Application Engineering

Guide for the Use of R-290 Refrigerant in Copeland Refrigeration

BULLETIN NO: AE4-1380 R6

Contents

COPELAND

Safety

Important Safety Information

Those involved in the design, manufacture, and installation of a system, system purchasers, and service personnel may need to be aware of hazards and precautions discussed in this section and throughout this document. OEMs integrating the compressor into a system should ensure that their own employees follow this bulletin and provide any necessary safety information to those involved in manufacturing, installing, purchasing, and servicing the system.

Responsibilities, Qualifications and Training

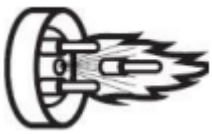
• OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.

• OEMs are also responsible for ensuring that all product, service, and cautionary labels remain visible or are appropriately added in a conspicuous location on the system to ensure they are clear to any personnel involved in the installation, commissioning, troubleshooting or maintenance of this equipment.

• Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission, troubleshoot and maintain this equipment. Electrical connections must be made by qualified electrical personnel.

• Observe all applicable standards and codes for installing, servicing, and maintaining electrical and refrigeration equipment.

Terminal Venting and Other Pressurized System Hazards



If a compressor's electrical terminal pin loses its seal, pressurized oil, refrigerant, and debris may spray out. This is called "terminal venting".

The ejected debris, oil, and refrigerant can injure people or damage property. The oil and refrigerant spray can be ignited by electrical arcing at the terminal or any nearby ignition source, producing flames that may project a significant distance from the compressor. The distance depends on the pressure and the amount of refrigerant and oil mixture in the system. The flames can cause serious or fatal burns and ignite nearby materials.

Each compressor has a terminal cover or molded plug that covers electrical connections. The cover or plug helps to protect against electric shock and the risks of terminal venting. If terminal venting occurs, the cover or plug helps contain the spray of refrigerant and oil and reduces the risk of ignition. If ignition occurs, the plug or cover helps contain the flames. However, neither the terminal cover nor the molded plug can completely eliminate the risk of venting, ignition, or electric shock.

See copeland.com/terminal-venting for more details about terminal venting. Additionally, a compressor's refrigerant lines keep refrigerant and oil under pressure. When removing or recharging refrigerant from this component during service, this can pose a pressurized fluid hazard.

Flammable Refrigerant Hazards

If flammable refrigerant is released from a system, an explosive concentration can be present in the air near the system. If there is an ignition source nearby, a release of flammable refrigerant can result in a fire or explosion. While systems using flammable refrigerant are designed to mitigate the risk of ignition if the refrigerant is released, fire and explosion can still occur.

See copeland.com/flammable-refrigerants for more information on flammable refrigerant safety.

Electrical Hazards

Until a system is de-energized, and capacitors have been discharged, the system presents a risk of electric shock.

Hot Surface and Fire Hazards

While the system is energized, and for some time after it is deenergized, the compressor may be hot. Touching the compressor before it has cooled can result in severe burns. When brazing system components during service, the flames can cause severe burns and ignite nearby combustible materials.

Lifting Hazards

Certain system components may be very heavy. Improperly lifting system components or the compressor can result in serious personal injury. Use proper lifting techniques when moving.

POE Oil Hazards

This equipment contains polyol ester (POE) oils. Certain polymers (e.g., PVC/CPVC and polycarbonate) can be harmed if they come into contact with POE oils. If POE oil contacts bare skin, it may cause an allergic skin reaction.

Precautions

• Always wear personal protective equipment (gloves, eye protection, etc.).

• Keep a fire extinguisher at the jobsite at all times.

• Keep clear of the compressor when power is applied.

- IMMEDIATELY GET AWAY **if you hear unusual sounds in the compressor. They can indicate that terminal pin ejection may be imminent. This may sound like electrical arcing (sizzling, sputtering or popping). However, terminal venting may still occur even if you do not hear any unusual sounds.**

• Never reset a breaker or replace a blown fuse without performing appropriate electrical testing

- **A tripped breaker or blown fuse may indicate an electrical fault in the compressor. Energizing a compressor with an electrical fault can cause terminal venting. Perform checks to rule out an electrical fault.**

• Disconnect power and use lock-out/tag-out procedures before servicing.

- Before removing the terminal cover or molded plug, check that ALL electrical power is disconnected from the unit. Make sure that all power legs are open. (Note: The system may have more than one power supply.)

- Discharge capacitors for a minimum of two minutes

- Always use control of hazardous energy (lock-out/tag-out) procedures to ensure that power is not reconnected while the unit is being serviced.

• Allow time for the compressor to cool before servicing.

- Ensure that materials and wiring do not touch high temperature areas of the compressor.

• Keep all non-essential personnel away from the compressor during service.

• For A3 refrigerants (R290) remove refrigerant from both the high and low sides of the compressor. Use a recovery machine and cylinder designed for flammable refrigerants. Do not use standard recovery machines because they contain sources of ignition such as switches, high- and low-pressure controls and relays. Only vent the R290 refrigerant into the atmosphere if the system is in a well-ventilated area.

• Never use a torch to remove the compressor. Only tubing cutters should be used for both A2L and A3 refrigerants.

• Use an appropriate lifting device to install or remove the compressor.

• Never install a system and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.

• Always wear appropriate safety glasses and gloves when brazing or unbrazing system components.

• Charge the system with only approved refrigerants and refrigeration oils.

• Keep POE oils away from certain polymers (e.g., PVC/CPVC and polycarbonate) and any other surface or material that might be harmed by POE oils. Proper protective equipment (gloves, eye protection, etc.) must be used when handling POE lubricant. Handle POE oil with care. Refer to the Safety Data Sheet (SDS) for further details.

• Before energizing the system:

1. Securely fasten the protective terminal cover or molded plug to the compressor, and

2. Check that the compressor is properly grounded per the applicable system and compressor requirements.

Signal Word Definitions

The signal word explained below are used throughout the document to indicate safety messages.

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Important Safety Information

1.General Information

DANGER

R-290 is flammable and should be handled by qualified personnel in accordance with appropriate care for safe use. Copeland highly recommends that service personnel use spark proof tools, anti-static gloves for hand and anti-static clothes. Avoid the build-up of electrostatic charge, work in a well-ventilated area. Fire and smoking is forbidden!

R-290 (Propane) refrigerant can be used as a Hydrocarbon refrigerant alternative for traditional HCFC/HFC low or medium temperature applications. R-290 CANNOT be used as a retrofit refrigerant, it is only to be used in new systems specifically designed for R-290.

Before supplying compressors for use with R-290, it is first necessary to perform an evaluation of the risks involved with the use of this refrigerant. The customer should perform a risk assessment to ensure proper knowledge about the handling and use of the R-290 in the refrigerant system (for further information please contact the Copeland™ Application Engineering Department). It is recommended that manufacturers of refrigeration systems using flammable refrigerants such as R-290, develop accurate charging, leak testing and system testing methods to guarantee that all necessary safety procedures have been met. Safety standards have been developed for the use of hydrocarbons, including leakage simulation tests and specifications for several electrical components which may come into contact with leaking refrigerants. The following set of UL and international standards, from the International Electrotechnical Commission, on electrical safety contains rules for the design and testing of appliances operating with flammable refrigerants:

UL-471
IEC 60335-2-24: Household refrigerators and freezers
EC 603352-34: Motor compressors
IEC 60335-2-89: Commercial refrigerators and freezers
IEC 60335-2-40: Heat pumps, air conditioners and dehumidifiers.

2. Compressor Nomenclature

CAUTION

Standard refrigeration compressors cannot be used in R-290 applications under any circumstances!

There are only a limited number of R-290 compressors available at this time; the compressor's nomenclature will be designated with a '**U**' in the eighth character for R-290 application. Example: ASE18C4**U**-IAA

Compressors designed for the use of R-290 will not be charged with a positive dry air charge but will have a slight vacuum from the factory.

3. System Component Compatibility

All of the components in the refrigeration system that may contain contaminants should conform to the requirements outlined in form **DIN 8964**(1). (AHRI is developing standards specific to Hydrocarbon-only refrigerants such as R-290 and the new specs will be out soon.)

The presence of the contaminants paraffin and silicon is not permitted.

4. Expansion Device

For a new application the first component to be designed should be the capillary tube.

Generally, when designing an R-290 system based on an existing R-22 system, the same capillary tube can be used although the length should be decreased by approximately 5%. It is not recommended to use a capillary tube with an internal diameter less than .024" (0.6 mm).

For each system the optimal dimensioning of the capillary tube should be performed in an appropriate test laboratory, in order to obtain the best working conditions.

For accurate sizing of TXV type expansion devices please contact the TXV manufacturer.

5. Evaporator and Condenser

Evaporator and condenser system options are available to reduce the required system charge. Examples would be smaller tubing dimensions and micro-channel style coils.

6. Filter Drier

Refrigerant R-290 requires the use of a normal filter drier. The Copeland EK filter driers are suitable for use with R-290 refrigerant (Propane). These filter driers use an XH-6 molecular sieve and this MS provides the best water adsorption capacity of any of the MS's on the market today.

Always consult the manufacturer for the proper selection of the filter drier.

7. Evacuation and Charging Equipment

Good refrigeration practice suggests system evacuation from both low side and high side, achieving a minimum level of **0.14 mbar (100 µHg)** with a non-condensable value of less than 0.3% by volume.

Use charging equipment suitable for use of the refrigerant R-290, and if possible, dedicate this equipment for use only with this refrigerant.

Deep Vacuum Operation

Never attempt to start a compressor while it is in a vacuum; always break the vacuum with a refrigerant charge before applying power. Operating a compressor in a deep vacuum could cause electrical arcing inside the compressor.

A low-pressure control is required for protection against deep vacuum operation. Refrigerant compressors are not designed for and should not be used to evacuate a refrigeration or air conditioning system. See **AE24-1105** for proper system evacuation procedures.

Service and repair of R-290 systems should be completed only by trained service technicians, taking into account all local laws and regulations. R-290 requires special handling and care due to its flammability. Good ventilation is required during service of the refrigeration system; vacuum pump vents need to be directed to open air. An electronic scale is also recommended to maintain the required charging accuracy.

8. Refrigerant Charge

For each system, the optimal refrigerant charge should be determined in an appropriate test laboratory in order to obtain the best working conditions. In addition, the system charge must not exceed the established SNAP guidelines.

The US Significant New Alternatives Policy (SNAP) The SNAP ruling for hydrocarbon is divided into two components:

Refrigerators and freezers: the charge limitations are 57g (2.0 ounces) in any refrigerator, freezer, or combination refrigerator and freezer.

Retail food refrigerator and freezers: the charge limitation for propane R-290 is 150g (5.29 ounces).

(For more information, visit **http://www.epa.gov/ozone/snap**.)

9. Moisture

In order to avoid problems that can shorten the life of the refrigeration system, use components that are supplied internally dried and properly sealed to prevent the entrance of moisture. These components should remain sealed until they are used.

The moisture content in a system should conform to form **DIN 8964**. The level of moisture present in the refrigeration circuit should be below 40ppm and after the system has been operating, the filter dryer should remove moisture from the system from a level below 20ppm.

10. Leak Control

It is recommended that special attention be given to the correct brazing, or other forms of union of the system components, to avoid the possibility of leaks. It is also recommended that a Nitrogen purge be implemented while brazing on any refrigeration system.

To maximize efficiency in controlling leaks, it is recommended to use a leak detector designed for use with refrigerant R-290, or as an alternative, a detector designed for use with Helium. Consult the manufacturer for their recommendations on the use of their equipment.

11. High Pressure Limit Control

To protect the system, it may be necessary to install a high-pressure limit switch to control the maximum discharge pressure. The settings on this limit switch should be in accordance with the limits established by the system manufacturer. High pressure switches must comply with the ignition test requirements in section SB5.2 of UL 471.

12. Oil Type and Specification

CAUTION

Compressors are charged with a specific quantity of Lubrizol RL22HB POE oil.

POE must be handled carefully and the proper protective equipment (gloves, eye protection, etc.) must be used when handling POE lubricant. POE must not come into contact with any surface or material that might be harmed by POE, including without limitation, certain polymers (e.g. PVC/CPVC and polycarbonate).

13. Application Instructions

Contact System OEM for specific application instructions. For general compressor guidelines, please reference AE4-1305 (Application Guidelines for AF, AR & AS Refrigeration Hermetic Compressors) and AE4-1344 (Application Guidelines for RFT, RRT, RST Compressors). Only use Copeland listed start components for R-290 compressor applications, as only these components have been tested to and meet the safety guidelines set forth by UL.

Standard refrigeration compressors cannot be used in R-290 applications under any circumstances!

Revision Tracking R6

The document format has been updated to the new Copeland format.

All occurrences of "Emerson" have been removed.

A note regarding A3 and R290 venting has been updated.