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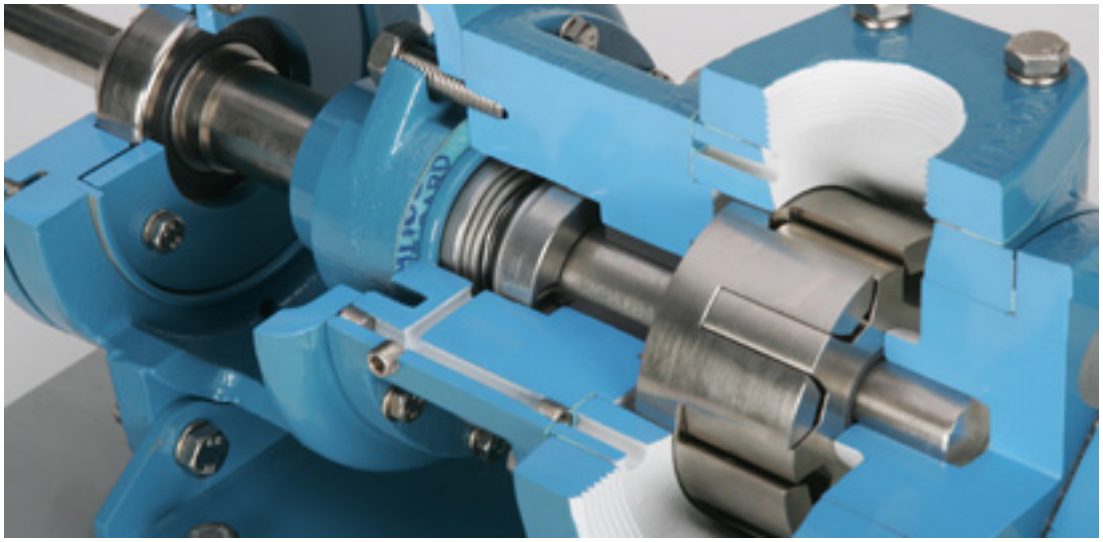


Here's what it takes to boost gear pump reliability in remote locations.

For internal gear pumps, a compressor lube-oil application might be viewed as an ordinary, nothing-special situation. Consider, though, internal gear pumps on screw compressor skids used for natural gas exploration in some of the most remote and desolate parts of the world. Reliability is a must with these critical units. That's because maintenance crews can be hundreds—*if not thousands*—of miles away. Dispatching a crew by helicopter may be the only way to address an emergency downtime requirement.

But difficult logistics are just part of the problem. Throw in a few more challenges, beginning with high thrust load because of system pressures that can run up to 400 psi. Add high radial loads due to side-mounted belt drives on some installations. Then top it all off with the need for the pump to be capable of starting up cold at -20 F. Got the picture?

Tuthill Pump's HG upgrades for its GlobalGear line of internal gear pumps have met these types of challenges and more. This upgrade package is being supplied to several of the major compressor skid suppliers, with installations dating back two years that have an operating record of no reported failures. HG upgrades address reliability issues for both bearings and mechanical seals individually, and for an integrated combination of bearings and seals.

How these upgrades work for bearings

Bearings are typically selected to handle either primarily axial or radial loads. In the compressor-lube applications described, the pump will see both high axial and radial loads. Axial load will be thrust caused by the combination of system pressure and differential pressure. Radial load will be the combination of load caused by differential pressure and whatever side load applied to the sheaves if belt-driven.

To deal with this combined axial and radial load situation, Tuthill uses an upgrade bearing arrangement of back-to-back, matched-pair, single-row, angular contact bearings (supplied by SKF) that are installed with heavy press interference fit to the rotor shaft. With the bearings held in place in a bearing cap, rotor-end clearances can be set by adjusting the bearing cap location with a jacking- bolt and locking-bolt arrangement similar to what is used in ANSI process pumps.

Compressor stations are high-vibration types of environments. Using press-fit bearings and the jacking-bolt/locking-bolt arrangement serves to lock the rotor position in place—*and is not dependent on small set screws or locknut tabs to keep the rotor securely in place*
. Another major advantage of this arrangement is that the bearings only need to be lubed every 15,000 hours. With the pumps running continuously, this makes for an 18-month-between-scheduled-maintenance interval.

An upgraded, heavy duty slurry-type seal with thick cross-sections on the pieces and drive components withstands high torque conditions in cold-lube startup situations.

How these upgrades work for seals

Sealing cold lube oil in a startup condition presents two special challenges. A high moment of inertia condition arises when cold lube oil surrounding the rotary portion of the mechanical seal creates a huge drag effect. This holds the rotary portion of the seal in place, while the shaft on which the rotary seal face is attached is instantaneously accelerated from a standing start to whatever the operating speed of the pump is. Unless the seal is specifically designed to withstand this high moment-of-inertia starting condition, there will be seal failures due to broken or bent drive pins and/or fractures in the drive faces as the motor-driven shaft breaks free and

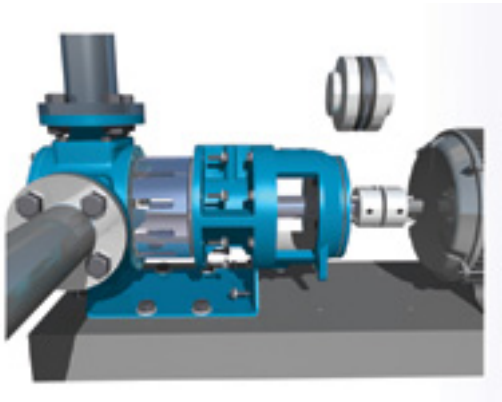
the seal breaks in pieces.

The other challenge is that thickened cold lube oil is a poor lubricant. For a brief period, the seal faces essentially run dry because the thickened oil is unable to penetrate into them. With this brief moment of run dry, seal faces of like materials can gall and seize as one piece welded together. "Stiction" is a term that has come into recent use to describe this phenomenon. If the seal faces do seize and weld together, the result will be seal failures due to broken or bent drive pins and/or fractures in the drive faces.

To address this cold-lube startup situation, Tuthill now incorporates an upgraded, heavy duty slurry-type seal that has thick cross-sections on the pieces and drive components to withstand high starting-torque conditions. Positive drive is used on the rotary with a grade of 400 series stainless set screws, and the stationary is pinned in place in the gland.

With this design, the compression springs of the rotary unit are on the atmospheric side—*thus, there's no opportunity for clogging of the springs*
. Moreover, the faces of the heavy duty slurry seal are of dissimilar hard materials that are guaranteed not to weld together.

This heavy duty slurry seal is a balanced seal to reduce face loads during operation, and an API plan 13 vent to suction is used to circulate lube oil into the seal chamber. The seal chamber is an oversized stuffing box to provide clearance for the lube oil to properly cool and lubricate the seal faces. For larger pump sizes with significant cantilevered loads, the GlobalGear pump incorporates oversized shafts and bearings that reduce deflection up to half and extend seal life.



The API 676-compliant GlobalGear upgrade features a back pull-out of the bracket and

rotor assembly. A proven problem-solver

The proven reliability of the GlobalGear pump with the HG upgrades is the result of careful attention paid to the design details—*not just of bearings and seals, but of the entire pump assembly as an integrated unit.*

Despite the high starting torque requirements for compressor lube-oil applications, broken shafts or gear teeth aren't encountered with this type of gear pump. The shafts are made of a higher strength AISI 4140 steel, and idlers and rotors are made of ductile iron ASTM A536, grade 80-55-06 that provides a degree of strength and resistance to breaking similar to that of steel gears.

The GlobalGear pump itself is API 676-compliant, and features a back pull-out of the bracket and rotor assembly. For high system-pressure requirements, high-pressure flanges are supplied—*generally 250# ANSI flanges for cast iron construction or 300# flanges for cast steel construction.*

Maintenance made easy

While design life is usually longer, it is recommended that the bearings and seals be renewed every five years. For scheduled periodic maintenance of the compressor stations, crews work on all types of different equipment. Seals and bearings are what generally wear out quickest. The mechanical seal and ball bearings of the HG GlobalGear can be replaced with a cartridge-style pump drive module, allowing fast and easy renewal by a non-specialized crew. Even more interesting is that the cost of the cartridge-style pump drive module is in line with that of some API cartridge-seal-only assemblies.

For many gear-pump applications, reliability may not be as crucial as it is for remotely located natural gas exploration compressors—and "stiction" may not be the hidden seal killer. On the other hand, Tuthill's successful experience with reliability-driven design upgrades on compressor lube-pump applications means that design options are now available to dramatically improve gear-pump reliability in a wide range of applications. From another perspective, if your operations have stacks of unfilled work orders piling up, planned bearing and seal renewal that can be done quickly by a non-specialized crew could offer an interesting and very cost-effective option. L**MT**

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