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COMPARISON OF **CRS CONDENSING UNITS**

Case study demonstrates possibilities and advantages of complete variable speed refrigeration systems

For over 85 years, we have been known for our wide range of refrigeration compressors. Today, in addition to compressors, we design and manufacture a number of value-added systems such as indoor and outdoor condensing units, rack systems, and mini-chillers. A system increasingly gaining attention from our OEM customers is a self-contained complete refrigeration system (CRS) often referred to as a 'cassette'. In some regions, we custom-design CRS based on our OEM customer's unique application requirements.

Our custom CRS is a 'plug and play' system that usually uses R-290-based fixed-speed or variable-speed compressors and come in three mounting formats: top mount, bottom mount and side mount. This is a very easy way for OEM customers to make their R-290 transition as they simply 'plug-in' our CRS into their cabinets. Our energy efficient and low charge CRS not only reduces installation and replacement cost but also saves space for the system and increases merchandise storage capacity.

Case Study Scope

In this case study, we developed a CRS with our Series VTC, R-290 variable speed compressor to achieve the following benefits for a beverage cooler application by making minimal changes to the original cabinet design.

- Reduced energy consumption
- Improved thermal stability
- Rapid "pull-down"
- Smaller displacement compressor
- Charge reduction
- SKU reduction
- Dual voltage, soft starting
- Lower noise and vibration

Figure 1:
Existing cabin designs

Figure 2:
With new CRS (R-290, variable speed)

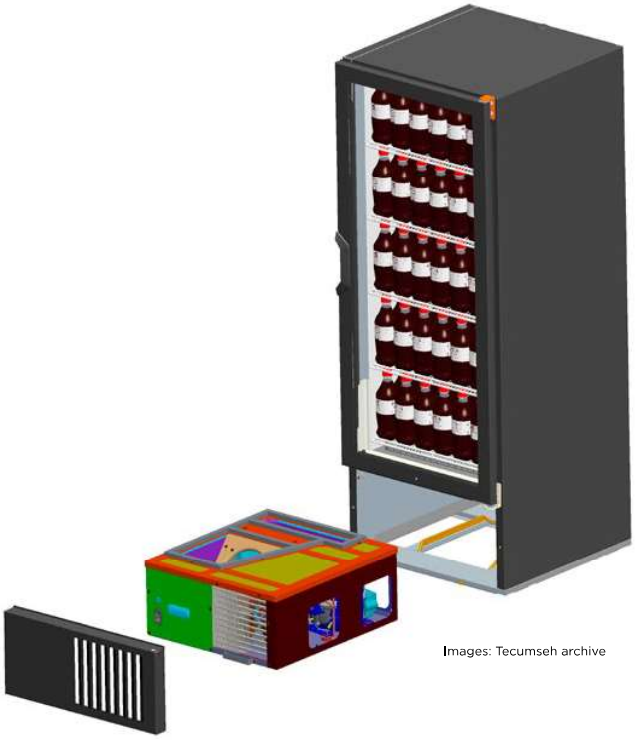
CRS Development

As we designed the new CRS solution we also considered the following:

- Significantly smaller cooling deck than most comparable designs.
- Electronic controls and variable-speed compressor for energy management & defrost control.
- 5mm Copper Alu grove condenser coil for high

efficiency and low charge. 5mm Copper Alu Evaporator.

- Better component layout and improved volume efficiency.
- Fast pull down and best-in-class energy performance to meet future Energy Star requirements.
- Service-friendly design with easy access to critical components.
- Light, yet solid design that makes handling and maintenance easy.



Images: Tecumseh archive

Testing & Validation

We compared the system performance between the new CRS against the baseline CRS with a R-134a fixed-speed compressor:

Testing plan

1. For the baseline R134a CRS
a) Measure energy consumption and pull down time at no load, full load and half reload
b) Measure DOE & Energy Star 4 tests
2. Then replace the baseline CRS with the new R290 variable-speed CRS and conduct the same tests
3. Compare results

Results

Compared to the baseline CRS with R-134a fixed speed compressor, the new CRS with R-290 variable-speed compressor has a significant improvement in energy consumption with many other benefits: shorter pull down, lower refrigerant charge and increased merchandising space. The new Tecumseh CRS makes OEM customer's R-290 transition easier, simplifies contractor's service and maintenance and reduces end-user energy consumption.

			Fixed speed (ON/OFF)	Variable speed	Improvement vs baseline
			Baseline THA0412Y (R-134a)	VTCX 360 U (R-290)	
			Test results	Test results	
1	Temperature Lowering (No Load) Temp. of the refrigerator 4.4 ° C Temp. ambient 32 ° C	Pull down time (PDT)	66 min	49 min	26%
		Energy consumption PDT	0.32 kWh	0.14 kWh	56%
2	Lowering of temperature (under load) Temp. of product 3.3 ° C (± 1 ° C) Temp. ambient 32 ° C	Pull down time (PDT)	17h, 27 min	15h, 12 min	13%
		Energy consumption for PDT	4.52 kWh	3.04 kWh	33%
		Product temp span at stabilization	7.2	6.8	6%
3	Temperature recovery after half load recharging Temp. of product 3.3 ° C (± 1 ° C) Temp. Environment 32 ° C	Pull down time	10h, 43 min	10h, 07 min	6%
		Energy consumption	3.48 kWh	1.89 kWh	46%
4	Energy Star 4 Test ASHRAE 72	Energy consumption	3.46 kWh	1.24 kWh	64%

Note: Data may change without notice.