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Refrigerant Migration: Dangerous But Preventable

Keep the oil warm and consider pump down to prevent compressor damage

A common cause of premature compressor failure is excessive migration of refrigerant vapor to the crankcase of the compressor during the off cycle. When this happens, refrigerant vapor can condense back into a liquid, mix with the oil, and dilute its lubricating properties. On start-up, the oil/liquid refrigerant mixture is then used to lubricate the bearing surfaces within the compressor. This mixture — being a poor lubricant — causes wearing of the bearing surfaces within the compressor.

Depending on the percentage of liquid refrigerant to oil, the bearing wear could be mild to severe. If a sufficient amount of refrigerant has returned to the compressor, it may be possible

on start-up for liquid to enter the cylinder(s) of the compressor and cause further damage to the compressor as it attempts to compress a liquid.

Refrigerant migration occurs as a result of a difference in vapor pressure between the oil in the crankcase of the compressor and the refrigerant vapor in another part of the system. Normally, the refrigerant vapor migrates back from the system's evaporator through the suction line during the off cycle. The greater the pressure difference between the refrigerant vapor in the evaporator and the oil vapor in the compressor, the more likely migration will occur. Migration will continue until there is no pressure difference between the refrigerant vapor in the evaporator and the vapor

pressure of the now refrigerant/oil mixture in the crankcase of the compressor.

Refrigerant migration is usually associated with a temperature difference between the refrigerant in the evaporator and the oil in the compressor. This is true because as the temperature of a liquid decreases, so does its vapor pressure. If the oil is cooler than the refrigerant in the evaporator, there will be a sufficient enough difference in the vapor pressures to cause the refrigerant to migrate back to the compressor.

Even when there is no temperature difference, some migration may occur. At the same temperature, refrigeration oil tends to have a lower vapor pressure than refrigerant.

To prevent migration from

occurring, it's common practice to keep the oil at a higher temperature than the refrigerant in the rest of the system during the off cycle. This is usually done with some type of resistive crankcase heater. There are several types of crankcase heaters commonly used: A heater that can be strapped around the belly of the compressor — commonly referred to as a bellyband heater — or a heater can be directly immersed in the oil of the compressor. Another method commonly used is to allow a small controlled current to flow through the start winding and run capacitor of the single-phase compressor during the off cycle.

Whichever type or method is employed, it's important not to overheat the oil. Always contact

the compressor manufacturer for their recommendations.

Crankcase heaters may not work effectively in applications where the crankcase of the compressor is exposed to extremely cold temperatures. The extreme cold may overpower the crankcase heater. On these systems, a positive way to prevent migration is to incorporate a pump-down cycle into the design of the system. This will pump most of the refrigerant out of the evaporator during the off cycle.

Severe refrigerant migration can lead to certain compressor failure, but it is preventable. When deciding how to best to prevent refrigerant migration, it's usually best to follow the guidelines published by the compressor and system manufacturers. [N](#)

FIELD SOLUTIONS

Alaskan Hydronics Contractor Spans Generations

Family-oriented hydronics contractor strives to keep America's 'Last Frontier' warm

It rains a lot in Juneau, Alaska. Last year, Alaska's capital city's annual precipitation totaled 7 feet. And, somehow, that didn't break the all-time record.

As inevitable as the rain, heavy snow is a threat in the winter. Each year, there's a potential for an avalanche to take out power transmission lines. Some years, this happens more than once.

Juneau's primary power supply is provided by the Snettisham Hydroelectric Project, which depends on water flowing out of Crater Lake and Long Lake. The

hydroelectric plant is 31 miles from town as the crow flies, and that crow would need to fly over Taku Inlet and a handful of towering, snow-covered peaks.

In this windy region, snow never remains exactly where it has fallen, and that's the genesis of Juneau's power challenges. When the long transmission lines are disrupted, Juneau falls back on diesel-powered generation, and the electric rates spike. When it happens — not if — the price per kilowatt hour triples or quadruples, and a resolution rarely comes quickly.

"We don't see the brutally low

temperatures that Alaskans in Fairbanks or other interior regions deal with," said Rusty Powers, co-owner of The Plumbing and Heating Company with his son, Chase Powers. "So, whether customers are using oil or propane, they're just as concerned about electric consumption as fuel efficiency. People around here go a little nuts curbing their electric use when town is using the backup plant."

FATHER AND SON, FROM DAY ONE

Rusty started the company in 1992, after moving to Juneau

from the remote villages of Yakutat and Angoon. After seven years as a tradesman, he made the tough decision to begin the company instead of buying the family's general store in Angoon. While running the store seemed promising, he opted to move to Juneau, where young Chase Powers was born and steeped in hydronic knowledge from the very beginning.

"Chase grew up in the service truck," laughed Rusty. "There were countless midnight service calls where he slept in the running truck while I fixed boilers.

But, when he was awake, he was a reliable go-fer. He'd bring me drain valves and primary controls from the truck and knew every part of a hydronic system by name."

The early education served Chase Powers well. Today, he's guided the company through years of growth and now splits his time between the boiler room and the office, where he designs systems and oversees the work of their six field employees. The Powers' attribute their success to their technicians and careful selection of quality products.

FIELD SOLUTIONS



EFFICIENT UPGRADES: The 2,600-square-foot home of Alaska's Lt. Gov. Byron Mallott features a three-section, 120-MBtuh Weil-McLain boiler and a Crown Mega-Stor 50-gallon indirect tank.



SCENIC VIEW: Service technicians Spencer Youngstrom (left) and Mark Vogel (right) showcase Taco Comfort Solutions' 007e in front of the Mendenhall Glacier.

"Without fail, we've always done the absolute best work we're capable of," said Chase Powers. "With a great company culture and a little luck, we've been able to attract and retain some of the very best technicians in Juneau. Without them, I don't know where we'd be."

With long-standing employees, heating systems that work, and service that's second-to-none, it's no surprise that The Plumbing and Heating Co. has an extensive list of customers who've been loyal for decades.

larly, most recently when their old boiler needs to be replaced. Chase Powers recently installed a new oil-fired system for the 2,600-square-foot home, and, this time, electric efficiency was a big consideration.

A three-section, 120-MBtuh Weil-McLain was paired with a Crown Mega-Stor 50-gallon indirect tank. Four heating zones are each pumped with a 007e, single-curve ECM circulator from Taco Comfort Solutions. With the ability to reduce electric consumption, Plumbing and Heating Co.'s technicians have found the 007e

installed in a laundry room, Chase Powers made sure a direct vent kit was installed, as he didn't want to risk pulling lint into the burner. A Tiger Loop oil de-aerator was installed as well to eliminate the use of a return oil line to the outdoor fuel tank.

Aside from the boiler and domestic tank, the rest of the work was done at the company's shop, which has long since been moved out of Rusty Powers' garage.

PREFABRICATED PERFECTION

As often as they can, the staff at The Plumbing and Heating Co. prefers to prefabricate their hydronic panels at the shop. Building the system just goes more smoothly in a controlled environment.

"We're quick to adopt new techniques and materials that prove themselves," said Rusty Powers. "After reading Dan Holohan's book, 'Pumping Away,' we started putting the circulator on the supply side of the boiler. In much the same way, we've jumped on Taco's 007e."

Four of the high-efficiency circulators are mounted on the hydronic panel at Mallott's home — one serves the water heater and the others each serve one zone of fin-tube baseboard. At the shop, technicians use sheet metal to wrap a piece of ¾-inch plywood on which everything is mounted. The panel also includes zone controls, a 4900 Series air separator, and a combination feed/backflow valve. The sheet metal allows the panel to lay flat on a table during fabrication without unsightly solder burns on the plywood.

Until recently, ECM-powered circulators were cause for concern in a region where oil makes up 90 percent of the heating systems. Cast-iron boilers inherently pro-

duce iron-oxide, which is quickly attracted to the strong, stationary magnets used in all ECM motors. The 007e features a technology called Bio Barrier, which keeps iron sludge from collecting within the pump and destroying it.

"Dad's been using the 007 since he started the company, and the 007e has the same pump curve," said Chase Powers. "Both circulators have the same flange widths, which made it an easy transition for us. I also like this pump's Sure-Start feature, which automatically purges air and self-frees the rotor."

and installing the sensor, the work at the Mallotts' home drew to a close without any real challenges. It's exemplary of the work that Rusty and Chase Powers and their team complete on a daily basis.

"Being a single dad while starting a heating company in Alaska was tough," said Rusty Powers. "I never imagined Chase would follow me into the trade. It's been the greatest blessing in the world to work with my son every day."

As The Plumbing and Heating Co. transitions into its second generation of ownership, the firm prom-

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— Rusty Powers, co-owner, The Plumbing and Heating Co., Juneau, Alaska



PUMPED UP: The Mallott residence utilizes four heating zones that are each pumped with a 007e, single-curve ECM circulator from Taco Comfort Solutions.

After fabrication was complete, the hydronic panel was simply hung on the wall with supply and return lines piped to the boiler, while the zone control was wired into the existing T-stat wires. In fact, it was the first thing installed at the home,

PASSING THE TORCH

After setting up the outdoor reset control (Juneau requires a minus 4°F design temperature)

ises to keep the heating systems in the country's smallest capitol city running comfortably and efficiently, despite what Mother Nature decides to throw at Juneau. [N](#)

Information courtesy of Dan Vastyan, an account manager and writer for Common Ground. Vastyan writes about HVAC, hydronic, plumbing, mechanical, radiant heat, geothermal, solar, and broad building systems industries. For more information, call 717-664-0535 or email cground2@ptd.net.

OFFICIAL DUTY

Alaska's Lt. Gov. Byron Mallott was Rusty Powers' very first customer and remains a customer today. This family friendship began in Yakutat, where Mallott became mayor at the age of 22.

"Byron called at 8 a.m. on my first official day of business just to check in on us," said Rusty Powers. "At the time, I was running the company out of my garage."

The Mallotts still call regu-

very well-received by locals since Taco's regional sales manager, Bob Kleinschmidt, and Robbin Hagen, hydronic sales engineer and distribution sales at Proctor Sales Inc., brought it to Chase Powers' attention.

"Once you explain to homeowners that this new circulator could significantly reduce their energy use, they're pretty much sold," said Chase Powers.

Because the cast-iron boiler is