Progress Supply Inc.

THE INSIDE STORY

Helpful Information for HVAC Contractors from Progress Supply's George Story

This is the first of a series of technical bulletins from your friends at Progress Supply

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SUPERHEAT. . . .WHAT'S ALL THE FUSS?

Everybody talks about it but does everyone understand it?

What is it?

Where is it?

Why is it?

What can I do about it?

How much should it be?

Who cares?

Yes, what's all the fuss about **SUPERHEAT?!**

Recently, I had someone tell me that superheat is not important. Other things in the system are more important and if those things are right, the superheat will fall in line. Then, you ask, why am I writing an article about superheat?

If you have read some of the questions to the several industry publications and some of the rebuttals, you can understand why this article. Numerous questions are asked of us about superheat. Come into our store and answer the many calls, the many questions we get asking for help with their system problems, then you will understand why this article is about superheat. I believe that there is a general misunderstanding about the subject. The call starts something like this: "I'm having a problem with my compressor, my system. I'm not getting enough cooling and I think that the compressor must be bad." After we find out what compressor it is and what temperature they want to maintain in the space, our next question asked is, "What is the superheat at the outlet of the evaporator and at the inlet to the compressor?"

Here are some of the answers we get:

"It's OK."

"I don't have a superheat tool."

"I felt the line and it is cool."

"What is superheat?"

"How do I measure superheat?"

What is Superheat?

"Let's go back to the beginning. **What is superheat?**

By definition, superheat is the heat added to the refrigerant above its saturation temperature (boiling point of the refrigerant). And what is the saturation temperature or the boiling point? You and I understand that the boiling point of water is considered to be 212°F at sea level (the boiling point of water in Denver is 203°F). Most of us don't think of water as having different boiling points. So why the difference?

Pressure.

At sea level the normal atmospheric pressure is 14.7 psia (0 psig). In Denver the atmospheric pressure is 12.2 psia and it is still 0 psig. Many of us may not realize these differences, but ask those in the mountainous areas about it.

Check Your Pressure/ Temperature Chart

Now that the little physics lesson is out of the way, let's get back to refrigerant. Again, what is the boiling point, or saturation temperature, of the refrigerant?

First, what refrigerant are we discussing?

Second, what is the pressure of the refrigerant?

Take out your Pressure/Temperature chart and look at the column for refrigerant R-22. Look down the column until you read 76 psig. My Pressure/Temperature chart tells me the boiling point, or saturation temperature, is 45°F.

What is the Pressure/Temperature chart? It is a chart of boiling points, or saturation temperatures, for each refrigerant. Yes, the saturation temperature changes as a function of its pressure. We do understand if you want a colder space you must have colder refrigerant, and to get colder refrigerant its pressure must be lowered.

Now, don't let this fact lull you into another false belief — if I know the temperature I know the pressure. This is only true when the refrigerant is saturated. In addition, don't let this fact cause you to lower the suction pressure to get more capacity or to pull the load down faster. But. . . .this is the subject for a different article.

How to Determine Superheat

Now that we know how to find the saturation temperature, what do we need to know in order to determine superheat?

We need to know the refrigerant's actual temperature. Most of us use a thermometer and insulate it to the line we are interested in. Hopefully, the suction line is well-insulated already. We assume the refrigerant inside that line is the actual temperature measured on the outside of the refrigerant line. Well, it's close, but it is not the actual temperature. This is because the metal of the line will transport higher temperatures to our point of measurement. The inside of the line has some oil in it and oil is an insulator. There may be some other factors that affect that measurement, but for most installations this measurement will suffice.

Generally, one can assume the refrigerant's temperature to be several degrees colder than the line temperature.

Now we have measured the pressure. It must be the pressure at the point we want to know what the superheat value is. We cannot take the pressure at the compressor and guess what the pressure will be at some other point. The only time taking the pressure at the compressor counts is if we want the superheat at the compressor, or, if the inlet to the compressor is within several feet of the evaporator outlet.

But what should the superheat be and where should there be superheat? Superheated refrigerant is in more of the system than any other form of refrigerant. We want superheat at the outlet of the evaporator, at the inlet to the compressor, at the outlet of the compressor and generally through the discharge line and into the condenser.

Let's look at several areas of the system.

Superheat at the outlet of the evaporator is important to make sure the evaporator coil is producing at its rated value. Each evaporator coil manufacturer rates their coil to produce a specific BTU value at a specific superheat value at the coil outlet. If the superheat is too high, the coil produces less than rated BTU's. If the superheat is

Example:

We read the pressure at the outlet of the evaporator and our gage reads 25 psig. The refrigerant is R-22. Our Pressure/Temperature chart tells us the saturation temperature is 2 °F. The thermometer reads 14 °F. The actual temperature is 12 degrees above the saturation, therefore, we can state there is 12 degrees of superheat.

too low, the coil may produce rated BTU's but the system may be less efficient. When liquid leaves the evaporator it must be boiled off before it gets to the compressor. If it boils off in the suction line and if the suction line is in the "refrigerated" space, this may be OK, it is still heat picked up within the space. If it boils off in the suction line outside the "refrigerated" space it is BTU's picked up that the compressor must handle and only adds to the compressor load with no value to the system. This only adds to system inefficiencies.

What Should the Superheat Be?

OK, what should the superheat be at the outlet of the evaporator? The first question is what superheat value did the system/coil designer specify to get the rated BTU output? If unknown, then the generally accepted values are 10 degrees for high temperature systems, such as air conditioning. Medium temperature systems, such as walk-in/reach-in coolers, generally operate at 6 to 7 degrees of superheat. Low temperature systems, such as walk-in/reach-in freezers, generally operate in the 3 to 5 degree superheat range ***(see table above).***

APPLICATION	USUAL SUPERHEAT AT THE EVAPORATOR OUTLET
High Temperature	10 degrees
Medium Temperature	6 to 7 degrees
Low Temperature	3 to 5 degrees

Why the difference? **Density.** BTU's are calculated by multiplying pounds of refrigerant per hour in circulation times the enthalpy of the refrigerant. As the suction pressure goes down the density goes down, as does the enthalpy (this article is not the place to get into this explanation).

Next, what should the superheat be at the compressor? First, one must understand that the superheat at the coil outlet and the compressor inlet are not to be considered the same unless the suction line is so short that no heat will be picked up in the suction line. In addition, the superheat adjustment for the coil is not the superheat adjustment for the compressor inlet. Yes, there are those who will tell you the TEV is only a compressor protector. This is not true. The TEV is an evaporator regulator. OK, what should the superheat be at the compressor? Compressor manufacturers would **like** to see 20 degrees of superheat at the compressor inlet under full load. This will permit the superheat to fall somewhat as the load falls off and yet not allow liquid to enter the compressor.

Why superheat at the compressor? Compressors do not like to ingest liquid refrigerant. They have been known to "puke their guts" when liquid entered their "belly." We'll discuss what to do about too low a superheat at the compressor in another article.

Why Superheat and Why is it Important?

Yes, why superheat and why is it important? It is one of the measures of evaporator cooling production. It is also a measure of compressor longevity. The next time you call, have the pressure and temperature at the point we are interested in—at the evaporator outlet and at the compressor inlet.

SUGGESTIONS

If you would like to see a future article on a particular subject please write, fax or call. Phone: **513-681-3881**
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George has been in the HVACR industry for almost 50 years. He is a graduate Electrical Engineer and a Registered Professional Engineer, with a wide range of experience within the industry. He was an engineer for a major controls manufacturer and a major HVACR manufacturer, and has operated the service divisions for several large mechanical contractors. He holds two U.S. Patents for controls systems for HVACR products. George was the manager of Customer Training for the Copeland Corporation. As a part of that position, he was responsible for their well-known Compressor Operation and Service Seminar. He also did training in several countries outside the U.S. George retired approximately a year ago and is currently working for Progress Supply based in their Dayton Branch. He is working as a Technical Specialist doing educational programs, assisting customers when problems arise and answering questions from customers.

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