Application Engineering

Oil Management for ZS and ZF Copeland Scroll™ Compressors (7 ½ to 15 HP) in Parallel Applications

BULLETIN NO: AE17-1320 R4

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

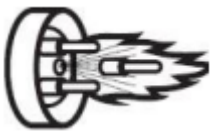
• OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.

• 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.

Introduction

Copeland Scroll refrigeration compressors have several inherent design differences from Copeland Discus semi-hermetic compressors. These differences require different considerations for oil management when using Copeland Scroll refrigeration compressors in parallel rack applications. Copeland has worked closely with several supermarket rack manufacturers to develop acceptable system design parameters.

The scope of this bulletin is to describe the design differences between ZF* and ZS* scroll compressors models and semihermetic ones, and to explain how they affect oil management and provide guidelines to ensure proper oil management. A list of models involved in this topic is detailed **below**.

Table 1 ZF and ZS* Scroll™ Compressor Models involved.*

ZF* models	ZS* models
ZF24K*	ZS56K*
ZF33K*	ZS75K*
ZF40K*	ZS92K*
ZF48K*	ZS11M*

Oil Volume

The typical horsepower range for Copeland Scroll refrigeration compressors in these applications is 7.5 to

15 HP. Although Copeland Scroll refrigeration compressors have more oil capacity (140 oz.) than comparably sized Copeland 3D Discus compressors (125 oz.), the amount of useful oil is much smaller. This is a result of the type of oil protection that is required for the different compressors.

Oil Protection

Copeland Discus compressors utilize the Sentronic oil protection system which monitors oil pressure from the oil pump to determine if there is satisfactory oil flow going to the bearings. The oil level can go down to the top of the oil pick up screen before there will be insufficient oil available to maintain oil pressure. This means that the compressor has approximately 100 oz. of useable oil.

Copeland Scroll refrigeration compressors do not have an external oil pump that readily allows the measurement of oil pressure. Therefore, an external monitor of oil level is required. The Copeland OMB/C is required and combines the functions of oil level control and time compressor shutoff. See Figure 1.

This device is mounted on the sight glass and monitors the level between ½ and the bottom of the sight glass. Therefore, the amount of useful oil prior to a potential control trip is only about 15 oz. This becomes very critical during start up commissioning.

For more information about OMB/C Oil Management Control visit https://www.copeland.com/en-us/shop/1/white-rodgers-omc-series-oil-management-control or review Table 2 for useful links.

Oil Return Pressure

Both low pressure and high pressure oil return systems have been successfully applied. However, they have different issues. The high pressure system requires an additional reservoir. The low pressure system already employs a separate reservoir. The main concern in the low pressure scheme is that the reservoir may drop below the required 20 PSIG differential to feed oil during low load conditions. The reservoir pressure depends on the oil separator feeding to keep adequate pressure above the crankcase pressure. The oil separator is sized for worst case conditions and in the event that only a couple of compressors are operating, the separator is ineffective. Therefore, the reservoir may be depleted if multiple compressors are calling for oil.

Figure 1 OMC Oil Management Control

Start Up Commissioning

During initial start up, oil will be lost from the compressor as it coats the various system surfaces. During this time, the OMB/C will cause the oil reservoir level to fluctuate until equilibrium is reached. Since there is less useful oil available, it is necessary to monitor the oil levels closely to prevent unnecessary trips. Service technicians frequently relate trips to the need to add oil, when indeed this may not be the case and results in a system with too much oil.

Oil Reservoir

To prevent nuisance oil level trips, it is imperative that oil be available to the OMB/C when they are required to fill. This means that a larger reservoir is needed than might be used on comparable Discus parallel applications.

Compressor oil circulation rates vary by mass flow. Therefore, a larger increase in reservoir volume is needed for medium temperature racks than low temperature racks. Our studies indicate that per compressor, increase in reservoir capacity should be:

- ZS MEDIUM TEMPERATURE = 50 OZ. PER COMPRESSOR
- ZF LOW TEMPERATURE = 20 OZ. PER COMPRESSOR

On systems having a common discharge header for the medium and low temperature racks, the increase in reservoir capacity should be the sum of the number of low temperature and medium temperature compressors feeding the header. For example, a rack with 4 ZS medium temperature compressors and 3 ZF low temperature compressors would require

For example: (4×50) + (3×20) = 260 additional oz. of oil.

Systems utilizing an integral oil separator/oil reservoir, supplying 8 - 10 compressors may not have sufficient oil capacity available to satisfy the OMB/C control. Consequently, the hot foaming oil being supplied causes the oil float to fluctuate resulting in erratic control performance. This condition also elevates the oil temperature, bottom shell temperature and generates numerous oil level trips. The additional reservoir eliminates this problem.

Oil Filters

The OMB/C, oil level controls, utilize a “Hall Effect” magnet to actuate the flow valve. Therefore, they are somewhat sensitive to any metallic particles and wear debris that may be in the oil. Therefore, we strongly recommend that a replaceable core oil filter be used.

Incorporating the above recommendations will provide valuable trouble free parallel rack applications with Copeland Scroll refrigeration compressors. Should you have any questions or need any additional information, contact your Copeland Application Engineer.

Revision Tracking R5
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