Application Engineering

Principles of Cleaning Refrigeration Systems

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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

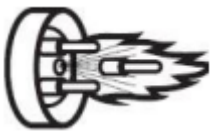
• OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.

• 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 strongly supports refrigerant recovery and recycling as part of the solution to the CFC/ozone depletion problem. Only the latest techniques should be used when servicing equipment containing CFCs.

Examination of compressors returned to the factory for replacement indicates that many such replacements could have been prevented if all contaminants had been removed from the refrigeration system at the time of field installation. Returned compressors are at times reported as motor failures, but in reality, the return is due to damaged bearings, valve reeds, or connecting rods caused by contaminants, which in turn caused motor damage as a secondary effect.

It is essential that all foreign materials be removed from the system at the time of the original installation. Filings, shavings, dirt, solder, flux, metal chips, bits of steel wool, sand from sandpaper, and wire from cleaning brushes have all been found in systems and frequently end up in the compressor. Many of these contaminants are so small they will pass through a fine mesh screen. In addition, the metal fragments may be rotating because of gas velocity and cut or break the usual compressor suction screen.

Suction Line Filter and Filter-Driers

As a result of the above types of contamination, a heavy-duty suction line filter or filter-drier is recommended for every field installation. These are available with reasonable pressure drop and will provide maximum protection for the most vulnerable part of the system. A set of access valves should be provided on the filter or filter-drier, to facilitate checking the pressure drop.

An additional benefit of a suction line filter or filter-drier is the added protection given the system if a burnout should occur. The filter will effectively prevent contamination resulting from the failure from traveling back through the suction line into the other parts of the system. An additional benefit of a suction line filter-drier is to capture any acid generated during the burnout before it causes any additional damage. This will minimize the contamination remaining in the system when the inoperative compressor is removed.

System Evacuation

Another important step in effectively cleaning a system before operation is proper evacuation. Air is very detrimental to refrigeration systems and must be removed before start-up and after field service. Blowing out lines with dry nitrogen may remove a major part of the air from a system, but if air is trapped in the compressor during installation, it is practically impossible to remove from the compressor crankcase by purging with nitrogen.

New and replacement compressors are shipped from the factory with a dry air holding charge and must be evacuated before being put in service.

Triple evacuation of the system or compressor, as required, is strongly recommended (twice to 1,500 microns and finally to 500 microns,) breaking the vacuum each time with dry nitrogen. The vacuum pump must be connected to both the high and low sides of the system through properly sized connections, since restrictive service connections may make the process so slow as to be unacceptable or may lead to false readings because of pressure drop through the fittings.

System Cleaning Procedure After Hermetic Motor Burn-out

When a motor burnout occurs in the compressor, the resulting high temperature arc causes a portion of the refrigerant/oil mixture to break down into carbonaceous sludge, corrosive acid, and water.

It has long been recognized that such contamination resulting from a burnout can result in repeat failures if the contaminants are allowed to reach and remain in the crankcase of the replacement compressor. This situation can be prevented by following proper clean up procedures after a burnout.

Flushing out a refrigeration system with R-11 should not be considered since scientific evidence has linked ozone depletion to R-11 emissions. In case of a motor burn, Copeland recommends the filter-drier cleaning procedure.

Basically, this involves the use of approved filter-driers incorporating an adequate desiccant (not a filter only) in both the liquid and suction lines. This system cleaning procedure has been used in countless installations over the years, and when this procedure has been properly followed, we do not know of a single instance where after proper cleaning there has been a second failure.

The filter-drier procedure has proven to be very economical, especially when the refrigerant in the system is recovered using safe recovery techniques. This can be easily accomplished if the compressor is fitted with service valves.

It is the only practical method we know of which can assure proper cleaning, especially where long lines and multiple evaporators and circuits are involved.

The size of the filter-driers (see Table 1) used to clean up the system should be such that the maximum pressure drop under normal operating conditions is within the limits shown. The connections on the filter-drier should normally be the same size as the connecting lines.

Exercise caution. Use rubber gloves and safety glasses and ventilate the workspace. The oil from a burnout could cause serious skin irritation and possibly burns. In some cases, the fumes are toxic.

1. If possible, close the compressor service valves to isolate the compressor from the system. In order to avoid losing refrigerant to the atmosphere Copeland strongly recommends recovering refrigerant using standard recovery procedures and equipment. At that point, remove the inoperative compressor, and install the replacement.

2. Since the normal color of refrigerant oil varies from oil to oil, take a sample of oil from the replacement compressor and seal in a small glass bottle for comparison purposes after the cleaning operation is complete. Suitable two-ounce bottles are obtainable at any drug store. If the compressor does not have service valves, see Step 6.

3. If the compressor has service valves, evacuate the compressor only, using the procedures previously outlined, since the rest of the system will be isolated. After evacuation, open the compressor service valves, close the liquid line valve, close any other available shut-off valves which will minimize the amount of refrigerant to be handled during pump down, and pump the system down. Although some contaminants will be returned to the compressor during the pump down procedure, the compressor will not be harmed by the short period of operation required, and the contaminants will be removed as they are circulated through the system after the installation of the filter-driers.

4. Inspect all system controls such as expansion valves, solenoid valves, check valves, reversing valves, contactors, etc. Clean or replace, if necessary, remove all installed filter-driers and clean or replace any filters or strainers. Install a Copeland HMI or AMI moisture indicator to precisely monitor system moisture conditions if the system does not have one.

5. Install the recommended size Copeland suction line filter-drier and oversized Copeland liquid line filter-drier.

   Go to Step 7.

6. For systems without service valves, including refrigerant recovery, evacuate the system, following the procedures previously recommended. Perform the inspections and filter-drier changes listed in steps 4 and 5, and charge through a filter-drier with the refrigerant which was removed and recovered. Add additional refrigerant as necessary.

7. Start the compressor and put the system in operation. As the contaminants in the system are filtered out, the pressure drop across the filter-drier will increase. Observe the pressure differential across the filter-driers for a minimum of four hours, preferably by means of one gauge and a manifold to eliminate gauge error. If the pressure drop exceeds the maximum limits shown in Table 1 for a temporary installation, replace the filter-drier and restart the system.

8. After the completion of step 7, allow the unit to operate for 48 hours. Check the odor (warning, smell cautiously) and compare the color of the oil with the sample taken in step 2. Use of a Copeland Universal

Acid Alert test kit is recommended to test for acid content. If the oil is discolored, has an acid odor, is acidic, or if the moisture indicator indicates a high moisture content in the system, change the filter-driers. The compressor oil can be changed if considered desirable. Allow the system to operate for an additional 48 hours and recheck as before. Repeat until the oil remains clean, odor and acid free, and the color approaches that of the original sample.

9. Replace the liquid line filter-drier with a Copeland EK of the normally recommended size. Remove the suction line filter-drier and replace with permanent type suction line filter or filter drier.

10. After the cleaning procedure is completed, recheck in approximately two weeks to ensure that the system condition and operation is completely satisfactory.

Table

Table 1 Maximum Recommended Pressure Drop for Suction Line Filter-Drier PSI (Bar)

System	Permanent Installation		Temporary Installation	
	Refrigerant			
	R22, R404A, R407C, R410A, R502, R507	R12, R134a	R22, R404A, R407C, R410A, R502, R507	R12, R134a
Air-Conditioning	3 (.21)	2 (.14)	8 (.55)	6 (.41)
Commercial	2 (.14)	1,5 (.10)	4 (.28)	3 (.21)
Low Temperature	1 (.07)	0.5 (.03)	2 (.14)	1 (.07)

Revision Tracking R7

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.