WATEROUS

Talking Points

Impeller Shaft Bearings

This is the outboard impeller–shaft bearing we've been talking about since 1935, when extensive testing proved to us that the water–lubricated, sleeve–type bearing is inferior to ball bearings for fire pumps that may see some really rugged or continuous duty. The following are some of the reasons why we experimented with and rejected this sleeve–bearing design over 40 years ago, and use oil or grease lubricated ball bearings on *both* ends of the impeller shaft.

Then—and now—our decision seems to be backed up by the fact that manufacturers of continuous–duty centrifugal pumps use this design almost exclusively. Among these manufacturers are Allis Chalmers, Aurora, Goulds, Ingersoll–Rand, Warren, and Worthington.

In a centrifugal pump, there can be to kinds of forces acting on a bearing" radial and axial. The three oil or grease lubricated, deep–groove bearings that support the impeller shaft of a Waterous CM or CS pump are designed to absorb *both* types of force.

The *radial* force is that force that is perpendicular to the shaft. Drawing water from a well in the manner shown is a fairly good example of a constant radial thrust. The weight of the bucket full of water pulls the cross–pipe (shaft) down against the bottom of the holes (bearings) in the uprights. The metal pipe rotating in the wooden uprights could be the crudest of sleeve bearings under a radial load. The pressure differences in a fire pump volute also create a radial load (which varies with capacity, etc.) on the shaft, and, of course, the supporting bearings. In a pump, where both shaft and bearings are metal, and that shaft may be turning at 4000 rpm or better, the friction problems can get interesting.

If you run a pump with sleeve bearings dry, you will probably develop a considerable amount of frictional heat. In fact, if they get too hot, you may ruin both the shaft and bearings.

Anyhow, for proper operation, you *must* lubricate a sleeve–type pump bearing—usually with the fluid being pumped. In a fire pump, this is water from a hydrant at best, or from a nearby river or pond. Add a little sandy river water for this "lubrication" of the sleeve bearing, and you will have some rapid wear problems. Then, there are times (priming, for instance) when the pump will be turning over without any water to lubricate that bearing.

If you're going to strain the water that lubricates the outboard bearing and try to prevent this rapid wear, you have just one more thing to check and maintain—the fine screen strainer. And if it really does the job, it *will* get clogged and require cleaning.

How about Waterous ball bearings and this radial thrust? Waterous has an advantage to start with here because of the locations of the stripping edges in a CM or CS pump. As mentioned before, the differences in pressure in the volute, which depend on the stripping–edge locations and capacity, result in radial thrust that is "taken" by the impeller shaft and, in turn, by the bearings. In a CM or CS pump, the stripping edges are located on opposite sides of the impeller shaft to offset this radial force. Nearly all of this thrust is cancelled out.

In pumps with stripping edges located on the same side of the impeller shaft, the combined thrust of both impellers is exerted on the shaft from the same direction. Many types of pumps have more thrust to handle in the first place that is present in a Waterous pump, regardless of what kind of bearings they use to handle it.

Radial deflection also brings up the question of bearing locations. Some say, and rightly so, that the closer the bearing is to the load, the less deflection you will have. Less deflection, *maybe*, but not less load on that bearing. In fact, the closest bearing will carry most of the load, and if it is lubricated by sandy water, the wear problems will be compounded.

You are probably called upon to defend arguments against the Waterous design, too. Here's one you may run up against.

"You use helical gears. They create an axial thrust load on the bearings. We use spur gears, and there;s no axial thrust on the bearing in our pump.: There is some truth in this. Axial thrust is usually present to a greater degree in a pump driven by modern, constant–mesh helical gears that in pumps that use old–style spur gears. We feel that the quietness of the helical gears and the smooth tooth–to–tooth load transfer more that offset the disadvantages that can be attributed to having a small amount of axial thrust present in the pump. The axial thrust caused by the helical gears is about 1/3 of the radial load imposed by the gearing, and the total load on the two bearings at the gear end is only a fraction of the safe bearing load. In short, we've designed our pumps with deep–groove ball bearings to take *both* kinds of thrust.

And now, Waterous has a development that eliminates all axial bearing thrust. The pump transmission uses a high–velocity, silent drive chain to cancel all axial thrust, and to provide a power flow that is even quieter and smoother that the crown–shaved helical gears.

How about this argument? "Your oil–lubricated outboard ball bearings require another stuffing box."

Sure it does, but let's look at it this way. When you look up electric motors in a catalog, you notice that there are two prices given. One is for a ball–bearing equipped motor, and the lower price is for one with sleeve bearings. Sometimes, depending on your application, you can get along fine with the plain–bearing version. But it's no secret that if you want the best motor for *all conditions*, if you want long life and fewer repair bills, you will pay a little more and get ball bearings.

And then there is that “special bearing” that some pump manufacturers use—available only from *their* factory, and at a greater cost than an automotive–type bearing would be. Compare this with any bearing used in a Waterous pump that is available from a good local automotive–supply shop anywhere in the country. It’s nice to know that an SKF No. 6307 ball bearing is the same as a New Departure 3307S or an MRC 307S, or any one of several equivalent bearings made by other manufacturers which are available around the world.

The only maintenance the extra stuffing box requires is using the pump once in a while, which you have to do anyhow to keep the other set of packing from drying out. It is little more work to tighten two sets of packing than one, once you are under the pump.

We think the top–quality ball bearings and superior impeller–shaft bearing design in Waterous pumps are important advantages that can be clearly pointed out to anyone who keeps abreast of modern, up–to–date engineering practices, These features may be presented as follows:

THE IMPELLER SHAFT SHALL BE SUPPORTED AT BOTH ENDS BY DEEP–GROOVE, OIL OR GREASE LUBRICATED BALL BEARINGS, PROTECTED BY ADJUSTABLE STUFFING BOXES, FLINGER RINGS, AND OIL SEALS.