Ways To Keep Reach-Ins Running Under Stress

By D.A. Jennings

In these days of economic uncertainty, technicians face difficult challenges. When focusing on initial price considerations, it is common for customers to retain old equipment beyond its optimum life and efficiency.

It is also common for purchasing personnel, whether at the contracting company or supply house, to shorten their capacity in an effort to reduce upfront costs. It is often difficult to service aged or undersized equipment. It is also difficult for the equipment to achieve the necessary performance when subject to conditions that are beyond design criteria.

In the example of a food service kitchen, it is not uncommon to see a reach-in cabinet that was validated through the industry standard of 73 degrees and 100 degrees F to maintain 41 degrees shelf temperature without door openings. But this same case may be subjected to a 105 degree temperature (with humidity) during heavy usage, while still needing to achieve 41 degrees product temperature.

What To Do

During recent testing, refrigerated reach-in cabinets (manufactured by Beverage-Air, a division of Carrier Commercial Refrigeration) were subjected to stress. Part of the equation was the inclusion of technology from XDX Innovative Refrigeration designed to improve evaporator heat transfer.

Oil logging has a significant impact on the operation of a remote, low-temperature refrigeration unit.

The process included typical industry standards, but concluded with a ramp-up of temperature from 80 degrees to 110 degrees over a 6-hour period, with four door openings per hour in an effort to provide real-world operating conditions in a certified lab facility.

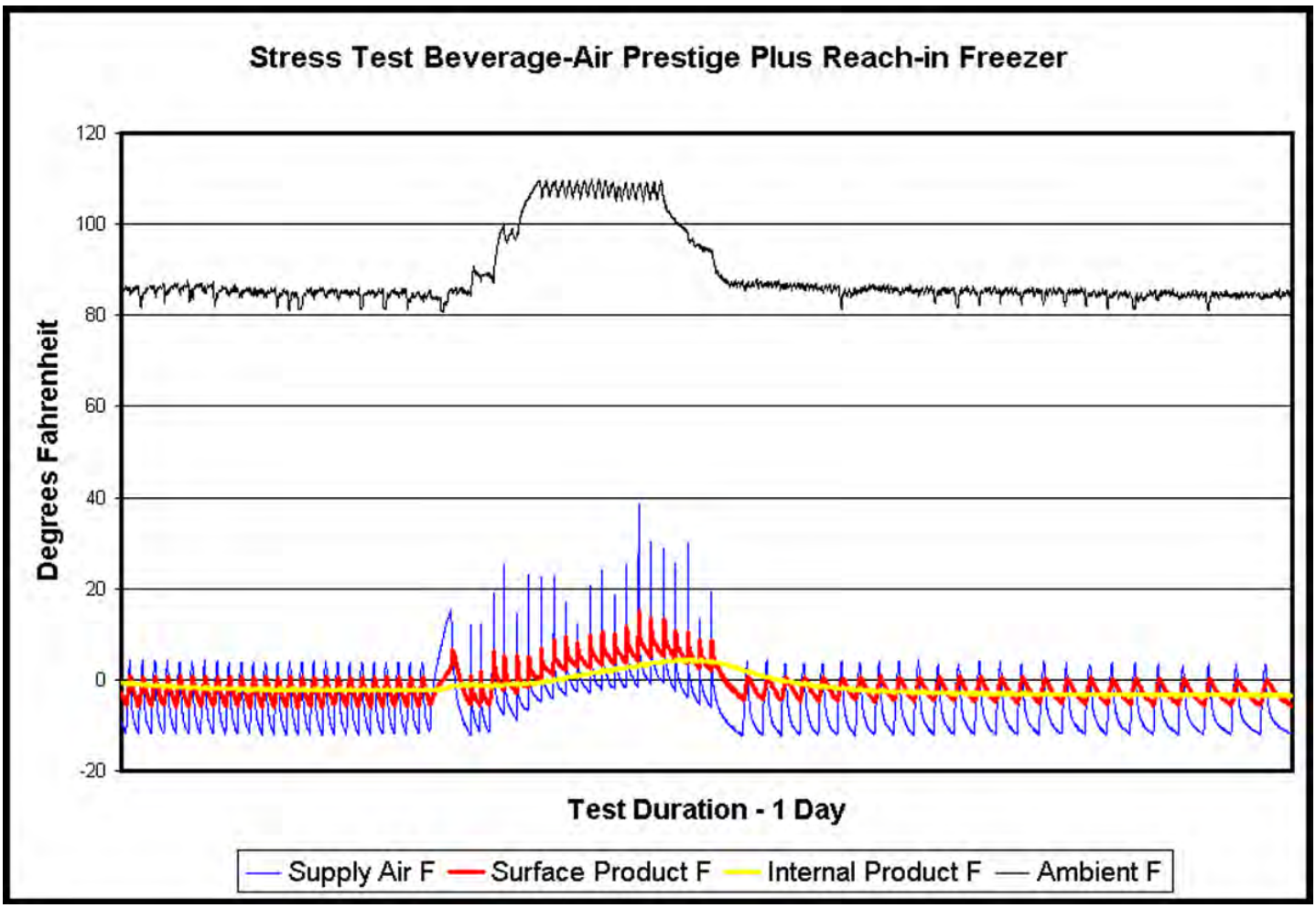
The XDX technology applies what the company calls an Altered Bi-phase Flow (ABF) regime; an annular (ring-like) film maximizes heat transfer throughout the evaporator, increasing the useable evaporator tube surface area. The result is a cooler tube wall with a higher evaporator pressure. The technology's primary benefits are the elimination of laminar refrigerant flow and the resulting poor heat transfer coefficients.

The refrigeration industry has long focused on having liquid at the entry to the evaporator to ensure that the maximum heat transfer capacity was available. The new approach focuses more on the rate of heat transfer. The method has been described as "distributed enthalpy," because the slow-moving refrigerant at the evaporator entry is more evenly distributed throughout the length of the evaporator, according to lab test and onsite applications.

XDX has named this technology XStream®. A multistage pressure drop separates the liquid from the vapor and entrains the liquid into the higher vapor velocity. The resulting temperature and pressure uniformity within the evaporator improved frost formation, refrigerant feed stability, compressor ratios, and net cooling rate. That directly impacts product temperature recovery.

The S.T.R.E.S.S. Test

The initial baseline test ran at the industry standard of 85 degrees and 55 percent relative humidity conditions, with pulldown followed by an extended run period without a defrost cycle. The refrigerating portions of the cycles got farther apart the longer the cabinet ran.



Between five and six hours, the change was dramatic until the temperature warmed due to a frosted coil and the inability to properly circulate air. After 10 hours the freezer was unable to cycle and steadily lost temperature.

Under identical conditions, the cabinet with the distributed enthalpy technology had no measurable increase in refrigeration cycle time for a 24-hour period. The reach-in freezer continued to maintain uniform cycle rates.

A defrost of the evaporator was performed in each instance prior to initializing the S.T.R.E.S.S.™ (Service Technician's Real-World Environment Simulation Standard) test portion of the validation. The room temperature incrementally elevated to 110 degrees while door openings were conducted.

The baseline application lost shelf temperature and was unable to recover even after the room temperature decreased. The reach-in freezer equipped with distributed enthalpy was able to recover shelf temperature and operated the balance of the 24-hour test without defrost.

Similar findings have been recorded in walk-in storage coolers and freezers where, in cooperation with Carrier's Cold Zone Division, the distributed enthalpy technology was used for three national food service chains. A constant trend throughout the validation process was temperature improvement; even aged equipment was able to reach Food and Drug Administration compliance.

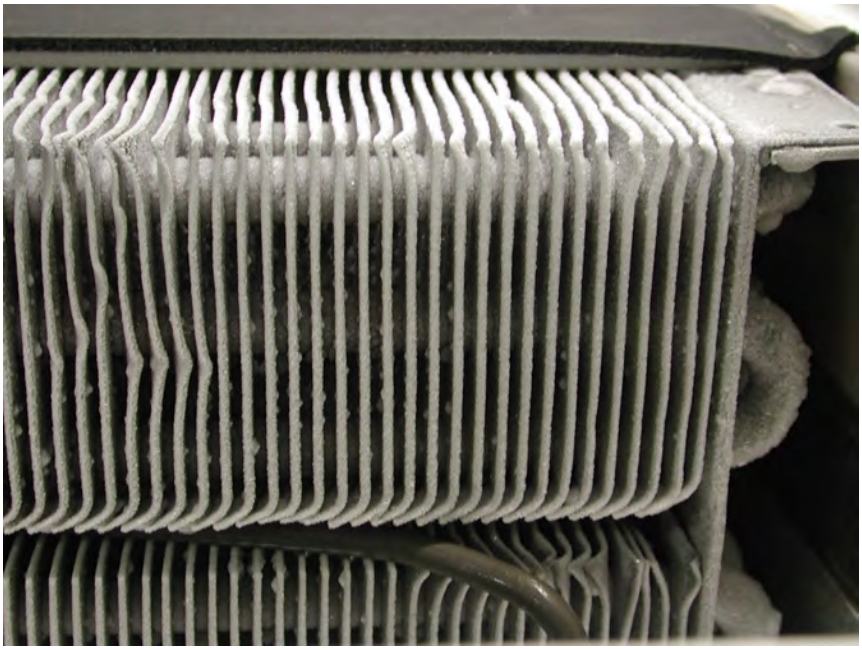
Other Considerations

Oil logging has a significant impact on the operation of a remote, low-temperature refrigeration unit. Colder evaporating temperatures, laminar refrigerant flow, and reduced oil viscosity discourage oil from returning to the compressor crankcase.

The annular flow that is derived from distributed enthalpy encourages oil to return to the crankcase and provides proper lubrication — even after extended periods of operation.

Reduced compressor ratios are a problem when condensers situated outdoors are exposed to debris. Cooler compressor operation has been directly attributed to improved refrigeration flow control.

The most visible aspect of the XStream technology is the manner in which frost forms along the evaporator. In applications where technicians experience refrigeration that dries out a room (because moisture is attracted by the initial passes of an evaporator coil until it blocks airflow), the improved refrigerant-side temperature differential allows frost to glaze across the tubing and fins, with a reduction in the bridging that typically diminishes airflow.



Fewer defrost durations and frequencies can resolve a number of service and operation struggles.

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