Application Engineering

*Application Guidelines for ZS**KAE and YS**KAE Refrigeration Copeland Compressors 1.3-4.5 HP*

BULLETIN NO: AE4-1387 R11

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

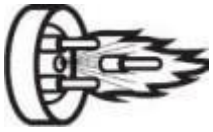
• OEMs are responsible for system design, selection of appropriate components, integration of this component into the system, and testing the system. OEMs must ensure that staff involved in these activities are competent and qualified.

• 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.

Servicing Best Practices: Installation and Repair

Compared to installing or repairing A1 refrigerant-based systems, A2Ls introduce three new required steps. However, these are all considered industry-accepted best practices for A1s. So, for those already performing these steps, you will notice little change to your standard procedures.

Requirement	A1	A2L	A2 & A3	Comments
Safely Remove Refrigerant Following Local and National Codes	Required	Required	Required	EPA rule 608, which Requires Recovery Except for Natural Refrigerants
Purge Circuit with Inert Gas (Oxygen Free Nitrogen)	Not Required	Required	Required	Initial Purge
Evacuate System	Not Required	Required	Required	Insure Outlet of Vacuum Pump is not Near Ignition Source
Purge with Inert Gas for 5 minutes (Oxygen Free Nitrogen)	Not Required	Best Practice	Required	Second Purge
Evacuate System Again	Not Required	Best Practice	Required	
Open Circuit by Cutting or Brazing	Final Step	Final Step	Final Step	Final Repair Preparation. Minimize Time that System is Open to Atmosphere.
Repair the System. Purge with Nitrogen when Brazing.	Required	Required	Required	
Leak Test and Pressure Test the System	Best Practice	Required	Required	
Evacuate the System	Required	Required	Required	Follow Industry Best Practices for Evacuation.
Charge the System	Required	Required	Required	Follow Industry Best Practices for Charging and Equipment Manufacturer's Recommendations.

Table 1 - A2L Best Servicing Practices

Standard repair procedures of A2L systems. *Note that purging, evacuation and leak/pressure tests will be required with A2L repairs/installations*

A2L Servicing Tools

Installation and service tools are also similar to those used for A1s. However, it's important to select "A2L- compatible" equipment where specified.

Tool (versus A1 R-404A)	A2L Requirement
Gauges	Use A2L- Compatible
Gauge Manifold	Right-handed (RH) threads (based on equipment service ports)
Charging Hose	RH Threads
Refrigerant recovery cylinder	Flammable label, left-handed (LH) threads
Vacuum Pump	Check with manufacturer to see if A2L-compatible (switch located away from work zone)
Recovery machines	Use A2L- Compatible
Gas detectors	Use A2L- Compatible
Electronic leak detectors	Use A2L- Compatible
Scales	No Change
Ventilation fan	Similar
Electrical Hand Tools	Use non-sparking (AHRI - 8017)
Dry Chemical / CO2 fire extinguisher	Use chemical-compatible option

Table 2 - A2L Servicing Tools

Required tools for A2L systems. While similar tools will be needed to service A2L systems, be sure to use A2L- compatible equipment when applicable.

A2L Servicing Best Practices (Copeland.com)

Introduction

The ZS**KAE and YS**KAE Copeland Scroll™ compressor represents the latest generation of compliant scroll technology for the refrigeration industry.

Nomenclature

The refrigeration scroll model numbers include the nominal capacity at standard 60HZ ARI rating conditions for medium temperature (20/120ºF). For additional information on this product, please refer to the Online Product Information accessible on Copeland.com/OPI.

Z = Scroll A1 Refrigerant

Y = Scroll A1 / A2L Refrigerant

S = Extended Medium Temperature Application

09K = nominal Capacity (x 1,000 Btu/hr)

A = Compressor Generation

E = POE Oil

Operating Envelope

The ZS**KAE and YS**KAE refrigeration scroll compressor models can be used with a variety of refrigerants depending on the model selected and the lubricant used. (See Table 3.) The ZS**KAE models are intended for extended medium and high temperature refrigeration type duty. YS**KAE models are approved for A1 / A2L refrigerants (See Table 3.) The approved operating envelopes for these models are such that they are ideally suited for applications such as ice machines, bulk milk and frozen carbonated beverage/frozen uncarbonated beverage. The models and operating envelopes are depicted in Figures on pages 16 and 17.

Application considerations

Accumulators

Due to the scrolls' inherent ability to handle liquid refrigerant in flooded start and defrost cycle operation conditions, accumulators may not be required. An accumulator is required on single compressor systems when the charge limitations exceed those values listed in Table 4. On systems with defrost 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.

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.

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 (11K) superheat, measured on the suction line 6 inches (152mm) from the suction valve, to prevent liquid refrigerant flood back.

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 (27K). 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 (27K), 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 (14K) difference.

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

Crankcase Heaters

Crankcase heaters are required on all ZS**KAE and YS**KAE scroll compressors where the system charge exceeds charge limit.

The listed crankcase heaters are intended for use only when there is limited access (See Table 5). The heaters are not equipped for use with electrical conduit. Where applicable, electrical safety codes require lead protection, a crankcase heater terminal box should be used. Recommended crankcase heater terminal box and cover kit numbers are listed in Table 6. If there are any questions concerning their application, contact your Copeland representative.

Discharge Line Thermostat

Figure 3 to 6 on pages 16 and 17 show the operating maps based on refrigerant for the ZS**KAE and YS**KAE scroll. Operation beyond these limits can cause high compression ratios or excessive internal compressor temperatures. This will result in overheating the scroll members, causing excessive wear resulting in premature compressor failure.

If the system is designed where operation within these guidelines cannot be guaranteed, then a discharge line thermostat is required in the compressor control circuit.

When installed approximately 6 inches from the discharge tube outlet, the thermostats have a cut-out setting that will ensure the external discharge line temperature does not exceed the 260°F limit. If a Rotalock service valve is installed on the discharge port connection, the thermostat should be located approximately 5 inches from the valve braze connection.

Kits have been set up to include the thermostat, retainer, and installation instructions. These thermostats must be used with ½" O.D. discharge lines to ensure proper thermal transfer and temperature control. They work with either 120 or 240-volt control circuits and are available with or without an alarm circuit capability. See Table 7 for a list of discharge line thermostat kit numbers.

Pressure Controls

Both high and low-pressure controls are required on all models. See Table 8 for set points.

Pump Down Recommendations

All the ZS**KAE and YS**KAE scrolls have an internal spring loaded low-leak discharge check valve suitable for pump down application. This valve prevents system pressures from equalizing and pump down can be achieved. However, during laboratory testing, we have observed a potential short cycling condition on the ZS09KAE through ZS33KAE models. This phenomenon can be attributed to 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 8. 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 3-minute time delay will limit the cycling of the compressor to an acceptable level.

IPR Valve

Refrigeration scroll compressors (1.3 - 4.5 hp) ZS09-33KAE and YS09-30KAE have internal pressure relief valves, which open at a discharge to suction differential pressure of 375 to 450 psi. This action will trip the motor protector and remove the motor from the line.

Internal Temperature Protection

Refrigeration scroll compressors (1.3 - 4.5 hp) ZS09-33KAE and YS09-30KAE with date codes prior to the 23I (September 2023) serial number incorporate a thermo-disc which is a temperature-sensitive snap disc device located at the muffler plate port. It is designed to open and route hot discharge gas back to the motor protector thus removing the compressor from the line. Compressors with serial numbers starting with 23I (September 2023) will no longer incorporate the TOD.

Motor Protection

Conventional inherent internal line break motor protection is provided.

Oil Types

Polyol ester lubricants must be provided if the scroll compressor is to be used with HFC refrigerants.

See Form 93-11 for a complete list of all Copeland approved lubricants

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.

Oil Charges

The recommended oil charges for these compressors are shown in Table 9.

Compressor Tubing and Mounting

Compressor mounting must be selected based on application. Consideration must be given to sound reduction and tubing reliability. Some tubing geometries or “Shock loops” may be required to reduce vibration transferred from the compressor to external tubing.

Starting Characteristics

Single-phase scroll compressors are designed with permanent split capacitor (PSC) type motors and therefore will start without the need of start assist devices in most applications, see Figure 10. However, if low voltage conditions exist at start up, protector trips can result.

Therefore, start assist devices (start capacitors and relays) are available to maximize starting characteristics under abnormal conditions, see Figure 7 for more details. See Table 11 for voltage ranges.

Fusite

Fusite pin molded orientation for single-phase and three-phase refrigeration scroll compressors are shown in Figure 13.

Shell Temperature

System component failure may cause the top shell and discharge line to briefly reach temperatures above 300°F. Wiring or other materials, which could be damaged by these temperatures, should not come in contact with the shell.

Connection Fittings

Scroll compressors are provided only with sweat connections. (Consult your Copeland representative for details).

See section on New Installation for suggestions on how to properly braze these fittings.

Three-Phase Rotation Direction

Scroll compressors are directional dependent: i.e., they will compress in one rotational direction only. On single- phase compressors, this is not an issue since they will only start

and run in the proper direction (except as described in the Labeled Brief Power Interruptions). Three-phase scrolls, however, will rotate in either direction depending on the power of the phasing so there is a 50/50 chance of connected power being “backwards.” Contractors should be warned of this. Appropriate instructions or notices should be provided by the Original Equipment Manufacturer.

Verification of proper rotation can be made by observing that the suction pressure drops, and the discharge pressure rises when the compressor is energized. Additionally, if operated in reverse the compressor is noisier and its current draw is substantially reduced compared to tabulated values.

Although operation of scroll in reverse direction for brief periods of time is not harmful, continued operation could result in failure.

All three-phase compressors are wired identically internally. Once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the same fusite terminals will maintain the proper rotation.

Brief Power Interruptions

Brief power interruptions (less than ½ second) may result in powered reverse rotation of single-phase refrigeration scroll compressors. High-pressure discharge gas expands backward through the scrolls at power interruption causing the scroll to orbit in the reverse direction. If power is reapplied while this reversal is occurring, the compressor may continue to run noisily in the reverse direction for several minutes until the compressor internal protector trips. This has no negative effect on durability. When the protector resets, the compressor will start and run normally.

Copeland strongly encourages the use of a timer which can sense brief power interruptions and lock the compressor out of operation for two minutes. A typical timer circuit is shown in Figure 14.

No time delay is required on three phase models to prevent reverse rotation due to power interruptions.

Deep Vacuum Operation

Do not run a refrigeration scroll compressor in a deep vacuum. Failure to heed this advice can result in permanent damage to the compressor.

A low-pressure control is required for protection against deep vacuum operation. See the section on pressure controls for the proper set points. (See Table 8)

Scroll compressors (as with any refrigeration compressor) should never be used to evacuate refrigeration or air conditioning systems. See AE-1105 for proper system evacuation procedures.

*ZS**KAE COMPRESSORS IN COPELAND™ CONDENSING UNITS*

The new FFAP Copeland condensing units will offer the latest technology utilizing the efficient ZS**KAE scroll product along with incorporating the Copeland Electronic Unit Controller (EUC) on all models.

In Table 10 are the approved refrigerants along with the minimum operating temperature ranges based on the refrigerants applied.

Performance data along with the applicable nomenclature information can be found on Copeland.com/OPI.

Features

All condensing units come equipped from the factory with the Electronic Unit Controller. The controller has a minimum low-pressure cutout setting of 0 psig. See Table 8 for the recommended pressure control settings based on refrigerant.

Condensing Unit Mounting

For 1.3 - 4.5 H.P. refrigeration scroll condensing unit applications, soft mounts are recommended. See Figure 10 and Figure 11.

Bump Start Protection

The bump start function has been enabled in the EUC so whenever power is applied or re-applied to the unit the system will energize the compressor for 2 seconds on and 5 seconds off. This will occur for 3 cycles, and then continuous power will be supplied to the system for normal operation.

Brief Power Interruptions

As part of the EUC control, a two-minute time delay has been programmed into the controller on all condensing units which will sense a brief power interruption and lock the compressor / unit out of operation for two minutes.

Headmaster Refrigerant Selection Instructions

Incorporated into the SINGLE FAN FFAP condensing unit is a dual pressure setting headmaster which will allow for the unit to operate in low ambient conditions with the approved refrigerants outlined in Table 3. Please follow the instructions provided below after the refrigerant selection is made, failure to do so will cause the system to operate outside of its approved compressor operating envelope.

The Headmaster Control Valve has a dual pressure setting feature which allows a choice between two fixed settings; The DS element has an internal spring which is set to maintain the lower setting. The element is then charged with air to obtain the higher setting (180 psig) and the capillary tube is pinched and fused. If the capillary tube is left intact, the valve will maintain a 180- psig setting. If the capillary tube is clipped and fused again, the valve will maintain a 100-psig setting.

It is important to fuse the capillary tube tip after clipping to prevent moisture from entering the element.

Tubing Considerations - Proper tube design must be taken into consideration when designing the tubing connecting the scroll to the remaining system. The tubing should provide enough “flexibility” to allow normal starting and stopping of the compressor without exerting excessive stress on the tube joints. In addition, it is desirable to design tubing with a natural frequency away from the normal running frequency of the compressor. Failure to do this can result in tube resonance and unacceptable tubing life. Figure 12 shows examples of acceptable tubing configurations.

These examples are intended only as guidelines to depict the need for flexibility in tube designs. In order to properly determine if a design is appropriate for a given application, samples should be tested and evaluated for stress under various conditions of use including voltage, frequency, and load fluctuations, and shipping vibration. The guidelines above may be helpful; however, testing should be performed for each system designed.

Rack Applications

ZS**KAE and YS**KAE Compressors are not approved for rack or parallel applications because the compressors do not have sight glasses and cannot be equipped with oil equalization devices.

Assembly Line Procedures

Unbrazing System Components

CAUTION

If the refrigerant charge is removed from a scroll unit by bleeding the high side only, it is sometimes possible for the scrolls to seal, preventing pressure equalization through the compressor. This may leave the low side shell and suction line tubing pressurized. If a brazing torch is then applied to the low side, 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. In the case of an assembly line repair, remove the refrigerant from both the high and low sides. Instructions should be provided in appropriate product literatures and assembly areas.

High Potential (Hipot) Testing

Many of the Copeland brand compressors are configured with the motor below the compressor. As a result, when liquid refrigerant is within the compressor shell the motor can be immersed in liquid refrigerant to a greater extent than with compressors with the motor mounted above the compressor. When Copeland brand compressors are Hipot tested and liquid refrigerant is in the shell, they can show higher levels of leakage current than compressors with the motor on top because of the higher electrical conductivity of liquid refrigerant than refrigerant vapor and oil. This phenomenon can occur with any compressor when the motor is immersed in refrigerant. The level of current leakage does not present any safety issue. To lower the current leakage reading, the system should be operated for a brief period to redistribute the refrigerant to a more normal amount before performing Hipot test again. 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.

Service procedures

Copeland Scroll Functional Check

Refrigeration scroll compressors do not have internal suction valves. It is not necessary to perform functional compressor tests to check how low the compressor will pull suction pressure. This type of test may damage a scroll compressor. The following diagnostic procedure should be used to evaluate whether a Copeland Scroll compressor is functioning properly.

1. Verify proper unit voltage.
2. Normal motor winding continuity and short to ground checks will determine if the inherent overload motor protector has opened or if an internal short to ground has developed. If the protector has opened, the compressor must cool sufficiently to reset.
3. 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.
4. Check for:
   a. Single-Phase Compressors

      If the suction pressure does not drop and the discharge pressure does not rise to normal levels the compressor is faulty.

   b. Three-Phase Compressors

      If the suction pressure does not drop and the discharge pressure does not rise, reverse any two of the compressor power leads and reapply power to make sure the compressor was not wired to run in the reverse direction.

The compressor current draw must be compared to published compressor performance curves at the compressor operating conditions (pressures and voltages). Significant deviations (±15%) from published values may indicate a faulty compressor.

NOTICE

Note that the ZS09-20KAE and YS09-19KAE- (TFD, TFE, TF7, TF5) three phase motors use a modified "Scott-T" connection and don't have equal resistance on all three windings. Two windings will have equal resistances and the third winding will be lower than the other two. See Figure 1. Carefully compare measured motor resistance values to the two different published resistance values for a given compressor model before replacing the compressor as being defective. Due to the nature of the Scott-T construction there is an inherent current imbalance in the motors that is much larger than what is seen in a standard 3-phase motor. Effectively you will have two terminals drawing similar currents while the third will draw a higher current. The current draw on the Scott -T motors as shown in the performance data and in the operating envelope (available online at Copeland.com/OPI) comes from the 2 main windings. The larger ZS21-33KAE and YS21-30KAE compressors have conventional three-phase motors with equal resistances in each winding.

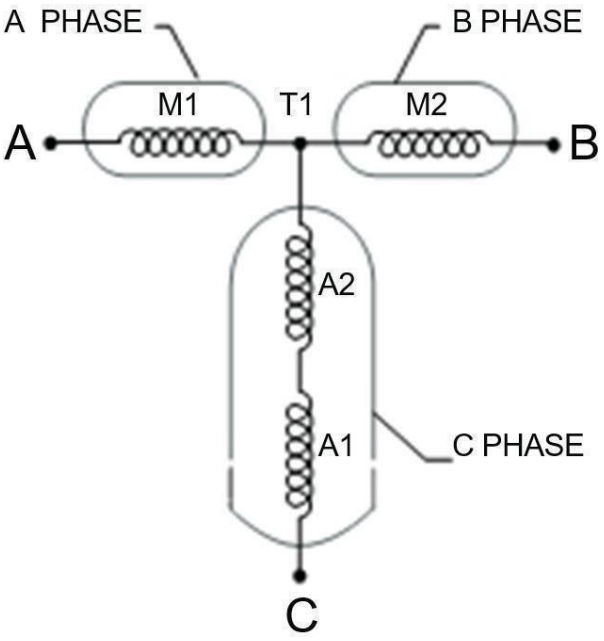


Figure 1 - Scott-Tee Three Phase

New Installation

- The copper-coated steel suction, discharge, and injection tubes on scroll 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 result.

Field Service

To Disconnect:

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

To Reconnect:

- Recommended brazing materials - Silfos® with minimum 5% silver or silver braze material with flux.
- Reinsert tubing fitting.
- Heat tube uniformly in Area 1, moving slowly to Area
  2. When joint reaches brazing temperature, apply brazing material. (See Figure 2)
- Heat joint uniformly around the circumference to flow braze material completely around the joint.
- Slowly move torch in Area 3 to draw braze material into the joint.

Do not overheat joint.

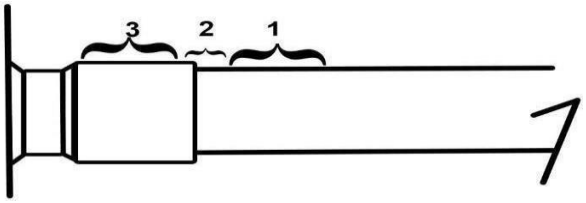


Figure 2 - Scroll Tube Brazing

General Guidelines and More

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

AE4-1294	**Megohm Values of Copeland® Compressors**
AE24-1105	**Principles of Cleaning Refrigeration Systems**
Form 93-11	**Refrigerants and lubricants approved for use in Copeland™ compressors**

Figures & tables

Model	HP	Refrigerant	Lubricant
ZS09KAE	1.3	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS11KAE	1.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS13KAE	1.9	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS15KAE	2.1	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS19KAE	2.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS20KAE	3	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS21KAE	3.2	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS26KAE	3.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS29KAE	4	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
ZS33KAE	4.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A	POE
YS09KAE	1.3	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS11KAE	1.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS12KAE	1.9	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS14KAE	2.1	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS16KAE	2.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS19KAE	3	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS21KAE	3.2	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS24KAE	3.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS26KAE	4	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE
YS30KAE	4.5	R-22/R-404A/R-507/R-134a/R-407A/R-407C/R-448A/R-449A R-454A/R-454C/R-455A	POE

Table 3 - Compressor Models and Approved Refrigerants/Lubricants

See Copeland Form 93-11 for a complete list of all Copeland approved lubricants.

Model Family	Charge Limits
ZS09, 11, 13, 15, 19, 20KAE	8 lbs.
ZS21, 26, 29, 33KAE	10 lbs.

Table 4 - Charge Limitations

Model	Part No.	Volts	Watts	Length (in.)
ZS09, 11, 13, 15, 19, 20KAE YS09, 11, 12, 14, 16, 19KAE	018-0094-00	240	40	21
	018-0094-01	120	40	21
	018-0094-03	480	40	21
ZS21, 26, 29, 33KAE YS21, 24, 26, 30KAE	018-0095-04	240	70	48
	018-0095-05	480	70	48
	018-0095-06	575	70	48
	018-0095-07	120	70	48

Table 5 - Crankcase Heater

Model Number	Kit Number
ZS09-20KAE YS09-19KAE	998-0358-00
ZS21-33KAE YS21-30KAE	998-7026-00

Table 6 - Conduit Ready Heater Terminal Box Kits -

Kit Number	Conduit Lead Connector	Alarm Contact
998-0540-00	NO	NO
998-0548-00	NO	YES
998-7022-02	YES	NO

Table 7 - Discharge Thermostat Line Kits

Table 8 - Pressure Control Settings

Model Type	Pressure Control	R-404A/ R-507	R-134a	R-22	R-407A/ R-448A/R-449A	R-407C
ZS*KAE YS*KAE	Low	8 PSIG min	4 PSIG min.	17 PSIG min	6 PSIG min	1in Hg min.
	High	450 PSIG max	340 PSIG max.	425 PSIG max.	428 PSIG max.	425 PSIG max.

Model Type	Pressure Control	R454A R454C R455A
YS*KAE	Low	3 PSIG min.
	High	406 PSIG max.

Model Family	Initial	Recharge	Frame Size
ZS09-20KAE YS09-19KAE	25	19	53
ZS21-33KAE YS21-30KAE	42	34	63

Table 9 - Recommended Oil Charges by Model Family

Refrigerant	Extended Medium Temp (-30 F to 25 F)	Medium Temp (0 F to 25 F)	High Temp (25 F to 45 F)
R-22		X	X
R-407C		X	X
R-404A	X		X
R-134a		X	X
R-407A			X

*Table 10 - FFAP Condensing Unit Operating Envelopes ZS**KAE*

Voltage	60 Hertz Rating			50 Hertz Rating		
Code	Rating	Min.	Max.	Rating	Min.	Max.
C	208/230-3	187	253	200-3	180	220
D	460-3	414	506	380/420-3	342	462
E	575-3	518	633	500-3	450	550
V	208/230-1	197	253	200-1	180	220
V*	208/230-1	187	253	200-1	180	220
5	200/230-3	180	253	200/220-3	180	242
7	380-3	342	418	X	X	X
J	265-1	239	292	220/240-1	198	264
R	X	X	X	220/240-3	180	264

Table 11 - Voltage Ranges (Typical)

*** The typical voltage range is (+/-) 10 % from rated voltage with the exemption of the 208/230 dual rated **V models which are -5% +10% (197 min to 253 max voltage) from nominal as shown in the above table. The following ZS**KAE models are now approved to operate within the full (+/-)10% range with a minimal voltage of 187 and a maximum voltage of 253 (ZS09,11,13,15,19, 20, 21, 26KAE-PFV and YS09, 11, 12, 14, 16, 19, 21, 24KAE-PFV). The following models are not qualified to the full (+/-) 10% at this time, ZS29KAE-PFV and ZS33KAE-PFV and YS26KAE-PFV and YS30KAE-PFV.**

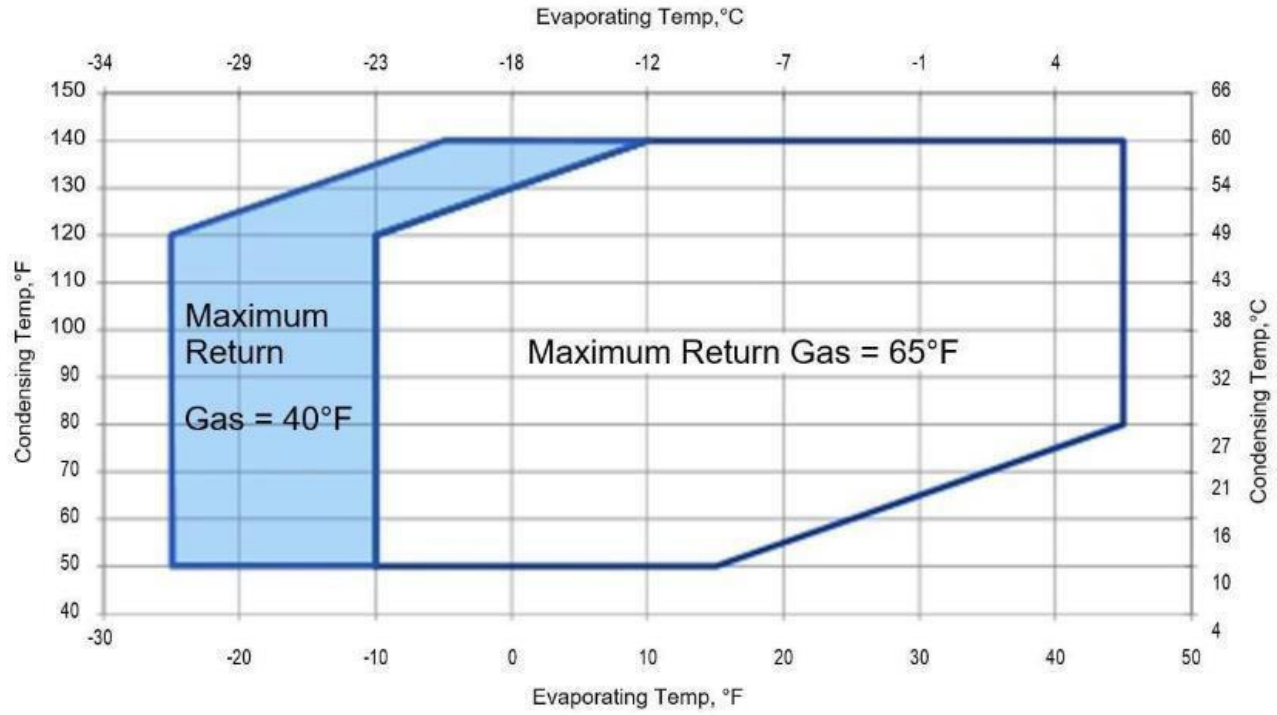


*Figure 3 - ZS*KAE and YS*KAE Application Envelope for R-404A/R-507 (Extended*

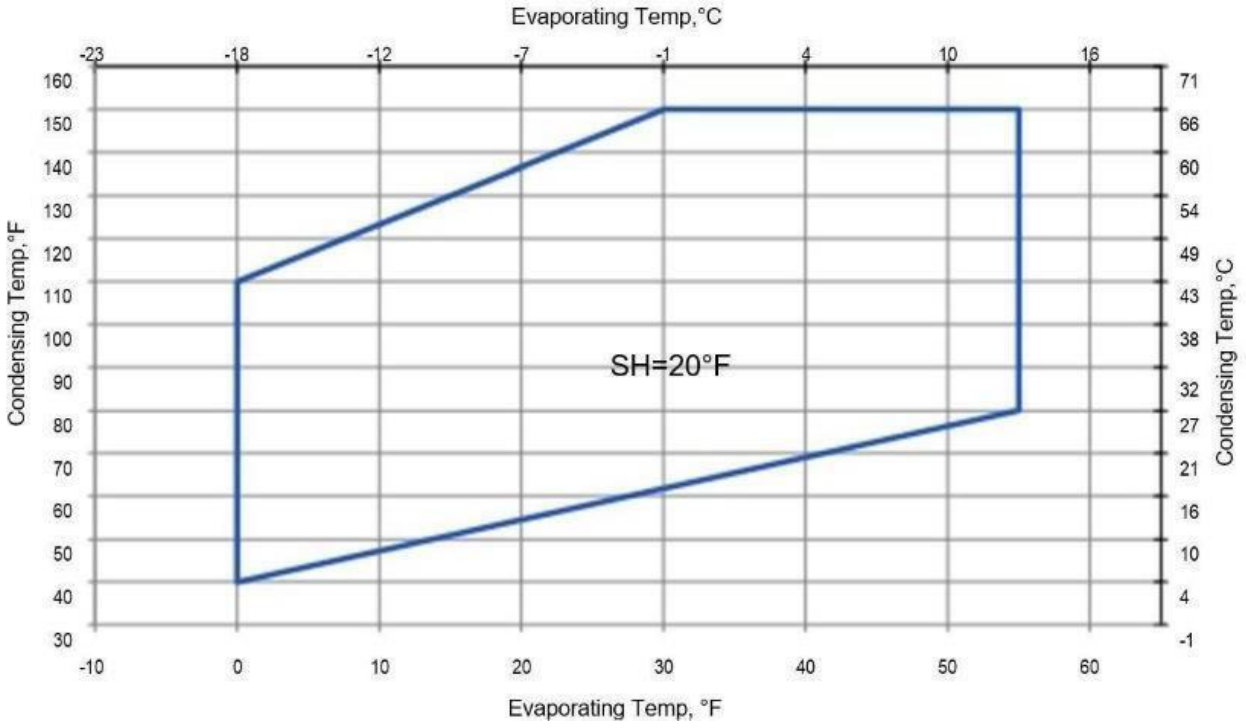


*Figure 4 - ZS*KAE and YS*KAE Application Envelope for R-22*

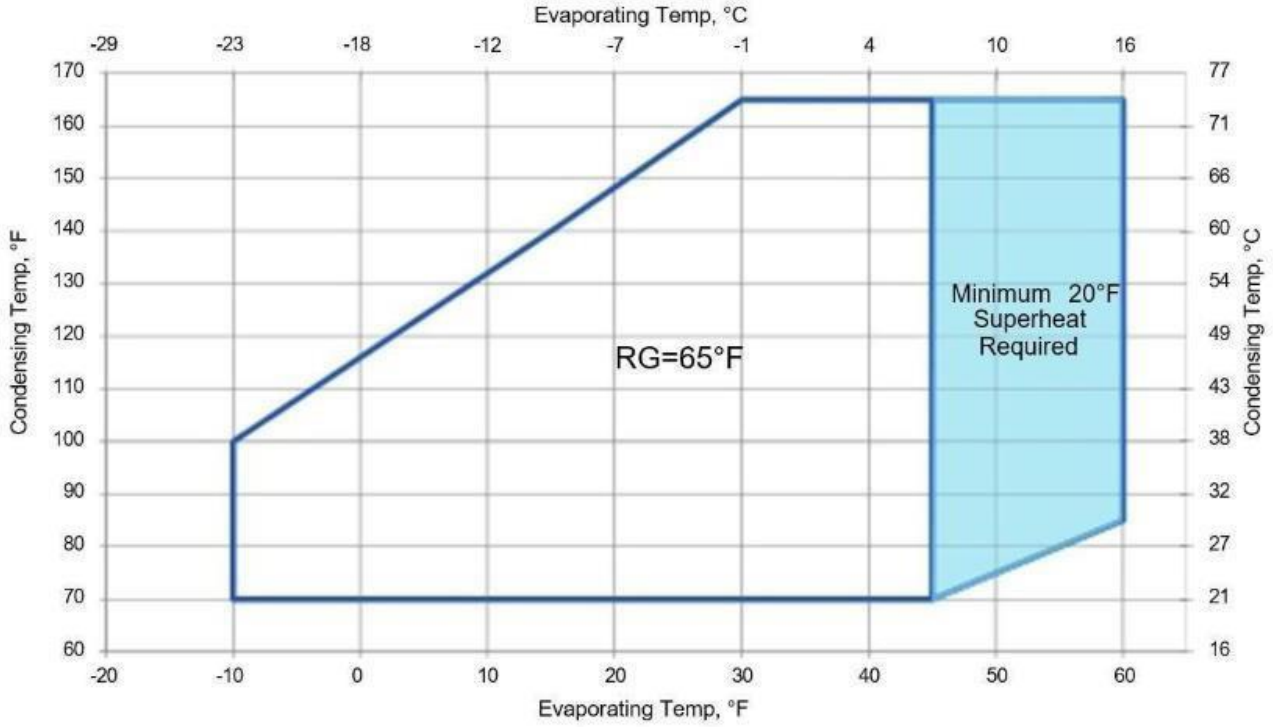


*Figure 5 - ZS*KAE and YS*KAE Application Envelope for R-134A*

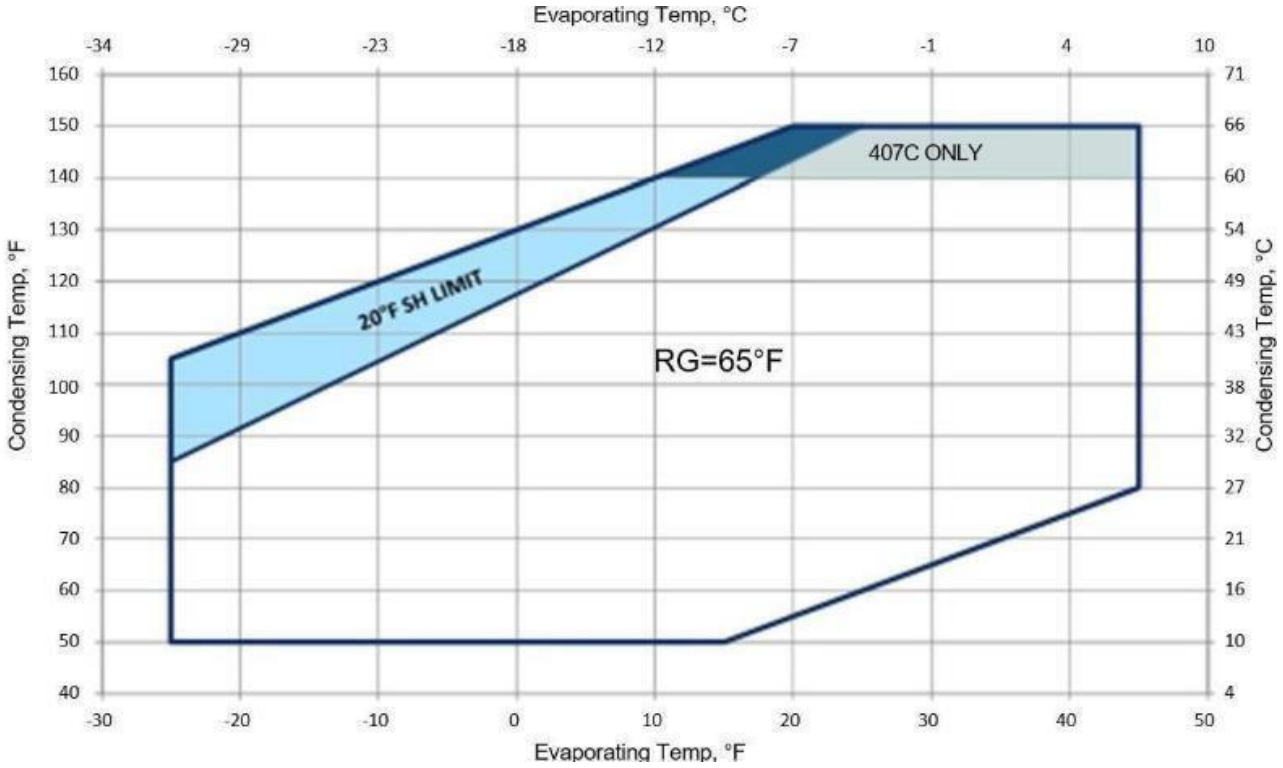


*Figure 6 - ZS*KAE and YS**KAE Application Envelope for R-407A/407C/R-448A/R-449A R-454A, R-454C, R-455A*

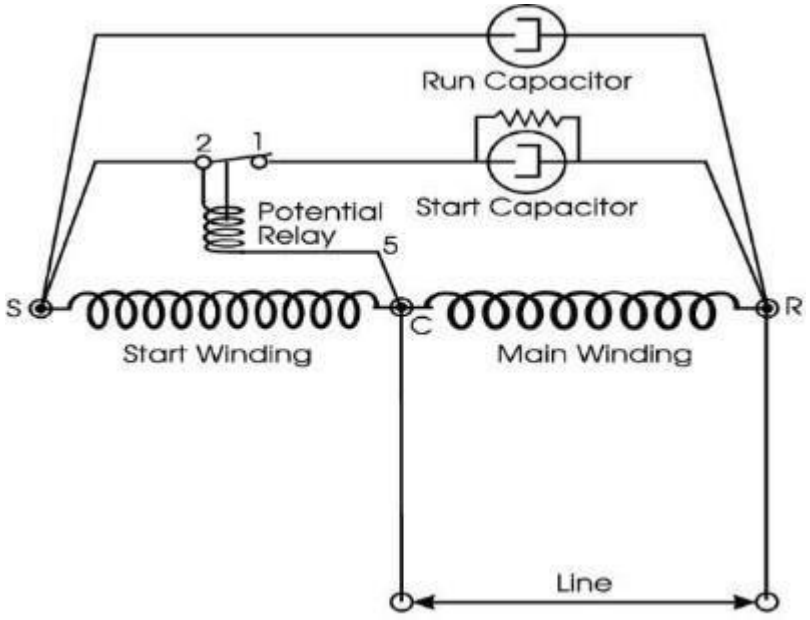


Figure 7 - Capacitor Start - Capacitor Run Motor

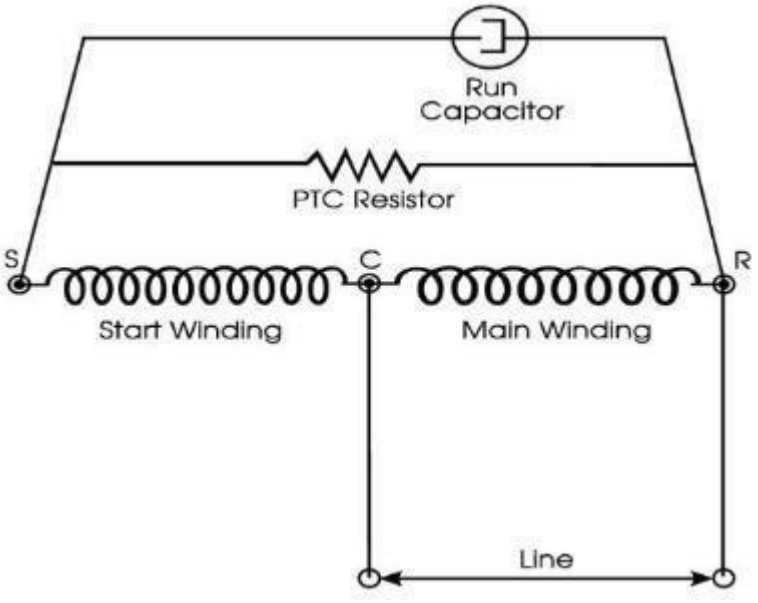


Figure 8 - Permanent Split Capacitor Motor (PSC)

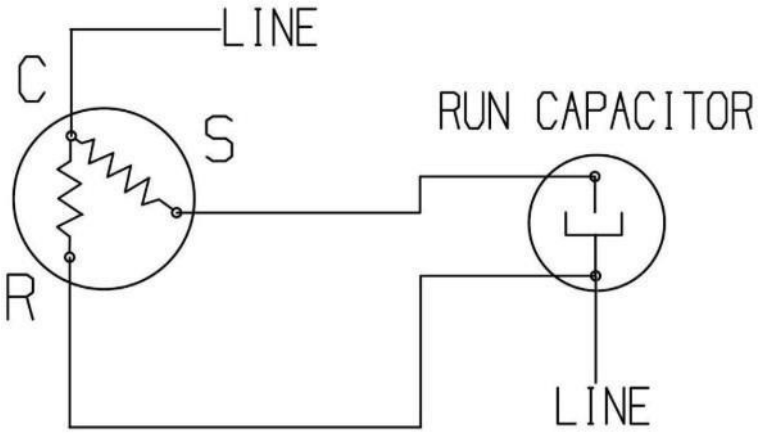


Figure 9 - Compressor Wiring Diagram Single Phase Motor with Internal Protection

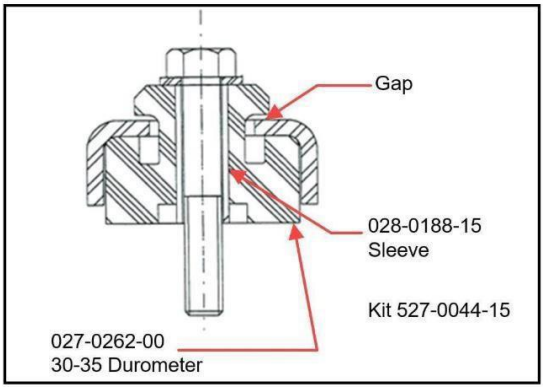


Figure 10 - ZS09KAE to ZS20KAE Refrigeration Scroll 53 Frame Condensing Unit Mounting

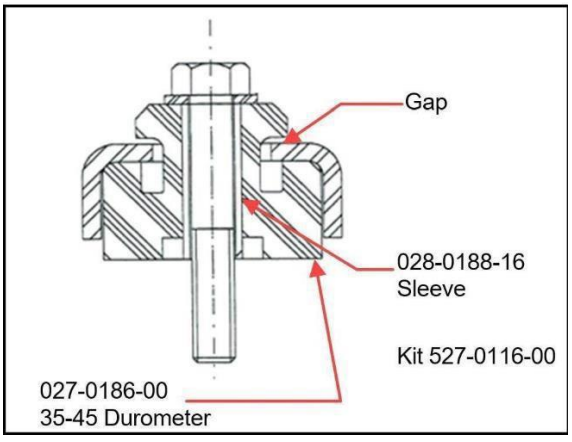


Figure 11 - ZS21KAE to ZS33KAE Refrigeration Scroll 63 Frame Condensing Unit Mounting

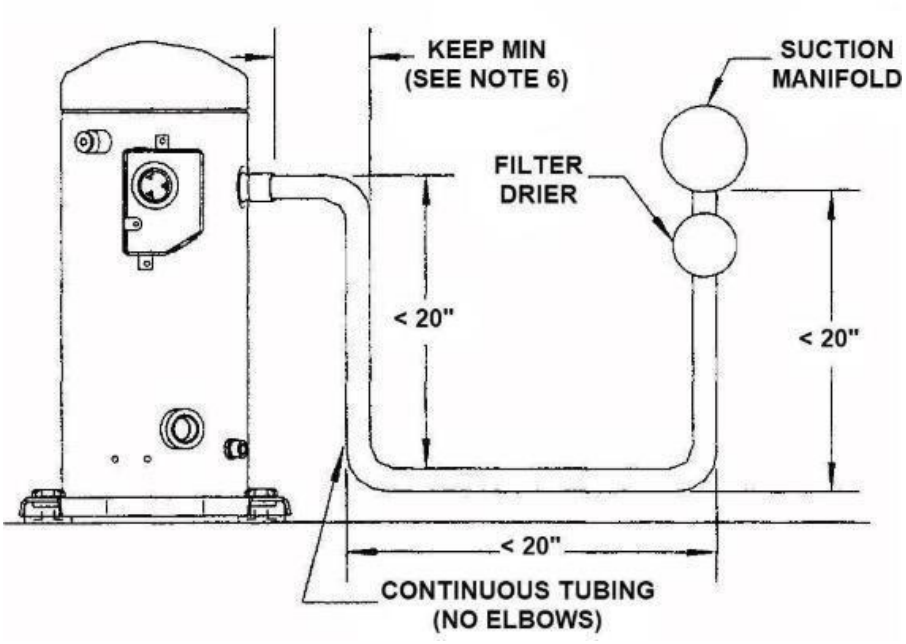


Figure 12 - Typical Suction Tubing

NOTES:

1. The above tubing configurations are guidelines to minimize tube stress.
2. Follow similar guidelines for discharge tubing and oil return tubing as needed.
3. If a run of over 20” is required, intermediate clamps may be necessary.
4. Do not hang weights on tubing (e.g., filter drier on suction tubing) except after clamps or close to the header.
5. Tube runs of less than 8” are not recommended.
6. This dimension should be made as short as possible (e.g., 2” or less) but still insuring a proper braze joint.
7. The above tubing recommendations are based on “no elbow joints”. The use of continuous tubing is preferred.

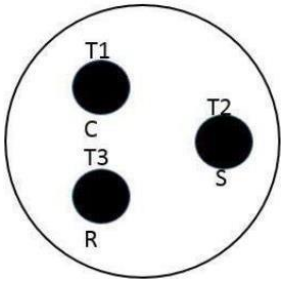


Figure 13 - Motor Terminal (Fusite) Connections for Single Phase and Three Phase Scrolls

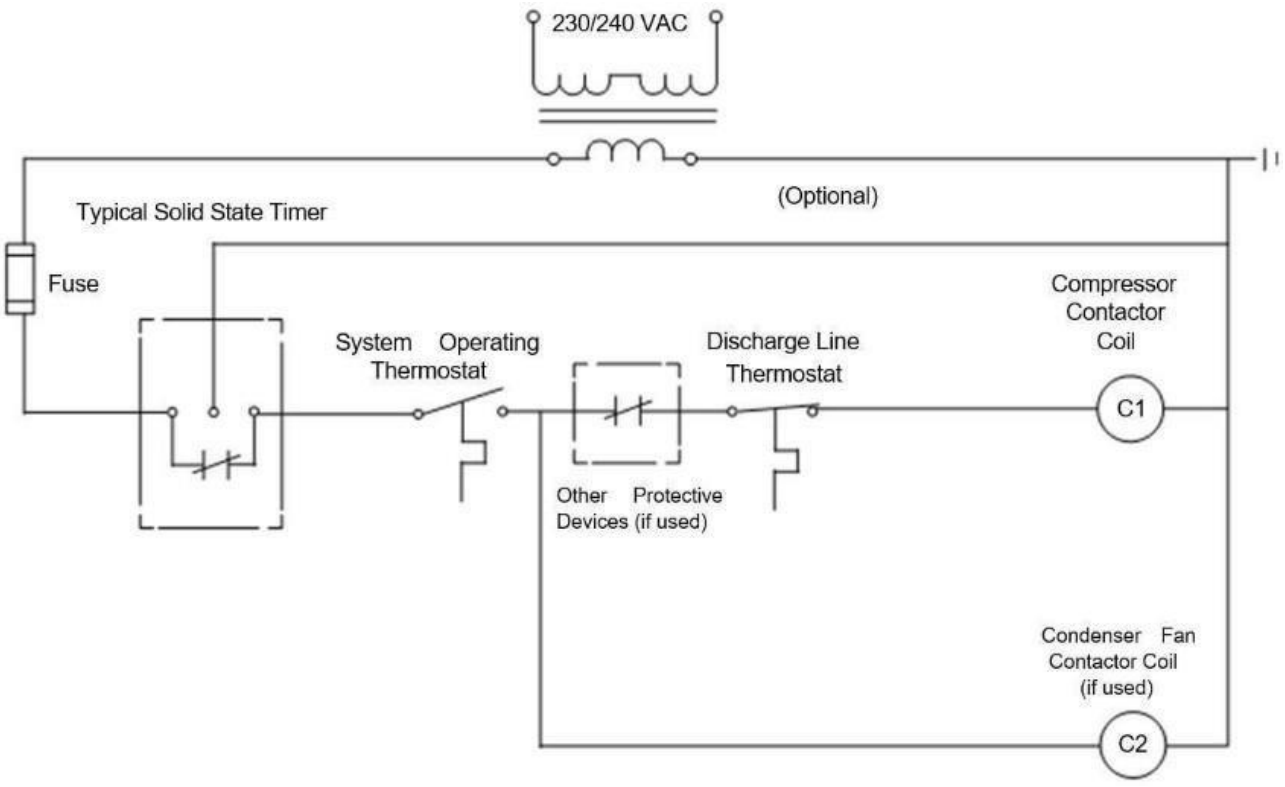


Figure 14 - Scroll Wiring Schematic

Time Delay Relay Specifications

Timer Opens: 1 Electrical Cycle (.016 Seconds with 60 HZ Operation) After Power is Removed

Timer Closes: 2 Minutes (+/- 20%) Later, Whether Power is Restored or Not

CSR = Current Sensing Relay Contact

Revision Tracking R11

The document format has been updated to the new Copeland format
All occurrences of " " have been removed
A note regarding A3 and R290 venting has been updated