		
	0.01%	32-43		
Squalene 0.001% Water	Not stated - moist air environment	80	Rolling 4-Ball 6.34-8.95 GPa (0.92-1.30 x 10 ⁶ psi)	Schatzberg & Felsen 1969 (2)
Dried Mineral Oil			Rolling 4-Ball	Ciruna & Szieleit 1972 (3)
Two Formulated Tetraester Oils - 0.005% Water	0.05%	29; 73	#204 Bearings 2.48 GPa (0.36 x 10 ⁶ psi)	Fein 1969 (4)
Emulsifying Hydraulic Fluid Purged with Argon	1% Sea Water	45	Rolling 4-Ball 6.89 GPa (1.00 x 10 ⁶ psi)	Schatzberg 1971 (5)
Mineral Oil-Based	0.1%	45	Angular Contact Bearing 2.27 GPa (0.33 x 10 ⁶ psi)	Felsen, et. al. 1972 (6)
Emulsifying Hydraulic Oil- 0.02% Water	0.5%	56		

Figure 3 Note: Water doesn't have the same viscosity of film strength as lube oil. Even a minute amount that is entrained in the oil will allow metal-to-metal contact within the bearing and start a chain reaction of wear and destruction. 0.002% is approximately one drop in one quart. (Liter)

Sometimes it is nearly impossible to avoid the use of lip seals in industrial equipment. When shafts are flooded with lubricant or the total area for sealing is restricted to one-half inch (12 mm) or less, there is a compelling reason for their use, but care must be taken to cope with their frailty and extremely short life expectancy. Read: "change them out every month or so and thereby avoid leakage in or out of the bearing enclosure."

Advocates of lip seals will theorize that they do not come in contact with the shaft and that they "hydroplane" on a thin film of oil at the sealing point. Another theory is that the lip seal acts as a small pump at the point of contact to maintain lubricant in the bearing enclosure, but also at that point ingests contaminants that are present in the near environment. Both theories may or may not have merit, but in practice shafts are grooved and sealing lips are carbonized by heat.

Lip seals were first introduced for use in the process industries in the 1930s, when they were the only sealing devices conveniently available for general use. Until the present time, they are very inexpensive to purchase and command 99 + % of the industrial rotating equipment sealing market, in sheer numbers. Most process plants have an extensive inventory of lip seals, stacked next to the spare bearings in the stock room. Rotating equipment repair often has a timing function that is necessary for economic operation of the plant and the inventory is deemed necessary.

Lip seals have their place in the mechanical universe, but it may not be on industrial rotating equipment. Automobiles have a series of lip seals that are found on the wheel bearings and power train. If they survive for 3,000 hours, you've had a good run. [3,000 hours @ 40 miles (64 km) per hour equals 120,000 miles (193,000 km)] Wash machines, lawn mowers, electric drills, even farm tractors, are adequately served by common rubber lip seals because of their relatively short service life. None of these are continuous duty machines as are pumps, motors and gearboxes in the process industries.

Lip seals are cheap, but not as cheap as they sometimes are perceived to be. The cost of installation is as much as for a bearing isolator. One pump failure after a lip seal burns out will cost as much as dozens of bearing isolators. Lip seals may already be functionally obsolete in the process industries, but hardly anyone realizes it.

It was not until the late 1970s that alternative, permanent, sealing devices for industrial/process rotating equipment were made available with the invention of the Bearing Isolator by what is now the Inpro/Seal Company. Even the term “Bearing Isolator” was invented at Inpro/Seal Company.

Bearing isolators are made to order for the various sizes and shapes of industrial rotating equipment. In order to service the customers as well as the lip seal manufacturers with 25,000 part numbers in their catalogs, bearing isolators must be able to be shipped the same day that they are ordered. Rotating equipment repair, as stated before, usually has a very short-term deadline for completion.

Other contact seals, such as spring or magnetically loaded face seals, have been used for bearing sealing, but with only limited success. Even the highly touted double face magnetic seal is projected to last no more than 18,000 hours and is somehow expected to protect 200,000 hour bearings. All contact seals have a finite life and a 100% failure rate over time.

figure 4

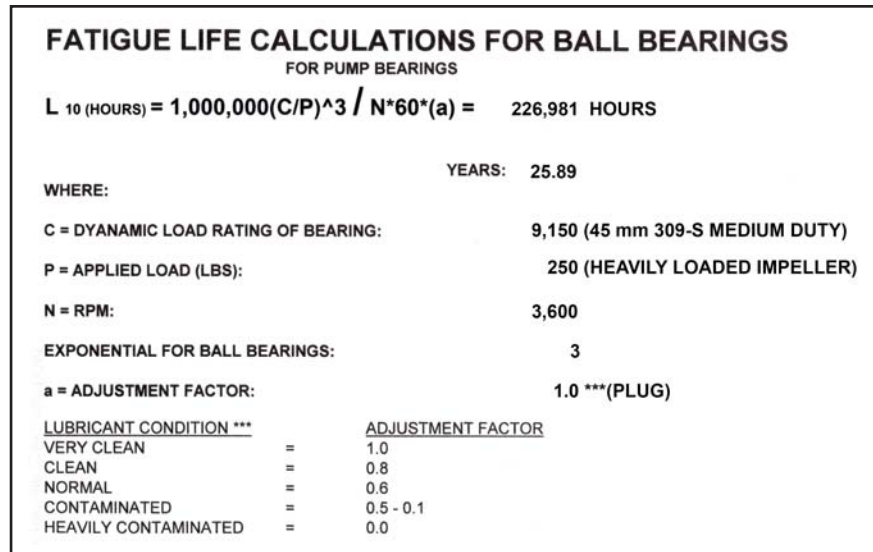


Figure 4

No one will benefit from casual installation of bearing isolators in place of lip seals on a one-at-a-time schedule. In order to maximize results, we must organize a structured program of some magnitude. Two programs that will produce real and quantitative outcomes are:

- 1) For the first 100 orders in the program, the Inpro/Seal Company will ship product the same day that it is ordered and then pay for the FedEx next day delivery. (At least 35% of our products are shipped the same day as ordered.)
- 2) The Inpro/Seal Company will furnish bearing isolators free of charge and after a period of time, participate in a set percentage of documented savings attributable to the use of said bearing isolators. (The Inpro/Seal Company has been in the Bearing Isolator business for 28 years and we know how we can benefit our customers.)

If you have read this far, you may or may not agree with us at Inpro that lip seals are as obsolete as buggy whips and do not have a place in contemporary process industries. The same thing happened to bias-ply tires and carbon steel razor blades. They both faded out when the superior technology of radial tires and stainless blades became available.



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