

Getting Comfortable with Designer Air

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Four Things You Need to Know About Modulation Technologies Q+A Session

1. Question: Can you explain further the operation of the UltraTech scroll compressor?

Answer: The Copeland Scroll Ultratech™ is a technology that is able to run in two steps of capacity. In the Ultratech scroll there are two by-pass ports in the scroll elements controlled by a solenoid valve. By alternately blocking or unblocking the by-pass ports we can allow the scroll to either operate at 100% or we can by-pass the outer portion of the scroll wrap and use the inner portion of the scroll wraps to deliver two thirds capacity. One of the nice benefits is that the system doesn't have to start or stop the compressor, it can essentially change on the fly. So early in the day it might run at the part load capacity and perhaps on a hot day or late in the afternoon it would kick up to the 100% mode utilizing the full capacity of the scroll. Also, in terms of how precisely the by-pass scheme works, it really delays the start of the compression process within the scroll compression elements to a reduced portion of the scroll geometry. The inherent initial volumes are smaller than at the outermost areas of the scroll form in the full load case and it makes the scroll elements look smaller, therefore making it operate much like a smaller displacement compressor would operate.

2. Question: For the digital scroll, are there any concerns in reference to oil entrainment or super heat at low loads?

Answer: When you talk about a modulation capability to 10:1, and all the way down to 10 percent rated capacity, it is certainly a good question about oil entrainment because you're dealing with low mass flow. The good news in the experience profile that we've had out there over a number of years of applications with digital scroll is when we get a flow state even though it maybe proportionately at a fairly low percent, let's say something well below 50%, when we're in a compression flow state in the duty cycle, we are actually operating at mass flow rates that emulate a normal full load condition. So we get very high flow rates. Then we go to a state where the scrolls are separated and we go to zero flow rate. So unlike a variable speed scheme where we're actually taking the shaft speed of the compressor and in real time taking the mass flow down to a very small amount, in this case for small bursts of time we're actually producing fairly high mass flows, albeit only at certain time intervals with a rest period in-between. This has is proven to be very effective at managing oil return to the compressors. And certainly anyone dealing with long line sets would recognize there's always a number of concerns with any kind of restrictive vessels. There are a number of application guidelines, but in general the digital scroll has not had a significant number of unique application requirements because of the notion of a very high mass flow rate during those time intervals when it is actually pumping. I am not aware of superheat concerns related to digital compressor applications at low capacity states, but there are other system components, including expansion devices, which must be properly designed and applied to work in concert with all the key components in the modulated system to assure proper operation.

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3. Question: How does one select a variable speed compressor application to take advantage of the over speed capability?

Answer: Variable speed lets us look at the variety of loads we know an application will see over its use profile. It then selectively sizes the compressor and system to match the load sample and for a short time meet a particularly demanding load sample. Examples can be in either cooling or heating scenarios.

4. Question: With VSD technology, are there any electrical issues, harmonics, grounding etc.?

Answer: Typical electrical application procedures need to be used, but we take our inverters thru a thorough design approach to mitigate any EMI (Electromagnetic Interface) concerns.

5. Question: In a residential two-story application, do you have concerns about airflow to the second floor during the lower levels of modulation?

Answer: Multistory cooling with a single system, whether modulated or not, can represent significant challenges due to varying conditioning load requirements. Proper design of duct work and other air handling considerations are very key to good comfort and performance in these types of applications. Systems with multiple comfort sensing schemes, including “zoning” capabilities which consider airflow consideration as a function of floor-specific loading, can be an effective approach when duct or other construction limitations result in poor distribution of airflow for conditioning.

6. Question: What about oil return issues in variable speed compressors? Is there anything internal to the compressor, such as the oil separator to prevent starving the compressor of oil? Does this technology require frequent purge events?

Answer: The ability to maintain oil levels within the compressor, known as the oil sump area, is extremely important to maintaining adequate lubrication delivery to the key compressor bearing surfaces across all operating conditions and loads. Continuous improvements are taking place regularly to account for the wide operating range of variable speed compressors to help them maintain proper circulation of the oil. The majority of these are listed on the Emerson Climate website: http://www.emersonclimate.com/en-us/Products/Compressors/Scroll_Compressors/copeland_scroll_commercial/Pages/modulation_technologies.aspx

7. Question: How is the trend toward greater efficiency continuing to impact compressors? What are the most important parameters for measuring and maintaining compressor efficiency (part load, etc.)?

Answer: Our industry continues to develop system technologies that simultaneously meet the needs of high ambient efficiency ratings and those that are more moderate, or tend to be designed to meet a weighted average across high and moderate ambient load conditions. In response, several different compressor capacity modulation technologies have been developed in both residential and commercial applications such as two-step, continuous digital, variable speed, and multiple-manifolded compressors. While fixed capacity systems will continue to play an

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important role within the U.S. air conditioning space, our industry's ability to apply the right modulation technologies to certain higher efficiency application needs will garner much focus. We will continue to provide a variety of cost effective compressor modulation solutions to meet the needs for both regulation compliance as well as other key benefits including comfort, indoor air quality and the need to keep end-user costs low.

8. Question: Can modulation reduce SKU's for 24 to 60 Ton units?

Answer: Yes, depending on how you stage your capacities with modulation and your strategy with respect to the number of circuits. For example in multiple compressor applications, a small number of SKU's can be paired in equal and unequal capacities.

9. Question: What options does Emerson Climate have for precise load matching, and temperature control in greater than 30 ton capacity range? Or even more so in the greater than 150+ range?

Answer: At 30 tons options exist for a tandem or even a trio. Variable speed tandem 15+15, digital tandem 15+15, trio 10+10+10, and a variable speed 30 ton. Each has pros and cons depending on the specific need. At >150 tons, 30, 40, and 60 ton compressors can be combined in similar ways.

10. Question: In residential and light commercial markets, which manufactures offer modulation systems? Most important, is there a resource to get familiar with diagnosing and troubleshooting modulation systems?

Answer: Most all of the larger system manufacturers offer some type of modulation system offering; whether it is enabled with electromechanical or true variable speed technology. There should also be application and troubleshooting guidelines that are published by the manufacturer.

11. Question: Does your variable speed compressor have oil pumps for proper lubrication during slower speeds?

Answer: Yes, our variable speed compressor designs all feature oil pumps which provide proper lubrication at lower speeds.

12. Question: In a variable speed system what is the typical percent range of modulation flow?

Answer: In the variable speed system capacity can range from 20 to 120%.

13. Question: Are EXV's required for lower capacities with a VFD and multiple compressors?

Answer: Yes, they are typically required. Some residential systems do have TXV's.

14. Question: What controls are required for the Variable Speed compressors to allow for over speeding?

Answer: The system control will be designed to manage the over speed capability based on the algorithms built into the system as designed by the manufacturer.

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15. Question: What other trends do you currently see gaining momentum that will impact compressors?

Answer: One other important area is the use of electronic sensors and controls on the compressor to improve system performance and reliability. The compressor as a “prime mover” of fluid in the system is similar to the “heart” in the human system. Monitoring the compressor can yield tremendous insight into what is going on in the system and can warn of and prevent certain situations from occurring that can damage both the compressor and the system. Understanding the predictive algorithms associated with how the compressor interacts with certain system conditions will continue to be an important part of taking system and compressor technology to the next level of reliability and performance. Emerson is providing this important technology, called “CoreSense™” on all of our major Copeland Scroll™ platforms including our variable speed line up for both residential and commercial applications.

16. Question: What are some of the latest developments your company has rolled out in your compressor offering in response to recent trends?

Answer: For residential applications, Emerson has launched a complete new high efficiency Copeland Scroll™ line up for fixed capacity – known by the model name “K6” and we have also launched our 2nd generation variable speed compressors and drives for the highest efficiency OEM product lines. For commercial applications we also have a broad variable speed line up as well as our mechanical modulation offerings of Copeland Scroll Digital™, UltraTech™ and a full line up of tandem compressor and other configurations to meet the ever increasing efficiency standards facing our commercial customers. We have also recently launched a new line of low condensing optimized compressors specifically designed to improve part load efficiency in water-cooled chiller applications.

17. Question: How is the Ultratech compressor switched from full capacity to reduced capacity or vice versa?

Answer: The compressor receives an Y1 and Y2 demand from the thermostat (or UltraTech controller or communicating system control) that energizes a solenoid inside the compressor, causing it to modulate.

18. Question: Do we need to consider the size of outdoor and indoor coil for the over speed of the VFD?

Answer: From a system design perspective, it is important to give appropriate consideration for both indoor and outdoor heat exchanger sizing and generally for all key functional components in the refrigerant cycle circuit. All of the key components must be designed to modulate to some extent, and adequately operate together to cover the desired range of system capacities and conditions being addressed in the application, including the ability to over speed.

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Fortunately, from a field perspective most of the common heat exchanger combinations are provided by the system manufacturers along with guidelines and tech support to insure proper selection for each application.

19. Question: Are the 30, 40, and 60 ton compressors available as Variable Speed?

Answer: Yes, actually the 20, 25, 30 and 40 ton compressors are available with a speed range of 2100-4500 RPM. The 60 ton is also released but its speed range is currently limited to 2700-3900 RPM.