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.

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.

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.

Emerson R-290 Fractional HP Fixed Speed Compressor Lineup

Low-Temperature

<table>
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<tr>
<th>R-290</th>
<th>AFE06</th>
<th>AFE10</th>
<th>AFE12</th>
<th>AFE15</th>
<th>AFE16</th>
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Medium-Temperature

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<th>ASE32</th>
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<th>ASE37</th>
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<th>RST44</th>
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Extended Medium-Temperature

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<td>4600</td>
<td>5390</td>
<td>5930</td>
<td>6020</td>
<td>6800</td>
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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

Filter Driers

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

Pressure Switch

- PS4: Pressure Switch

Shut-Off Valves

- BVE/BVS: Welded Ball Valves
- ACK: Spun Copper Check Valves
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.

Emerson R-290 Fractional HP Variable Speed Compressor Lineup

R-290, 20°F/120°F/RG40°F/SC0°F
R-290, -10°F/110°F/RG40°F/SC0°F

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<th>Btu/Hr</th>
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<th>2,000</th>
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Variable Speed Features and Benefits

Regulatory Compliance
- Potential impending DOA 2024 energy reductions
- EPA refrigerant requirements
- CARB commercial refrigeration 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
**M-Line Model Summary**

<table>
<thead>
<tr>
<th>HP</th>
<th>Model</th>
<th>Electrical</th>
<th>BTUH (90/10)</th>
<th>L</th>
<th>W</th>
<th>H</th>
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**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 |
| 1/5 | MUJL-0033 | IAA | 1550 | 13.98 | 11.67 | 9.64 | AFF10C1U |
| 1/2 | MUZL-0044 | IAA | 1730 | 16.18 | 13.05 | 11.7 | AFF10C1U |
| 1/2 | MUZL-0045 | IAA | 1790 | 17.68 | 14.34 | 11.79 | AFF10C1U |
| 3/4 | MUZL-0067 | IAV | 2580 | 16.92 | 13.3 | 11.7 | AFE12C4U |
| 3/4 | MUZL-0070 | IAV | 2690 | 18.50 | 14.34 | 11.79 | AFE12C4U |
| 3/4 | MUZL-0077 | CAA / IAV | 3060 | 16.99 | 13.56 | 11.7 | AFE12C4U |
| 3/4 | MUZL-0078 | CAA / IAV | 3130 | 16.92 | 13.56 | 11.7 | AFE12C4U |
| 3/4 | MUZL-0081 | CAA / IAV | 3300 | 16.6 | 13.56 | 11.7 | AFE12C4U |
| 3/4 | MUZL-0082 | CAA / IAV | 3450 | 18.10 | 14.34 | 11.79 | AFE12C4U |
| 1 | MUZL-0098 | CFA / CFV | 3900 | 16.6 | 13.56 | 11.7 | AFE12C4U |
| 1 | MUZL-0100 | CFA / CFV | 4000 | 16.6 | 13.56 | 11.7 | AFE12C4U |
| 1 | MUGL-0106 | CFA / CFV | 4250 | 18.10 | 14.34 | 11.79 | AFE12C4U |

**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*T 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

**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.

![Dixell Controller Image](image-url)
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.
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.