Application Engineering

Application Guidelines for Copeland CS Compressors for Refrigerants R-22, R-134A, R-404A, R-448A, R-449A, R407A and R-507*

BULLETIN NO: AE4-1433 R3

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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

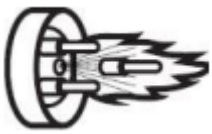
• OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.

• 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.

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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.**

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• 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.

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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.

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Introduction

Hermetic compressors have been developed for the 1 HP to 7 HP refrigeration applications. These compressors are designed to operate safely and reliably in the high, medium and extended medium temperature ranges. It must be noted however, that under low evaporating conditions and when operating with R448A, R-449A and R407A the operating envelope for these models is restricted.

Nomenclature

The Copeland “CS” compressor model numbers include the nominal capacity at the standard ARI 60Hz rating conditions (R404A Refrigerant). Please refer to product literature for specific model number details. See **Figure 3**.

Operating Envelope

There are various refrigerants that have been approved for use with this family of compressors, see Table 2 at the end of this bulletin. The “CS” model compressors are intended for refrigeration type duty. The approved operating envelopes are depicted in **Figure 4** through **Figure 8**. These compressors are approved to operate down to a 70ºF (21°C) condensing temperature.

The envelopes are defined by the following compressor limitations:

- Discharge line temperature 225°F (107°C)
- Discharge valve backer 275°F (135°C)
- Oil sump 200°F (93°C)
- Motor windings 275°F (135°C)

If the system design is such that operation within these guidelines cannot be guaranteed, then the following additional controls must be added:

1. Discharge line thermostat - Located 6" from the compressor and set to cut-out the compressor at 250°F (121°C) maximum.
2. Low pressure control - Refer to Table 3 for recommended low pressure cut-out settings based on the various refrigerants.

Superheat Requirements

In order to assure that liquid refrigerant does not return to the compressor during the running cycle, attention must be given to maintaining proper superheat at the compressor suction inlet. Copeland recommends a minimum of 20°F (11°C) superheat, measured on the suction line 6 inches (152mm) from the suction valve, to prevent liquid refrigerant floodback.

Another method to determine if liquid refrigerant is returning to the compressor is to accurately measure the temperature difference between the compressor oil crankcase and the suction line. During continuous operation we recommend that this difference be a minimum of 50°F (27°C). This “crankcase differential temperature” requirement supersedes the minimum suction superheat requirement in the last paragraph. To measure oil temperature through the compressor shell, place a thermocouple on the bottom center (not the side) of the compressor shell and insulate from the ambient.

During rapid system changes, such as defrost or ice harvest cycles, this temperature difference may drop rapidly for a short period of time. When the crankcase temperature difference falls below the recommended 50°F (27°C), our recommendation is the duration should not exceed a maximum (continuous) time period of two minutes and should not go lower than a 25°F (14°C) difference.

Contact your Copeland representative regarding any exceptions to the above requirements.

Suction Accumulator

The addition of a suction accumulator can be an effective method to prevent damage to the compressor due to liquid floodback. Through extensive testing, Copeland recommends the use of a suction accumulator if the system refrigerant charge exceeds the refrigerant charge limit. For “CS” compressors the refrigerant charge limit is 6 pounds.

On systems with defrost harvest schemes or transient operations that allow prolonged uncontrolled liquid return to the compressor, an accumulator is required unless a suction header of sufficient volume to prevent liquid migration to the compressor is used.

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Excessive liquid flood back or repeated flooded starts will dilute the oil in the compressor causing inadequate lubrication and bearing wear. Proper system design will minimize liquid flood back, thereby ensuring maximum compressor life.

Liquid Line Check Valve

On pre-charged units that use “CS” compressors with charge levels greater than 6 lbs., a check valve is required in between the receiver and condenser. This will reduce the potential for liquid refrigerant migrating to the compressor during transport and storage. The addition of a crankcase heater on pre-charged units will also assist in forcing any refrigerant that might have migrated to the compressor sump during an extended off or storage time. It is recommended that the crankcase heater be energized a minimum of 4 hours before initial startup.

Crankcase Heaters

Crankcase heaters are recommended on all outdoor applications or indoor applications below 40°F (4.44°C) a crankcase heater is also required on any system with an accumulator. Reference AE22-1182 for liquid refrigerant control in refrigeration and air conditioning systems. New crankcase heaters are available for use with the “CS” model compressors. See **Table 7** for part numbers.

Pump Down Recommendations

If short cycling occurs please check these several factors:

1. Location of low-pressure control sensor. If it is located right at the suction inlet of the compressor, it will be more sensitive to pressure spikes.
2. Actual low-pressure setting. Refer to our recommended setting in **Table 3**. If the differential pressure setting is too close, this will increase the possibility of short cycling.
3. Type of Low-pressure control can have an effect on cycling. The encapsulated non-adjustable type is more susceptible to causing excessive cycling due to tolerances.
4. If short cycling cannot be avoided, using a 5-minute time delay will limit the cycling of the compressor to an acceptable level.

Lubricants

CS* compressors that are approved for use with HFC/HFO refrigerants are charged with polyol ester lubricant (POE). HFC/HFO refrigerants require the use of a POE lubricant to provide proper miscibility and lubricity. The model nomenclature denotes if the compressor is charged with a POE lubricant. If the seventh character in the model nomenclature is the letter E then the compressor is charged with a POE lubricant, example CS24K6E-PFV.



POE may cause an allergic skin reaction and 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). Refer to the Safety Data Sheet (SDS) for further details.

In the event lubricant needs to be added to the system, the proper Copeland approved lubricant must be used. See **Table 2** for a list of approved Lubricants for this compressor Model and Form 93-11, Refrigerants/Lubricants Approved for Use in Copeland Compressors, for a complete list of approved lubricants. The compressor recharge is 4 oz. less than the initial oil charge listed on the nameplate.

Practical Considerations

The application restrictions imposed on these models may require careful system design. Some considerations for the designer are as follow:

1. Units operating at low evaporator temperatures will be susceptible to overheating with dirty condensers and/or restricted air flow. Large condensers (with low TD’s) should be designed into systems using these compressors and proper condenser coil maintenance will be more critical. System Air flow across the compressor and condenser should be designed to maintain a Discharge line temperature (Measured 6 inches from the compressor) below 250°F (121°C)

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while functioning within the approve operating envelope of each compressor.

2. Traditional superheat settings at the TXVs may be too high to maintain the return gas temperature limits specified.
3. Suction lines should be well insulated.
4. Suction to liquid heat exchangers may not be desirable if return gas temperatures specified are to be maintained.
5. Minimum suction line pressure drops will be important to maintain saturated suction temperature limits at the compressor.
6. If operating condition can't be maintained per **Figure 5** (MT Envelope) with R448A, R449A and R407A the following recommendation should be followed:

- A 250°F (121°C) discharge line temperature cut out is required to be applied 6" from the compressor on the discharge line when applying R-448A and R449A refrigerants. Highly insulated suction lines from the evaporator to the compressor may be required to reduce superheat gains.
- Liquid line to suction line heat exchangers are not recommended.
- Low pressure control- Refer to **Table 3** for low pressure cut-out setting.

Use of R-22 Refrigerant

To avoid compressor reliability problems, all models will have restricted operating envelopes at low evaporating temperatures. The restrictions are listed below:

Table 1 Restricted Operating Conditions

Evaporator* Temp (ºF.)	Maximum Return Gas (ºF.)	Maximum Condensing Temp. (ºF.)
0	40	110
10	40	130

***SATURATED SUCTION TEMPERATURE AT THE COMPRESSOR SHOULD NOT FALL BELOW 0°F.**

Deep Vacuum Operation

WARNING

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.

Compressor Cycling

The largest stress on the compressor running gear is experienced during the compressor startup and shut down periods.

Reciprocating

In design, it must be noted that the inherent design of the spring suspension in reciprocating compressors has a finite life as with any spring suspension.

The ideal suggested compressor cycle rate for reciprocating compressors is a maximum of 12 cycles per hour. This includes a recommended off time between cycles of 10 seconds minimum. The recommended minimum run time from startup to shutdown is 5 minutes. For designs outside of these parameters it is suggested to contact the Application Engineering department for review and approval.

Cycle rate in relation to oil logging

Cycle rate also contributes to oil logging in the evaporator. Each time the compressor starts; there is a quick reduction in the suction pressure and therefore the crankcase pressure. The pressure drop causes a reduction in the saturation temperature, resulting in the oil-refrigerant mixture flashing into foam and vapor with the frequent result that a large percentage of the crankcase oil is pumped out of the compressor.

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If the compressor operates for sufficient time to stabilize the system, the oil will return to the compressor because the system was designed to minimize potential oil traps, but if the running period is very short, the oil may still be trapped in the system when the compressor cycles off. Under such conditions the compressor can operate without lubrication to the bearings, with the obvious potential for damage.

Starting Components

All of the capacitors should be “Heavy Duty Type I”. The starting capacitors should have a bleed resistor across them to extend the life of the relay. Increasing the starting capacitors voltage may also help to extend its operational life.

Electrical Connections

Single-phase motor wiring diagrams are shown in **Figure 9**, **Figure 10**, **Figure 11**.

It is recommended that insulated terminal connectors be used within the compressor's terminal box whenever possible. Ensure that the terminal connections do not interfere with the closing of the terminal box cover.

Terminal covers must be installed properly prior to energizing the compressor.

A molded plug electrical connection option is available on CS**K6E models. See **Figure 1** for a reference to this connections and **Table 11** for some details of available models with that option.

Motor Protection

Conventional internal line break motor protection is provided. The protector opens the common connection of a single-phase motor and the center of the Y connection on three-phase motors. The three-phase protector provides primary single-phase protection. Both types of protectors react to current and motor winding temperature.

IPR Valve

“CS” compressors have internal pressure relief valves which open when the suction to discharge pressure differential is between 450 to 550 psi.

This results in increased compressor current and protector ambient causing the protector to open and interrupt the power to the compressor.

High Potential (Hipot) Testing

See bulletin AE4-1294 for Megohm testing recommendations. Under no circumstances should the Hipot or Megohm test be performed while the compressor is under a vacuum.

Figure 1 Molded Plug Connector



Mounting

“CS” compressors are internally spring mounted to reduce vibrations. Resilient type mounts have been developed specifically for these compressors. The approved Copeland mounting kit part is **527-0044-08** for both 60 and 50 hertz applications.

Typical mounting assemblies are shown in **Figure 13** and **Figure 14**.

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Assembly Line Procedures

Pulling Plugs

All hermetic compressors are pressurized with 7 to 15 psi (.5-1 kg/cm2) of dry air before they leave the factory. The plugs that seal the compressors should not be removed until the compressor has had sufficient time to reach factory temperature, if stored in an unheated space, and is ready to be brazed into the system. If a compressor contains POE oil, it should not be open to the atmosphere longer than 5 minutes. The larger suction tube plug must be pulled first to relieve most of the pressure in the compressor.

Brazing Procedure

See **Section 20.5** for details related to the proper procedures for brazing the suction and discharge lines to a CS* compressor with a copper plated steel suction fitting. It is important to flow nitrogen through the system while brazing all joints during the system assembly process. Nitrogen displaces the air and prevents the formation of copper oxides in the system. If allowed to form, the copper oxide flakes can later be swept through the system and block screens such as those protecting capillary tubes, thermal expansion valves, and accumulator oil return holes. This can lead to a blockage of oil or refrigerant which in turn can cause damage to the system and compressor.

Unbrazing System Components



If the refrigerant charge is removed from a unit, the high and low side of the system must be evacuated. Refrigerant will not be able to cross the valve plate inside the compressor. If one side is not evacuated and a brazing torch is then applied, the pressurized refrigerant oil mixture could ignite as it escapes and contacts the brazing flame. It is important to check both the high and low sides with manifold gauges before unbrazing. For all un brazing process remove the refrigerant from both the high and low sides. Instructions should be provided in appropriate product literatures and assembly areas.

Service Procedures

Copeland Compressor Functional Check

The following diagnostic procedure should be used to evaluate whether a CS* compressor is functioning properly:

1. Proper voltage to the unit should be verified. Determine if the internal motor overload protector has opened or if an internal motor short or ground fault has developed. If the protector has opened, the compressor must be allowed to cool sufficiently to allow it to reset.
2. Check that the compressor is correctly wired.
3. Verify that no system safety devices are keeping the compressor off. Check that the condenser fan is properly working. With service gauges connected to suction and discharge pressure fittings, turn on the compressor. If suction pressure falls below normal levels the system is either low on charge or there is a flow blockage in the system.
4. To test if the compressor is pumping properly, the compressor current draw must be compared to published compressor performance curves using the operating pressures and voltage of the system. If the measured average current deviates more than ±15% from published values, a faulty compressor may be indicated. A current imbalance exceeding 15% of the average on the three phases of a three phase compressor should be investigated further. A more comprehensive trouble-shooting sequence for compressors and systems can be found in Section H of the Copeland Electrical Handbook, Form 6400.

Before Replacing or Returning a Compressor

Be certain that the compressor is actually defective. As a minimum, recheck a compressor for Hipot, winding resistance, and ability to start before returning to Copeland. More than one-third of compressors returned to

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Copeland for warranty analysis are determined to have nothing found wrong.

Compressor Replacement after Motor Burn

In the case of a motor burn, the majority of contaminated oil will be removed with the compressor. The rest of the oil is cleaned through use of suction and liquid line filter dryers. A 100% activated alumina suction filter drier is recommended but must be removed after 72 hours.

See AE24-1105 for cleanup procedures and AE11- 1297 for liquid line filter-drier recommendations. It is highly recommended that the suction accumulator be replaced if the system contains one. This is because the accumulator oil return orifice or screen may be plugged with debris or may become plugged shortly after a compressor failure. This will result in starvation of oil to the replacement compressor and a second failure.

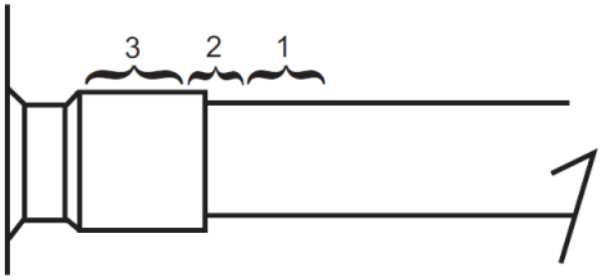
Start-up of a New or Replacement Compressor

It is good service practice, when charging a system, to charge liquid refrigerant into the high side only and charge the low side of the system with vapor only. Note that blended refrigerants should still be charged in a liquid state but an orifice or diffuser should be used to flash the refrigerant as it enters the suction line to prevent liquid refrigerant from returning to the compressor. It is not good for any compressor to have liquid refrigerant dumped from a refrigerant cylinder into the crankcase of the compressor. Do not start the compressor while the system is in a deep vacuum. Internal arcing may occur when a compressor is started in a vacuum. Do not operate compressor without enough system charge to maintain at least 7 psig (0.5 kg/cm2) suction pressure. Do not operate with a restricted suction. Do not operate with the low pressure cut-out disabled. Allowing suction pressure to drop below 7 psig (0.5 kg/cm2) for any length of time may overheat the compressor and cause early bearing and piston ring damage. Never install a system in the field and leave it unattended with no charge, a holding charge, or with the service valves closed without securely locking out the system. This will prevent unauthorized personnel from accidentally operating the system and potentially ruining the compressor with no refrigerant flow.

New Installation

- The copper-coated steel suction, discharge, on CS** compressors can be brazed in approximately the same manner as any copper tube.
- Recommended brazing material - Any Silfos material is recommended, preferably with a minimum of 5% silver. However, 0% silver is acceptable.
- Use of a dry nitrogen purge to eliminate possibility of carbon buildup on internal tube surfaces is recommended.
- Be sure process tube fitting I.D. and process tube O.D. are clean prior to assembly.
- Apply heat in Area 1. As tube approaches brazing temperature, move torch flame to Area 2. (See Figure 2.)
- Heat Area 2 until braze temperature is attained, moving torch up and down and rotating around tube as necessary to heat tube evenly. Add braze material to the joint while moving torch around circumference.
- After braze material flows around joint, move torch to heat Area 3. This will draw the braze material down into the joint. The time spent heating Area 3 should be minimal.
- As with any brazed joint, overheating may be detrimental to the final result.

Figure 2 Tube Brazing



Field Service

To disconnect:

- Recover refrigerant from both the high and low side of the system. Cut tubing near compressor.

To reconnect:

- Clean mating surfaces to be brazed and follow New Installation recommendation in **Section 20.5**.

General Guidelines and More Information

For general CS* Copeland compressor information please log in to Online Product Information at Copeland.com/OPI, refer to the Application Engineering bulletins listed below, or contact your Application Engineer

AE22-1182	**Liquid Refrigerant Control in Refrigeration and Air Conditioning Systems**
AE24-1105	**Principles of Cleaning Refrigeration Systems**
AE4-1294	**Megohm Values of Copeland Compressors**
AE11-1297	**Liquid Line Filter-Driers**
AE4-1421	**Application Guidelines for Copeland CS**KIE Compressors in Ice Machines**
Form 93-11	**Refrigerants and lubricants approved for use in Copeland compressors**

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Figure 3 CS Nomenclature*

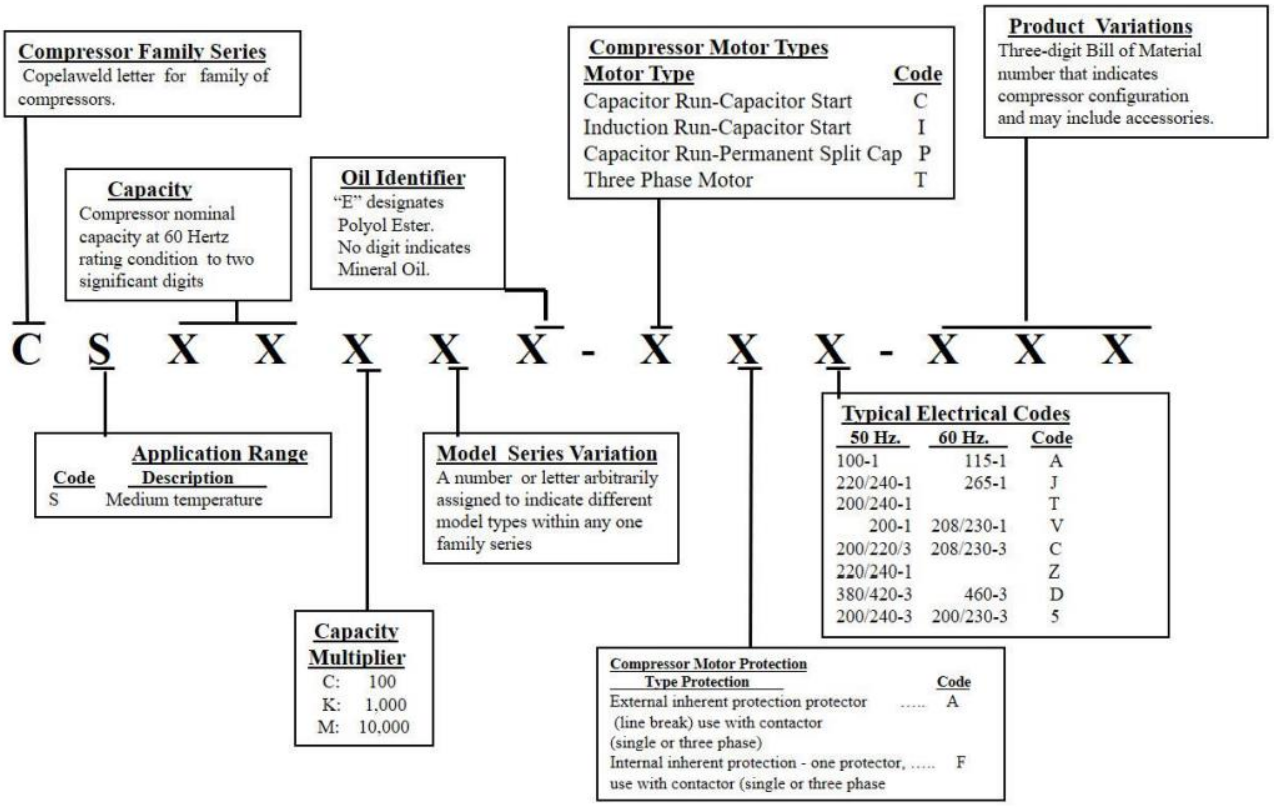


Table 2 Recommended Refrigerants and Oil

Refrigerant	Recommended Oil
R-22	Mineral Oil
R-134A	Polyolester Oil, POE-32
R-404A	
R-448A	
R-449A	
R-407A	
R-507	

Note: Refer to Form 93-11 for complete list of refrigerants and oils

Table 3 Minimum Recommended Low Pressure Control settings

Application	R-404A	R-507	R-134A	R-22	R-448A	R-449A	R-407A
Extended Medium Temp	10 psig Min	11 psig Min	N/A	N/A	N/A	N/A	N/A
Medium Temp	N/A	N/A	N/A	20 psig Min	13 psig Min	13 psig Min	12 psig Min
High Temp	28 psig	N/A	0 psig Min	N/A	N/A	N/A	N/A

Note: Based on the 5°F outside of the lowest point in the envelope at sea level and using vapor pressure readings.

Table 4 Spacer Mounting Assembly Kits

Standard Option	**527-0044-08 (See Figure 13)**
Only for: CS17K6E-PFV, CS24K*E-*, CS27K6E-***, CS33K6E-*****	**527-0044-00 (See Figure 14)**

Note: CSKIE" are optimized Ice Machine Models. See AE4-1421 for more details.**

Table 5 Single-Phase Electrical Parts Kit

Compressor Model	Start Capacitor		Run Capacitor		Relay	
	SERVICE	OEM	SERVICE	OEM	SERVICE	OEM
CS07KQE-PFV	914-0036-04	014-0061-28	914-0037-10	014-0064-06	940-0001-55	040-0166-15
CS07KQE-PFZ	914-0006-11	014-0006-16	914-0037-16	014-0064-12	940-0001-55	040-0166-15
CS10K6E-PFJ	914-0036-02	014-0061-26	914-0037-16	014-0064-12	940-0001-55	040-0166-15
CS10K6E-PFV	914-0008-51	014-0061-04	914-0037-17	014-0064-13	940-0001-60	040-0166-19
CS10KIE-PFV	914-0008-51	014-0061-04	914-0037-17	014-0064-13	940-0001-60	040-0166-19
CS12K6E-PFJ	914-0036-02	014-0061-26	914-0037-16	014-0064-12	940-0001-55	040-0166-15
CS12K6E-PFV	914-0008-51	014-0061-04	914-0037-11	014-0064-07	940-0001-60	040-0166-19
CS12KIE-PFV	914-0008-51	014-0061-04	914-0037-11	014-0064-07	940-0001-60	040-0166-19
CS13K6E-PFV	914-0006-03	014-0006-13	914-0037-17	014-0064-13	940-0001-55	040-0166-15
CS13K6E-PFZ	914-0006-03	014-0006-13	914-0037-17	014-0064-13	940-0001-55	040-0166-15
CS14K6E-PFJ	914-0008-51	014-0061-04	914-0037-17	014-0064-13	940-0001-60	040-0166-19
CS14K6E-PFV	914-0036-04	014-0061-28	914-0037-11	014-0064-07	940-0001-55	040-0166-15
	914-0008-70	014-0061-16	914-0037-36	014-0064-25		
CS14KIE-PFV	914-0036-04	014-0061-28	914-0037-36	014-0064-25	940-0001-55	040-0166-15
CS16K6E-PFV	914-0006-03	014-0006-13	914-0037-17	014-0064-13	940-0001-55	040-0166-15
CS16K6E-PFZ	914-0006-03	014-0006-13	914-0037-17	014-0064-13	940-0001-55	040-0166-15
CS16KIE-PFV	914-0006-03	014-0006-13	914-0037-12	014-0064-08	940-0001-55	040-0166-15
CS17K6E-PFV	914-0036-03	014-0061-27	914-0037-17	014-0064-13	940-0001-54	040-0166-14
CS18K6E-PFJ	914-0036-04	014-0061-28	914-0037-18	014-0064-14	940-0001-55	040-0166-15
CS18K6E-PFV	914-0036-04	014-0061-28	914-0037-12	014-0064-08	940-0001-55	040-0166-15
CS18KIE-PFV	914-0036-04	014-0061-28	914-0037-12	014-0064-08	940-0001-55	040-0166-15
CS20K6E-PFV	914-0006-03	014-0006-13	914-0037-12	014-0064-08	940-0001-55	040-0166-15
CS20K6E-PFZ	914-0006-09	014-0006-14	914-0037-12	014-0064-08	940-0001-54	040-0166-14
CS20KIE-PFV	914-0006-03	014-0006-13	914-0037-36	014-0064-25	940-0001-55	040-0166-15
CS24K6E-PFV	914-0006-03	014-0006-13	914-0037-18	014-0064-14	940-0001-64	040-0166-23
CS24KIE-PFV	914-0006-03	014-0006-13	914-0037-18	014-0064-14	940-0001-64	040-0166-23
CS27K6E-PFV	914-0006-03	014-0006-13	914-0037-18	014-0064-14	940-0001-64	040-0166-23
CS27K6E-PFZ	914-0006-03	014-0006-13	914-0037-37	014-0064-26	940-0001-60	040-0166-19
CS33K6E-PFV	914-0006-10	014-0006-15	914-0037-21	014-0064-17	940-0001-68	040-0166-27

Note: CSKIE" are optimized Ice Machine Models. See AE4-1421 for more details.**

Table 6 Run Capacitor Kits details

Run Capacitor		
SERVICE	**OEM**	**Features**
914-0037-10	014-0064-06	RUN CAP KIT W/CLAMP
914-0037-11	014-0064-07	RUN CAP KIT W/CLAMP
914-0037-12	014-0064-08	RUN CAP KIT W/CLAMP
914-0037-16	014-0064-12	RUN CAP KIT W/CLAMP
914-0037-17	014-0064-13	RUN CAP KIT W/CLAMP
914-0037-18	014-0064-14	RUN CAP KIT W/CLAMP
914-0037-21	014-0064-17	RUN CAP KIT
914-0037-36	014-0064-25	RUN CAP KIT
914-0037-37	014-0064-26	RUN CAP KIT

Table 7 Compressors Crankcase Heater Kits

Compressor Model	SERVICE	OEM
CSK*E-PFJ /-PFV / -PFZ / -TF5**	918-0088-00	018-0088-00
CSK6E-TFD**	918-0088-01	018-0088-01
CS07KQE-PFV / -PFZ / -TF5	918-0088-02	

Table 8 Crankcase Heater Kits description

SERVICE	OEM	Description
918-0088-00	018-0088-00	Kit 40/49W, for 240Vac applications
918-0088-01	018-0088-01	Kit 40W, for 480Vac applications
918-0088-02	-	Kit 58W, for 240Vac
918-0088-03	-	Kit for 50W, for 480Vac

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Table 9 Retainer Heater Part Kits

Standard	032-0463-00
Only for CS16K6E-PFZ model	032-0323-00

Table 10 Terminal Kit Details (Grounding Screw)

Terminal Kit
521-0192-00

Table 11 Compressor Models with Molded Plug option available

Compressor Models		
CS10K6E-PFJ	CS13K6E-TF5	CS18K6E-PFV
CS10K6E-PFV	CS14K6E-PFJ	CS18K6E-TF5
CS10K6E-TF5	CS14K6E-PFV	CS20K6E-PFV
CS12K6E-PFJ	CS14K6E-TF5	CS20K6E-PFZ
CS12K6E-PFV	CS16K6E-PFV	CS20K6E-TF5
CS12K6E-TF5	CS16K6E-PFZ	CS24K6E-PFV
CS13K6E-PFV	CS16K6E-TF5	CS24K6E-PFZ
CS13K6E-PFZ	CS18K6E-PFJ	CS24K6E-TF5

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Figure 4 Medium Temperature Operation Map (R-22)

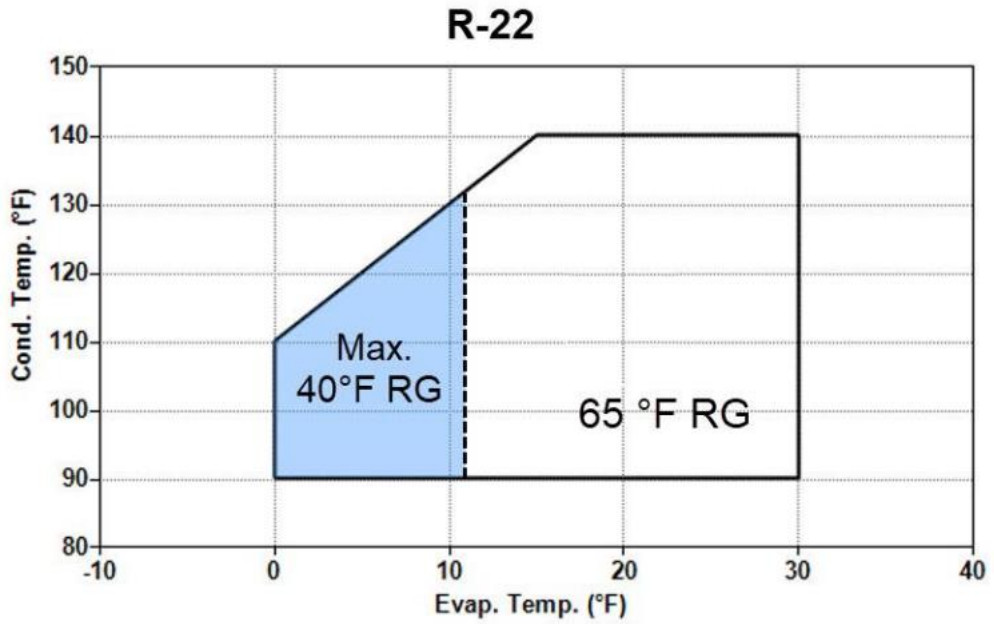


Figure 5 Medium Temperature Operation Map (R-448A / R-449A / R-407A)

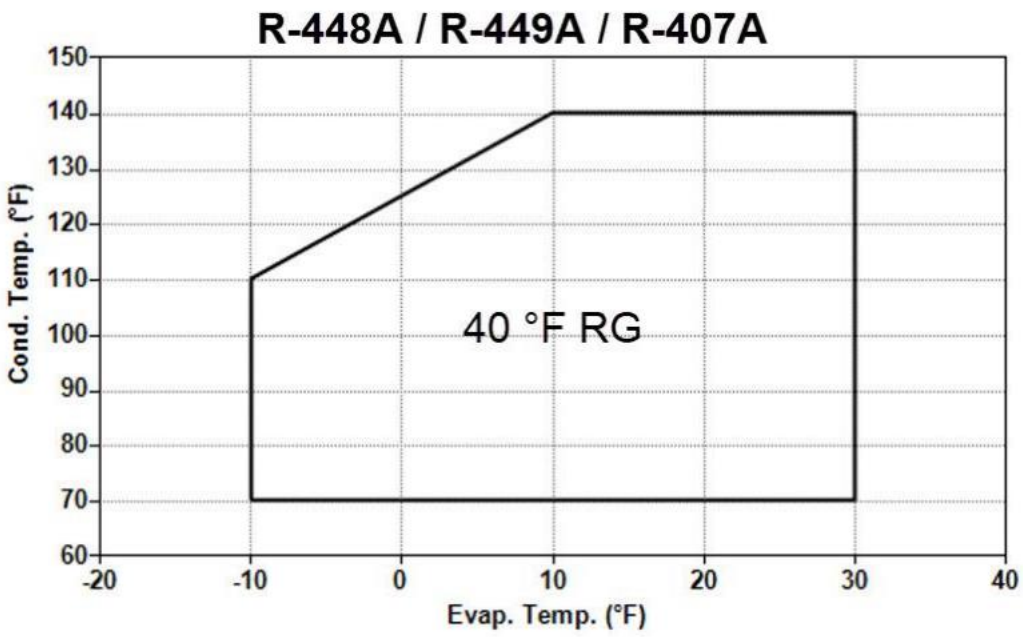


Figure 6 Extended Medium Temperature Operation Map (R-404A and R-507)

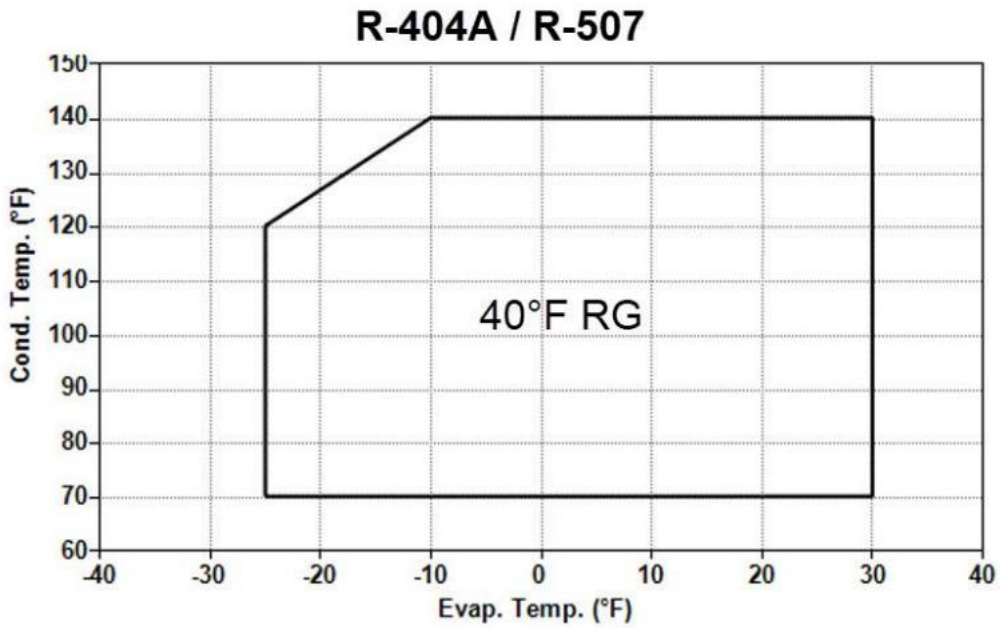


Figure 7 High Temperature Operation Map (R-134a)

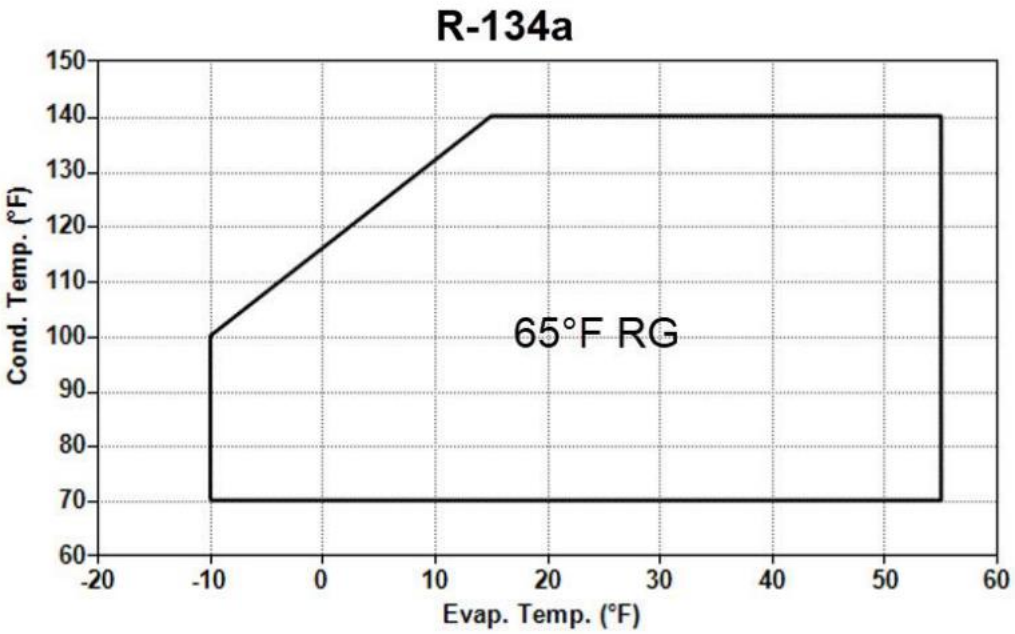


Figure 8 High Temperature Operation Map (R-404A)

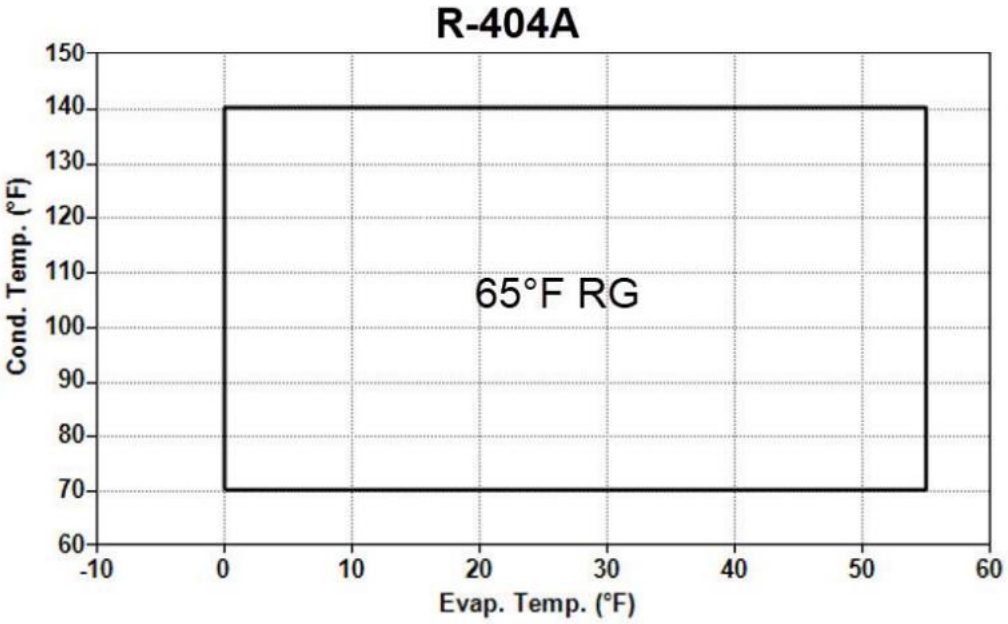


Figure 9 Capacitor Start – Capacitor Run Motor (CSCR)

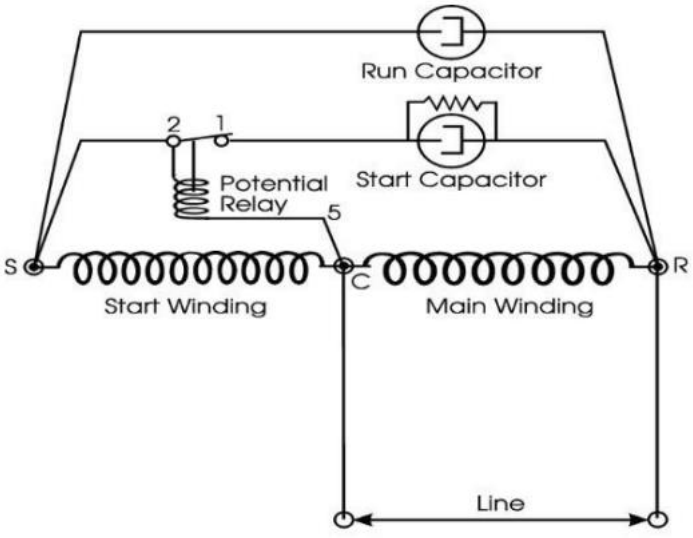


Figure 10 Capacitor Start – Induction Run Motor

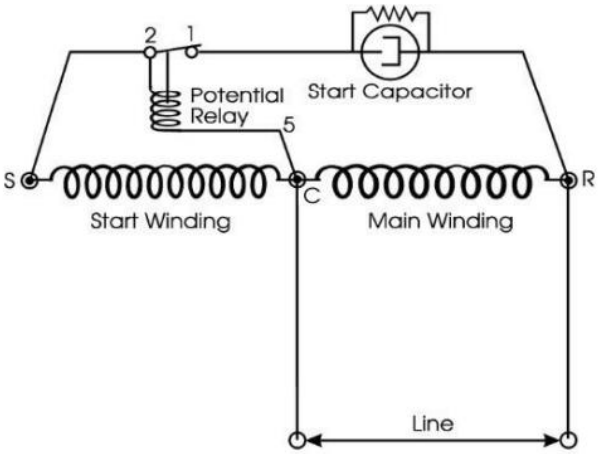


Figure 11 Permanent Split Capacitor Motor (PSC)

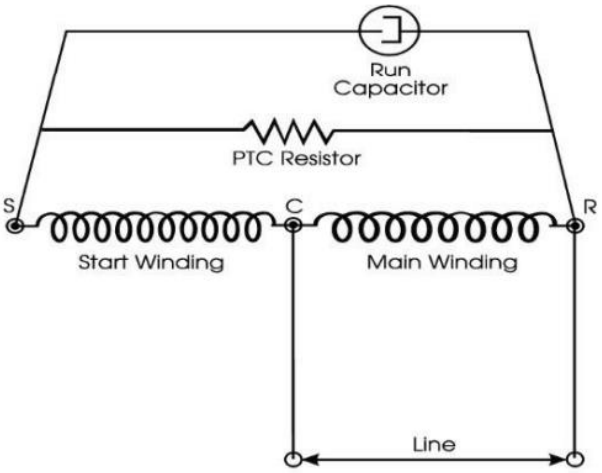


Figure 12 CS Compressor



Figure 13 Spacer Mounting Kit # 527-0044-08

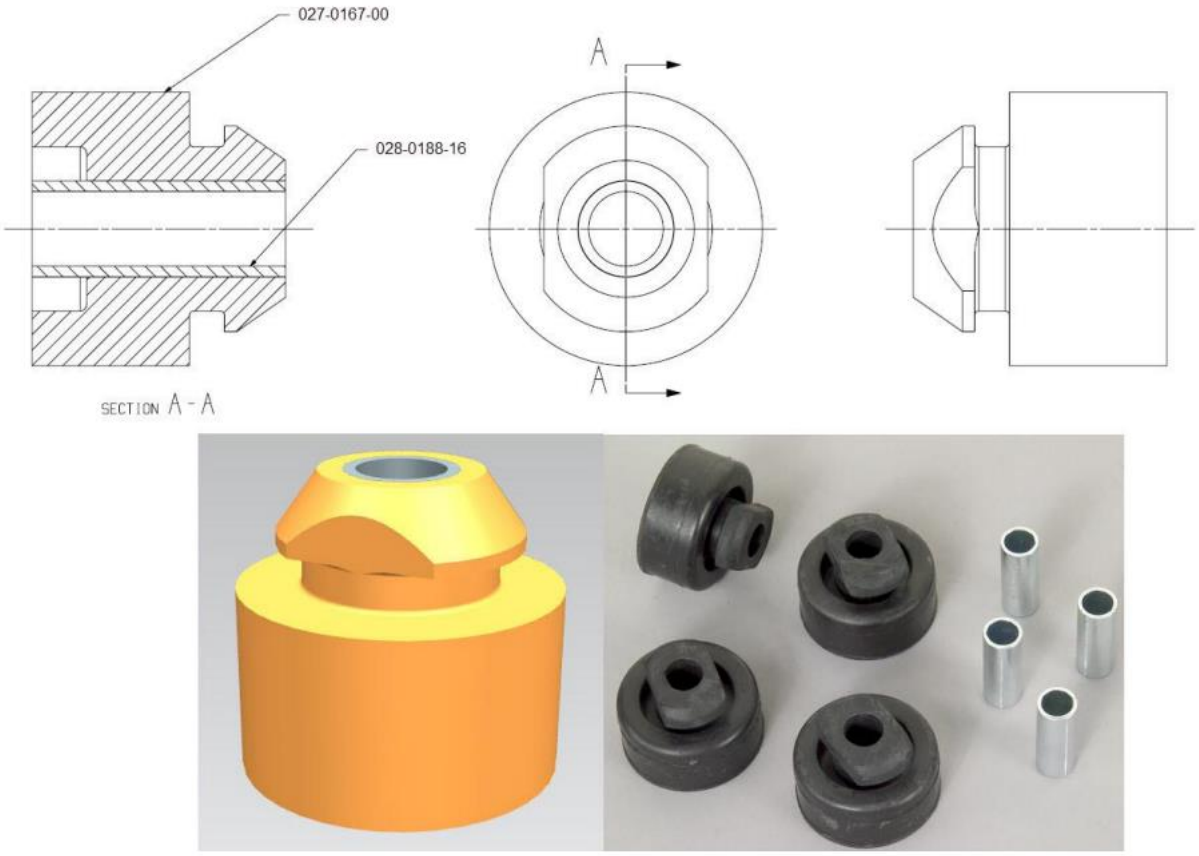


Figure 14 Spacer Mounting Kit # 527-0044-00

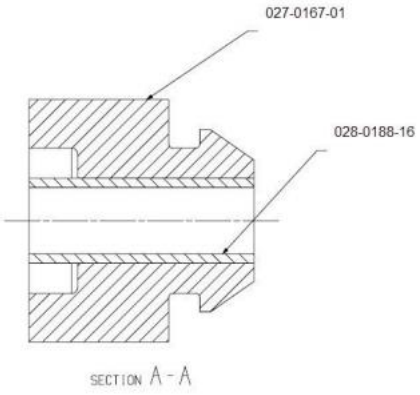
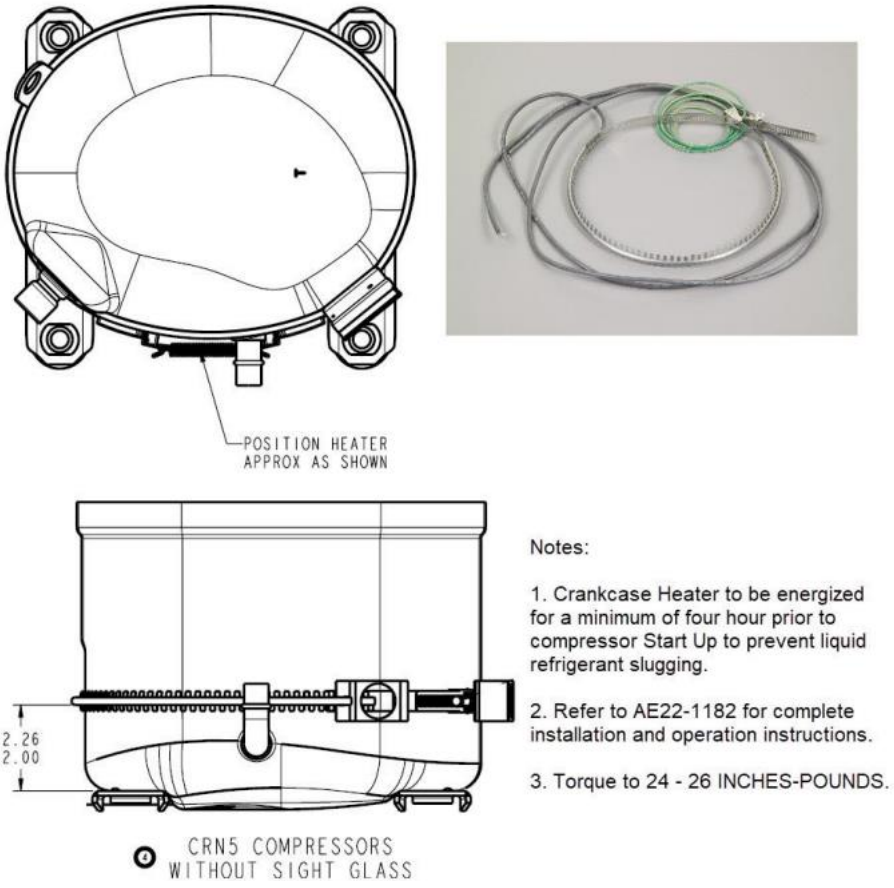


Figure 15 Crankcase position



Revision Tracking R3

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

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