Aspects of the Compressor Retrofit

Following these key guidelines during a compressor changeout can ensure a successful, more efficient replacement.

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As much as industry professionals would like to believe that compressors will last forever, the truth is compressors will eventually fail in the field. This failure necessitates replacing the compressor, and with the complicated systems in the field today, this is not always such a simple process. Following good practices and procedures are critical to prevent premature failure of the replacement compressor. Below are guidelines to consider that will ensure the life of the replacement compressor.

Six key aspects of the retrofit process

1. Refrigerant recovery: All refrigerant must be removed from the system before beginning the compressor replacement process. Since modern refrigerants are either an ozone-depleting gas or a greenhouse gas, law mandates that the refrigerant cannot be vented directly into the atmosphere.
   - Be sure to disconnect all electrical power circuits and lockout before proceeding. Install a piercing valve in the process tube or use the high- and low-side service valves, if available.
   - Connect the service manifold to the system valves and to the refrigerant recovery machine (be sure the machine is approved for the refrigerant being removed), along with a properly approved refrigerant recovery cylinder.
   - When the recovery process is complete the system can be prepared for the nitrogen purge prior to brazing in the new compressor.

2. Follow standard refrigeration practices: Proper pipe-fitting and brazing techniques are critical to ensuring a long life for the replacement compressor. Be sure to deburr any copper lines that were cut with a tubing cutter. It is recommended to purge the system with nitrogen to prevent any oxidation from forming on the inside of the tube while brazing. Oxidized particles and loose copper pieces can get caught in the orifices of the metering devices as well as damage the compressor bearings.

3. Cleanliness: As stated above, it is important to keep debris out of the refrigeration system because dirt and debris can damage the system. Whenever a compressor is replaced, be sure to replace the filter-drier. A suction-line filter-drier should also be installed in the event of a compressor burnout. This will help prevent debris and particulates from reaching...
the metering devices and the compressor. Also, be sure to wait until you are ready to braze in the compressor before pulling the rubber plugs on the tubes. If the plugs are pulled too soon, there is a risk of moisture in the air mixing with the oil in the compressor. Modern oils, such as polyolester and alkyl benzene have the ability to act like a sponge and will soak up the humidity from the atmosphere. This moisture will react with the copper in the system forming acids and sludge that will clog the system and potentially damage the compressor. As a general rule, the compressor should not be open to the atmosphere for more than 15 minutes. This duration is a period when the compressor is vulnerable and easily affected by climate conditions, so it is best to minimize the time between the removal of the plug and the brazing in of the compressor. To maintain a long-lasting refrigeration unit, pulling a deep vacuum of 500 microns or lower is crucial after the compressor is replaced. During the evacuation step, moisture is removed by reducing the pressure in the system until water is vaporized (boiled) and then removed by the vacuum pump. Again, this will prevent acid and sludge buildup from the moisture reacting with the copper in the system.

4. Charging: Technicians should also be conscientious of charging the system properly. Too little charge and the system will never meet the temperature setpoints, or the system will run for a longer period than it should. Also, too little refrigerant will cause the compressor motor to run hot, as it is designed to be cooled by suction gas. Too much charge and there is a risk of flooding the compressor with liquid, which can wash lubricant from the bearings and potentially cause component failure. Add refrigerant to the system until it is able to achieve stable conditions at the proper setpoints. Be sure to check the documentation from the manufacturer for the proper refrigerant charge, and it is always recommended to weigh in the charge with an electronic charging scale.
Checking superheat for systems with a capillary tube is also recommended to ensure adequate charge and prevent liquid floodback. Systems equipped with a TXV will require a refrigerant subcooling check.

**5. Select the right compressor:** This is an obvious but critical step because a compressor that is too small will not be able to handle the heat load of the system. This will result in long run cycles and an inability to achieve desired temperatures in the refrigerated space. On the other hand, a compressor that is oversized will consume excessive energy and result in superfluous cycling, which would shorten the life of the compressor and increase the risk of liquid refrigeration floodback. The standard compressor capacity match should be within a ±10% range. This will prevent short cycling or oversizing the compressor and make sure the system is performing properly and efficiently.

**6. Lubricants:** One of the most important aspects of the retrofit process is to correctly match the type and amount of lubricant within the refrigeration system. Be sure to check the manufacturer’s specifications prior to installation. Industrial lubricants commonly used today are mineral and POE for R-22 and POE for R-134a and R-404A. Lubricants can vary based on a variety of characteristics, including its miscibility, viscosity and hydroscopicity. The proper type and amount of oil to be used in the compressor should be based on data provided by the compressor manufacturer, making it imperative to check with the manufacturer’s specifications before moving forward with the retrofit process. Miscibility (proper mixing of lubricant and refrigerant) is why manufacturers specify this information. Pay close attention to these specifications, as some manufacturers indicate an initial oil charge. Most replacement compressors will come pre-charged with the correct oil type and charge of oil. Always double check with the manufacturer prior to installation.

These tables show AHRI and ASHRAE applications and test-condition guidelines.
A compressor rated on AHRI standards will have a different capacity and efficiency rating when using the ASHRAE rating system.

check that the oil that is in the compressor is compatible with the refrigerant that is used by the system. It is a good idea to measure the oil volume being replaced in the compressor to ensure that there is no additional oil trapped in the system. If oil is trapped in the system, remove it because this can impact the operation of the system.

Ratings
Sometimes compressors are rated under different rating agencies. The two most common are ASHRAE and AHRI. Each has different rating systems for various "standard" operating points. Therefore, a compressor rated on AHRI standards will have a different capacity and efficiency rating...
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when using the ASHRAE rating system. Unfortunately, there is not a good method to convert one to the other without testing a compressor in both conditions. If in doubt, contact the compressor manufacturer. See Figure 1 for AHRI and ASHRAE applications and test-condition guidelines.

Compressor electricals & accessories
One of the final items to take a look at when replacing a compressor is the electrical components. Be sure to check that the run and start capacitors are still within the specifications written on their product labels. If they are not, then replace them. Double check the relay to make sure that there are no shorts in the relay. And finally, check the overload. If any of the above components are not operating to specification, all this hard work will be in vain. Take care not to over-tighten the bolts for the rubber grommets—the grommets should not bulge beyond their diameter. Over-tightening causes excess vibration.

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