

Transformer Oil Pumps

Pump Design

Pumping transformer oil has a unique advantage over pumping most other fluids. Transformer oil is a dielectric and is used in transformers because it does not conduct electricity, a property that actually makes it possible for the oil to flow over the pump motor without causing electrical problems for the motor. Allowing the pump motor to operate in an environment where it is surrounded by oil is a distinct advantage because the oil lubricates the bearings and keeps the motor windings cool and free from water, which extends the motor life.

In order to maintain dielectric properties transformer oil has a very low water content, therefore, it is critical that transformer oil not be exposed to atmosphere and that air is prevented from entering an oil filled transformer. Air will increase the moisture content of the oil thus reducing its dielectric properties. A key advantage of this "oil-immersed" design is that a mechanical seal or packing can be eliminated in this design. For a traditional pump the impeller shaft must be coupled to the motor shaft. This arrangement requires a mechanical seal where the pump shaft exits the pump housing. This type of seal is a maintenance item and would be a potential leak point which, apart from the environmental hazards, also creates the potential to reduce the dielectric properties of the oil. The Cardinal Pump eliminates the requirement for this seal creating a leak tight pump design.



This oil-immersed configuration does, however, demand stringent design, manufacturing and quality controls. Transformer oil is a good dielectric but only a fair lubricant, particularly at the typical operating temperatures. The pump bearing design and manufacturing tolerances must consider that the lubricant is transformer oil. Standard "canned pumps" or hermetically sealed pumps should not be used with transformer oil unless the bearings have been designed for the low viscosity of transformer oil.

Failure Mode

Transformer oil is not only an electrical insulator, in the case of an oil-immersed pump, it is also acts as a noise insulator resulting in a pump that runs very quietly. This benefit is countered if a pump is in failure mode. Typically there is little indication a pump is in failure mode until the final stages of failure when the bearing and/or impeller may be destroyed. Noise and vibration are insulated by the oil.

Bearing failure begins with bearing wear. Bearing wear can occur over a long period of time (years) before it ever results in bearing failure, if the bearing fails at all. Bearing wear results from metal to metal contact and, because the pump and motor are immersed in oil, the wear debris is picked up by the oil and pumped into the transformer. The metal particles can be various sizes; from dust to larger pieces, depending on the bearing design and failure mode. The impact of this debris can depend on the size of the particles, transformer design and luck. As described above, typically this happens without any noticeable change in the pump performance. Predicting pump failure is the difficult part.



The lifetime of transformer oil pumps varies with the pump design, manufacturer, year of manufacture, application and operational history. The Cardinal Pumps division of Unifin International has an extensive database gathered from inspecting and rebuilding thousands of transformer oil pumps. This database allows the prediction of which pumps are most likely to fail.

Controlling the Risk of Pump Failure

1. Ensure that the pump selected is suitable for the application. (i.e. use a pump designed to pump transformer oil)
2. Ensure inspection, repairs and remanufacturing are performed by companies that have expertise with transformer oil pumps – preferably with the specific pump being serviced.
3. Include the inspection and maintenance of pumps in the transformer maintenance plan. The relative cost of a pump on a critical Main Output Transformer or Generator Step-up Transformer is minor compared to the cost of downtime and repair of the transformer.
4. For important applications a bearing wear monitoring system is available to give early warning of preliminary bearing wear. Bearing wear can be checked by maintenance personnel without taking the pump off line.
5. Develop a replacement plan. Delta T Heat Exchangers will visit an installation site and take an inventory of all the transformer oil pumps. Unifin's database can then be used to rank the pumps in order of their failure probability and recommend the top candidates for replacement.

Replacement

Unifin's Cardinal Pump division can replace or remanufacture transformer oil pumps from all manufacturers including; Harley, GE, Westinghouse, SCAI, Ingersoll Rand, ASEA and others. Pumps can be manufactured with sleeve or ball bearings, oversized bearings and the TecSonics™ bearing wear monitoring system.