

1.5 to 5 Ton ZPS*K6 Copeland Scroll™ Two-Stage Compressors

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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. Safety 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 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.







NOTICE is used to address practices not related to personal injury.



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	<p>ELECTRICAL SHOCK HAZARD</p> <ul style="list-style-type: none"> • Disconnect and lock out power before servicing. • Discharge all capacitors before servicing. • Use compressor with grounded system only. • Molded electrical plug must be used when required. • Refer to original equipment wiring diagrams. • Electrical connections must be made by qualified electrical personnel. • Failure to follow these warnings could result in serious personal injury.
 WARNING	<p>PRESSURIZED SYSTEM HAZARD</p> <ul style="list-style-type: none"> • System contains refrigerant and oil under pressure. • Remove refrigerant from both the high and low compressor side before removing 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. • Use only approved refrigerants and refrigeration oils. • Personal safety equipment must be used. • Failure to follow these warnings could result in serious personal injury.
 WARNING	<p>BURN HAZARD</p> <ul style="list-style-type: none"> • Do not touch the compressor until it has cooled down. • Ensure that materials and wiring do not touch high temperature areas of the compressor. • Use caution when brazing system components. • Personal safety equipment must be used. • Failure to follow these warnings could result in serious personal injury or property damage.
 CAUTION	<p>COMPRESSOR HANDLING</p> <ul style="list-style-type: none"> • Use the appropriate lifting devices to move compressors. • Personal safety equipment must be used. • 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 ZPS*K6 two-stage modulated Copeland Scroll™ compressors are ideally suited for residential and light commercial applications where a capacity stage reduction and part-load efficiency are desired. The ZPS*K6 is based upon the ZP*K6 fixed capacity scroll compressor. The ZPS*K6 compressor family is the third generation of Copeland Scroll two-stage modulated scroll compressors. (Reference AE4-1311 for ZPS*K4 and ZPS*K5 for previous generation application requirements and recommendations)

How It Works

A 24-volt DC solenoid valve inside the compressor provides the means to modulate the compressor. When the solenoid valve is energized the compressor is in full-load and when de-energized the compressor is in part-load. When the ZPS*K6 solenoid is energized a 3-way solenoid valve provides pressure to a lift ring assembly that is used to open and close the scroll modulation ports. A single-speed motor continues to run while the scroll modulates between the two capacity stages. See **Figure 1** for hardware pictorial.

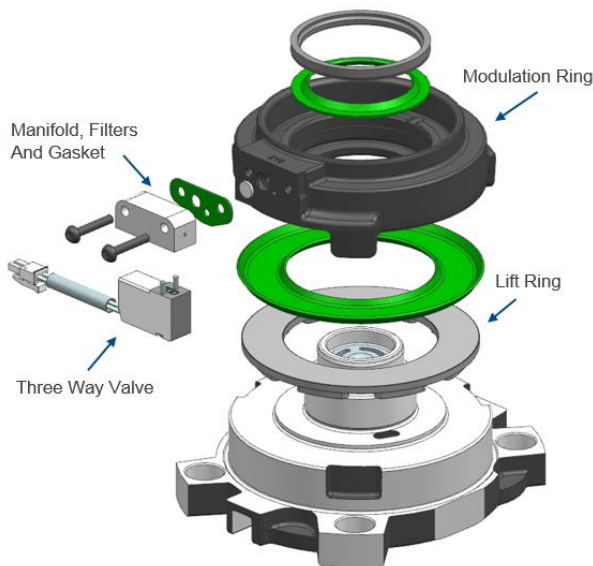


Figure 1 ZPS*K6

Capacity Control

The compression process of a scroll compressor is described in **AE4-1400, Figure 7**. At any point in the compression process, there are several pockets within the scroll that are compressing gas. Modulation is achieved by venting a portion of the gas in the first

suction pocket back to the low side of the compressor thereby reducing the effective displacement of the compressor. Full capacity is achieved by blocking these ports, thus increasing the displacement to 100%. When the solenoid is energized, the compressor is in full-load or 100% of its capacity. When the solenoid is de-energized the compressor is in part-load or approximately 67% of its full-load capacity. The loading and unloading of the two-stage scroll are done 'on the fly' without shutting off the motor between stages. The unloaded mode default was chosen for two reasons:

1. It is expected that the majority of run hours will be in a low capacity, unloaded mode.
2. It allows a simple two-stage thermostat to control capacity through the second stage in both cooling and heating.

Nomenclature

The model numbers of the Copeland Scroll compressors include the approximate nominal 60Hz capacity at AHRI operating conditions of 45°F(7.2°C) evaporating temperature and 130°F (54.4°C) condensing temperature. An example would be the ZPS49K6E-PFV which has 49,100 Btu/hr (14.4 kW) at the above mentioned full-load condition. Both full and part-load performance data are published throughout the entire operating envelope and can be found in the Online Product Information (OPI) at Emerson.com/OPI.

APPLICATION CONSIDERATIONS

In most respects, the two-stage scroll will operate like a standard scroll in both the high and low capacity mode. The basic application guidelines in AE4-1400 should be adhered to for ZPS*K6 compressors. There are a few important differences outlined below that must be observed when designing a system with the Copeland Scroll ZPS*K6 two-stage compressor.

Operating Envelope

The ZPS*K6 compressor family is approved for use with R-410a only. See **Figure 1** for the R-410a operating envelope. The maximum condensing limit is the point where the compressor can still run with a low supply voltage of 197 for the -PFV (208-230 volt) and -10% for all other motors. The ZPS compressors can operate at both full and part-load capacity throughout

the entire specified operating envelope shown in **Figure 1**. The envelope represents acceptable operating conditions with 20F° (11K) superheat in the return gas.

High Pressure Control

A high-pressure cut-out is recommended for the highest level of system reliability. If a high-pressure cut-out control is used the maximum setting should not exceed 650 psig (45 bar). The high pressure cut-out control should have a manual reset for the highest level of system protection. **It is not recommended to use the compressor to test the high pressure switch function during the unit assembly line run test.**

Low Pressure Control

A low pressure cut-out is recommended on all ZPS*K6 applications for the highest level of system reliability. The low pressure cutout should be set no lower than 20 psig (1.4 bar) for heat pumps and 55 psig (3.8 bar) for air-conditioning units.

Crankcase Heat

A crankcase heater is recommended on single-phase compressors when the system charge is over the charge limit shown in **Table 1**. A crankcase heater is required for systems containing more than 120% of the compressor refrigerant charge limit listed in **Table 1**. This includes long line length systems where the extra charge will increase the standard factory charge above the 120% limit.

Available crankcase heaters are listed in **Table 3**. Refer to **Figure 5** for proper installation of the crankcase heater.



Crankcase heaters must be properly grounded.

Defrost Cycle

Defrosting with the compressor in full-load, versus part-load, is highly recommended and will help defrost the outdoor coil in a shorter period, reduce sound, and help the reversing valve shift positions during low outdoor ambient temperatures when flow conditions can be low.

CAUTION

Reversing valve sizing must be within the guidelines of the valve manufacturer. Required pressure drop to ensure valve shifting must be measured throughout the operating range of the unit and compared to the valve manufacturer's data. Low ambient heating conditions with low flow rates and low pressure drop across the valve can result in a valve not shifting. This can result in a condition where the compressor appears to be not pumping (i.e. balanced pressures). It can also result in elevated compressor sound levels.

Unloader Solenoid Wiring

NOTICE

The current in the ZPS*K6 modulation solenoid circuit must be less than 0.9 mA for the solenoid valve to change from full-load to part-load. If the current is greater than 0.9 mA the solenoid valve can stay in full-load. A time delay relay or another current consuming load in series with the modulation solenoid could result in current greater than 0.9 mA.

Standard Wiring with 24 Volts

A nominal 24-volt direct current coil activates the internal unloader solenoid in the ZPS*K6 compressors. The input control circuit voltage must be 18 to 28 volt AC or DC. The maximum solenoid VA is 5. The external solenoid electrical connection is made with a molded plug assembly, see **Table 3** for the appropriate part number. This plug contains a full wave rectifier to supply direct current to the unloader coil if the control circuit is AC. If the control circuit is DC, the same plug with the full wave rectifier can be used as the full wave rectifier will have no effect on the DC voltage input. When a DC power source is used, the polarity of the DC input to the plug isn't critical. The rectified molded plug can be sourced from some of the same suppliers of the molded electrical plug used to power the compressor motor. A simple wiring diagram is shown in **Figure 4**.

Part-Load Starting

There are several benefits associated with starting the compressors in part-load. Improved starting is realized during a low voltage and/or flooded start condition

whereby stress on the motor, scrolls, and 3-way modulation valve is significantly reduced. Starting in part-load can result in the compressor starting and accelerating to full speed faster, thereby reducing the perception of light dimming. Part-load starting also reduces the inrush current on the 24 volt transformer. For the highest level of system reliability, part-load starting is recommended for all ZPS*K6 compressors.

Wired with CoreSense™ Diagnostics

CoreSense provides both diagnostics and active protection, in addition to modulation features. Please read AE8- 1379 for more information on CoreSense Diagnostics for modulated compressors. A simple wiring diagram for CoreSense is shown in **Figure 6**. **Table 3** lists CoreSense and molded plug part numbers for various types of applications.

APPLICATION TESTS

Refer to the **Application Tests** section of **AE4-1400** for the application tests to run to help ensure a reliable application. Consult with your Copeland™ Application Engineer if interpretation of application test results are required.

ASSEMBLY LINE PROCEDURES

Hipot (AC High Potential) Testing



Use caution with high voltage and never hipot when compressor is in a vacuum.

If the 24-volt modulation solenoid circuit is dielectric (hipot) strength tested, the maximum applied voltage should not exceed 1,000 volts RMS for 1 second at 2.0mA maximum leakage current.

Suction Funnel

The ZPS*K6 compressor includes a suction funnel which is bolted onto the fixed scroll internally. The funnel can be seen by looking through the suction tube from the outside of the compressor.

It is important that nothing is inserted into the suction tube further than the normal depth of the unit suction tube assembly.

Refer to the **Assembly Line Procedures** section of **AE4-1400** for suction funnel pictorial views and additional guidelines to follow for OEM assembly line processes.

SERVICE PROCEDURES



Use caution when troubleshooting energized circuits.

Unloader Test Procedure with Standard 24 Volt Wiring

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader on and off at ten second intervals. An increase in compressor amperage should be observed when switching from part-load to full-load and a reduction in compressor amperage should be observed when changing from full-load to part-load. The percent change in current depends on the operating conditions and voltage.
2. Shut off power and remove the control circuit molded plug from the compressor and measure the unloader solenoid coil resistance. The solenoid coil should have continuity and not be grounded or have infinite resistance. If the coil resistance is infinite, zero, or grounded, the compressor must be replaced. See **Table 2** for modulation solenoid resistance values.
3. Check the molded plug.

Voltage check: Apply control voltage to the plug wires (18 to 28 VAC). The measured DC voltage at the connectors in the plug should be around 15 to 27 VDC.

Resistance check: Measure the resistance from the end of one molded plug lead to either of the two female connectors in the plug. One of the connectors should read close to zero ohms while the other should read infinity. Repeat with other wire. The same female connector as before should read zero while the other connector again reads infinity. Reverse polarity on the ohmmeter leads and repeat. The female connector that read infinity

previously should now read close to zero ohms. Replace plug if either of these test methods doesn't show the desired results.

Unloader Test Procedure with CoreSense

If it is suspected that the unloader is not working, the following methods may be used to verify operation.

1. Operate the system and measure compressor amperage. Cycle the unloader on and off at ten second intervals by applying and removing Y2 voltage to the module. Wait five seconds after power is applied to Y2 before taking a reading. An increase in compressor amperage should be observed when switching from part-load to full-load and a reduction in compressor amperage should be observed when changing from full-load to part-load. The percent change in current depends on the operating conditions and voltage.
2. If Step 1 does not give the expected results remove the solenoid plug from the compressor and with the unit running and the thermostat calling for Y2 to be energized test the voltage output at the plug with a dc voltmeter. The reading should be 18 to 28 VDC for CoreSense (see **Table 4** CoreSense part numbers). If not, unplug the harness from the module and check voltage at the 'DC Sol' pins of the module. The module will not power the unloader solenoid if the compressor is not running or Fault Code 1 or 9 is active.
3. If the correct DC voltage is at the control circuit molded plug measure the unloader coil resistance. The solenoid coil should have continuity and not be grounded or have infinite resistance. If the coil resistance is infinite, zero, or grounded, the compressor must be replaced.

Replacing ZPS*K4 and ZPS*K5 with ZPS*K6 in Service Applications

ZPS*K6 compressors may be used to replace ZPS*K4 and ZPS*K5 in service applications. The ZPS*K6 compressors have the same mounting configuration and approximately the same tube location as the K4 and K5 compressors. Special consideration needs to be given to the compressor contactor since some ZPS*K6 compressors has higher RLA and LRA values than the ZPS*K4 and ZPS*K5 compressor that is being

replaced. In some cases, the system contactor may need to be upsized. The run capacitor may need to be changed to match the specification called for by the new ZPS*K6 compressor. The allowable tolerance on run capacitors is +5 to -0 microfarads. If the ZPS*K4 or ZPS*K5 compressor being replaced has a start capacitor and relay for light dimming effects, the replacement compressor must have a new start capacitor and relay of the correct ratings or no start kit at all. For more information on compressor electrical data please refer to the Online Product Information at **Emerson.com/OPI**.

Modulation plug part number 529-0138-01 will be shipped with the service compressor to help keep the residual current in the modulation circuit to less than 0.9 mA. This modulation plug has the molex plug that is needed to plug directly into the CoreSense, or White-Rodgers Unitary Control Board. If the system doesn't have one of these controls, cut the molex plug off and connect the individual wires to the appropriate termination points per the system wiring diagram.

For more information on service practices refer to **Service Procedures** in **AE4-1331**.

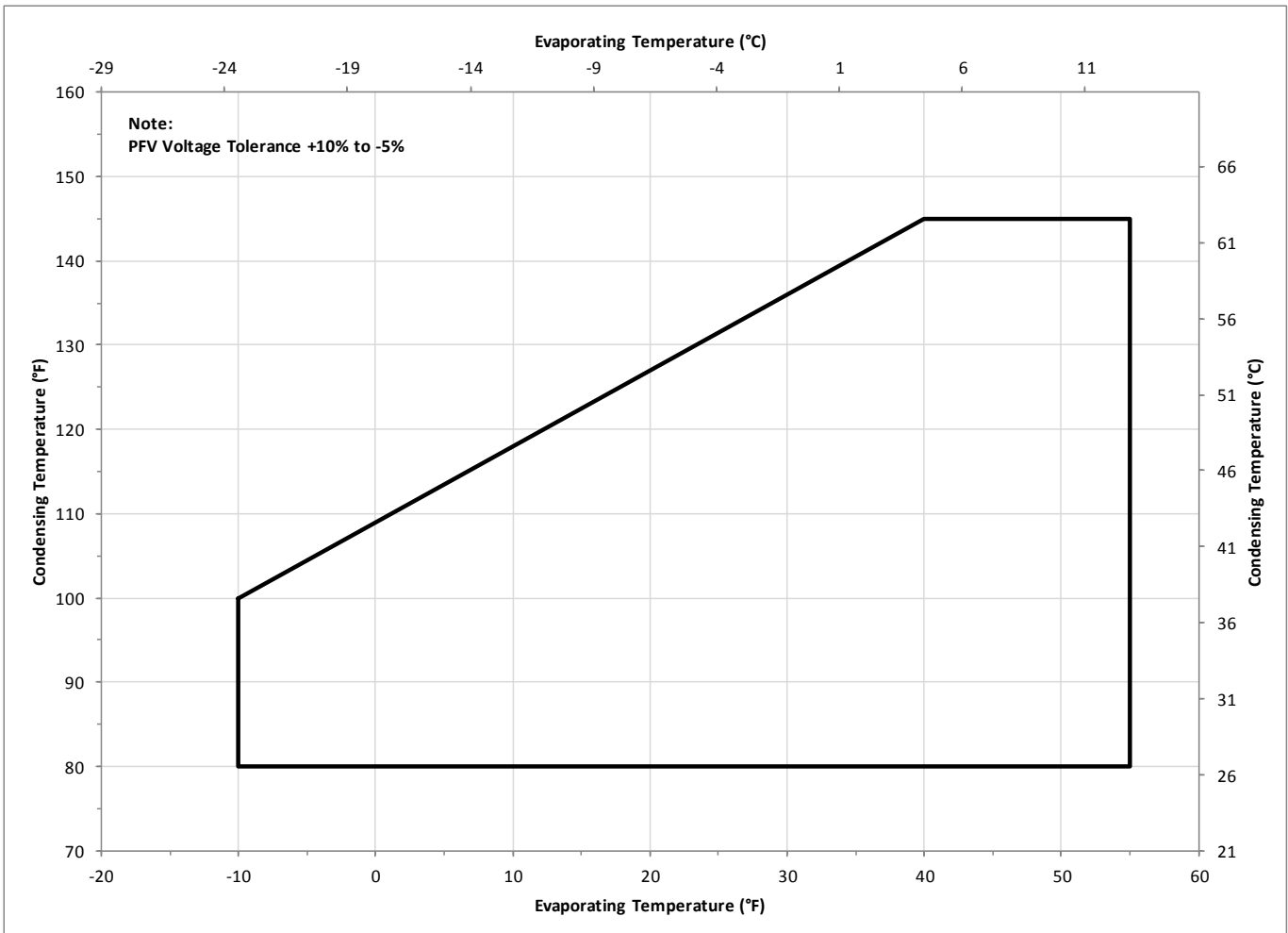


Figure 2
Operating Envelope

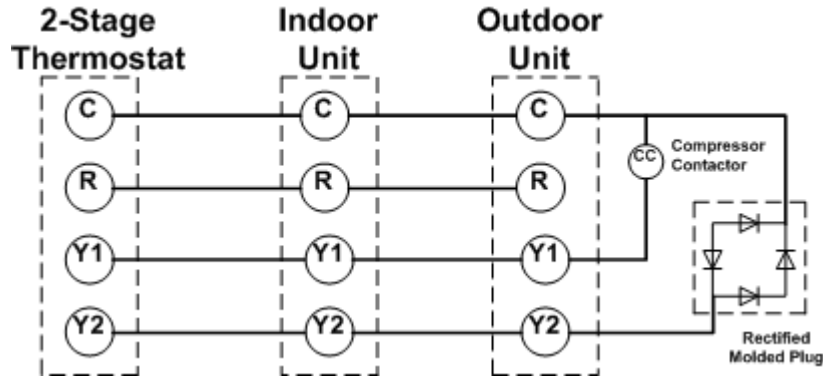


Figure 3
Example of 24 Volt Modulation Control Wiring

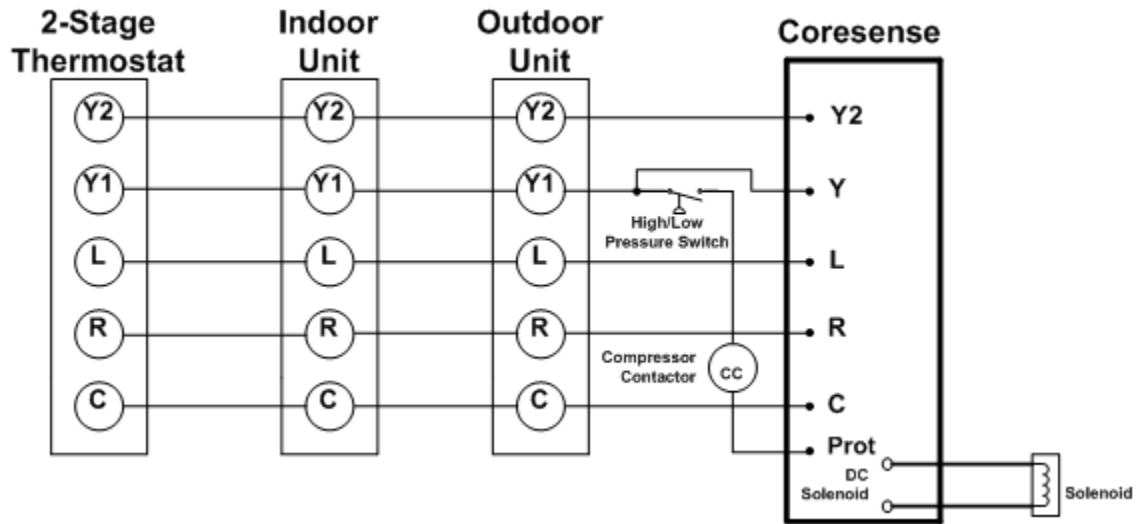
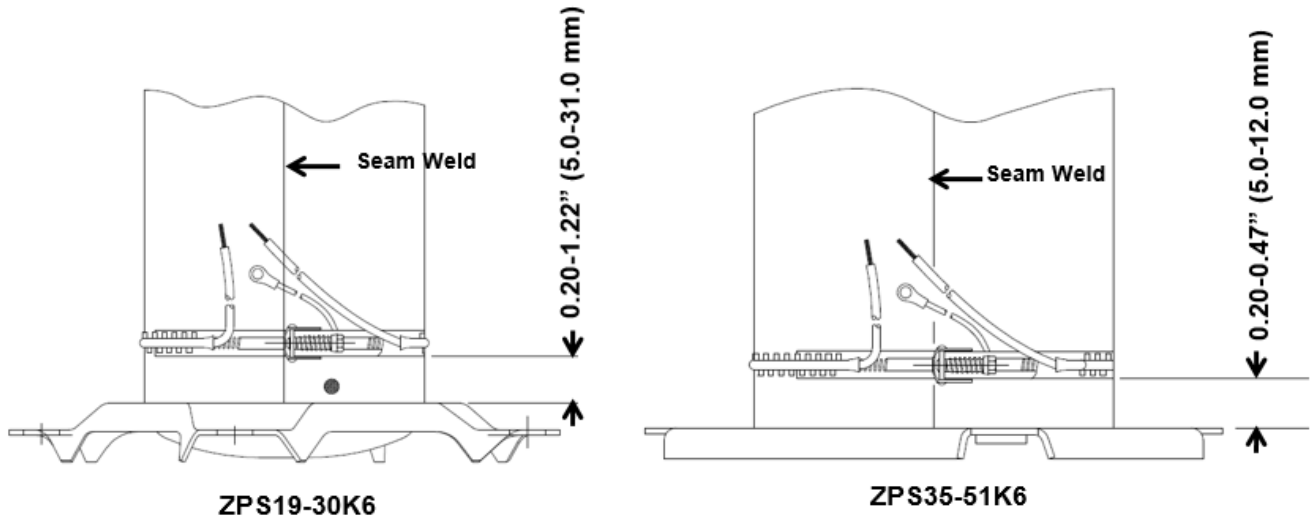


Figure 4
Example of Modulation Control Wiring with CoreSense

Connect the heater so that the connection point straddles the compressor seam weld



⚠ WARNING

Verify the correct crankcase heater voltage for the application and ensure heater is properly grounded

Figure 5
Crankcase Heater Location

Table 1 - Compressor Refrigerant Charge Limits

Model	Frame Size*	Charge Limit		120% x Limit**	
		Pounds	kg	Pounds	kg
ZPS19 - 30K6	53	8	3.6	9.6	4.3
ZPS35 - 51K6	63	10	4.5	12.0	5.4

*Approximate Shell Diameter (e.g. 63 = 6.5 Inches)

**Charge Allowance For System

Table 2 - Solenoid Resistance Values

Compressor Family	Compressor Models	Solenoid Resistance
ZPS*K6	All Models	1640 Ω

Table 3 - Compressor Accessories

Part Category	Part Description	Part Number	Models	Notes
Mounting	Compressor Mounting Kit	527-0044-15	ZPS19-31K6	30-35 Durometer
	Compressor Mounting Kit	527-0116-00	ZPS35-51K6	35-45 Durometer
Crankcase Heater	Crankcase Heater, 120V, 40W	018-0094-01	ZPS19-31K6	21" Leads
	Crankcase Heater, 240V, 40W	018-0094-00		21" Leads
	Crankcase Heater, 480V, 40W	018-0094-03		21" Leads
	Crankcase Heater, 575V, 40W	018-0094-04		21" Leads
	Crankcase Heater, 120V, 40W	018-0096-01	ZPS35-51K6	21" Leads
	Crankcase Heater, 240V, 40W	018-0096-00		21" Leads
	Crankcase Heater, 480V, 40W	018-0096-02		21" Leads
	Crankcase Heater, 575V, 40W	018-0096-03		21" Leads
	Crankcase Heater, 240V, 40W	018-0096-04		48" Leads
	Crankcase Heater, 480V, 40W	018-0096-05	48" Leads	
	Crankcase Heater Junction Box	998-7026-00	ZPS35-51K6	
Electrical	Grounding Screw	100-0605-00	All Models	10-32 x 8mm Long, Taptite Screw
	Molded Plug	529-0370-00	All Models	Universal Plug, 10 Gauge, 42" Leads
	Molded Plug Retainer Clip	032-0717-00	All Models	Locks the Molded Plug To Fence
	Flexible Metal Conduit Retainer	032-7051-01	All Models	use with 032-0717-00
	Modulation Plug	529-0061-00	All Models	Rectified Plug, OEM Use
	Modulation Plug	529-0062-00	All Models	OEM Use With CoreSense
	Modulation Plug	529-0138-01	All Models	OEM & Service, Universal Plug For All Applications
	Run Capacitor	Refer To Online Product Information At www.EmersonClimate.com For Model Specific Requirements		
	Start Capacitor			
	Start Relay			
SecureStart™	943-0120-00	All Models	1-Phase Only	
Diagnostics & Protection	CoreSense™ Diagnostics Module	571-0072-00	All Models	1-Phase Applications
	Discharge Line Thermostat	998-7022-02	All Models	Conduit Ready, fits 1/2" tube
Suction & Discharge	Discharge Rotalock O-Ring Seal	020-0028-00	All Models	
	Suction Rotalock O-Ring Seal	020-0028-02	All Models	
	Rotalock Service Valve, Disc 1/2"	998-0510-98	All Models	
	Rotalock Service Valve, Suct 3/4"	998-0510-38	ZPS19-31K6	
	Rotalock Service Valve, Suct 7/8"	998-0510-90	ZPS35-51K6	
	1/2" Disc Stub Adapter to 1"-14 Rotalock	036-0538-00	All Models	Requires 020-0028-00 Seal
	3/4" Suct Stub Adapter to 1-1/4"-12 Rotalock	998-0034-01	ZPS19-31K6	
	7/8" Suct Stub Adapter to 1-1/4"-12 Rotalock	998-0034-02	ZPS35-51K6	

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