EMERSON Climate Technologies

Application Engineering

Copeland brand products

BULLETIN

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# Application Guidelines for ZBKC / ZBKCE Refrigeration Copeland Scroll™ Compressors 1.3 to 7.5 HP

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## Safety Instructions

Copeland Scroll™ compressors are manufactured according to the latest U.S. and European Safety Standards. Particular emphasis has been placed on the user's safety. Safey icons are explained below and safety instructions applicable to the products in this bulletin are grouped on Page 3. These instructions should be retained throughout the lifetime of the compressor. **You are strongly advised to follow these safety instructions.**

### Safety Icon Explanation

| | |
|---|---|
| DANGER | DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury. |
| WARNING | WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. |
| CAUTION | CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. |
| NOTICE | NOTICE is used to address practices not related to personal injury. |
| CAUTION | CAUTION, without the safety alert symbol, is used to address practices not related to personal injury. |

**Instructions Pertaining to Risk of Electrical Shock, Fire, or Injury to Persons**

| | |
|---|---|
| **WARNING** | **ELECTRICAL SHOCK HAZARD**<br>• Disconnect and lock out power before servicing.<br>• Discharge all capacitors before servicing.<br>• Use compressor with grounded system only.<br>• Molded electrical plug must be used when required.<br>• Refer to original equipment wiring diagrams.<br>• Electrical connections must be made by qualified electrical personnel.<br>• Failure to follow these warnings could result in serious personal injury. |
| | |
| **WARNING** | **PRESSURIZED SYSTEM HAZARD**<br>• System contains refrigerant and oil under pressure.<br>• Remove refrigerant from both the high and low compressor side before removing compressor.<br>• Use appropriate back up wrenches on rotalock fittings when servicing.<br>• 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.<br>• Use only approved refrigerants and refrigeration oils.<br>• Personal safety equipment must be used.<br>• Failure to follow these warnings could result in serious personal injury. |
| | |
| **WARNING** | **BURN HAZARD**<br>• Do not touch the compressor until it has cooled down.<br>• Ensure that materials and wiring do not touch high temperature areas of the compressor.<br>• Use caution when brazing system components.<br>• Personal safety equipment must be used.<br>• Failure to follow these warnings could result in serious personal injury or property damage. |
| | |
| **CAUTION** | **COMPRESSOR HANDLING**<br>• Use the appropriate lifting devices to move compressors.<br>• Personal safety equipment must be used.<br>• Failure to follow these warnings could result in personal injury or property damage. |

**Safety Statements**

- Refrigerant compressors must be employed only for their intended use.
- Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission and maintain this equipment.
- Electrical connections must be made by qualified electrical personnel.
- All valid standards and codes for installing, servicing, and maintaining electrical and refrigeration equipment must be observed.

### Introduction

The ZBKC/ZBKCE 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 (20/120°F). For additional information on this product, please refer to the Online Product Information accessible from the Emerson Climate Technologies web site at www.emersonclimate.com.

### Operating Envelope

The ZBKC/ZBKCE refrigeration scroll compressor models can be used with a variety of refrigerants depending on the model selected and the lubricant used. (See **Table 1** at the end of this bulletin.)

The ZBKC and ZBKCE models are intended for medium temperature refrigeration type duty. The approved operating envelopes for these models are such that they are ideally suited for applications such as ice machines, bulk milk and FCB/FUB. The models and operating envelopes are depicted in **Figures 1A, 1B** and **1C** at the end of this bulletin.

### 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 2**. 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.

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. Emerson 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 Emerson Climate Technologies representative regarding any exceptions to the above requirements.

### Crankcase Heaters

- Single-phase

  No crankcase heaters are required on single-phase scroll compressors.
- Three-phase – outdoor only

  Crankcase heaters are required on three phase compressors where the system charge exceeds 10 lbs.

The listed crankcase heaters are intended for use only when there is limited access (See **Table 3**). 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 3A**. If there are any questions concerning their application, contact the Emerson Climate Technologies, Inc. Application Engineering department.

### Discharge Line Thermostat

**Figures 1A, 1B**, **1C** and **1D** show saturated suction temperature, maximum condensing temperature, maximum return gas temperature, and maximum discharge line temperature. 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 with in these guidelines cannot be guaranteed, then the discharge line thermostat is required in the compressor control circuit.

The thermostats have a cut out setting that will insure discharge line temperatures below the 260°F maximum limit. It should be installed approximately 7 inches from the discharge tube outlet. If a service valve is installed at the discharge tube, the thermostat should be located 5 inches from the valve braze.

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 4** for a list of discharge line thermostat kit numbers.

### Pressure Controls

Both high and low-pressure controls are required on the following models, (1.3-2 HP) ZB10-14KCE. Only low-pressure controls are required on the following models, (2-7.5 HP) ZB15-57KC/E. See **Table 5** for set points.

Application Note: There are exceptions to the pressure settings listed in **Table 5**. Certain OEMs are approved for LPC settings below our standard recommendations.

### Pump Down Recommendations

**Table 6** identifies the "ZB" models that incorporate the low-leak check valve suitable for pump-down applications. The standard disc is not intended for use with a pump down.

**NOTICE**

Typically, the compressors that use the low-leak discharge check valve are suitable for pump down applications. 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 ZB15 through ZB29 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 5.** 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.

**NOTICE**

The ZB10 through ZB14 models will require the following recommendations for pump down applications:

1. Install an external check-valve in the discharge line to prevent back-flow from the high side to low side. Install check-valve as close to the compressor discharge fitting as possible to minimize discharge gas volume.
2. Set low pressure to recommended settings in **Table 5**.
3. Since these models are single-phase only, add a time delay relay to prevent reverse rotation. Refer to "Brief Power Interruptions" section of this bulletin for additional information.

### IPR Valve

Refrigeration scroll compressors (2-7.5 HP) ZB15-57KC/E 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. The ZB10-14KCE models DO require a high pressure control in addition to a low pressure control, since these models do not have an IPR valve.

### Internal Temperature Protection

Refrigeration Scroll compressors (1.3-7.5 HP) ZB10-57KC/E incorporate a thermo disc which is a temperature-sensitive snap disc device located at the scroll discharge port. It is designed to open and route hot discharge gas back to the motor protector thus removing the compressor from the line.

### 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. ZBKC compressors are intended for use with R22 and are supplied with mineral oil. See **Form 93-11** for a complete list of all Emerson approved lubricants.

**CAUTION**

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

### Oil Charges

The recommended oil charges for these compressors are shown in **Table 7**.

### Oil Management for Rack Applications

Copeland Scroll refrigeration compressors may be used on multiple compressor parallel rack applications. This requires the use of an oil management system to maintain proper oil level in each compressor crankcase. The sight glass connection supplied can accommodate the mounting of the oil control devices.

Unlike semi-hermetic compressors, scroll compressors do not have an oil pump with accompanying oil pressure safety controls. Therefore, an external oil level control is required.

The Emerson OMB Oil Level Management Control combines the functions of level control and timed compressor shut-off should the level not come back to normal within a set period of time. This device has been found to provide excellent performance in field tests on Copeland Scroll compressors and is recommended for parallel system applications.

**Note: Emerson Climate Technologies' Application Engineering Department should be contacted for approved oil management systems.**

Immediately after system start-up the oil reservoir level will fluctuate until equilibrium is reached. It is advisable to monitor the oil level during this time to assure sufficient oil is available. This will prevent unnecessary trips of the oil control system.

**Note: If oil management problems are occuring please refer to AE17-1320 or contact the Emerson Climate Technologies, Inc. Application Engineering Department.**

### Compressor Tubing and Mounting

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

### Mounting for Rack Systems

For 1.3-7.5 HP compressors, specially designed rubber grommets are available for refrigeration scroll compressor applications. These grommets are formulated from a durometer material specifically designed for refrigeration applications. The durometer limits the compressor motion, thereby minimizing potential problems of excessive tubing stress. Sufficient isolation is provided to prevent vibration from being transmitted to the mounting structure. This mounting arrangement is recommended for multiple compressor rack installations. See **Figure 2A** for a detail of this mounting system.

**NOTICE**

The use of standard soft grommets is not recommended for most refrigeration scroll rack installations. These softer mounts allow for excessive movement that will result in tube breakage, unless the entire system is properly designed.

### Condensing Unit Mounting

For 1.3-7.5 HP refrigeration scroll condensing unit applications, soft mounts are recommended. See **Figure 2B**.

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 3** shows examples of acceptable tubing configurations.

**CAUTION**

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.

### Starting Characteristics

Single-phase scroll compressors are designed with PSC type motors and therefore will start without the need

of start assist devices in most applications. 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.

### Fusite

Fusite pin orientation for single-phase and three- phase refrigeration scroll compressors are shown in **Figure 4** and inside the terminal box.

### Shell Temperature

**⚠ CAUTION**

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 with either braze connections or roto-lock adapters depending on the bill of material selected (reference **AE4-1219** for roto-lock torque values). Consult your District Sales Manager or Application Engineer for details.

All ZBKC/E models have copper plated steel suction and discharge fittings for a more rugged, leak resistant connection.

See section on New Installation (see **Figure 6**) 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.

Emerson 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 5**.

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

### Deep Vacuum Operation

**⚠ WARNING**

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

A low-pressure control is required for protection against vacuum operation. See the section on pressure controls for the proper set points. (See **Table 5**)

Scroll compressors (as with any refrigeration compressor) should never be used to evacuate refrigeration or air conditioning systems. See **AE24-1105** for proper system evacuation 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 of time to redistribute the refrigerant to a more normal configuration and the system Hipot tested 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.

**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.

4a. Single-Phase Compressors

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

4b. 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.

**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.
- 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.

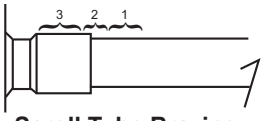
## Field Service

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.




**Scroll Tube Brazing**

- 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.

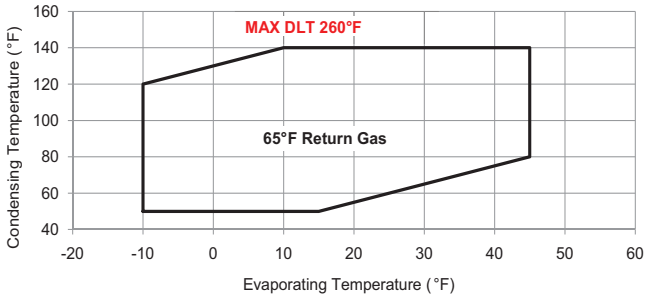



**Figure 1A**
**ZB*KCE Application Envelope for R-404A / R-507 (1.3 - 7.5 HP)**

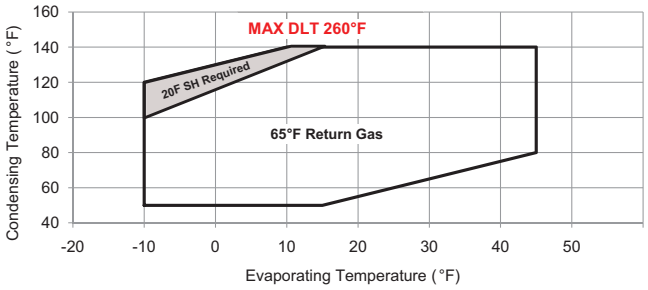



**Figure 1B**
**ZB*KCE Application Envelope for R-407A / R-407C (1.3 - 7.5 HP)**

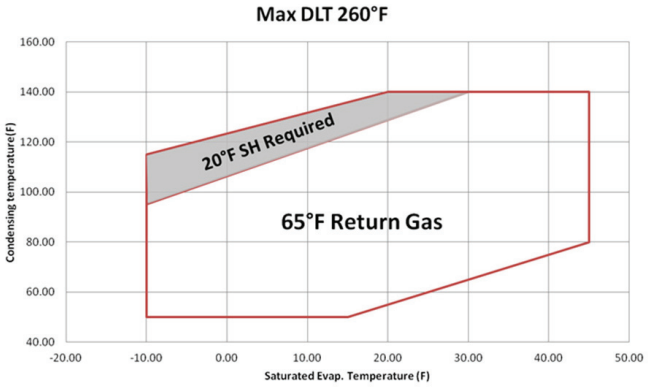



**Figure 1C**
**ZB*KCE Application Envelope for R-407F (1.3 - 7.5 HP)**

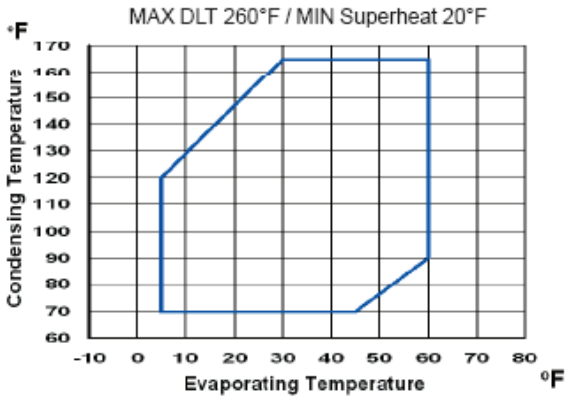



**Figure 1D**
**ZB*KCE Application Envelope for 134a 2-7.5 HP**

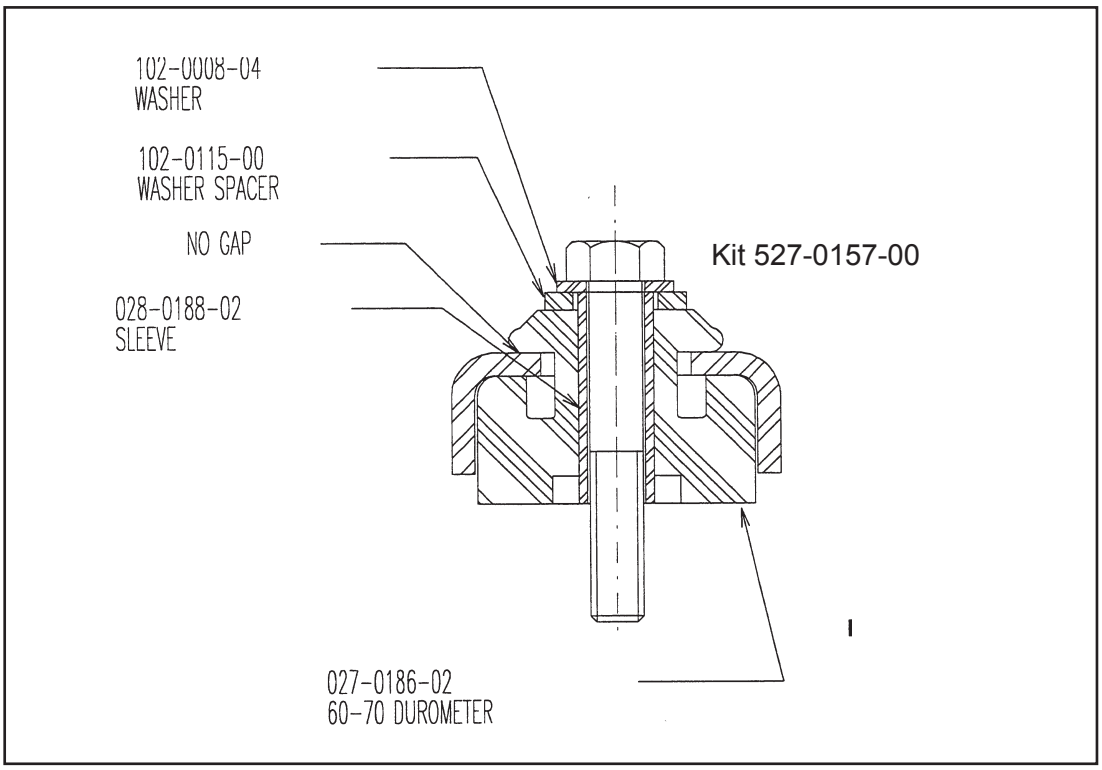



**Figure 2A**
**1.3-7.5 HP Refrigeration Scroll Rack Mounting**

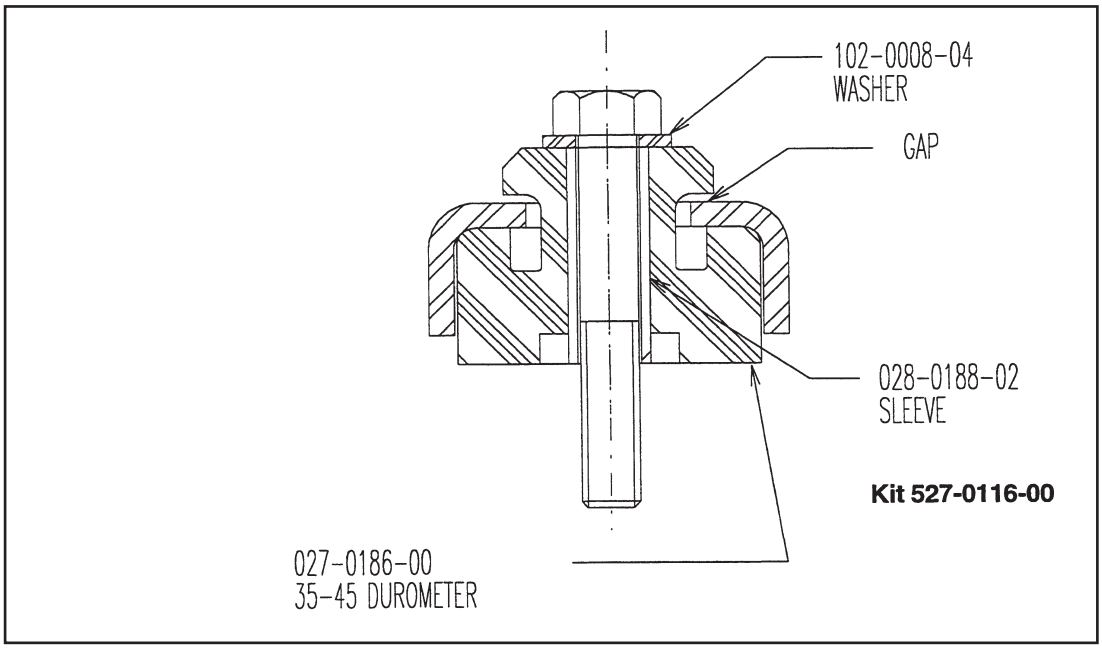



**Figure 2B**
**1.3-7.5 HP Refrigeration Scroll Condensing Unit Mounting**

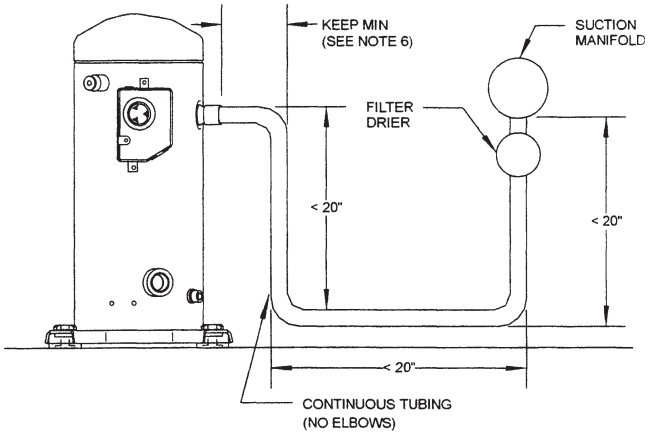



**Figure 3**
**Typical Suction Tubing**

**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.

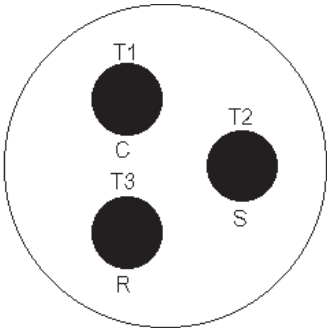



**Figure 4**
**Motor Terminal (Fusite) Connections for Single Phase and Three Phase Scrolls**

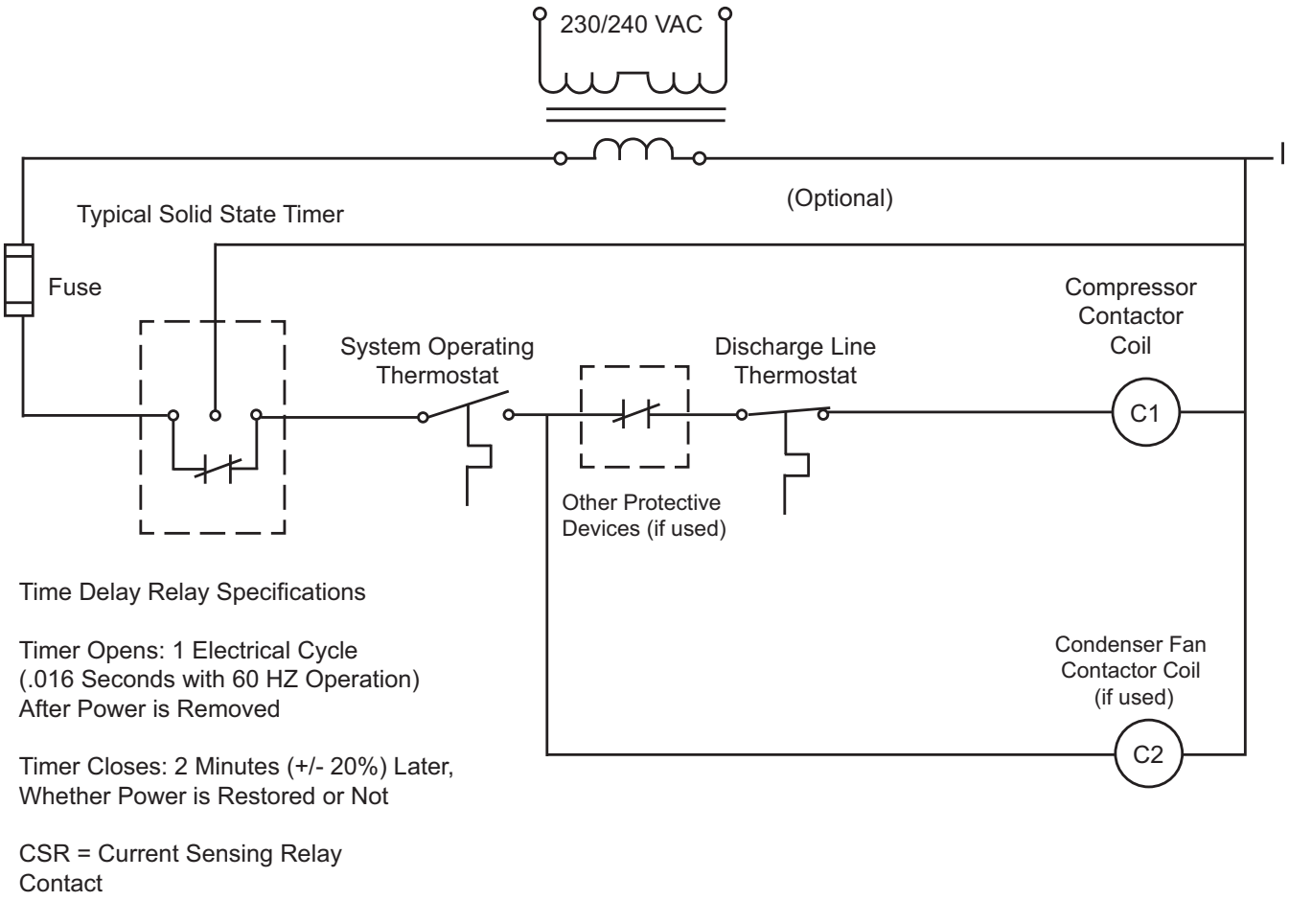



**Figure 5**
**Scroll Wiring Schematic**

**Table 1**
**Compressor Models and Approved Refrigerants/Lubricants**

| Model | HP | Refrigerant | Lubricant |
|---|---|---|---|
| ZB10KCE | 1.3 | R-404A/ R-507 | POE |
| ZB11KCE | 1.5 | R-404A/ R-507 | POE |
| ZB13KCE | 1.8 | R-404A/ R-507 | POE |
| ZB14KCE | 2.0 | R-404A/ R-507 | POE |
| | | | |
| ZB15KCE | 2.0 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | MO/POE |
| ZB19KCE | 2.5 | R-22/ R-404A/ R-507/ R-134a | MO/POE |
| ZB21KCE | 3.0 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | MO/POE |
| ZB26KCE | 3.5 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | MO/POE |
| ZB29KCE | 4.0 | R22/ R404A/ R507/ R134a/ R407A/ R407C/ R407F | POE |
| | | | |
| ZB30KCE | 4.0 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | MO/POE |
| ZB38KCE | 5.0 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | MO/POE |
| ZB42KCE | 5.5 | R-22/ R-404A/ R-507/ R-134a | MO/POE |
| ZB45KCE | 6.0 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | MO/POE |
| ZB48KCE | 6.5 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | POE |
| ZB57KCE | 7.5 | R-22/ R-404A/ R-507/ R-134a/ R-407A/ R-407C/ R-407F | POE |

See Emerson Climate Technologies **Form 93-11** for a complete list of all Emerson approved lubricants.

**Table 2 – Charge Limitations**

| Model Family | Chrg. Lmts. |
|---|---|
| ZB10,11,13,14KCE | 6 lbs |
| ZB15,19, 21, 26, 29, 30, 38, 45, 48, 57KC/E | 10 lbs |

**Table 3 – Crankcase Heater**

| Model | Part No. | Volts | Watts | Length |
|---|---|---|---|---|
| ZB10,11, 13, 14 | 018-0052-00<br>918-0041-01 | 120 | 40 | 21” |
| ZB10,11, 13, 14 | 018-0052-01<br>918-0041-00 | 240 | 40 | 21” |
| ZB15, 19, 21, 26, 29, 30, 38, 45, 48, 57 | 018-0057-04<br>918-0043-00 | 240 | 70 | 48” |
| ZB15, 19, 21, 26, 29, 30, 38, 45, 48, 57 | 018-0057-05<br>918-0043-01 | 480 | 70 | 48” |
| ZB15, 19, 21, 26, 29, 30, 38, 45, 48, 57 | 018-0057-06<br>918-0043-02 | 575 | 70 | 48” |
| ZB15, 19, 21, 26, 29, 30, 38, 45, 48, 57 | 018-0057-07<br>918-0043-07 | 120 | 70 | 48” |

**Table 3A**
**Conduit Ready Heater Terminal Box Kits**

| Model Number | Kit Number |
|---|---|
| ZB10-ZB14 | N/A |
| ZB15-ZB29 | 998-7026-00 |
| ZB30-ZB57 | 998-7024-00 |

**Table 4 – Discharge Thermostat Line Kits**

| Kit Number | Conduit Lead Connector | Alarm Contact | Discharge Line Diameter |
|---|---|---|---|
| 998-0540-00 | No | No | 1/2" |
| 998-0548-00 | No | Yes | 1/2" |
| 998-7022-02 | Yes | No | 1/2" |
| 998-7022-04 | Yes | No | 5/8" |
| 998-7022-07<br>ZB48 & ZF25 only | Yes | No | 3/4" |

**Table 5 – Pressure Control Settings**

| Model | Control Type | R-404A / R-507 | R-134a | R-22 | R-407A/ R-407F | R-407C |
|---|---|---|---|---|---|---|
| ZB10/11/ 13/14KCE | Low<br>High | 17 PSIG min.<br>450 PSIG max. | N/A | N/A | N/A | N/A |
| ZB*KC* | Low<br>High | 17 PSIG min.<br>450 PSIG max. | 4 PSIG min.<br>263 PSIG max. | 37 PSIG min.<br>382 PSIG max. | 8.5 PSIG min.<br>428 PSIG max. | 6.5 PSIG min.<br>402 PSIG max. |

**Table 6**
**Check-Valve Type**

| Model Number | Check Valve Type |
|---|---|
| ZB10KCE | Standard Disc |
| ZB11KCE | Standard Disc |
| ZB13KCE | Standard Disc |
| ZB14KCE | Standard Disc |
| ZB15KC/E | Spring Loaded Low-Leak |
| ZB19KC/E | Spring Loaded Low-Leak |
| ZB21KC/E | Spring Loaded Low-Leak |
| ZB26KC/E | Spring Loaded Low-Leak |
| ZB29KC/E | Spring Loaded Low-Leak |
| ZB30KC/E | Spring Loaded Low-Leak |
| ZB38KC/E | Spring Loaded Low-Leak |
| ZB42KC/E | Spring Loaded Low-Leak |
| ZB45KC/E | Spring Loaded Low-Leak |
| ZB48KC | Spring Loaded Low-Leak |
| ZB57KC | Spring Loaded Low-Leak |

**Table 7**
**Recommended Oil Charges by Model Family**

| Model Family | Initial | Recharge |
|---|---|---|
| ZB10KCE | 25 | 22 |
| ZB11, 13, 14KCE | 25 | 21 |
| ZB15KC/E | 44 | 40 |
| ZB19, 21, 26, 29KC/E | 49 | 45 |
| ZB30KC/E | 64 | 60 |
| ZB38KC/E | 64 | 60 |
| ZB45KC/E | 64 | 60 |
| ZB48KCE | 60 | 56 |
| ZB57KCE | 64 | 60 |

Note: The oil level of refrigeration scroll compressors should be adjusted to the mid-point of the sightglass during normal operation.