Compressor Performance Analysis

This article is written by regular contributor, experienced rack refrigeration tech and RSES CM Jeremy Smith. Thanks Jeremy.

A technique that you can use to diagnose compressor problems and to help differentiate them from other possible issues is the use of compressor performance analysis.

Manufacturers do extensive testing of their compressors before they sell them, and a part of that testing is available to you as a troubleshooting tool. The compressor performance chart. I'll primarily refer to Copeland compressors as they are what I service most, but I've been able to find charts and data from other manufacturers through their websites and tech support lines.

Let's look at a real-world example. I went to do a follow-up check after a major leak and recharge on a set of freezers. On arrival, the cases, which had been running now for 14 or 15 hours since having been repaired, weren't as cold as expected. Checking the unit, here is what I found:

Copeland compressor
2DA3-060L-TFC
R404A
27# suction
185# discharge
209v (average of all 3 legs)
13.9A draw.
Unit at 18-20°F

The suction line was cool to the touch and the sight glass had

a thin ‘river’ of refrigerant in it. The high suction pressure really jumped out at me here as worthy of more consideration.

Now, a high suction pressure in this instance can be caused by high load (note the high unit temperature) or it can be caused by a compressor problem. Looking over the data here, I was concerned about the health of the compressor and its ability to pump properly. I did a quick “pump down test” and found it inconclusive. The compressor pulled to 24” Hg easily and held there. Still, I wasn’t happy with this, so I pulled out my smartphone and opened the Copeland Mobile app.

> *A quick note on pump down ‘tests’. They really aren’t effective on most modern compressors. I performed the test and included the results here to illustrate exactly that fact.*

Entering the model of the compressor leads you to select the application (R502 low temp which is closest to R404a low temp). Selecting the “Diagnostics” tab brings you to a screen where you and input pertinent data and the app then outputs both the expected amperage at your conditions and the percent deviation
from the norm.

In this case, my expected amperage was significantly higher than my observed amperage, so the high suction was definitely caused by a compressor problem.

I recovered the refrigerant from the machine and removed the compressor head and valve plate for internal evaluation.

Finding a single broken suction reed, the rest of the internals were intact making this a good candidate for a new valve plate. I Installed new valve plates, evacuated and restarted the machine and re-evaluated operation.

Had this been a hermetically sealed compressor, I would have had no choice but to condemn and replace the compressor. This time, the amperage was within 5% of specifications (sorry, didn’t get a screenshot) and I continued to monitor unit operation until equipment reached 0° F, verified and completed proper
charging of the unit and called it a day.

Why not use RLA (Run Load Amps) (? Or use LRA÷6 (Or is it 8?) to diagnose?

The simple answer is that they just aren’t sufficiently

accurate enough for me dealing with high stakes, high dollar equipment and they shouldn’t be accurate enough for you, either.

Let’s return to my real-world example…

The compressor has a listed RLA of 25.8 and a LRA (Locked Rotor Amps) of 161.0. Now look back at the original screenshot of the app. It calls for an amp draw of 17.09A at that set of conditions. If we compared that to the RLA, even the correct amperage looks low. If we use common LRA divisors 161 ÷ 6 gives us 26.83A and 161 ÷ 8 gives us 20.125A. Maybe a little better than the RLA method but still off by a significant amount. Enough to cause concern and possibly lead to an incorrect diagnosis.

Not a one of these methods gives us an accurate expected amperage for this machine. That inaccuracy can lead us to draw a bad conclusion and potentially wasting time and money pursuing a “bad” compressor that is in fact, working exactly as it should.

Like most things in HVAC/R using a fixed operational target without considering the specific conditions can lead to misdiagnosis and a lot of wasted time. You would be surprised what is available within manufacturer specs if you take the time look.

– Jeremy Smith, CM