

Propane (R-290) Compressors,  
Components and Condensing Units  
for the Commercial Refrigeration Industry



## As higher-GWP refrigerants continue to be phased out, the evaluation and approval of alternative refrigerants increase in importance.

The refrigeration industry's primary concern is complying with new and upcoming regulations. At Emerson, our focus is unequivocal: nearly every internal development program we've undertaken in commercial refrigeration has been geared toward achieving this compliance. And one of the solutions we've researched, tested and implemented in our products is propane (R-290). While propane has met hesitation from some due to certain limitations and misconceptions, it is gaining momentum in the refrigeration industry and is a viable solution to complying with the refrigerant phase-down of hydrofluorocarbons (HFC).

### Advantages

Because propane was introduced to the industry more than 100 years ago, its performance efficiencies and thermodynamic properties have been well vetted. It performs very similarly to or better than R-404A in terms of pressure, discharge temperature, volumetric capacity, capacity loss and coefficient of performance, but without the downside of ozone depletion due to leaks.

Propane's many benefits include:

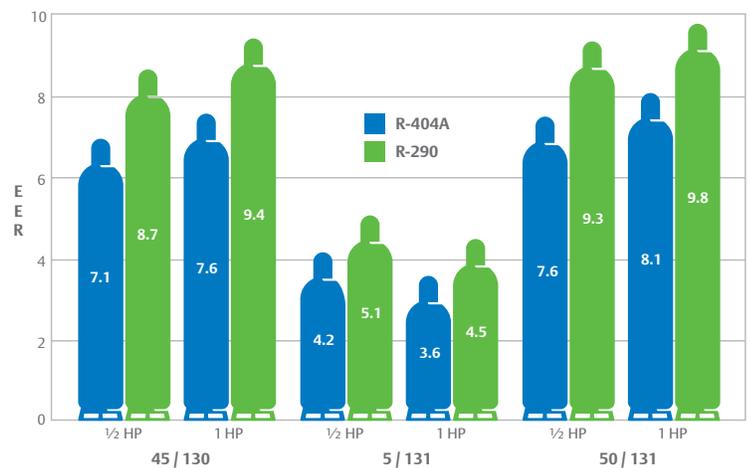
- Hydrocarbon-based, non-synthetic substance
- EPA-approved in commercial refrigeration applications
- Very low environmental impacts: GWP = 3, ODP = 0
- Relatively affordable
- High-efficiency, high-performance, reliable
- Safe when proper protocols and procedures are followed

From the standpoint of minimal effect on the environment, it is in an elite class of refrigerants and is very appealing for achieving regulatory compliance.

### Product Offerings and Market Readiness

As the refrigeration industry continues to evolve, we continue working to enable our customers the most seamless means to evolve with it. As lower-GWP refrigerants continue to gain traction, we'll continue to innovate our products for customers, allowing them to incorporate these refrigerants. Our approach to this challenge has remained consistent throughout: to rigorously engineer and evaluate component performance against worst-case regulatory scenarios.

**MBP R-404A vs. R-290**  
Energy Efficiency Ratio (EER) Comparison



Results from Emerson test labs comparing the EER of R-404A to R-290 in medium back pressure (MBP) show a significant improvement when using R-290.

At our test labs, we've found propane capable of high-performing, efficient operation. Compared to the refrigerants it will likely replace, it yields more capacity with lower wattage consumption. Overall, we've seen more than a 10 percent efficiency improvement in our propane performance testing.

We offer propane compressors and other system components ideally suited for low- and medium-temperature applications that address regulatory compliance challenges. We also continue to invest in facilities for testing needs to serve our customers, like our new lab expansion that will be A2L (YF, XE, R32 fluids) and A3 (propane, isobutene) capable as well as provide testing for compression.

## Improved Efficiency With Natural Refrigerants

Emerson offers a new solution for operators looking for improved energy efficiency using natural refrigerants. The Copeland™ ZB\*KAU scroll compressor represents the latest innovation in compliant scroll technology for refrigeration equipment from 0.75 HP - 1.6 HP (8,400 - 13,450 BTU/hr at medium temperature ARI). It is more efficient than standard reciprocating compressors with 70% less moving parts for increased reliability.



**ZB\*KAU Model Summary**

**Medium-Temperature**

R-290	ZB07	ZB09	ZB10	ZB11
Capacity (Btu/Hr)	8,400	10,000	11,350	13,450

Available in:

- From 0.75 to 4 HP
- 50Hz and 60Hz, 3-phase, multiple voltages
- Larger capacities than 13,450 Btu/hr

The ZB\*KAU models are intended for medium-temperature refrigeration type duty and are ideally suited for applications such as self-contained display cases with multiple circuits, packaged condensing units for cold room applications, and refrigeration applications below the 150g R-290 refrigerant charge.

Copeland scroll technology is an all-around superior refrigeration solution:

- Smooth scroll movement leads to low sound and vibration
- Smooth start and stop of a scroll means longer compressor life
- 70% fewer moving parts than a reciprocating compressor means better reliability
- Axial & radial scroll compliance provides improved liquid handling capability
- Hermetic design reduces leak potential

## Applications and Special-Use Considerations

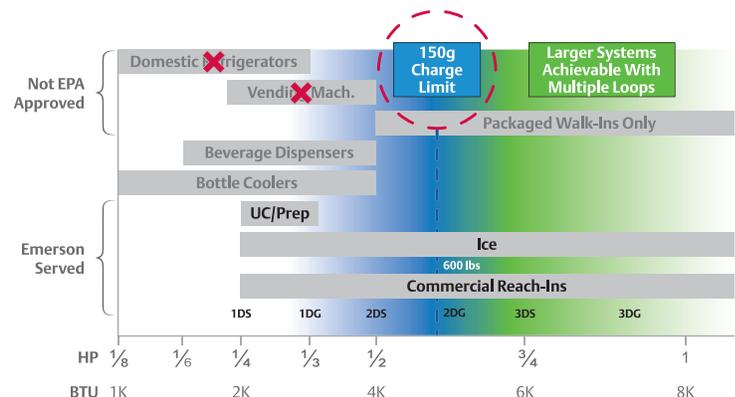
Propane is ideally suited to replace hydrofluorocarbons R-404A, R-507A, R-407A and HFC-134A in smaller commercial applications — such as beverage coolers, frozen drink machines, ice machines, small ice cream freezers and small reach-in units — due to its extremely low global warming potential (GWP).

To date, R-290's 150g charge limit has hindered its wider adoption, narrowing its use primarily to self-contained refrigeration cases or requiring the use of multiple condensing units to achieve higher capacities. The updated UL standard raises the charge limits on these commercial stand-alone displays based on whether they have an open or closed design:

- 500g maximum charge limit in open appliances (without doors and drawers)
- 300g maximum charge limit in closed appliances (with doors and drawers)

Although OEMs should begin planning their design cycles to enable these charge increases, other legislative approvals will need to take place before higher-charge R-290 systems can be implemented throughout the U.S. and Canada. Pending approvals by other governing bodies include:

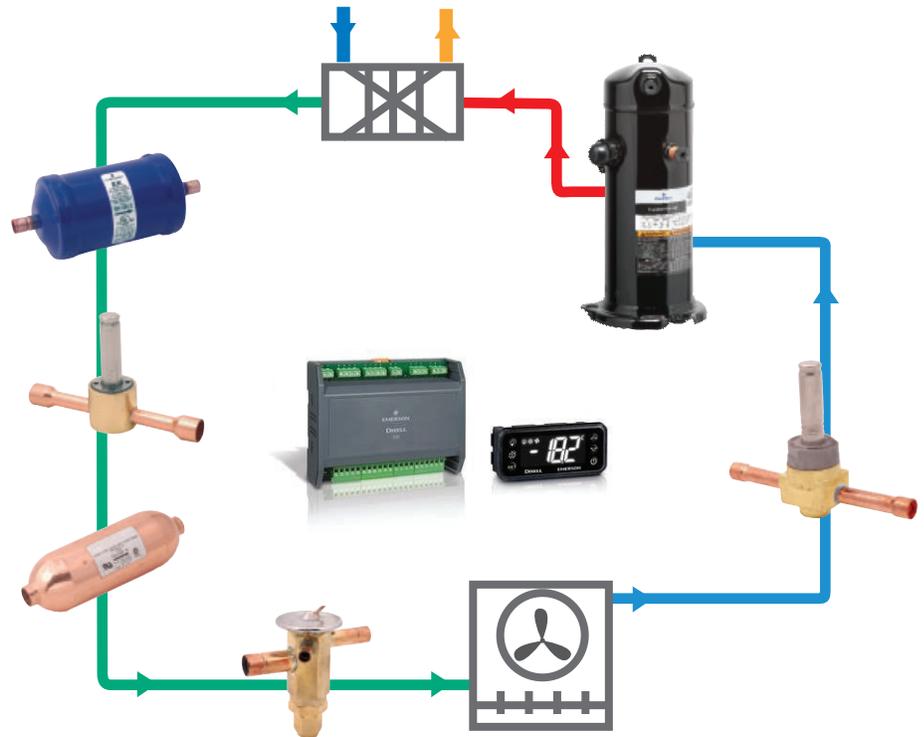
- Environmental Protection Agency's (EPA) Significant New Alternatives Policy (SNAP) program
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) 15 safety standard for refrigeration systems
- State and local building code updates
- International Code Council (ICC) updates in its upcoming code revision cycle



## Emerson's Complete R-290 Offering

In addition to the newly launched R-290 Copeland scroll compressors, Emerson offers a complete range of fractional horsepower compressors, condensing units, controllers, and other system components to serve the industry for their R-290 needs in various refrigeration applications.

## Refrigeration System Diagram



### Emerson R-290 Fractional HP Fixed Speed Compressor Lineup



#### Low-Temperature

R-290	AFM06	AFF10	AFF12	AFE15	AFE16	AFE20	AFE22	AFE25	AFE26	RFT29	RFT30	RFT37
Capacity (Btu/Hr)	700	1130	1425	1515	1860	2020	2160	2580	2590	2890	2900	3660

#### Medium-Temperature

R-290	ASE12	ASE17	ASE21	ASE24	ASE32	RST37	ASE37	ASE39	ASE39	RST44	RST53	RST58
Capacity (Btu/Hr)	1525	1765	2240	2500	3400	3620	3770	4280	4390	4530	5270	6000

#### Extended Medium-Temperature

R-290	ASM09	ASM12	ASM16	ASM19	ASM22	ASM27	ASM31	ASE46	ASE53	ASE59	RST60	RST68
Capacity (Btu/Hr)	878	1265	1710	1880	2170	2630	3110	4600	5390	5930	6020	6800

### UL Approved System Components

#### Solenoid Valves



50RB/100RB	Small Direct Acting Valves
200RB	Normally Closed, Pilot-Operated, Serviceable Valve
500RB	Normally Open, Pilot-Operated, Serviceable Valve

#### Thermostatic Expansion Valves



A	Conventional Valve
B	Balanced Port Valve
HF	Balanced Port with Replaceable Power Element
PM	Pulse-Width Modulating Valve



#### Pressure Switch

PS4 Pressure Switch



#### Shut-Off Valves

BVE/BVS	Welded Ball Valves
ACK	Spun Copper Check Valves

#### Filter Driers



EK/ADK	Hermetic Driers through 16 cu. in.
CU	Spun Copper Driers
ALF	Hermetic Liquid Filters

## Copeland™ Variable Speed Reciprocating Hermetic Compressors for Refrigeration Applications

Copeland reciprocating hermetic compressors provide cost-effective solutions to systems requiring a wide range of evaporating capability. More than 300 models of variable speed and fixed speed compressors are available from Emerson including low-, medium-, and high-temperature models for foodservice, ice machines, soft serve machines, frozen carbonated beverage machines, air dryers and beverage dispensers.

Versatility and a wide choice of operating ranges make Copeland compressors the first choice for every refrigeration need. The breadth of our hermetic line means system design engineers can match the right compressor to the job requirement for optimum energy efficiency. The energy efficiency of new variable speed compressors averages 22% higher than comparable capacity fixed speed R-290 compressors, with additional energy savings available from system optimization. Our compressors are available to support worldwide equipment needs, with many choices of refrigerants and electrical variations, and every compressor is backed by Emerson’s reputation for quality and reliability.

## Variable Speed Features and Benefits

### Regulatory Compliance

- Potential impending DOA 2024 energy reductions
- EPA refrigerant requirements
- CARB commercial reeferation standards

### Improved Energy Efficiency

- Less on/off cycling
- Low amp gradual compressor motor startup
- 13% improvement over high-efficiency, fixed speed, R-290 compressor

### Improved Performance and Accuracy

- Tight temperature control
- Fast temperature pull-downs and recovery
- Precise humidity control
- Extra capacity during extreme hot or cold weather
- Low noise operation

### Improved Reliability

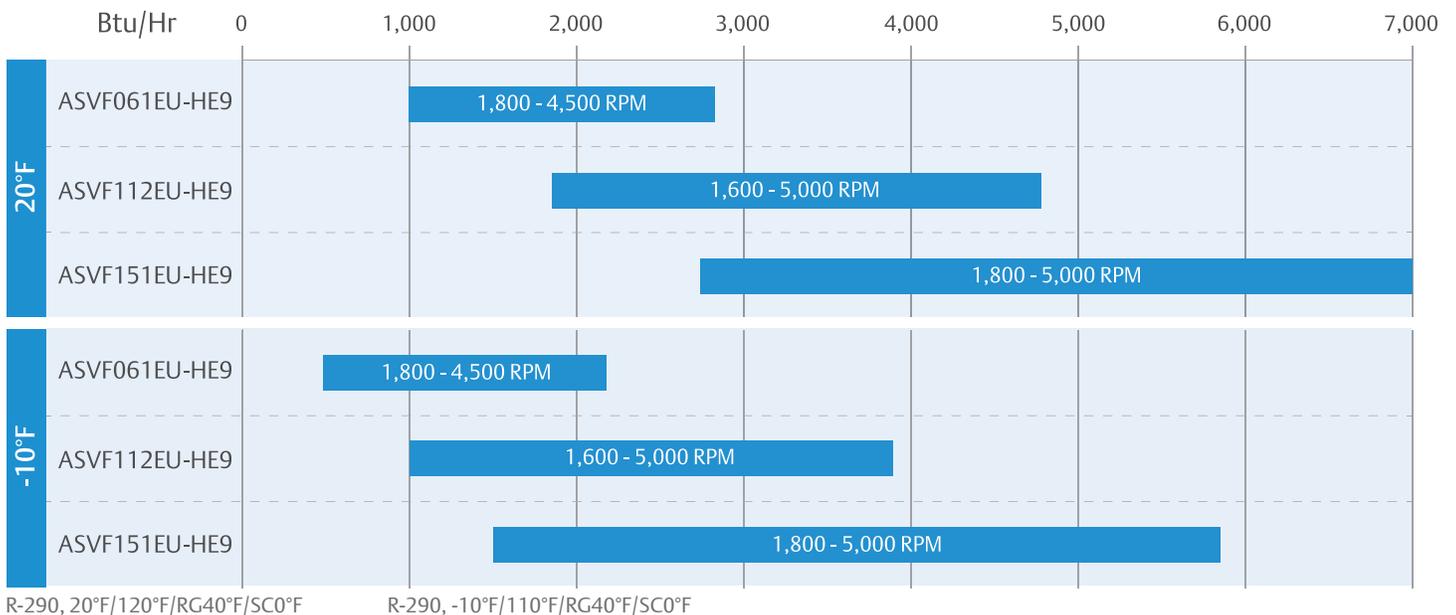
- Protection and proactive prevention of compressor failure using inverters
- Ability to handle voltage fluctuations
- Reduces number of start-stops

### Operational Benefits

- SKU reduction simplifies service
- Versatile applications
- Temperature precision helps reduce food spoilage



## Emerson R-290 Fractional HP Variable Speed Compressor Lineup



## M-Line Model Summary

HP	Model	Electrical	BTUH 90/-10	L	W	H	Compressor
Low Temp - Copevap Base							
1/5	MUPL-0029	IAA	1370	20.12	11.66	10.47	AFF10C1U
1/3	MUPL-0041	IAA	1660	20.12	11.66	10.47	AFF12C1U
1/2	MUPL-0045	IAA	1800	19.88	11.66	10.46	AFE15C5U
1/2	MUPL-0057	IAA	2320	19.88	11.66	10.46	AFE20C5U
1/2	MUPL-0058	CAA	2320	19.88	11.84	10.46	AFE20C5U
3/4	MUPL-0070	CAA	2800	19.88	11.84	10.46	AFE25C5U
Low Temp - Steel Base							
1/5	MUJL-0028	IAA	1280	14.09	12.42	9.63	AFF10C1U
1/4	MUZL-0030	IAA	1410	16.69	13.28	11.7	AFF10C1U
1/4	MUZL-H030	IAA	1420	16.69	13.19	11.7	AFF10C1U
1/3	MUJL-0036	IAA	1550	13.98	11.67	9.64	AFE13C4U
1/3	MUJL-H040	IAA	1690	14.04	9.62	11.67	AFE13C4U
1/2	MUZL-0044	IAA	1730	16.18	13.05	11.7	AFE13C4U
1/2	MUZL-H044	IAA	1760	16.18	13.05	11.7	AFE13C4U
1/2	MUGL-H045	IAA	1790	17.68	14.34	11.79	AFE13C4U
3/4	MUZL-0066	IAV	2530	16.99	13.42	11.7	RFT22C1U
3/4	MUZL-H067	IAV	2580	16.92	13.3	11.7	RFT22C1U
3/4	MUGL-H070	IAV	2690	18.50	14.34	11.79	RFT22C1U
3/4	MUZL-0077	CAA / IAV	3060	16.99	13.56	11.7	RFT26C1U
3/4	MUZL-H078	CAA / IAV	3130	16.92	13.56	11.7	RFT26C1U
3/4	MUZL-0081	CAA	3230	16.6	13.56	11.7	RFT30C1U
3/4	MUGL-H082	CAA / IAV	3270	18.50	14.34	11.79	RFT26C1U
3/4	MUZL-H082	CAA	3300	16.6	13.56	11.7	RFT30C1U
3/4	MUGL-H086	CAA	3450	18.10	14.34	11.79	RFT30C1U
1	MUZL-0098	CFA / CFV	3900	16.6	13.56	11.7	RFT37C1U
1	MUZL-H100	CFA / CFV	4000	16.6	13.56	11.7	RFT37C1U
1	MUGL-H106	CFA / CFV	4250	18.10	14.34	11.79	RFT37C1U

## M-Line R-290 Condensing Units

Copeland™ M-Line condensing units can help OEMs achieve regulatory compliance while giving end users optimal performance in low- and medium-temperature applications, with energy savings up to 30 percent.

- Latest generation of Copeland hermetic compressors
- Electronically commutated fan motors (an optional feature)
- Condenser coil tubing design that enables additional coil rows
- Available in Copevap base for condensation management

Designed with OEM and end user concerns in mind, Emerson offers A\*E and R\*T compressors rated for use with R-290 and available in fractional horsepower options to serve as the basis of Copeland M-Line condensing units.

- Minimal sound output for quiet operation
- Up to 30 percent energy-efficiency improvements compared to R-404A
- Little to no environmental impacts

Low temp application capacities: 1300-4200 Btu/h

Medium temp application capacities: 1800-7000 Btu/h

HP	Model	Electrical	BTUH 90/25	L	W	H	Compressor
Medium/Ext Medium Temp - Copevap Base							
1/5	MUPM-0022	IAA	1990	19.88	11.66	10.46	ASE12C4U
1/5	MUPP-0023	IAA	2010	19.88	11.66	10.46	AFM06C1U
1/5	MUPM-0024	IAA	2250	19.88	11.66	10.46	ASE17C4U
1/3	MUPM-0031	IAA	2760	19.88	11.66	10.46	ASE21C5U
1/3	MUPM-0039	IAA	3800	19.88	11.66	10.46	ASE32C4U
1/2	MUPM-0047	IAA	4120	19.88	11.66	10.46	ASE37C5U
1/2	MUPM-0048	CAA	4190	19.88	11.84	10.46	ASE37C5U
Medium/Ext Medium Temp - Steel Base							
1/5	MUJM-0019	IAA	1820	13.96	11.66	9.64	ASE12C4U
1/5	MUJM-H022	IAA	1990	14.00	11.67	9.63	ASE12C4U
1/5	MUJM-0022	IAA	2040	13.96	11.66	9.64	ASE17C4U
1/5	MUZM-0023	IAA	2050	16.15	13.05	11.70	ASE12C4U
1/5	MUZM-H024	IAA	2080	16.15	13.05	11.70	ASE12C4U
1/5	MUGM-H024	IAA	2130	17.65	14.34	11.79	ASE12C4U
1/5	MUJM-H024	IAA	2250	14.00	11.67	9.63	ASE17C4U
1/4	MUZM-0026	IAA	2330	16.15	13.05	11.70	ASE17C4U
1/4	MUZM-H027	IAA	2360	16.15	13.05	11.70	ASE17C4U
1/4	MUGM-H028	IAA	2420	17.65	14.34	11.79	ASE17C4U
1/4	MUJM-0028	IAA	2650	13.98	11.67	9.64	ASE24C4U
1/3	MUJP-H032	IAA	2830	14.19	11.77	9.63	AFF10C1U
1/3	MUJM-H032	IAA	3010	14.04	9.62	11.67	ASE24C4U
1/3	MUZM-0036	IAA	3140	16.18	13.05	11.70	ASE24C4U
1/3	MUZM-H036	IAA	3200	16.18	13.05	11.70	ASE24C4U
1/3	MUGM-H038	IAA	3310	17.68	14.34	11.79	ASE24C4U
1/3	MUJM-H039	IAA	3800	14.04	9.62	11.67	ASE32C4U
1/2	MUZM-0046	IAA	4040	16.18	13.05	11.70	ASE32C4U
1/2	MUZM-H047	IAA	4130	16.18	13.05	11.70	ASE32C4U
1/2	MUGM-H049	IAA	4340	17.68	14.34	11.79	ASE32C4U
1/2	MUZP-0050	CAA	4380	16.61	13.56	11.70	RST37C1U
1/2	MUZP-H051	CAA	4500	16.61	13.56	11.70	RST37C1U
1/2	MUGP-H054	CAA	4780	18.11	14.34	11.79	RST37C1U
1/2	MUZP-0059	CAA	5160	16.60	13.56	11.70	RST44C1U
3/4	MUZP-H061	CAA	5320	16.60	13.56	11.70	RST44C1U
3/4	MUGP-H065	CAA	5720	18.10	14.34	11.79	RST44C1U
3/4	MUZP-0066	CAA	5750	16.60	13.56	11.70	RST53C1U
3/4	MUZP-H068	CAA	5930	16.60	13.56	11.70	RST53C1U
3/4	MUZP-0072	CAV	6260	16.61	13.56	11.70	RST58C1U
3/4	MUGP-H073	CAA	6440	18.10	14.34	11.79	RST53C1U
3/4	MUZP-H074	CAV	6460	16.61	13.56	11.70	RST58C1U
3/4	MUGP-H081	CAV	7030	18.11	14.34	11.79	RST58C1U

## Dixell Controllers for R-290 Applications

Dixell controls are UL and CE listed and can be used in R-290 systems including, but not limited to, reach-in refrigerators and freezers, beverage coolers, and display cabinets.



## Challenges

- Class A3 refrigerant that is flammable
- Globally mandated low charge limits of 150g restrict application range
- Requires special handling requirements certifications
- Lack of trained technicians

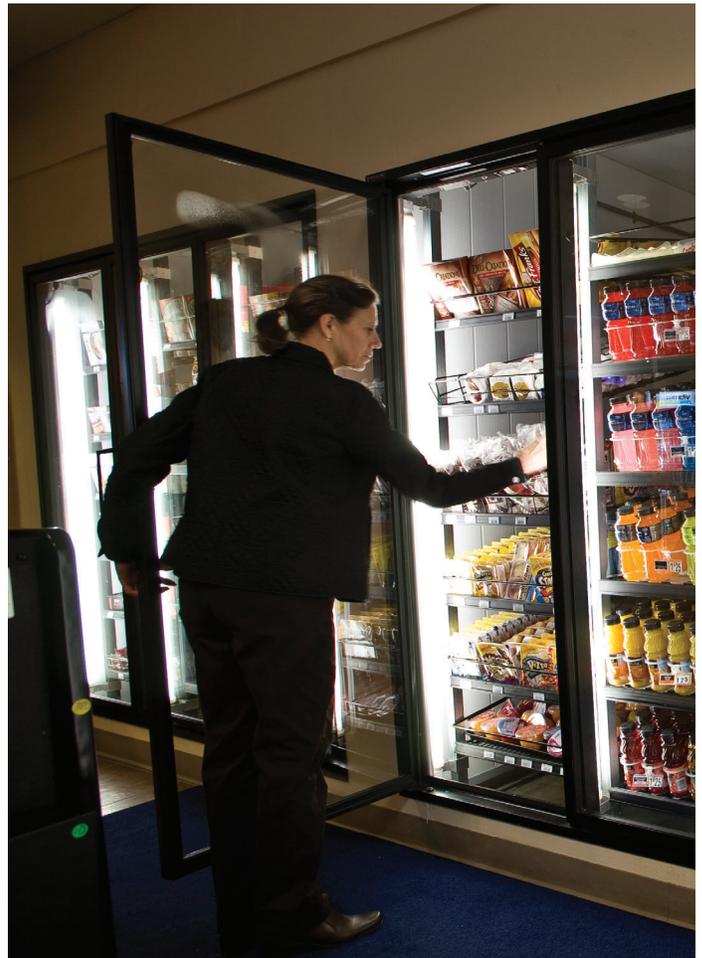
While there are challenges to the implementation of propane, for environmentally forward-leaning companies, it is an increasingly attractive option. While an uncertain regulatory environment may have cleared the way for wider R-290 adoption, the implementation of an industry-wide safety infrastructure will be necessary for propane to gain full adoption.

Propane is more combustible than hydrofluorocarbons and there are a number of special-use considerations for using it in refrigeration applications. Some examples include, but are not limited to:

- Sealed/gas-tight or fire-/explosion-proof electrical components (UL471/EN 60079-15)
- Spark-free fan motors (brushless)
- Ventilation and leak sensor safety measures
- Special charge and leak detection processes during manufacturing

It's also important to note that while propane has tremendous potential in commercial refrigeration, it is not a "drop-in" refrigerant. Equipment and components must be specifically designed for use with propane, as it requires a different compressor that will not always directly match the capacity or cost of existing HFC models.

Please reference the REQUIREMENTS FOR REFRIGERATORS AND FREEZERS EMPLOYING A FLAMMABLE REFRIGERANT IN THE REFRIGERATING SYSTEM in the UL471 standard for commercial refrigerators and freezers for the detailed list of considerations.



### Service Considerations

**Service Requires Training and Attention**

- Equipment suitable for explosive environments (vacuum pump)
- Special procedures, including refrigerant recovery

Training and certification is recommended for the use of propane refrigeration from authorized industry trainers like RSES and compliance with UL471.

**RSES**<sup>®</sup>  
The HVACR Training Authority

## About Emerson

Emerson (NYSE: EMR), headquartered in St. Louis, Missouri (USA), is a global technology and engineering company providing innovative solutions for customers in industrial, commercial, and residential markets. Our Emerson Automation Solutions business helps process, hybrid, and discrete manufacturers maximize production, protect personnel and the environment while optimizing their energy and operating costs. Our Emerson Commercial and Residential Solutions business helps ensure human comfort and health, protect food quality and safety, advance energy efficiency, and create sustainable infrastructure. For more information visit **Emerson.com**.

Climate.Emerson.com

2015ECT-46 R8 (4/22) Emerson and Copeland are trademarks of Emerson Electric Co. or one of its affiliated companies.  
©2022 Emerson Climate Technologies, Inc. All rights reserved.

**EMERSON. CONSIDER IT SOLVED.™**