Lube Oil Filtration for Gear Box and Bearing Protection

Introduction

The accelerated ageing of mechanical systems is typically caused by wear, which results from the degradation and particulate contamination in the lubricating oil. Gear boxes and bearings all require lubrication because they are comprised of moving components. Wear can be significantly reduced by the proper application and maintenance of a filtration system that will reduce the particulate concentration in the lube oil.

Gearboxes are the casings or housings in which the system of gears is sealed. The main functions of the gear boxes are to change the rate of rotation and change the direction of rotation of a machine shaft. The combination of various sizes and types of gears provides the desired output.

Bearings reduce friction by providing metal balls or rollers to roll against, allowing a shaft or device to spin smoothly. There are many types of bearings, each used for a different purpose within various pieces of industrial equipment. The main function of bearings, regardless of the end use, is to make objects slide easier.

Gearboxes and bearings can be found in many industrial settings. In steel mills and pulp & paper mills gearboxes are used to drive the rollers and conveyors while bearings make the rollers and shafts slide easier.

In industrial environments the typical applications are shown below. Usually, industrial facilities will have maintenance departments and, possibly, reliability engineers that are responsible for maintaining these systems.

- Industrial equipment gear boxes
- Turbine gear boxes
- Locomotive gear boxes
- Pinion gears
- Planetary gear drives
- Roller bearings
- Reduction gears

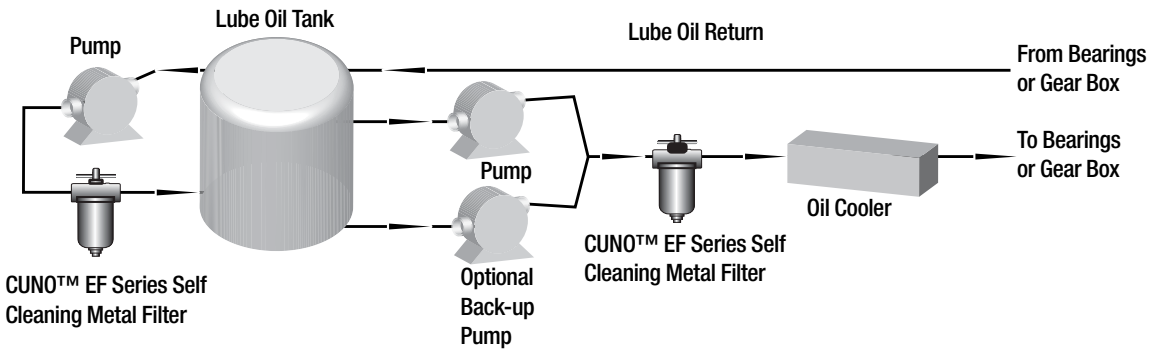
The primary function of lube oil is two fold, to reduce friction and help minimize heat build-up between the moving parts. Therefore lube oil systems are critical components for long life and functionality of the bearings and gear boxes.

This Application Brief will discuss the importance of minimizing the effects of contamination in lubricating oils and the benefits of filtration in order to maximize efficient machine performance.

The Process

The typical process schematic is shown in Figure 1.

Figure 1. – Typical Lube Oil Process



Oil is pumped from a storage sump or container through a filter device, cooled and the cleaned oil is delivered to the gearbox or bearing journal. The heat laden oil is returned to the storage sump. In some cases of high contaminant loading, (i.e coal pulverizing machines, or systems under heavy load) the oil storage sump may also have a recirculation loop with a clean-up filter device installed in this loop.

The Problem

There are numerous ingression points for unwanted contaminant to enter the system. External sources of contamination include degradation of the seals, gasket materials, and improper maintenance procedures. Contamination may also be internally generated, usually wear debris from gears, bearings, splines or other components that are in constant frictional contact with each other.

Whether the contamination is externally or internally generated, hard particle contamination that is in the system may become embedded in softer components of the gearbox or bearing chase and cause abrasive wear, galling or scratching of mating surfaces. Abrasive wear, galling and scratches of surfaces may lead to a variety of catastrophic failure modes. One of which is the inability of the lube oil to adequately cool the fluid from the additional excessive heat generated by the frictional forces. Systems that are inadequately cooled may be prone to seize from overheating because of the chemical changes, or breakdown of the lube oil.

Another mode of failure that abrasive wear causes is premature component failure. Abrasive wear will increase the amount of contaminant that is introduced into the lube oil; this increase in contaminant affects the lubricating ability of the oil and increases abrasive wear if the contaminant load is not decreased. The American National Standards Institute (ANSI) has established guidelines for typical clearances in microns for various shaft size and machine fit classifications (see Table l). Most industrial plant equipment is manufactured to either a Class 2 or Class 3 fit.

Table 1. – ANSI Clearance Guidelines

Shaft Size (in)	Clearance (microns) by Class			
	Class 1	Class 2	Class 3	Class 4
1	63 to 191	35 to 102	22 to 64	< 25
1.5	83 to 228	45 to 122	30 to 76	< 30
2	101 to 269	55 to 142	35 to 86	< 32
3	132 to 315	73 to 170	48 to 124	< 37
6	211 to 439	117 to 239	76 to 150	< 45

Class of Fit and Micron Clearance

The Solution

Depending on the end use of the gear box or bearing system, they may be located in remote areas, including offshore, windmill farms, marine or other industrial processes that make access difficult and costly. One commonality exists – operators need to keep the systems operating and the CUNO™ EF series self cleaning metal filter will provide proper lube oil contamination reduction to minimize abrasive wear within the gear box or bearing journal.

3M Purification's CUNO EF series self cleaning metal filter line of self-cleaning elements lends itself to the requirements for lubricating oil filtration for gear box and bearing protection. The all metal design is a durable construction, is compatible with lube oil and grease, is capable of withstanding high pressure applications and will provide long service life with consistent performance. It is available in sizes as fine as 38 microns, 0.0015" spacing.

The CUNO EF series self cleaning metal filter elements are edge type filters that provide a positive cleaning action with no interruption to service flow. Self-cleaning also reduces the need to dispose of plugged filter cartridges. In difficult to service, remote or challenging environments such as offshore turbines, or wind farms, or continuously operating industrial equipment, the CUNO EF series self cleaning metal filter system will provide an effective and cost efficient filtration solution to maximize the performance of moving part.

Recommendation

The critical nature of gear boxes and bearings demand that contamination control be an important part of the lubrication system. When using a CUNO EF series self cleaning metal filter, the proper degree of protection is achieved to help maintain system efficiency.

Filter recommendations are summarized in the Table below.

Application	Recommendation	3M Purification Literature ID	Spacing*
On-board marine (to 900 hp)	CUNO™ EF EG Series	LITHSAKEG	0.005" to 0.008" (~125 to 200 micron)
Grease systems	CUNO™ EF G Series	LITHSAKG	0.008" to 0.015" (~200 to 400 micron)
Industrial Systems • Pinion Gears • Roller Bearings	CUNO™ EF EG Series	LITHSAKEG	0.005" to 0.012" (~125 to 300 micron)
Turbine systems • Shafts • Reduction gears	CUNO™ EF EG Series	LITHSAKEG	0.0015" to 0.005" (~38 to 125 micron)

*Sizing of the CUNO EF series self cleaning metal system should be based on lube oil flow rate

For cold start applications and sizing of CUNO™ EF series self cleaning metal filter systems and sizing, consult 3M Purification technical support.

CUNO™ EF EG Series Self Cleaning Metal Filter

CUNO™ EF G Series Self Cleaning Metal Filter

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