

Preventative Maintenance of HVAC/R Systems: Fix the Problem, Don't Treat the Symptoms

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Introduction

If you complain to your doctor about a terrible pain, hopefully your doctor does not simply provide you with a painkiller but instead tries to find the cause of the pain and treat the cause. Rather than treat the symptoms, you want your doctor to attempt to fix the underlying cause of the problem. Pain from an appendicitis attack requires more than pain killer, it requires an operation to fix the problem. Similarly, if your car muffler fails you hope the mechanic's solution is not to just turn the radio up louder. In these vastly different examples the message is clear, treat the underlying problem, not just the symptom of the problem

The same message applies to air conditioning and refrigeration systems. If you are just changing a failed compressor without attempting to rectify the underlying problem that caused the failure, or simply recharging the system with out fixing the leak, you're no better than the doctor that gives pain killers to the appendicitis victim or the mechanic that turns the radio up louder to fix the muffler problem! Don't you think that the equipment owner would pay more to fix the underlying problem, and avoid the future hassle associated with another failure? If you fixed the underlying cause of the problem, don't you think the equipment owner would call you back, instead of just calling the next contractor in the yellow pages.

One of your goals as a contractor is to change your role from one who is simply called on the hottest day of the year (when the system has failed) to one who is building a relationship with your customers. You want to get the equipment owner to look at the value of the service received, and not simply settle on the lowest price for the specific job. Many technicians that are reading this may be saying, "I deal with residential customers and all they care about is lowest price!" This is not necessarily true, because by and large these same residential customers bring their car to a "dealership" rather than the local independent mechanic and pay much higher hourly labor rates. Many times the equipment owner does not see a difference in the quality of the service so they select the lowest cost "supplier." The focus of this article is to suggest ways to build relationships with your customers and improve the perceived value of your service. Use this article as the first step in developing your own preventative maintenance program for your customers. "Preseason Tune-Ups" must do more than simply hose off the condenser coils, change the filters, and connect the gauges for a few minutes. The equipment owner's view of a preseason tune-up is a service to get the system running right, and an attempt to solve problems before the system fails. This article will focus on just a few of the common failure items you should be investigating as part of your PM program.

Lets look at issues that can cause system failure.

- 1. Compressor Failure**
- 2. Relay (electronics)**
- 3. System Leaks Refrigerant**
- 4. Contamination**
- 5. Compressor Failure**

Today's compressors are amazingly reliable considering their duty cycle and their cost. High head pressure, low charge (loss of motor cooling and lubrication), and acid formation are about the only ways to keep them from running for more than 8,000 hours (assuming a 30% summer duty cycle and assuming 5 months/year operation that means more than 7 years of operation). Some technicians want the compressor to fail, since they believe that is where the money is, and that they make their best money on change-outs. However, more and more technicians are beginning to realize that a consistent flow of maintenance and tune up money from a loyal customer actually makes more money in the long run. In addition, when that customer finally does change their system out or replace a critical component, they are less likely to shop based on price. This is the scenario that appears to be true, as evidenced by the dramatic increase in service contracts and system insurance/maintenance programs. If an owner's system fails and he does not know you, then why should he call you, or pay more for your service? In this case, clearly you are competing solely on price with everybody in the yellow pages.

So how do we keep the compressor running? There are several preventative maintenance measures that can be performed to help ensure long compressor life.

Always check for acid in the system as part of every tune-up and service call. This is a moneymaker for you and a money saving investment for the equipment owner. A QwikCheck refrigerant acid test is inexpensive and takes less than 10 seconds to use in the field. If acid is detected, use QwikShot along with a filter/dryer change to remove the acid without leaving any residue (don't use an acid neutralizer, since the neutralization process forms corrosive salts and water as byproducts). If the refrigerant is acid free, check for moisture. If you don't have a sight-glass with a moisture indicator, try Mainstream's new QwikLook moisture indicator. It attaches to the service valve and checks for excessive moisture levels.

Check to see if the wire leads to the compressor are tight and clean. A loose or dirty spade connector will arc causing pitting and other damage to the spade. If the wire leads are dirty, clean them with some fine grit sandpaper or steel wool. If the wire leads are loose or damaged, reattach the compressor lead wires with a QwikLug wire terminal adapter. Check the run and common wire leads, since these typically fail before the start winding lead. If only one lead looks bad, consider changing all the leads, since the others may be very close to failing as well. There is nothing worse than a system failing a few weeks after you performed a preventative maintenance service. If the original three (run, start, common) female spade connectors attaching the wire leads to the compressor are tight, you may want to cover these spade terminal connectors with an oxide inhibiting compound, which is available at most electrical supply houses and can help prolong the life of the original spade connectors.

Assuming you have already checked the system pressures and the refrigerant's condition and charge, you may want to suggest the equipment owner install high and low pressure safety switches. Pressure switches are easily connected and disconnected from the system service valves. Because they have a valve-core depressor built-into the attachment, they are quick to connect and can be removed as needed to attach a manifold gauge set. Operating at high head pressure due to a failed condenser fan motor or clogged condenser can cause compressor failure. A high-pressure shut off avoids this potential problem. Low-pressure operation means the compressor is operating without proper cooling and/or lubrication flow, and could cause air and moisture to contaminate the system from any leaks on the low side of the system. If the equipment owner does not elect to purchase these high and low pressure safety switches, instruct them that when the system fails to turn the unit off until you can get there to repair it. Explain how operating the system in a failed state could damage the equipment.

Check the evaporator, filter, and condensate-pan for scum and biological growth. Besides reducing the airflow through the system (and potentially clogging the drain line), an accumulation on the evaporator will raise the compressor pressure ratio, making the compressor work harder (and lowering the performance). Use a time-release pan cleaner such as QwikTreat to keep the pan and drain line clear. Clean the evaporator and inlet airflow passage. Change the filter, if needed. Likewise a restricted condenser airflow passage will also increase compressor pressure ratio, shorten compressor life, and

reduce system performance. These coils are easy to clean. During your service call or tune-up, check the exterior condition of the compressor and filter/dryer. These housings can easily rust in humid environments. A can of paint or rust proofing can slow the corrosion process and extend the life of the unit. Of course, be sure to inform the equipment owner about the rust proofing service you have performed. One other potential problem is a corroded condenser fan. Spending its life in a humid environment causes the motor shaft to rust, and when the rusted shaft surface contacts the permanently lubricated bearings in the fan motor, it significantly shortens the life of the bearing. A light coat of spray-on lubricant on the fan motor shaft and other critical rust areas will extend the life significantly. Also, check to see that the female spade connectors on the capacitors are not damaged or corroded.

A recent article on preventative maintenance suggested waxing the outside of the unit to prevent rust and make the exterior look new, since image is key in the service business. Some technicians do this to help prevent severe rusting and to make the unit look better after they leave. The key is to provide a service that the customer feels was valuable and worth the investment.

Relay Failures

The next possible failure mode is the electrical circuit. Check the status of the contacts on the relay. If the relay contacts are pitted, the relay should be replaced, not simply cleaned. Once pitted, the surface will quickly degrade after a clean-up, since the hard coat on the contact has been removed. If they are severely pitted, try to determine if the pitting is due to age or if the unit is cycling repeatedly for some reason. Safety controls (low pressure, high pressure, case temperature, motor current, or thermostat anticipators) could be causing the short-cycling. You should resolve this problem, because if the unit is short-cycling, the compressor will fail sooner rather than later. If you just performed a preventative maintenance service and the compressor does fail, I doubt the customer will call you back. For air conditioning/heating applications, suggest a setback thermostat. They can save the equipment owner on energy bills and pay for themselves. You might consider offering to install one.

System Leaks

There is no requirement by the EPA to fix minor leaks, however the EPA requires the repair of substantial leaks on any system that is normally charged with more than 50 pounds of refrigerant. A substantial leak is defined by the EPA as 35% loss of charge per year for industrial process and commercial refrigeration systems. For all other systems, a 15% loss of charge per year is considered substantial. In fact, many technicians will tell you that they routinely make a few bucks on every service call by topping off the system. It may be better customer service, however, to find the leak. Wouldn't you like to be the technician that fixed the leak that had been plaguing the owner for years?

When looking for a leak, the first thing to check for is oil residue, since this is an indication of a leak. At the leak, refrigerant and entrained oil leaks out of the system. While the refrigerant will vaporize, the oil remains at the area of the leak sometimes leaving a residue that is clearly noticeable. The longer the system has been leaking the larger the residue, unless it has been cleaned off for some reason. Electronic refrigerant leak detectors are ideal for quickly finding or confirming the location of a leak, however they are sometimes ineffective at identifying the exact location of very small leaks. It is only for these very small leaks that the use of an ultraviolet (UV) leak detector is suggested. The use of a UV leak detection approach requires the introduction of a fluorescent fluid or dye into the system. Since sufficient time must be provided for the UV fluid to mix with the oil, circulate through the system, and accumulate at the leak, it is typically a leak detection approach that is started on one service call and completed at a subsequent service call. Like the oil, the UV fluid will accumulate at a leak. When illuminated with a UV light (black light), the UV fluid/oil mixture, which has accumulated at the leak, will fluoresce making the residue easier to see than simply an ordinary oil residue. QwikFind fluid is the

only UV fluid on the market that is not a dye. QwikFind is a blend of anti-wear and anti-oxidant additives that naturally fluoresce, and are used by many oil manufacturers to improve the lubrication qualities of their oil.

Refrigerant Contamination

The last potential deathblow to your system, which is by no means insignificant, is refrigerant contamination. One quick, easy, and admittedly crude check for non-condensable gasses is to compare the measured high-side pressure with the saturation pressure at the condenser coil temperature. If the refrigerant charge is correct, then saturated conditions exist in the condenser. By comparing the saturation pressure to the actual high-side pressure, you can determine if there are any non-condensable gasses present in significant quantities in the refrigerant. Non-condensable gasses will raise the actual pressure above the saturation pressure. However, this method requires an accurate measurement of condensing refrigerant temperature so that the saturation pressure can be determined from a saturation pressure/temperature chart, and it requires an actual condenser pressure measurement. Typically, a pressure more than 20 psi above the saturation pressure does indicate that a non-condensable gas problem may exist. If non-condensable gases are trapped in the system, recovering vapor from the condenser should remove these non-condensable gasses and reduce the pressure discrepancy. To detect small quantities of non-condensable gas requires detailed laboratory analysis and is not justifiable except in larger systems.

Check the system for acid and treat the system if acid is detected. Treatment for acid will also remove any trapped moisture so there is no need to test for moisture, if acid is detected. If acid is not detected, go the next step and check for moisture. Moisture accelerates the formation of acids, and can form ice, which can clog an expansion device and lead to recurring problems. You need to monitor the system for moisture. On many residential installations, the installer may not have installed a sight glass in order to save money on the initial installation. Retrofitting a sight-glass is probably not practical, due to the excessive cost associated with recovering refrigerant and recharging the system. In these cases, consider installing a QwikLook moisture indicator. QwikLook is a moisture indicator that installs in minutes to the low-side service valve and is perfect for those installations that don't have an inline moisture indicator.

The failure to adequately evacuate lines sets before connecting them and the moisture trapped in open oil containers can lead to significant moisture levels in systems. The potential problem with moisture has changed dramatically with POE oils because they are extremely hygroscopic (meaning they absorb moisture). When the oil container is open, air fills the space above the oil in the partially filled container and the moisture in the air will be absorbed into the oil. A final comment on impurities is in order.

1. Never put any water-based cleaners or flushes into a refrigeration system. If you introduce any water-based additive into a system, you need to evacuate the system to below 29 inches of mercury vacuum and assure that the entire system is heated above 75F for any water removal. However this does not assure timely water removal, for that you need warmer temperatures and deeper vacuums.
2. Keep the system sealed when ever practical.
3. Always pull a deep vacuum before charging. On a R-22 system with a volume of 10 cubic feet, the difference in evacuating from 10 to 25 inches of mercury vacuum means that after recharging the non-condensable gas level drops from 14 % non-condensables (by volume) to 3.5 % (calculations assume ideal behavior, 70F ambient, 5 cubic inch vapor volume). An evacuation to 28 inches of mercury would drop the non-condensable gas concentration after recharging with R-22 to 1.4%. The ARI standard for non-condensables is 1.5% (by volume).

Conclusion

Equipment owners do look at the value of the service received, but when the value is perceived to be identical, they pick the lowest cost supplier. You should convince them that the services you provide really are different, and you provide more value. This can be accomplished by doing a more thorough and complete job, by fixing the problem, and solving the underlying cause of the problem.