E360 Outlook

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Technological Transformation

Applying the latest technologies to modern refrigeration challenges

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Today's commercial refrigeration industry is facing a confluence of challenges. Chief among these are a surplus of regulations, a shortage of qualified technicians, and a consumer base demanding fresh, premium quality foods. And while supermarket, restaurant, mixed retail and convenience store operators try to sort out these complexities, they're also tasked with driving profitability.

In recent years, commercial refrigeration manufacturers have stepped up their efforts to develop technological solutions that help store operators achieve compliance, sustainability and profitability goals. With so many seemingly new technologies emerging in this uncertain regulatory climate, operators have many opportunities to leverage these technologies and address a wide range of challenges.

The pervasiveness of electronic controls

The first key pillar of commercial refrigeration transformation is the use of electronic controls at the individual component, system and facility/supervisory levels. While each has very specific purposes, they're designed to serve as the brains of the new equipment, typically relying on sensors to measure an environmental condition or mechanical operation. This provides operators with the tools to perform a variety of critical tasks, from continual monitoring and automated reporting to diagnostics, troubleshooting and corrective actions.

Let's look closer at the different levels of electronic controls:

Component controls: integrate with a single component — such as a compressor or door heater — to maintain efficient operations and diagnose issues that would not be possible without electronics.

System controls: operate multiple components within a system — such as a valve, compressor and fan — to control, direct and optimize system-level efficiencies. Both component and system controls can work independently or connect with other controls for system-level communications.

Supervisory controls: coordinate the operation of multiple systems — such as refrigeration, HVAC and lighting — allowing component- and system-level controls to communicate their conditions and store operators or technicians to assess system status and monitor overall facility operations. More advanced controls are equipped to make system changes as conditions warrant.

The emergence of electro-mechanical components

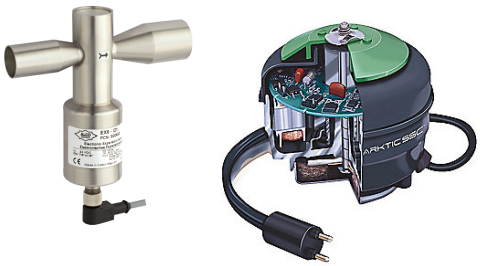
The second important technological development is the emergence of new electro-mechanical components that perform specific functions within the refrigeration cycle, including compressors, valves and fans. These are either designed to be self-contained to combine electronics and the components in a pre-assembled package, or as two separate components that are installed together, depending on the type of control or component.

Scroll compressors combine multi-refrigerant capabilities with reliable operation and energy efficiency.

On the other hand, scroll compression technology doesn't necessarily need electronic controls to address many operator challenges. Scroll's inherent benefits combine multi-refrigerant capabilities with reliable operation and energy efficiency. The addition of controls helps to take scroll compressor benefits to the next level.

The addition of controls allows compressors to modulate capacity.

One of those benefits includes the ability to modulate capacity to enable precise temperature control and much-improved energy efficiencies. This modulation is achieved through one of two methods: adding on-board digital capabilities to the compressor or using a dedicated variable-speed controller. Capacity modulation is so effective in reducing energy consumption that some utilities offer incentives for operators to make the change.



Electronic valves and motors adapt to changing conditions and improve efficiency.

Manufacturers have also developed new electronic valves and motors as additional ways to improve commercial refrigeration system efficiencies. Electronic expansion valves provide precise control of refrigerant flow and system superheat using today's new class of lower-GWP, HFC refrigerant alternatives. Finally, electronically commutated motors combine brushless DC motors with electronic controls to enable efficiencies in continuous operation across a wide range of capacities.

Addressing regulatory challenges

Now that we have a better understanding of which new technologies are at play, it's easier to see how they help operators address challenges related to the complex regulatory landscape, namely: environmental responsibility, energy efficiency and food safety.

Environment — We know that the Environmental Protection Agency has rules in place to phase down the use of high-GWP HFC refrigerants and decree a list of environmentally friendly alternatives. Many of these new refrigerants — both natural and synthetic — have different performance characteristics than their incumbents. Many of the new controls and components used in new systems are designed to address these performance challenges, such as higher heat of compression and pressures. Controls are also used to detect refrigerant leaks, and new condensing unit designs allow operators to reduce overall refrigerant system charges.

Controls protect the environment by detecting refrigerant leaks, thereby reducing refrigerant use.

Energy — On the energy side, the Department of Energy is mandating significant reductions in energy consumption, and new components are available today to help operators achieve that goal. Many of these focus on optimization via demand-usage methodologies — such as defrost and anti-sweat heaters — and only operate when the controls detect the necessary conditions, rather than on a continual cycle.

Energy is reduced by optimization via on-demand usage.

Food safety — Electronics are also helping operators address recent food safety reforms introduced by the Food Safety Modernization Act. To comply, operators need to perform continual temperature and humidity monitoring from farm to fork. These controls not only help to automate the measurement and reporting processes, but also help prevent food-borne illnesses, reduce food shrink and protect retailer profits.

Electronics perform continual monitoring of temperature and humidity from farm to fork.

Minimizing maintenance requirements

Finally, the advanced diagnostic capabilities these electronics enable — via component- and system-level controllers, cutting-edge IoT connectivity and even machine-learning capabilities — help operators prevent system failures, limit their reliance on technicians, and take maintenance operations into their own hands. And when maintenance is required, the diagnostics greatly improve the servicing process.

By having remote access to detailed system information before arriving to the installation, technicians are able to quickly diagnose and fix refrigeration system errors. This not only improves the technician's ability to provide effective service (regardless of their experience level), it also reduces an operator's maintenance costs.

The good news for operators is that by adopting refrigeration strategies that utilize these technologies, they can simultaneously address many compliance and operational challenges — while protecting profitability. As these technologies become more commonplace and regulations evolve, look for manufacturers to continue to improve upon electronic controller and component capabilities that further optimize refrigeration system performance efficiencies.