TRANE® TRACKS

TECHNICIAL NEWSLETTER

Summer 2009

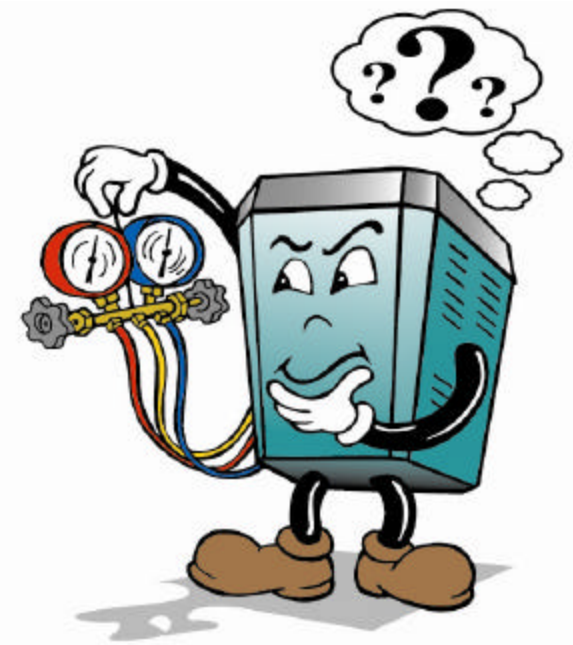
TRANE

It's Hard To Stop A Trane.®

This four part newsletter series titled:

Obituary of a Compressor

will focus on compressor failures and proper clean up procedures in the following categories:



--Electrical Failures
--Refrigerant Starvation
--Refrigerant Flooding
--Refrigerant Contaminants

Part 3 of 4:

Refrigerant Flooding

Obituary of a Compressor

While my engineers designed me for 25 years of life, I only lasted for 6. I was placed in a beautiful custom home with challenging line sets & duct applications. The long undersized duct runs caused high static pressures and reduced air flow. The long refrigerant line sets required 4 additional pounds of refrigerant and no one added a crankcase heater to help me manage this.

The indoor unit with the PSC motor and electrostatic filter is only moving 280 CFM per ton and the expansion valve can not modulate low enough. The installing technician did not recognize the air flow issue and added 7 pounds of refrigerant to increase the suction pressure. I can feel the liquid refrigerant hammering my valves.

Oddly enough, it was not this flood back condition during the hot summer that caused my death, but my long off cycles during the spring & fall. The liquid refrigerant migrated into my shell and displaced the oil when I sat idle for long periods of time. I remember that one spring afternoon when I heard the contactor close. I tried to start but was unable to push the liquid refrigerant & oil out of my cylinder walls. I sat in locked rotor conditions and my crankshaft snapped under the strain—I could pump no more.

The technician did not thoroughly diagnose my deteriorating condition—thinking it was just another mechanical failure. He recovered the refrigerant, bolted in a new compressor and replaced the drier & capacitor. He weighed in the refrigerant charge and added a little extra for the long line sets. He started the system and added a few more pounds to compensate for the low suction pressure. I feel sorry for this new compressor because it will suffer the same premature death as I.

Finding a failed compressor is only the start of the diagnostics process. The real trick is to find out why the compressor failed.

Always use a refrigerant scale to weigh out the refrigerant charge and compare this to the data plate.

An excessive amount of refrigerant is a good indicator that you may have a liquid restriction or poor indoor air flow.

Four General Areas of Refrigerant Flooding:

1) **Lack of air flow across the evaporator**
2) **Loss of crankcase heater with excessive refrigerant charge**
3) **Overfeeding metering device or leaking check valve**
4) **Underground line sets**

Lack of Air Flow

A HVAC system must be correctly applied to its environment. Proper air flow across the evaporator plays an enormous part in system performance and compressor longevity.

Reduced air flow creates a flooding potential for the compressor. You do not need to see ice on the suction line for damage to occur. Low superheat with liquid slugging will destroy valves, bloat internal mufflers and rupture internal discharge lines.

Scroll compressors are a little more tolerant with slugging than reciprocating, but they are not immune to damage. Liquid refrigerant will wash the oil out of the bearings and the scroll will seize.

The floods continue with metering devices & refrigerant overcharge.

Oversized (or missing) pistons, leaking check valves and excessive refrigerant charge will cause the same devastation as inadequate air flow—both of these will deliver low superheat.

Your refrigerant pressures will help you determine which symptom is straining your compressor. A lack of indoor air flow will produce low suction pressure and a high temperature split across the evap coil. A flooding metering device will produce a higher suction pressure with low superheat **and** low subcooling—the temperature split may be close to normal.

Underground refrigerant line sets

Stay away from under ground refrigerant line sets when possible. This design will create two situations:

The world's longest oil trap

A vapor line that acts as a liquid receiver

Liquid refrigerant will always migrate to the coldest spot in a system; this will likely be the line sets under ground.

A vapor line full of liquid refrigerant will slug the compressor on start up—especially during long off cycles.

The addition of a liquid line solenoid valve (cooling only units) will reduce the migration of liquid refrigerant and help save the life of the compressor.

Crankcase Heater?

A Crankcase heater is a **necessary evil** in an HVAC system. The **evil** is that it will consume energy when the system is off; this reduces system efficiency.
The **necessity** is that it will help save the life of the compressor.

Refrigerant is chemically attracted to compressor oil and is soluble when the refrigerant is in a liquid form. Liquid refrigerant will also migrate to the coldest area in the system, and it migrates rapidly. There is a good chance the compressor is full of liquid refrigerant if it is cooler than the rest of the system.

The three pictures on the right show a sight glass in a compressor shell. The top picture shows the case full of liquid refrigerant and oil. The second picture shows what happens five seconds after the compressor starts. The liquid refrigerant boils and causes a violent foaming of the oil. This oil is pumped out of the shell which leads to the third picture—a compressor running without oil.

The oil will need to run through the entire refrigerant circuit before returning to the compressor. This can take several minutes. The end results are worn bearings, scored cylinders and internal ruptures.

The Refrigerant Piping Application guide goes into detail on refrigerant line set design and the application of accessories such as crankcase heaters. This application guide can be found in the FSR section of our local web site: www.desertmountaintrane.com.

Remember, not only is it important to install a crank heater in systems with long line sets or excessive refrigerant charge; it is also important to inspect these heaters with every system maintenance and service call.

If you are replacing a compressor whose death was caused by flooding or lack of crankcase heat, flush the evap coil with nitrogen when installing the new compressor. The oil that was forced out of the compressor during flooding conditions is most likely to puddle in the evaporator & suction line. If this oil is not removed, the new compressor may end up with double the amount of oil.
The results are increased compressor amp draws, reduced system efficiency & reduced system capacity.