Progress Supply Inc. THE INSIDE STORY

Helpful Information for HVAC Contractors from Progress Supply's George Story

This is one of a series of technical bulletins from your friends at Progress Supply
May, 2000

LUBRICATION SAFETY CONTROLS

Apparently someone is reading these articles. I have had several calls and suggestions for a subject. I want to thank you for your comments and suggestions.

Let's discuss the compressor **Lube Oil Protection Control.** The various items that we will discuss are:

- ✔ Which compressors use them?
- ✔ Why a Lube Oil Protection Control (LOPC)?
- ✔ How do they work?
- ✔ Why do they trip?
- ✔ How do I check them out?

When we think of the LOPC, we generally think of the larger semi-hermetic compressors. However, in today's use of Scroll compressors for use in the refrigeration side of the business, especially the grocery store rack systems, we are seeing a new form of LOPC.

It used to be simple. If a compressor had an oil pump, it generally used an LOPC. Note that I said generally. Carlyle, for example, recommends an LOPC on their 06D single compressor applications. They require one on the 06E. They also require one on the 06D when used in a multiple compressor application. In today's Copeland line, even the small ¼ HP through 3 HP air-cooled semi-hermetic compressors uses an oil pump. These compressors, however, do not use an LOPC. The larger semi-hermetic compressor uses an external, replaceable oil pump. These compressors must use an approved LOPC to maintain warranty.

Let's discuss why an LOPC. Whenever two metal parts are moving against one another without lubrication heat will be generated and ultimately damage will occur to one or both of the parts. All compressors have metal parts that are moving against one another. The crankshaft rotates in the bearings and in the rod journals. The pistons or piston rings move against the cylinder walls. Without lubrication these parts will fail and the compressor will be a 'pile of junk.' With this background, I suppose the question is, ***"Why don't all compressors use and/or require an LOPC?"***

Hermetic compressors do not have an oil pump as one defines an oil pump. These compressors use an offset hole in the crankshaft that causes the oil to be lifted up the crankshaft to cross-drilled holes at each bearing and rod location. The cross-drilled holes deliver oil to the bearings and rods. Because this type of lubrication system does not use an oil pump, there is no way to measure a differential pressure.

Earlier I said that we would look at the LOPC of the refrigeration scroll compressors. Yes, the scroll is a hermetic compressor and, yes, it uses the offset hole to deliver oil to the bearings. **Then why and how does it use an LOPC?** ***More on this later.***

The smaller Copeland semi-hermetic compressor does have moving parts and an oil film is needed between these parts to prevent failure. These compressors have an oil pump but do not use an LOPC. Why? One needs to understand a little history of these compressors. They were designed for use with Sulphur Dioxide and Methyl Chloride. By today's definition, they were medium pressure refrigerants like R-12. The compressor's original design was a splash gravity lubrication system. With the advent of high pressure refrigerants like R-502, R-22 and now with the use of POE lubricants for use with HFC refrigerants, it became necessary to have a pressurized lubrication system.

The oil pump on these compressors is integral to the bearing housing. As such, there is no way to measure the pump's differential pressure. In addition, the differential pressure is relatively low, in the range of 3 to 8 psig. For these reasons, the Copeland air cooled compressor does not use an LOPC.

With this background, let's look at how they work. **There are two basic forms of the LOPC.** One is the old standby **electro-mechanical control.** The other is an **electronic control.** They both do the same thing—they stop the compressor should the lubrication to the compressor fail.

Basically, the LOPC measures the differential pressure between the compressor's crankcase and the pump's discharge. If the differential pressure is within the compressor manufacturer's specifications, a timing mechanism in the LOPC stops timing and the compressor continues to operate. If the differential pressure gets too low, indicating a loss of lubrication, the timing mechanism continues to time out. When the timing period is reached, the LOPC contacts will stop the compressor.

Copeland specifications are:

- Timing starts at 9 psid +/- 2 psid
- Timing stops at 14 psid +/- 2 psid
- Timing period 120 seconds

When the compressor starts, the differential pressure across the pump is 0. The LOPC sees a low differential pressure and the timing mechanism starts. If everything in the compressor is OK, the differential pressure will quickly build up to a value above the LOPC's cutout pressure and the timing stops. If, at any time during the compressor's operation, should the pump's differential pressure fall to the "Timing Start" point, the time will start. If this condition continues for the timing period, the LOPC contacts will open and the compressor will stop.

The above conditions are black and white, good or bad. The pressures are OK or not OK.

But what happens when the differential pressure is fluctuating between "good" and "bad?"

Again, when the compressor starts, the timing mechanism is activated and when the pressure rises above the cutout point the timing stops. However, should the pressure alternately rise and fall, the timer will start and stop. If this condition continues for approximately five minutes in a Copeland compressor, the LOPC recognizes a lubrication problem and will stop the compressor. This condition will cause the technician to believe that the LOPC is defective, causing nuisance trips. The timing for Copeland is 120 seconds, two minutes, not five minutes. This process happens in both the electro-mechanical and electronic controls.

The timing mechanism in the Electro-Mechanical LOPC is a wire wound heater and bi-metal. The heater is 120 volt. The bi-metal and heater, in combination, are designed to warp the bi-metal at a rate to trip the switch in approximately two minutes. The heater is in series with the LOPC's differential pressure switch.

At compressor start, the differential pressure switch is closed and the heater is energized. It will stay energized until the differential pressure switch opens or the bi-metal warps far enough to trip the switch and stop the compressor. The switch in the LOPC is of the manual reset type.

The Electro-Mechanical LOPC has two piping connections. These can be cap tube type with ¼ inch flare nuts or a ¼ inch flare connection at the control. The control with the cap tubes will have the connections made at the compressor crankcase and at the oil pump discharge. Note that the one connection is to be made at the compressor's crankcase and not at the suction pressure inlet to the compressor. When using the cap tube type control, it is very important that care be given during the installation not to kink the tubes and not to allow the tubing to rub on itself.

If one is using the control with the flare connections at the control, tubing must be connected between the crankcase and the low pressure connection of the control and between the oil pump discharge and the high pressure connection of the control. Most often, flexible hose is used in this application. Care must be taken to use hose that does not have a leak rate to it.

The electronic type of LOPC uses two separate items. One item is a differential pressure switch, or an electronic pressure sensor. The second is an electronic module. Wiring interconnects the sensor and module. The module is basically a solid state timer.

Both types have the differential pressure switch or the pressure sensor screwed directly into the compressor's oil pump. When using this sensor, the oil pump must have been manufactured to accept it. These pumps are recognized by a plug that is screwed into the oil pump near the bottom of the pump. The sensor has a female receptacle and the wiring attached to the module has a male plug attached.

The sensor sends a signal to the electronic module. When the differential pressure is below the manufacturer's "trip" point, the timer will start to time out.

When the differential pressure rises to or above the "cutout" point, the timer will stop timing and the compressor will continue to operate.

Should the differential pressure stay in the unsafe region for two minutes, the control will cause its switch to open and stop the compressor. The control must be manually reset. Like the electro-mechanical control, if the differential pressure alternately rises and falls between the trip and cutout points, after approximately five minutes the control recognizes a problem and will stop the compressor.

Why does the LOPC trip? First of all, there is no such thing as a nuisance trip. They trip for a reason and the primary reason is because the differential pressure has fallen to an unsafe level. What can cause this pressure to be in the unsafe level?

- The oil is "stuck" out in the system. The system operation did not allow the oil to return to the compressor.
- Refrigerant has migrated to the compressor during the off cycle, no continuous pump down. With a lot of refrigerant in the crankcase, sufficient differential pressure may not build up.
- True short cycling.
- Pressurized crankcase. Blow-by in the piston cylinder area causes the crankcase pressure to rise above the motor compartment pressure, not allowing the oil to return to the crankcase.
- A motor protector trip in a compressor that has the internal motor protector. This type of motor protection can stop the motor but leave the control system powered.

How does one properly check out an LOPC? Let's get one myth buried now. You do not press the reset button on the control stopping the compressor and then releasing it to start the compressor. Doing this only verifies that the switch is working.

In addition, there are several controls that pressing the button does not stop the compressor. Now what do you do coach?

The electronic control is by far the easiest to check out. Unplug the wiring from the sensor. This makes the module believe that there has been a loss of differential pressure. The module will time out and the compressor will stop. Reconnect the plug to the sensor and press the reset button.

The electro-mechanical control is more difficult to check out. The easiest way to properly check it out is to pump down the compressor to 0 psig. Disconnect the piping connection to the oil pump discharge and cap the connection. Start the compressor and two minutes later the compressor should stop. This checks out the differential pressure switch, the heater, the bi-metal and the switch. There are other ways but this is the easiest way.

What about the refrigeration Scroll compressor? To repeat, the Scroll is a hermetic compressor and does not have an oil pump. The refrigeration Scroll does have a sight glass and the oil level is visible through it.

The Trax Oil control was designed to be an oil level control. It bolts to a compressor at the sight glass location. The original design was to add oil to a semi-hermetic compressor should the level fall below a predetermined level in the crankcase. In multiple compressor refrigeration applications, i.e. racks, oil level management is important. The Trax Oil meets this need. It is bolted to the Scroll's sight glass stub. When the level is low it will actuate a solenoid valve and add oil to the compressor. If, however, the oil level does not rise to a safe level, after a timing period, the Trax Oil control will stop the compressor.

When I taught the RSES electric controls course, the LOPC was probably the most misunderstood control. I believe that it is misunderstood because of the myths that have been passed on. Press the reset button. If the compressor stops and then starts when the button is released, the control is good. I'm not sure how many technicians understand that there is a wire wound heater in the control like a light bulb can burn out. When the heater is gone there is no protection.

Considering the time to understand and check it out vs. the cost of replacing these larger semi-hermetic compressors, and the lost product or lost production, proper and timely preventative maintenance of the LOPC is very low cost.

SUGGESTIONS

If you would like to see a future article on a particular subject please write, fax or call.

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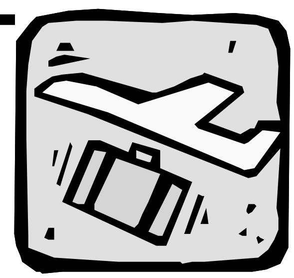

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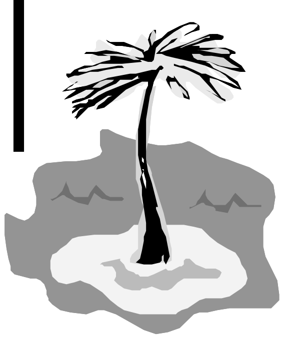

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