Tecumseh provides OEM solution to meet Energy Star requirements in an existing glass door merchandiser utilizing elements from its *Tecumseh IntelliCOOL™ technology platform*

Combining various components of its ***Tecumseh IntelliCOOL™ Technology Platform***, Tecumseh has provided an OEM customer an integrated-condensing-unit solution allowing them to meet the Energy Star Requirements in an existing glass door merchandiser. In addition to reduced energy consumption, the platform also results in improvements in performance, manufacturing, and serviceability. The system is environmental friendly using R290 natural refrigerant.

Tecumseh IntelliCOOL™

Original Configuration

The application was a 2-glass-door merchandiser with a bottom mounted refrigeration system. The cabinet was equipped with a fixed speed compressor (10.0 cm^3 displacement), on/off thermostat, and utilized ~255g of R134a refrigerant. The system was equipped with a capillary tube and incorporated a 30 minute off cycle defrost every 12 hours.

The Challenge

Notoriously, glass door cabinets are less efficient than solid door cabinets and have additional heat-loading through the glass doors. These types of cabinets typically require larger capacity refrigeration systems, which results in high energy consumption.

Since this was an existing cabinet and not a new development, the challenge was to convert the cabinet from R134a to R290, while simultaneously reducing the energy consumption to allow the product to meet the Energy Star requirements. This was to be done without making any significant structural changes to the cabinet and minimizing any changes to the existing refrigeration system.

The "Benchmark"

The 1st step was to adapt the cabinet for use with R290 while ensuring similar (or improved) performance, robustness in the application, and minimal structural changes to the cabinet. This resulted in the following actions:

- Replaced the existing compressor, condenser fan, and condenser coil with a Tecumseh Condensing Unit utilizing the highly-efficient TCX413U fixed speed R290 compressor (6.93 cm^3 displacement) and an integrated condenser coil and fan.
- Optimized the R290 refrigerant charge
- Maintained existing low-side components: evaporator coil, fan, and controls
- Verified and maintained existing capillary tube
- Maintained existing fan-cycle and defrost operations
- Verified refrigeration system performance and robustness in the application

This configuration resulted in a system that was optimally adapted for R290 and had adequate performance and robustness. The cabinet was then subjected to the standardized ASHRAE 72 energy consumption testing methods and the results measured. *(See figure #1).*

An IntelliCOOL™ Technology Platform Based Solution

Utilizing the laboratories at Tecumseh's North American Technical Center, a series of development and testing activities were conducted to produce a system that could achieve the desired results. These activities included iterations of development, performance testing, and energy consumption testing.

Ultimately, the following changes were made to the "benchmark" system to achieve the desired results.

- Replaced TCX413U fixed speed R290 compressor (6.93 cm^3 displacement) with Tecumseh's newly released ***VTCX410U variable-speed R290 compressor*** (6.06 cm^3 displacement) and associated Tecumseh inverter.
- Replaced the on/off thermostat (controls) with Tecumseh's newly released ***"Split" Electronic System Controller*** with integrated energy management algorithm, variable speed compressor control, and independent fan controls.
- Replaced the capillary tube with a thermal-expansion-valve (TXV)
- Optimized the R290 refrigerant charge
- Maintained existing low-side components: evaporator coil and fan
- Maintained existing defrost operations
- Verified refrigeration system performance and robustness in the application

The final solution consisted of an integrated-condensing-unit package that incorporated the new components and a remote display/user-interface that could be mounted on the exterior of the cabinet.

Results

The ASHRAE 72 Energy Consumption Results of the various iterations are displayed below in Figure I:

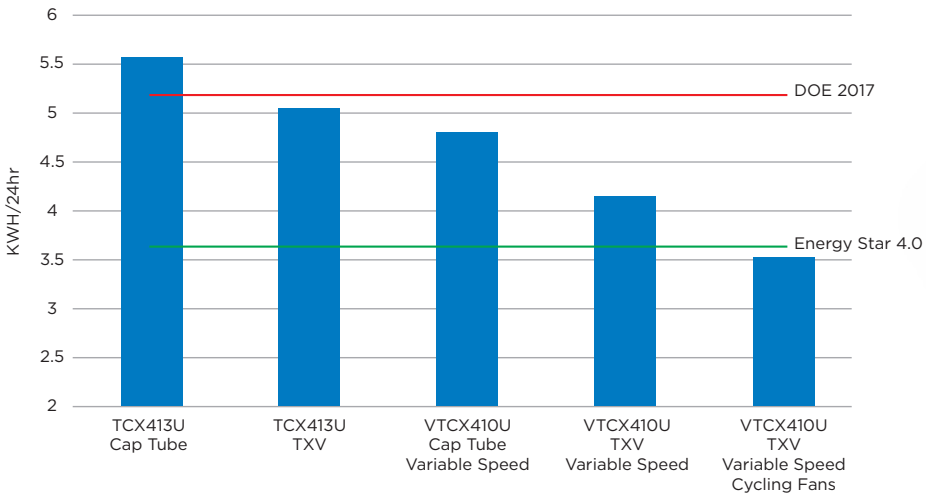

Figure I - ASHRAE 72 Results

Conclusions

The final solution, an integrated-condensing-unit that incorporates various components from ***Tecumseh's IntelliCOOL™ Technology Platform***, has many benefits for the OEM:

- ✔ 37% energy reduction as compared to benchmark configuration that was already adapted for R290
- ✔ Ability to increase cooling capacity by ~80% from normal use requirements to provide more capacity for pull-down or peak demands
- ✔ 54% reduction on charge
- ✔ Smaller displacement compressor
- ✔ Full integrated condensing unit solution to improve manufacturing and serviceability
- ✔ Remote display unit/user-interface that can be mounted on the exterior of the cabinet
- ✔ Enhanced alarms and diagnostic port/fault codes to improve serviceability

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