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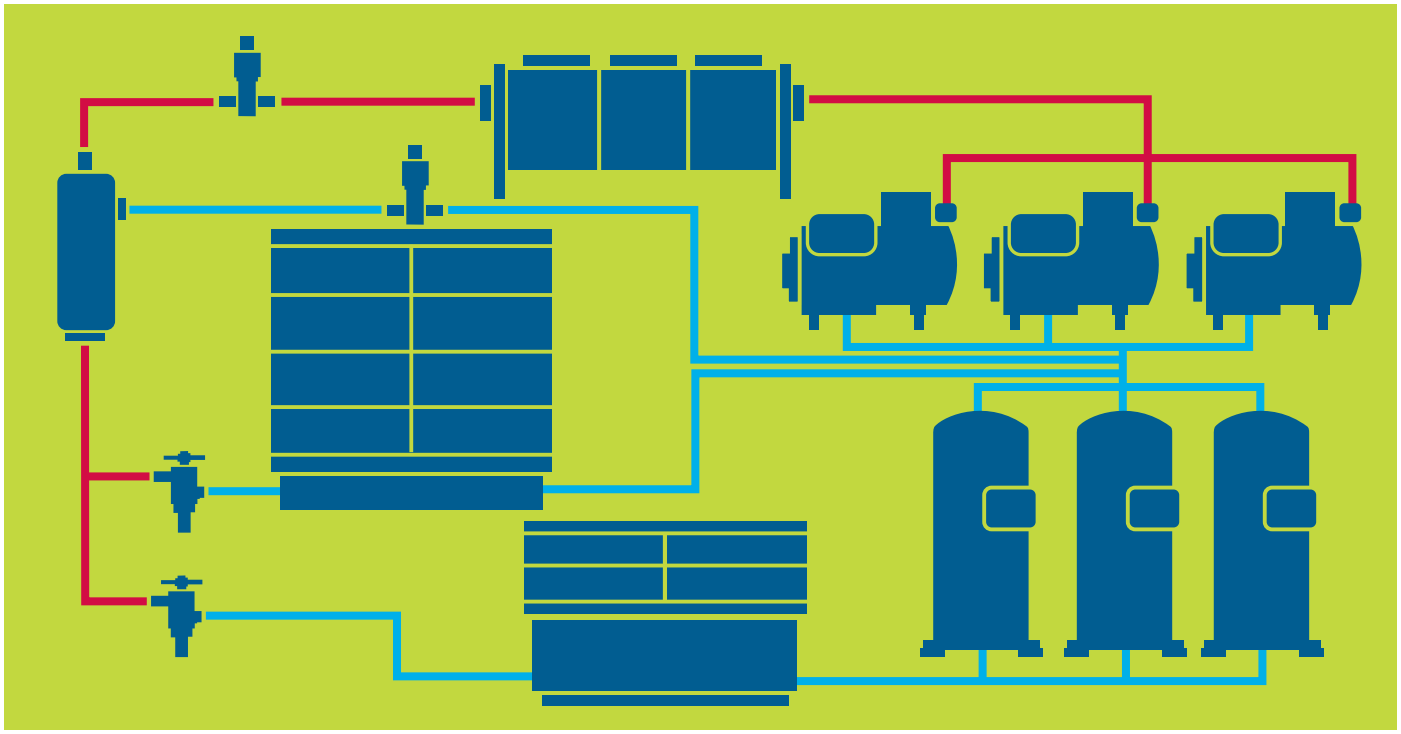
Exploring the Potential of CO_2 Transcritical Booster Systems



Welcome to the first installment of a new column that will focus on the technologies, emerging products and research projects taking place at our recently opened Helix Innovation Center. In this edition, we will place the spotlight on the CO_2 transcritical booster system that, among many other things, is providing refrigeration to our supermarket industry module.

We installed a CO_2 transcritical booster system to anchor our supermarket module for several reasons. It has the potential to provide an efficient, eco-friendly refrigeration source for medium- and low-temp display cases, walk-ins and freezers. But that's only the beginning. We designed our CO_2 transcritical booster system to not only meet the entire air conditioning and heating needs of the supermarket module, we're also reclaiming its exhaust heat for the facility's hot water and snow melt system beneath the sidewalks.

We also chose CO_2 because we feel it has the potential for much broader applications than what is commonly thought in the industry today. Our system is designed with the flexibility to demonstrate and exploit these possibilities.

Real-World Simulation Evaluates the Viability of CO_2 in Warmer Climates

CO_2 transcritical booster systems have gained wide acceptance in northern climates throughout the world. As a natural refrigerant with near zero global warming potential, CO_2 is becoming a preferred option for retailers seeking to meet sustainability goals and take regulatory compliance out of the equation. But with a critical point of 87.8 °F, special measures are required to keep CO_2 systems operating at high efficiencies above this temperature.

This is the reason very few retailers have attempted to deploy CO_2 systems in warmer regions. It's also one of the limitations with CO_2 transcritical booster systems that we are determined to eliminate.

One unique aspect of The Helix is its environmental control chamber, located just outside the facility. This chamber serves each of the five industrial modules on-site and is capable of simulating operating temperatures between -20 °F and 120 °F. So, if we want to measure how a

CO_2 transcritical booster system performs in the middle of summer in a supermarket in Miami, we can do that.

The great thing about our facility is that we have the flexibility to control every variable that contributes to refrigerated system performance. This allows us to simulate a year's worth of performance in one week from any location in the world. And, we can use this space to solve problems with rapid prototyping and evaluation of new ideas.

For example, if we want to test one of the available methods for increasing CO_2 transcritical booster system performance in hot weather, we have several options. First, we have ample space left in our medium-temperature suction group to add a compressor and test it in a parallel compression configuration. We could install an ejector device to evaluate its effectiveness in the CO_2 refrigeration cycle in real-world conditions. Or, we could retrofit our gas coolers with adiabatic pads to measure their ability to keep the CO_2 system below its critical point.

Like every industry module in The Helix, the supermarket is an entity unto itself, meaning that the power coming into the module is completely isolated. This allows us to measure the power consumed by the store on its own, while further isolating the energy consumption of any one piece of equipment. Because everything is within this controlled environment, we're able to evaluate the performance of the CO_2 transcritical booster system in the supermarket and the larger building envelope.

What all this means to our customers is that you now have a real-world test lab for designing the ideal refrigeration system for your supermarkets, simulating the conditions and environments that are most challenging without risking product loss or potential damage to your brand. While today the system is CO_2 based, we have the ability to change the refrigerant as well as the system architecture. We hope that this opportunity will only spawn new ideas and open the doors to further innovation.

CO_2 Transcritical Booster System Profile for the Supermarket Module

The Helix Innovation Center utilizes a CO_2 transcritical booster system that's designed to accommodate medium- and low-temperature requirements in the supermarket. The medium-temperature suction group is based on three Copeland™ CO_2 semi-hermetic compressors (Copeland 4MTLS), supplying cooling to the store's refrigerated cases, walk-in cooler and air conditioning.

Medium-Temp Compressor Suction Group	Equipment Served
Copeland transcritical CO_2 compressors • 4MTLS11ME-FSD (with VSD) • 4MTL82KE-FSD (qty: 2) Total BTUs: 225,000	• Floral case with three doors • Cake case • Upright dairy (qty: 2) • Upright produce (qty: 2) • Upright deli (qty: 2) • Upright meat (qty: 2) • Walk-in cooler • Air conditioning

For the low-temperature group, three Copeland Scroll™ CO_2 compressors (Copeland Scroll ZO) — including one Copeland Scroll Digital™ compressor (Copeland Scroll ZOD) to enable varying capacity modulation for the group — supply cooling to the store's frozen food cases and walk-in freezer.

Low-Temp Compressor Suction Group	Equipment Served
Copeland Scroll CO_2 compressors • ZO34K3E-TFD • ZOD34K3E-TFD (Copeland Scroll Digital) • ZO21K5E-TFD	• Frozen foods with three doors (qty: 3) • Ice cream with three doors (qty: 2) • Walk-in freezer