Most commonly, when a failed compressor is returned to the manufacturer for analysis, the cause of compressor failure could have been prevented. This includes following a step-by-step procedure during the preparation, installation and startup of the replacement compressor. The same rule applies for starting up/commissioning a new system. A little extra time spent on this can pay off down the road.

To see why, it is important to first understand how compressors and other components fail to begin with. For compressors, poor voltage and/or power factor, phase imbalances and even loose connectors can result in poor starting and high winding temperatures. These result in the breakdown of the winding insulation and short circuits.

On the refrigerant side, poor charging practices, not using micron gauges to evacuate, and slow leaks can result in inadequate motor cooling and excessive discharge temperatures. Poor airflow, incorrect defrost setups and incorrect component sizing are also potential causes.

I have seen enough burned up and flooded compressors to verify that these are real things and that they happen too often and result in higher costs for everyone. I can also assure you that proper startup and commissioning practices could have eliminated almost all of them.

Best Practices

What constitutes a proper startup or commissioning program? Best practices. Essentially, we need to do all the things that we were taught in trade schools or apprenticeship programs.
The reason we are taught to do these things was, simply, to avoid all the reasons for unnecessary component failure in systems. In other words, most of us have seen and heard what needs to be done, but from talking with people over the years, the payoff is not all that clear cut.

Time is in short supply on jobs and it can be difficult to take the extra time needed to watch a system after installation to ensure proper startup/commissioning that will enable it to perform a few years down the road or longer. The good news is that we don’t have to. Properly done, it should only take just a little longer to ensure that all potential causes of failure, and the reason the system failed in the first place, have been eliminated. This is where being smart with your time and having a strategic approach pays off.

Create a Startup/Commissioning Form

A good place to start is to use a startup/commissioning form. To back this up, almost all of the best rated contractors in surveys use some way of tracking what needs to be done on a job and when it is performed. It is too easy to miss certain steps that may prove invaluable down the road. There are many ways a compressor can overheat and fail, and it is possible to miss some of them if a strategic method to find them is not used.

Always refer to the compressor tear-down analysis of the failed compressor, if available. This will tell you if the compressor was flooded, overheated or suffered from poor oil return and will tell you things to look for.
specifically. If the compressor failed due to overheating, pay attention to any conditions that may lead to this type of failure for example. New processes, just like new skills, eventually become second nature and can build better technicians.

The startup/commissioning form should begin with a quick section on visual checks. This is especially important if the system is still operational upon technician arrival, but it can still be of value for non-operational systems as the process can sometimes identify things that could cause problems down the road, such as overgrown vegetation and condenser air recirculation issues.

Following this, proper installation steps should be listed with pertinent steps such as mounting bolt torque and conductor-terminal connection torques for that matter. Spade connections should be tight with no wiggle room. Check conductors for discoloration and replace them if observed. These may be little things, but terminal box fires have occurred as a result.

**A little time and effort combined with a startup and commissioning form to guide you will pay big dividends.**

Just remember that the compressor does not operate independently. Check the compressor relay for burned connectors and make sure the relay pulls in with no hesitation or buzzing chattering. Replace it if you suspect anything.

It is a good practice to always replace them regardless of whether you replace the compressor. Some compressor manufacturers require the compressor relay be replaced with a new, factory specified relay to honor the warranty, so that should tell you it’s importance.

**Check Start Hardware**
Check all start hardware such as start and run capacitors, as well as start relays. If any of them test poorly or look suspicious, replace them. There should never be any hesitation when a compressor or fan starts. If there is, find out why and fix it.

While you’re at it, it is important to verify the voltage values for all three phases if applicable. Note the values on the form. If the voltage is bad, you can replace any or all the compressors, but the result will always be the same. Take care when brazing in the compressor. Use lots of heat and do it as quickly as possible to avoid heat migration into the compressor.

Evacuation should be completed using equipment that provides the least resistance to draw out the non-condensable gasses as possible. Ditch the manifold gauge; several evacuation tools exist now that will allow you to draw a vacuum far more quickly and with greater accuracy using a micron gauge, large diameter hoses and core removal tools.

There is no reason you cannot draw the proper vacuum level in a reasonable amount of time with today’s tool options. Look for vacuum decay indicating moisture or leaks and learn how to tell the difference if you do not currently know. Small leaks can be picked up using a micron gauge and these will save you a lot of headaches down the road as slow leaks can result in failed compressors and poor cooling performance. Note the vacuum level achieved and the amount of vacuum decay on the form.

**Charge Properly**
Charging should be done to manufacturer’s specifications whenever possible and charge only what is indicated. Over charging a system will not make it operate better unless additional charge is warranted by specific conditions and recommended by the manufacturer. Too many compressors have died by incorrect charging and it is no harder to charge the correct amount than to add it haphazardly.

Weigh the refrigerant charge coming out as well as going in. Note both values on the form. If you recover significantly less refrigerant that what is
supposed to be in there, it is a good indication of what likely went wrong, and you should find out why. Also note the indoor and outdoor ambient conditions as these are important when charging as they will directly impact the correct values of subcooling and super heat that will be used to charge the system. Wet bulb is the key value indoors for air conditioning as it represents the load that will fluctuate the most unless you have your thermostat differential set at 25°F. As before, note these values on the form.

**Check Voltage and Current**

Once the system is started and charging is complete, check voltages and current values and verify that they match what the manufacturer specifies for the conditions present. Remember that compliant scrolls will require a break in period so take this into account. Note system pressures, subcooling and superheat values as required and, once again, make sure they fall within acceptable values as outlined by the manufacturer. Don’t go by a rule of thumb as the ambient and indoor conditions can result in substantially different values that are still correct.

For multi-compressor systems, like those found on supermarket racks, check the oil level between compressors to ensure that both correct oil return is occurring and that the oil is being shared appropriately between compressors through the oil equalization lines. Also, for compressors with mechanical oil pumps such as semi-hermetic designs, check the oil pressure and the oil differential control to ensure it is working as intended. The compressor sight glass is a great tool to ensure that proper oil management is occurring.

**Check Airflows**

Check and note airflows at the evaporator and condenser and ensure that they are at a value that they are supposed to be. If the airflow is wrong, none of the other values have any meaning until it is corrected. It is hard to overstate how important this is. Programs and training classes are available and training classes to help technicians quickly learn or refresh how to properly determine airflow. It is a valuable skill that will improve a service technician’s value.

Finally, do one more inspection to catch anything that might have been missed. Remember that things like flash gas in the liquid line can be a result of a plugged drier or stuck solenoid valve just as much as they can from a low refrigerant charge. Never add refrigerant or adjust anything until all other possible causes have been eliminated. This will only make it harder to find the real problem.

A little time and effort combined with a startup and commissioning form to guide you will pay big dividends in reducing call backs and the associated costs that go along with them. Not to mention that it will free up more time to do other calls that will increase the amount of beneficial work that can be performed—making more of the time you have available.

Finally, given how quick word of mouth can travel with social media, leaving a better impression with your customers and getting better reviews goes a long way in building your customer base.

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