HVAC&R ENGINEERING

update

Hermetic motor burnout: How to avoid the catastrophic cost.

“Looks like we can count on getting through another hot summer,” thought the building manager as he perused the maintenance report. Yet even as he initialed the paper and placed it in the “HVAC” file, the sequence of events leading to massive amounts of time, money and inconvenience had begun.

Only three months ago, during the prescribed annual system inspection, almost everything about the building’s big refrigeration unit had checked out just fine. The starter was replaced after it was discovered that deterioration of the load-side terminals caused the motor some excessive starting and stopping. But that was to be expected after years of use. The hermetically sealed compressor motor was running right up to spec. And a spectrochemical analysis of the oil was well within normal ranges.

But....

It had begun with a single weak gasket — one of the 30 gaskets designed to seal the joints of the hermetic motor unit. Soon the small leak was allowing enough moist air into the system to create a reaction with the refrigerant and lubricating oil. Hydrogen and oxygen from the invading moisture combined with fluorocarbons in a violent reaction — forming hydrochloric and hydrofluoric acid — and adding it to the liquid that would be continually changed from liquid to gas and back again.

The acid contamination would become the real problem. Eating at the remaining gaskets. Eventually creating other tiny leaks, and actually increasing its own corrosive content as the fluid mixture coursed throughout the system. Soon it began to eat into the insulation on the windings of the motor that kept it flowing.

The first winding being eaten away didn’t start the fire. But when the wire that lay next to it lost some of its insulation two days later, a tiny electrical spark jumped the gap between the two bared wires as the motor shorted out. The extra heat quickly burned the insulation from the next wire, and the next, and the next. In seconds the entire mass of windings was involved in a sparking, arching fire inside the sealed housing — spewing bits of molten metal and plastic, carbon, and other contaminants throughout the entire system. — until the motor ground to a halt

The cooling flow of refrigerant finally stopped. And that created additional chemical reactions as the heat built even higher and the motor windings melted down. Soon soot could be seen coating the inside of the sight glasses all along the loop.

It would be almost 45 minutes before the first tenant would call to complain about the lack of air conditioning.

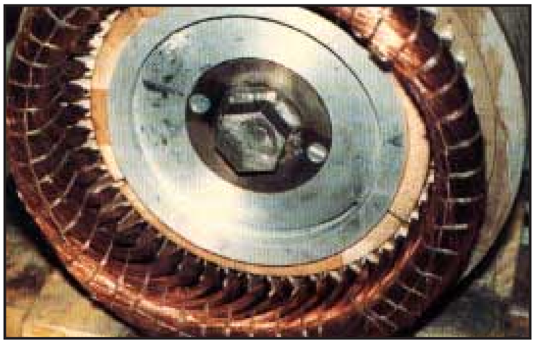
It would be almost 45 days before they could get the system back on line.

YORK® INTERNATIONAL CORPORATION

Burnout in a hermetically sealed chiller motor can *really* put a chill on your system.

The motors don't last for-ever.

Even with the most careful maintenance, even under the best of conditions, the average life of a centrifugal chiller motor in a large HVAC or refriger-



Motor Stator Before Burnout

ation system is about ten years according to Hartford Steam Boiler Inspection & Insurance Co. Motor burnouts can be the result of common chiller problems such as contamination of refrigerant due to gasket or tube leaks, poor purging, or electro-mechanical starter problems like short cycling or a lightning hit. It can be caused by line disturbances like unbalanced voltage and single phase operation on a 3-phase motor. Or just by age.

In fact anything which can cause the motor to overheat can result in dangerous deterioration of the winding insulation. Motor manufacturers have determined, as a general rule, that an increase in winding temperature of 10°C above designed limits will result in an approximate 50% decrease in the life of the windings.

Causes of chiller motor burnout in hermetically sealed systems.

- **Tube or Gasket Leaks** will allow water to enter the refrigerant stream which cools the hermetic motor. This could contaminate the system and eventually short out the motor.
- **Inadequate Purging** of the system will permit moist air to remain in the refrigerant stream, where it could eventually cause a short circuit in the motor.
- **Electro-mechanical Starter Problems** can cause the motor to overheat, reducing the life of the winding insulation and causing a short circuit.

Will you be prepared for the high cost of clean-up?

When the motor "goes" in a hermetically sealed chiller unit, the whole system, essentially, goes with it. Because contamination is spread throughout the closed loop, the entire system will need to be cleaned and overhauled.

You can't afford to take shortcuts. Leaving even minute amounts of contami-

Motor Stator After Burnout

nants in the refrigerant stream, can result in a quick re-occurrence of the burn-out, even on a brand new motor.

If the motor is not replaced with a new one, it will have to be re-wound and extensively repaired by the manufacturer. Cost of clean-up and motor replacement on an average-sized hermetically sealed system can easily exceed $45,000. Add the potential cost of temporary relocation for employees and tenants while the system is being repaired. Plus time and labor of clean-up, administrative, and management personnel — which is sure to get significantly higher as new EPA clean-air legislation takes effect regulating use and disposal of CFC's.

Then because systems which have had one burn-out are more likely to have a recurrence, you can expect to see your insurance costs rise.

The results could put your system out of commission for months.

A hermetically sealed motor usually has to be repaired or replaced by the original manufacturer. So it frequently means a wait of several weeks to receive

Comparing repair procedures for chiller motor burnout.

This greatly abbreviated list is based on the detailed directions provided by several different HVAC manufacturers to their authorized service representatives.

Hermetically Sealed Design

1. Remove all refrigerant from system , passing it through a 50-ton filter drier, and store for possible re-use or discard according to EPA regulations. Retain a sample for acid analysis.
2. Remove all oil from system and discard according to EPA regulations. Retain a sample for acid content analysis.
3. Remove motor and return to manufacturer for rewinding or replacement.
4. Tear down compressor.
5. Thoroughly clean the inside of the oil reservoir, the motor shell, the transmission shaft (including gears, if any), all bearings and related passages and covers, using a suitable sol vent.
6. Rebuild compressor.
7. Tear down the oil pump and lube circuit. Remove filter; filter housing, and related housings. Clean all parts thoroughly with a suitable solvent.
8. Reassemble oil pump and lube circuit, install new oil filter, and add a new charge of oil.
9. If the machine has a float valve or equivalent metering device, remove the cover and thor oughly clean the chamber and float valve with solvents as in item 5.
10. Break into heat exchangers and clean inside of shells and all tube surfaces.
11. Install filter drier and moisture indicator between evaporator and condenser.
12. Close up shells. Replace oil charge.
13. Wait — possibly a month or more — for a new motor, or for your re-wound motor to arrive from the manufacturer.
14. When available, remount motor.
15. Replace all gaskets and seals on motor housing.
16. Reassemble the compressor, pressure test, and evacuate the unit.
17. If the acid content of the removed and stored refrigerant charge is low enough, return the charge from the storage drums to the machine through a filter-drier, adding fresh refriger ant to make up the difference. If not, put in all new refrigerant.
18. Start the system and operate for two days.
19. After two days, shut down system, drain oil, remove the oil filter, and replace with fresh oil and filter. Check both oil and refrigerant for acid content.
20. If acidity still exists, replace refrigerant charge.
21. Restart and operate as a test for 15 days.
22. Shut down and repeat steps from item 19.
23. Restart and operate as a test for 15 more days.
24. Shut down and again repeat steps from item 19. If no indication of acid remains, or it has reached a constant level, the machine may be considered cleaned up. Otherwise a plot of acidity vs. time will indicate the probable need for additional tear-down and clean-up mea sures; or complete replacement.

Open Motor Design

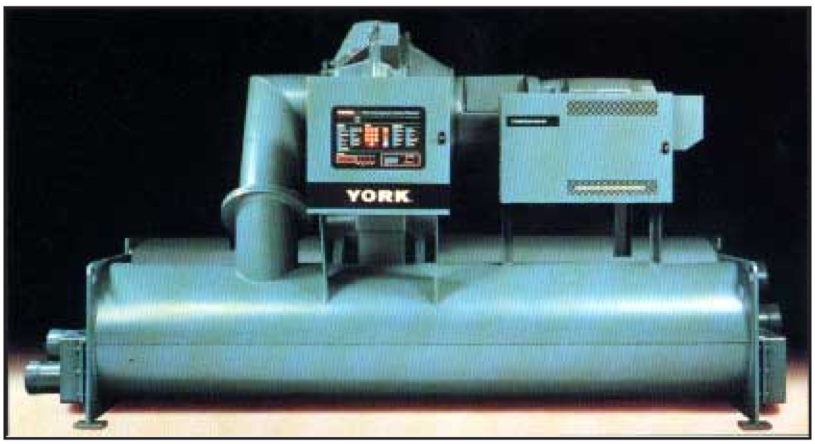
1. Remove motor.
2. Rewind locally
3. Re-install re-wound motor, or if it is not advantageous to wait several days for re-winding, install spare motor.
4. Restart System.

a new motor. And even if a motor is available quickly, it cannot be installed until the entire system is ready.

Unfortunately, that's no small task.

Look at the repair procedures outlined in the chart, below. Virtually every part of the unit will need to be opened, tested, taken apart, meticulously cleaned, then tested again before it can be re-assembled and recharged. Even then, it's so easy to miss small amounts of the contaminants during the clean-up, that equipment manufacturers recommend a pre-use monitoring period of at least 30 days.

Those few weeks of shutdown can easily stretch into several months.



Open motor chiller design. Avoiding disaster from the start.

Less prone to burnout.

Chiller motor burnout, doesn't have to be a catastrophic event.

Any electric motor is going to burn out eventually. But open motor design is gaining favor for its simplicity, efficient operation, reduced incidence of burnout, and ease of repair.

The open drive chiller developed and pioneered by YORK locates the chiller motor completely outside of the sealed refrigerant stream. So unlike hermetically sealed motors, acidity or contaminants that may get into the refrigerant will have no effect on the motor windings. And because the simpler design of the open motor chiller requires only about one-third the gasketed joints needed in a hermetic chiller motor system, the refrigerant in the open system is that much less subject to leakage and contamination.

Less expensive to repair.

If an open motor should fail for any reason, the time and expense of repair is going to be significantly less.

Because of its relative simplicity, an open motor can usually be rewound locally, in a matter of days, for considerably less cost than a new one. Then it can be reinstalled in a couple of hours.

Because there's no contamination of the refrigerant, no charge is lost, and no cleaning is needed. So instead of overhauling the system, waiting weeks for delivery of a new motor, and then testing for a month to be sure it's safe; you need only bolt a new motor into place, make the simple electrical connections, and re-start the system.

It's that easy.

And that much less expensive.

Open motor design for more options

Not only does a YORK open motor system minimize the cost of a burnout, open motor drive chillers are more cost effective to convert to CFC - free refrigerants, now and in the future. Because refrigerant doesn't come into contact with open motor wiring, a typical conversion only requires replacement of a minimum number of seals and gaskets making your chiller compatible with today's alternative refrigerants.

Learn more about how a YORK CodePak open motor chiller protects and enhances your chiller investment. Call your YORK representative for the details.