

## P445 Series Electronic Lube Oil Control

The P445 Series Electronic Lube Oil Control is designed for use on refrigeration compressors equipped with an oil pump that accepts a single-point differential pressure transducer. The P445 senses net lube oil pressure and de-energizes the compressor if lube oil pressure falls below the manufacturer's recommendation for longer than the time delay. Front-mount LEDs (Light-Emitting Diodes) indicate the status of the lubrication system and a user-selectable time delay can be set to minimize compressor short cycling.

A Johnson Controls R10A Current Sensing Relay is also separately available to prevent the P445 from locking out during normal compressor off cycles.



**Figure 1: P445 Electronic Lube Oil Control with Sensor and Cable**

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>SPDT Relay Contacts for Liquid Line Solenoid and Alarm Applications</b>	Enables liquid line solenoid applications; Improves performance of alarm indication, including circuits which use neon lights
<input type="checkbox"/> <b>Relay Contact Output for Compressor</b>	Provides reliable, long-lasting operation
<input type="checkbox"/> <b>Built-in Test Circuit</b>	Verifies proper control operation quickly without additional tools or equipment
<input type="checkbox"/> <b>Improved Noise Immunity</b>	Exceeds requirements of UL 991 section 9 for transient overvoltage immunity and IEC 801-3 and IEC 801-6 for electromagnetic current immunity. This reduces the effect of noise caused by contacts or variable speed motor drives.
<input type="checkbox"/> <b>Selection of Anti-short-cycle Time Delay on Loss of Power</b>	Allows for choice of anti-short-cycle strategy for a wide range of equipment requirements; possible elimination of short-cycle timer
<input type="checkbox"/> <b>User-friendly Display Panel</b>	Continuously displays status of the compressor lubrication system
<input type="checkbox"/> <b>Standardized Mounting, Outer Case Size, and Wiring</b>	Easily replaces many existing electromechanical and electronic lube oil controls

# Dimensions

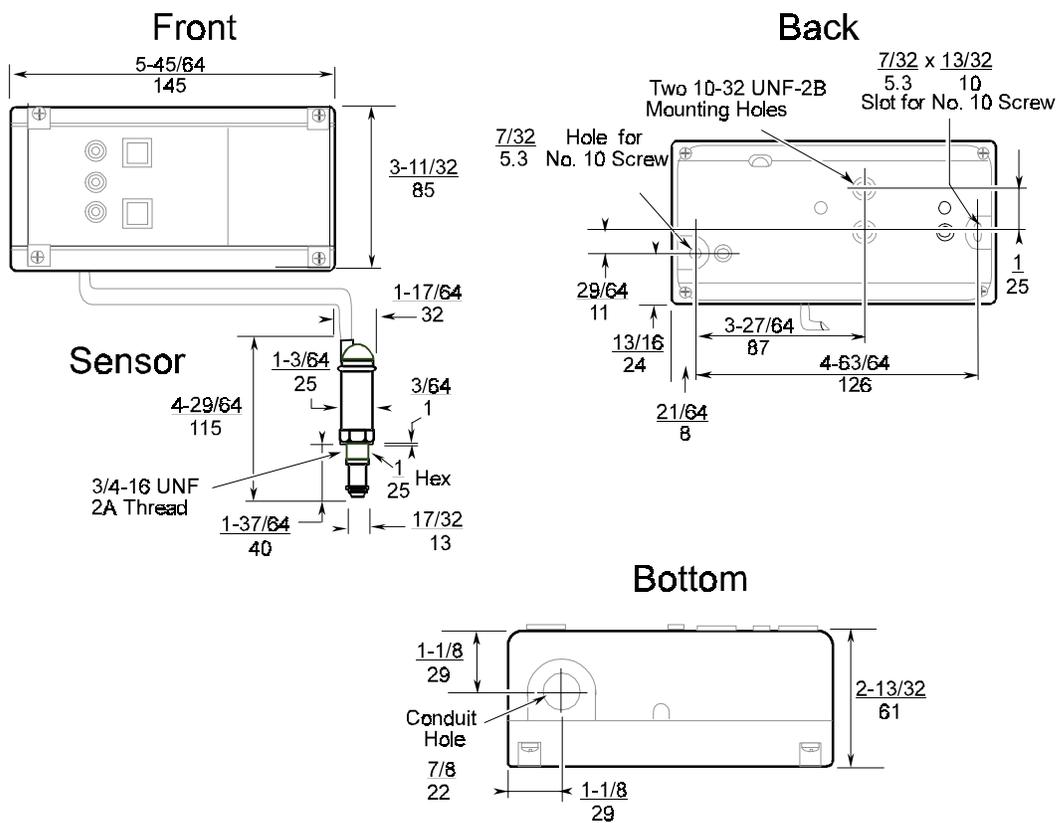


Figure 2: Control and Sensor Dimensions, in./mm

# Operation

The P445 operates as follows:

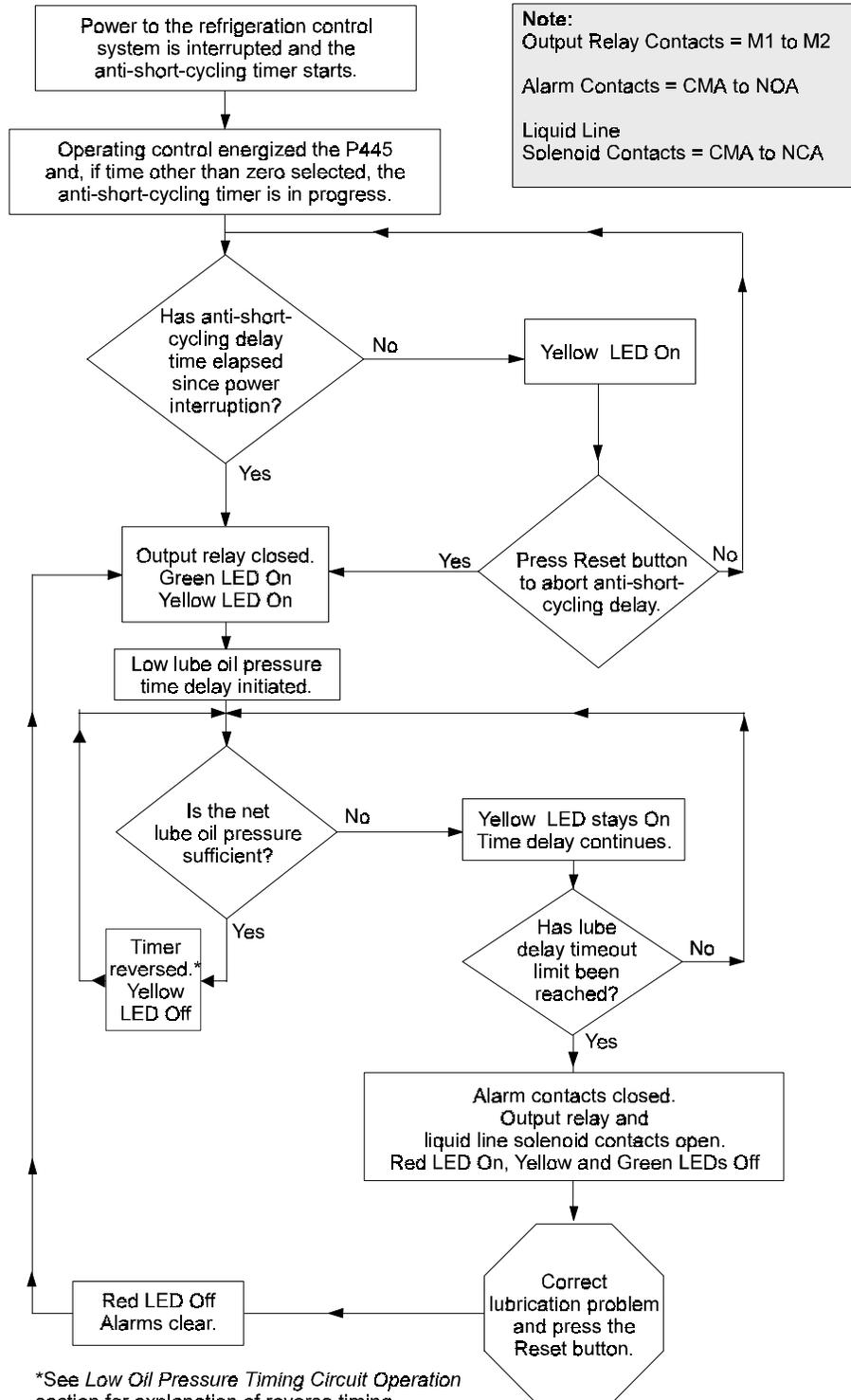


Figure 3: P445 Flowchart

## Installation

**WARNING:** All P445 Series Controls are designed for use **only** as operating controls. Where an operating control failure would result in personal injury or loss of property, it is the responsibility of the installer to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

To install:

1. If panel mounting the P445, use the mounting slots on the back of the control case. If mounting the control to a compressor, use the two threaded holes on the back of the control case. Use **only** the mounting screws provided. Damage to internal components may occur if other screws are used.

**Note:** The control is not position sensitive. When direct mounting to a compressor is required, a mounting bracket (Part No. 271-51) is available.

2. Use the following procedure to install the sensor:

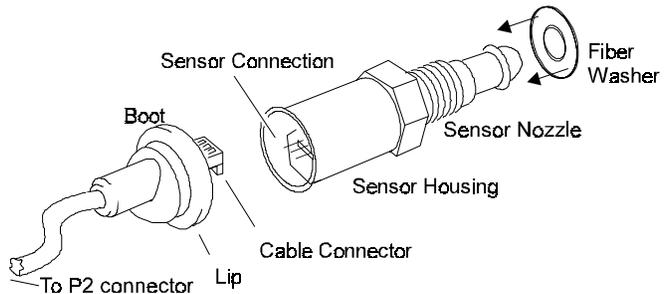
**Note:** When modifying an existing refrigeration compressor to accept the sensor, follow the procedures recommended by the original equipment manufacturer (e.g. a sensor block may be needed from the compressor manufacturer).

- a. Wipe and dry all mating surfaces before mounting the sensor.
- b. Fit the fiber washer over the sensor nozzle. (See Figure 4.)
- c. Install the sensor in the lube oil sensor port according to the compressor manufacturer's instructions.
- d. Hand tighten until surfaces of fiber washer and compressor housing meet.
- e. Tighten until sealed. **Do not** apply more than 25 lb-ft of torque to the fiber washer. Torque over 25 lb-ft may cause seal failure.

3. Use the following procedure to connect the cable to the sensor: (See Figure 4.)

- a. Roll the lip of the rubber boot back over itself.

- b. Insert the cable connector into the sensor connector.
- c. Roll the lip of the boot over the edge of the sensor housing.



**Figure 4: Sensor Installation**

4. Connect the sensor cable to the P445 at P2. See Figure 5 for the location and orientation of the sensor connection.

**Note:** The control will not lock out on low lube oil pressure with a backwards sensor connection at the sensor or at the circuit board.

### Setting the Anti-Short-Cycling Timer

To change the anti-short-cycling delay timer from the factory-set 100 second position, move the jumper into the desired position. (See Figure 5, Inset B.)

**Note:** If the jumper is completely removed, the P445 will operate at the default delay of 100 seconds.

### Johnson Controls R10A Series Relay Connection

To connect an R10A Wide Range Current Sensing Relay, cut and discard resistor R39. Connect the R10A to the two terminals, W1 and W2. (See Figure 5, Inset A.)

**IMPORTANT:** The R10A Relay will **not** work when the P445's anti-short-cycling delay timer is set at 0 seconds. Set the timer to 35, 65, or 100 seconds.

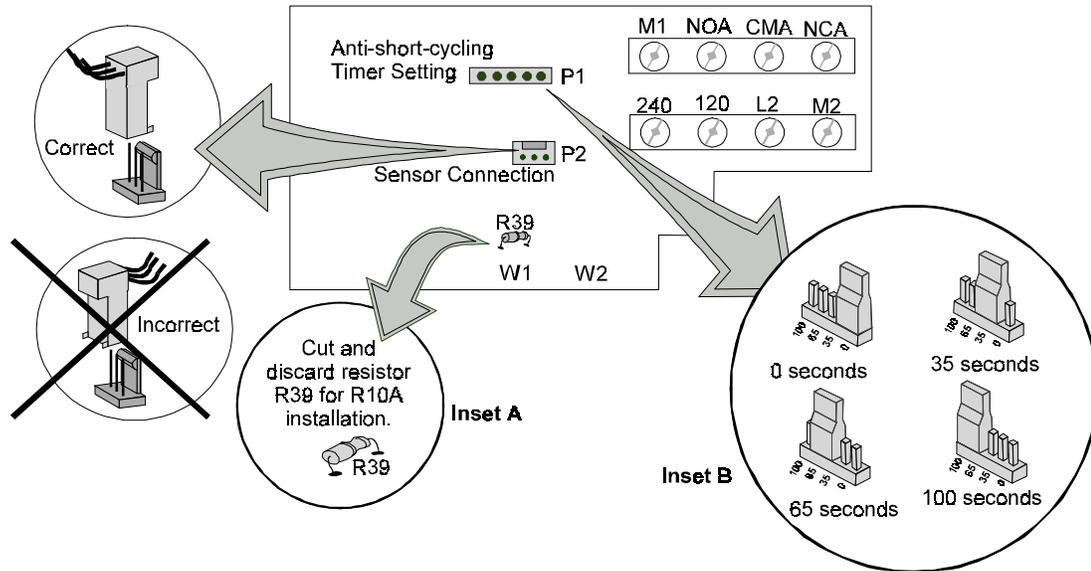
# Wiring

See Figures 6 through 11 for typical wiring diagrams or refer to compressor manufacturer's specifications.

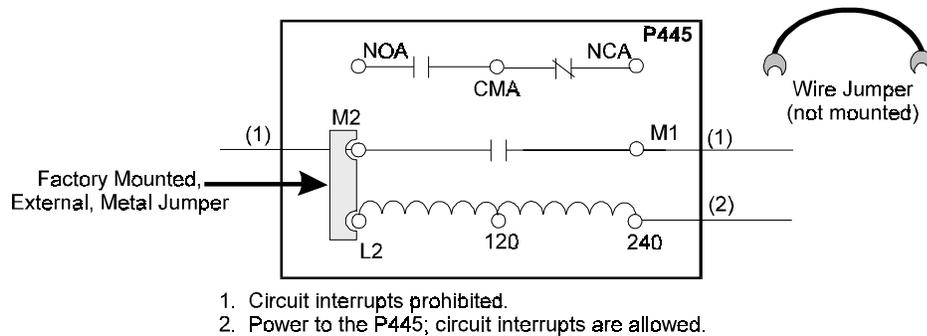
- Make all wiring connections using copper conductors only.
- All wiring must be installed to conform to the National Electric Code and local regulations.



**WARNING: Shock Hazard.** To avoid possible electrical shock or damage to equipment, disconnect power supply before wiring any connections.



**Figure 5: Terminal Designations and Jumper Positions for Anti-short-cycling Delay**



**Figure 6: P445 Ladder Diagram**

# Wiring Diagrams

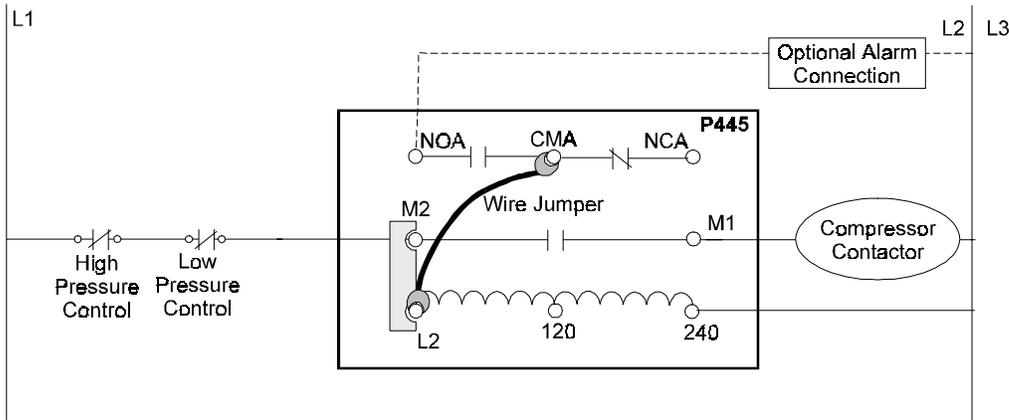


Figure 7: Typical P445 Application with Optional Alarm Circuit Powered by Line Voltage

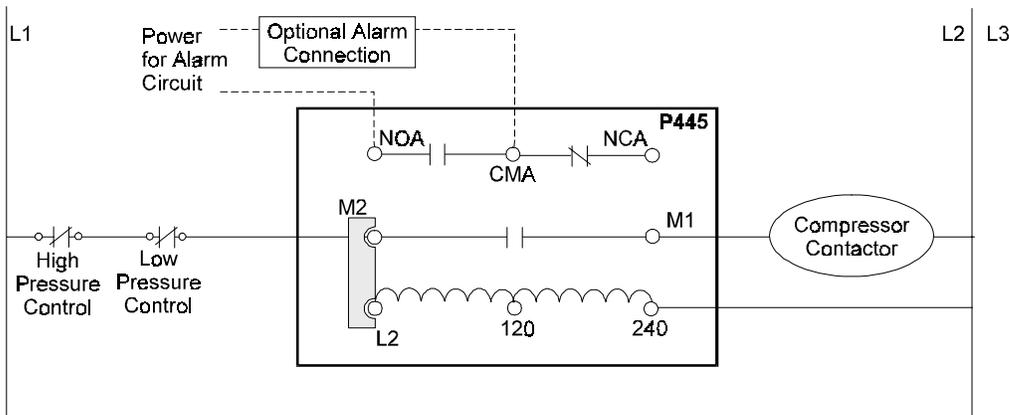


Figure 8: Typical P445 Wiring with Alarm Circuit Powered by a Separate Voltage

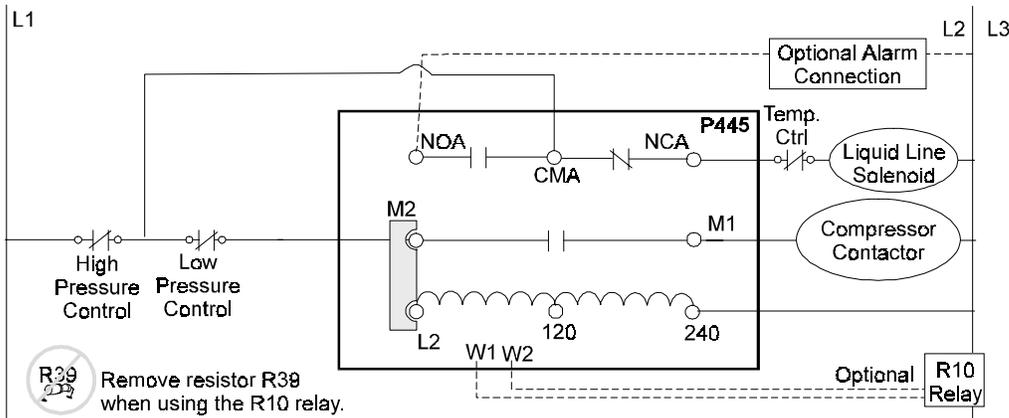


Figure 9: Typical P445 Application with Liquid Line Solenoid Valve

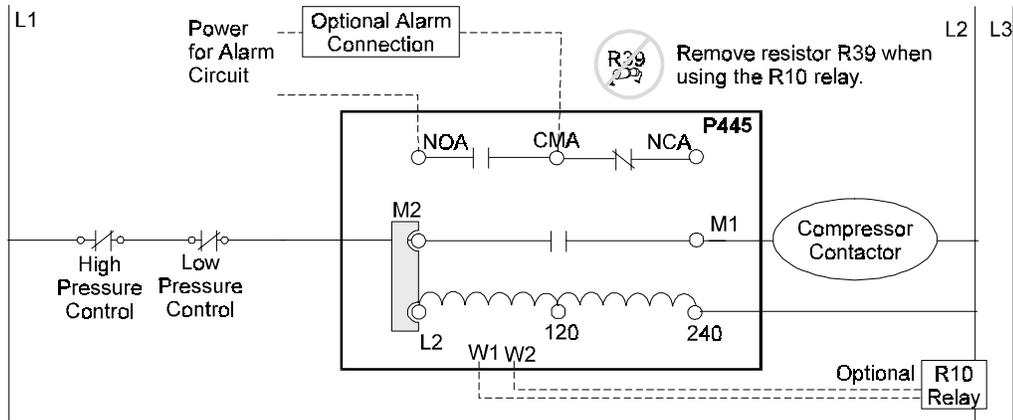


Figure 10: Typical P445 Application with Control in Front of Compressor Contactor

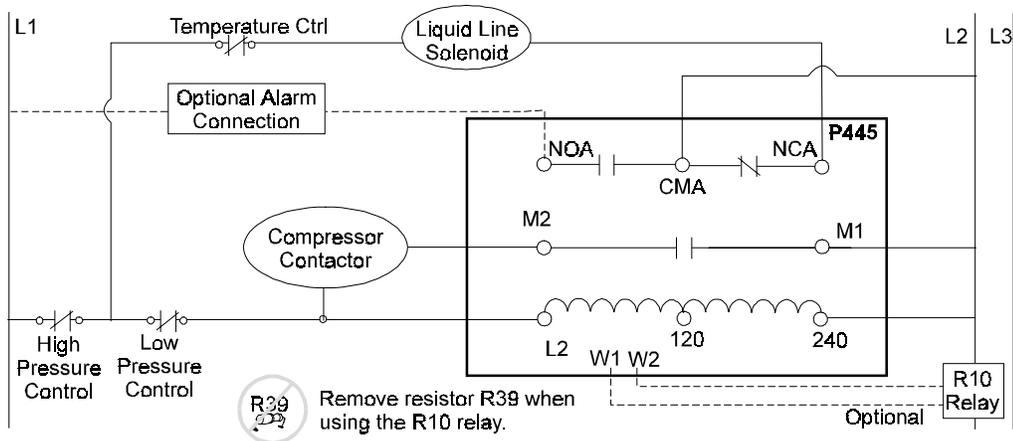


Figure 11: Typical P445 Application with Control After Compressor Contactor

## Checkout Procedures

### LEDs Operating Status

The operating status of LEDs are:

- Green LED only:** The compressor contactor is energized, and the system's net oil pressure is at or above the fixed setpoint of the P445 sensor.
- Green and Yellow LEDs (both):** The compressor contactor is energized, but the lube oil pressure is below the setpoint and the timing circuit is active.
- Red LED:** The P445 has de-energized the compressor contactor (lockout condition) because of a low lube oil pressure condition.
- Yellow LED only:** Power to the P445 has been interrupted and restored before the anti-short-cycling delay has elapsed. The compressor contactor will remain de-energized until the anti-short-cycling delay is complete, and then restart automatically.

## Low Oil Pressure Timing Circuit Operation

P445 timing functions are designed to comply with compressor manufacturer requirements. Standard P445 models de-energize the compressor contactor if the low pressure condition lasts longer than the factory set time delay or if repeated low pressure conditions occur within a short period of time.

The standard timing function used on the P445 is integrative; that is, the oil pressure monitoring circuit compares the amount of time that the oil pressure is above setpoint with the amount of time that the oil pressure is below setpoint. If the oil pressure is above setpoint more than it is below setpoint, the P445 will not shut down the compressor. If the oil pressure drops to zero, the P445 will time out in either 90 or 120 seconds, depending on the model. If the oil pressure is below setpoint more than half of the time, the P445 will time out based on the ratio of low pressure to good pressure. For example, if the oil pressure is below setpoint 2/3 of the time, the P445 will shut down the compressor after approximately 400 seconds. This allows the control to lock out on repeated low oil pressure signals that are interrupted by short periods of good pressure.

Special quantity orders are available with timing that resets every time the oil pressure rises above the setpoint. Call Johnson Controls Application Engineering at (414) 274-5035 for further information.

## Electrical Checkout Procedure

Use the following procedure to test the P445 during initial installation and maintenance.

1. De-energize the supply voltage to the P445 and the compressor circuit.



**WARNING:** To avoid the risk of electrical shock or damage to equipment, determine if more than one supply voltage exists and disconnect **all** power before proceeding.

2. Disconnect the contactor from the compressor motor or pull the disconnect to isolate the compressor during this part of the test.

Note: On systems using a current sensing relay (R10A), remove relay connections to P445 terminals (W1 and W2), and connect a jumper between these two terminals. (See Figures 5, 9, 10, and 11.)

3. Re-energize the supply voltage to the P445. Check that all operating and limit controls are closed.
4. The compressor contactor circuit energizes and both the yellow and green LEDs illuminate after the short-cycle delay has expired. The green LED indicates that the compressor contactor is energized. The yellow LED indicates that net oil pressure is low and the timing circuit is activated.
5. After the factory set low pressure time delay, the P445 de-energizes (locks out) the contactor. The red LED illuminates and the yellow and green LEDs turn Off. The P445's alarm contacts (Terminals CMA to NOA) close and the liquid line solenoid contacts (Terminals CMA to NCA) open.
6. Press Reset. The red LED turns Off and the green and yellow LEDs turn On. The contactor is now energized.

Note: **The P445 cannot be reset without power.** The control will remain in a lockout condition (compressor contactor de-energized) until the Reset button is pressed--even if power is removed from the P445.

7. De-energize the supply voltage. Reconnect the compressor leads to the contactor or reset the disconnect. If an R10A Series Relay is used, remove the jumper and reconnect the relay leads to the P445.
8. Re-energize the supply voltage. If the operating and limit controls are closed, and power has been removed for longer than the anti-short-cycling delay, the compressor will start and both the green and yellow LEDs will be illuminated. The yellow LED turns Off when the pressure level reaches the setpoint, *generally within seconds of starting the compressor.*

## Operational Control Test

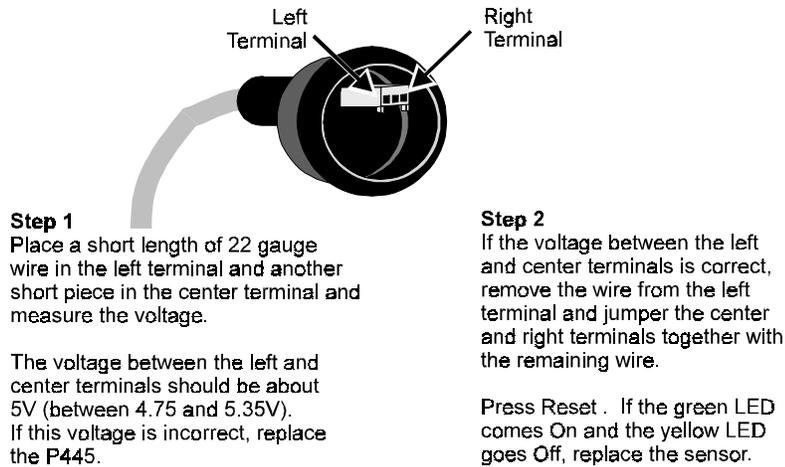
Use this test to check that the P445 is operating correctly. This test simulates a low oil pressure condition and initiates an abbreviated (eight second) timing cycle followed by a lockout of the compressor.

1. With power to the P445, adequate oil pressure, and the contactor energized (only the green LED is On), press and hold the Test button down.
2. The yellow LED (low pressure warning stage) will light for approximately eight seconds before the red LED illuminates and the P445 de-energizes (locks out) the compressor contactor. The P445 alarm circuit (NOA contact) will be energized.
3. Push the Reset button to energize the contactor and restart the motor.

## Troubleshooting

**Table 1: Troubleshooting P445 Problems**

LED Status	Troubleshooting Procedure
<b>Red LED On</b>	<ol style="list-style-type: none"> <li>1. Connect a pressure gage at the oil pump and at the crankcase.</li> <li>2. Press Reset. <ul style="list-style-type: none"> <li>• If the green and yellow LEDs light, but the compressor remains Off, check the wiring.</li> <li>• If the system immediately shuts down, the compressor may be overheated or the pressure sensor or sensor cable may be bad: <ol style="list-style-type: none"> <li>a. Check compressor temperature; if the compressor is overheated, an R10A Relay can be installed with the P445 to provide controlled shutdown based on thermal overload. Determine the cause of overheating and correct.</li> <li>b. Unplug the sensor cable from the sensor and press reset; if the system restarts correctly with the sensor unplugged, replace the sensor.</li> <li>c. If the system does not restart with the sensor unplugged, unplug the sensor cable from the P445 circuit board and press reset; if the system restarts correctly, replace the sensor cable.</li> </ol> </li> <li>• If the green and yellow LEDs both come On for the duration of the time delay and the system shuts down, observe the crankcase and oil pump pressure gages: <ol style="list-style-type: none"> <li>a. If the system does not reach sufficient oil pressure by the end of the time delay, check the compressor and system for problems.</li> <li>b. If the system does reach sufficient pressure, disconnect the sensor cable at the sensor, connect a voltmeter to the left and center pins of the sensor cable via two short pieces of 22 gauge wire (see Figure 12), and press Reset.</li> <li>c. If the voltage between these terminals is not approximately 5V (between 4.75 and 5.35V), test the sensor cable for continuity. Replace the cable and repeat this step if the cable is faulty.</li> <li>d. If the cable is OK, and the voltage is still insufficient, replace the P445.</li> <li>e. If the P445 and the cable are OK, remove the voltmeter and use a single piece of 22 gauge wire as a jumper between the center and right pins of the sensor cable (see Figure 12) and press Reset. If the green LED comes On and the yellow LED goes Off, replace the sensor; otherwise, replace the P445.</li> </ol> </li> </ul> </li> </ol>
<b>No LEDs</b>	Check power source.
<b>Dim, Flickering Yellow LED</b>	<ol style="list-style-type: none"> <li>1. Check power source.</li> <li>2. Confirm that the compressor is operating at sufficient pressure, without excessive pressure fluctuations.</li> <li>3. If the oil pressure is sufficient and the yellow LED still flickers, replace the sensor.</li> </ol>
<b>Control does not lock out the compressor when lube oil pressure is low.</b>	<ol style="list-style-type: none"> <li>1. Check sensor cable at circuit board and sensor for proper installation.</li> <li>2. Follow the procedure described in Figure 12 for troubleshooting the control and sensor.</li> </ol>



**Figure 12: Troubleshooting Using the Cable Terminals**

**Table 2: Troubleshooting R10A Relay Problems**

<b>Problem</b>	<b>Possible Solution</b>
<b>Control does not respond to R10A Relay.</b> (Control de-energizes compressor (red LED) after compressor shutdown.)	Make sure that the anti-short-cycle delay is <i>not</i> set at 0 seconds.
<b>Control does not respond to R10A Relay.</b> (Indicated by the green LED coming On for approximately 4 seconds and then turning Off, followed by the yellow LED turning On for the duration of the selected anti-short-cycle time delay. This process repeats indefinitely.)	<ol style="list-style-type: none"> <li>1. Check that resistor R39 has been cut and discarded.</li> <li>2. Check the R10A Relay; replace if necessary.</li> </ol>
<b>Contactor energizes for 3 or 4 seconds,</b> remains Off for anti-short-cycling time delay, and then repeats (compressor is unable to start during the 3 to 4 second period).	<p>Most likely caused by insufficient current to the R10A Current Sensing Relay (normal P445 operation for when there is no current).</p> <ol style="list-style-type: none"> <li>1. Check compressor for internal overloads.</li> <li>2. Check the compressor wiring.</li> <li>3. Check compressor's contactor.</li> <li>4. Check compressor for general failure.</li> </ol>

## Repairs and Replacement

Field repairs or calibration must not be made. Sensors, sensor cables, and replacement controls are

available as separate items through local Johnson Controls wholesalers and the original equipment manufacturer.

## Ordering Information

**Table 3: Ordering Information**

Product Code Number	Description
<b>P445NCB-22C</b>	Electronic Lube Oil Control, 120 Second Delay Before Lockout Fixed Setpoint Pressure: 9 psi (62 kPa), 36 in. Cable, Includes Sensor with Long Fitting and American Threads (Copeland)
<b>P445NCB-25C</b>	Electronic Lube Oil Control, 90 Second Delay Before Lockout Fixed Setpoint Pressure: 10 psi (69 kPa), 48 in. Cable, Includes Sensor with Short Fitting and Metric Threads (Tecumseh/Bitzer)
<b>P445NCB-82C</b>	Electronic Lube Oil Control, 120 Second Delay Before Lockout Fixed Setpoint Pressure: 6.5 psi (44.8 kPa), 36 in. Cable, Includes Sensor with Long Fittings and American Threads (Carlyle)
<b>P300AC-3C</b> <b>P300AC-4C</b> <b>P300BC-2C</b>	P445NCB-82 Replacement Sensor: 6.5 psi (44.8 kPa) P445NCB-22 Replacement Sensor: 9 psi (62 kPa) P445NCB-25 Replacement Sensor: 10 psi (69 kPa)
<b>KITP445-82C</b>	P445NCB-82 Electronic Lube Oil Control, 120 Second Delay Before Lockout Fixed Setpoint Pressure: 6.5 psi (44.8 kPa), 36 in. Cable, Includes Sensor with Long Fittings and American Threads (Carlyle) CST29A-600C Sensor Block for Carlyle Compressor Series O6CC, O6D, and O6E; includes Allen Head Bolts Note: Contact Carlyle Compressor Co. at (513) 432-6000 to order O6DA505632 Sensor Block Gasket
<b>WHA27A-601R</b> <b>WHA27A-602R</b> <b>WHA27A-603R</b> <b>WHA27A-600R</b> <b>WHA27A-604R</b> <b>WHA27A-605R</b> <b>WHA27A-606R</b> <b>WHA27A-607R</b>	Sensor Accessory Cable; Available Lengths: 12 in. (±0.25 in.) 18 in. (±0.25 in.) 24 in. (±0.25 in.) 36 in. (±0.25 in.) 48 in. (±0.25 in.) 60 in. (±0.25 in.) 72 in. (±0.50 in.) 96 in. (±0.50 in.)
<b>R10A-2C</b>	Wide-range Current Sensing Relay
<b>271-51</b>	Universal Mounting Bracket

# Specifications

<b>Product</b>	P445NCB Electronic Lube Oil Control; manual reset, with alarm and liquid line solenoid outputs	
<b>Power Requirements</b>	120 or 240 VAC, 50/60 Hz +10%, -15%; power consumption: 3 VA	
<b>Fixed Setpoint Pressure</b>	P445NCB-82:	6.5 psi (44.8 kPa)
	P445NCB-22:	9 psi (62 kPa)
	P445NCB-25:	10 psi (69 kPa)
<b>Lube Oil Time Delay (Factory Settings)</b>	P445NCB-25:	90 ±12 seconds
	P445NCB-22, P445NCB-82:	120 ±15 seconds
<b>Anti-short-cycling Timer</b>	Four selectable positions: 0, 35, 65, and 100 seconds (nominal times)	
<b>Type of Refrigerant</b>	Non-corrosive refrigerants only	
<b>Maximum Electrical Rating</b>	Isolated relay output to compressor contactor (M-1 and M-2) Pilot duty 375 VA at 120 VAC, 750 VA at 240 VAC	
<b>Electrical Connections</b>	Control:	Screw type terminals on a barrier terminal strip
	Sensor:	3-pin plug and accessory cable
<b>Alarm Circuit (Relay)</b>	NOA contact:	Pilot duty 125 VA at 120/240 VAC; 60 W at 120/240 VAC tungsten
	NCA contact:	Pilot duty 125 VA at 125 VAC, 250 VA at 250 VAC
<b>Backplate Material</b>	0.062 in./1.6 mm cold rolled steel	
<b>Case and Cover Material</b>	High impact thermoplastic	
<b>Ambient Operating Conditions</b>	-40 to 131°F (-40 to 55°C)	
<b>Ambient Storage Conditions</b>	-40 to 185°F (-40 to 85°C)	
<b>Agency Listings</b>	UL File SA516, guide SDFY cUL file SA516, guide SDFY7	
<b>Dimensions (L x W x D)</b>	Control: 5-45/64 in. x 3-11/32 in. x 2-13/32 in. (145 mm x 85 mm x 61 mm) Sensor: 4-29/64 in. x 1-3/64 in. (115 mm x 25 mm)	
<b>Approximate Shipping Weight</b>	1.70 lb (0.515 kg)	
<b>Accessories</b>	See <i>Table 3: Ordering Information.</i>	
<b>Sensor Differential Pressure</b>	6.5 psi (44.8 kPa)	
<b>P300AC-3C</b>	9 psi (62 kPa)	
<b>P300AC-4C</b>	10 psi (69 kPa)	
<b>P300BC-2C</b>		
<b>Sensor Overpressure</b>	No reverse pressure allowed 100 psi (690 kPa) maximum differential (high to low) pressure; 225 psig (1551 kPa) maximum system pressure (high, low, or both with differential <100 psi)	
<b>Sensor Torque</b>	25 lb·ft maximum	

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.



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