

## OIL PRESSURE SAFETY CONTROL FOR SEMI-HERMETICS

### 1 Oil Pressure Differential Switches

The oil pressure differential switch breaks the control circuit and shuts down the compressor when the pressure difference between the oil pump outlet and the crankcase is too low. The switch must be correctly calibrated and tamper proof. If the oil differential pressure drops below the minimum acceptable value the compressor will be stopped after a 120 seconds delay. If the oil pressure switch trips it should not be reset or by-passed but the cause for the failure must be found prior to resetting then starting up again.

**NOTE:** Oil pressure safety control with an approved switch is a condition of warranty !

#### Oil Pressure Differential

Normal oil pressure is between 1.05 and 4.2 bar higher than crankcase pressure. Net oil pressure can be read by connecting two pressure gauges and comparing the readings, one should be connected to the oil pump and the second to the crankcase or the suction service valve. If the differential is lower than 0.63 Bar, the oil pressure switch should trip.

#### Reasons For Low Oil Pressure

##### Low oil level (seen in the compressor oil sight glass)

- Check that the pressure in the crankcase is lower than the suction valve pressure by 0.1 bar (this pressure differential helps the oil to come back to the crankcase).
- Poor oil return to the compressor caused by low refrigerant pipeline velocities.
- Oil carryover into the system caused by too frequent start-up of the compressor while the time required for oil return is not available due to frequent switching-off and on.
- Oil foaming on start up caused by too high refrigerant concentration in the oil in the crankcase.

##### If there is sufficient oil in the compressor

- The oil screen may be blocked.
- The crankcase may be full of a refrigerant / oil mixture due to the migration of refrigerant from evaporator to compressor during standstill then it is possible to see foaming during start up. The oil pump cannot build sufficient oil pressure
- The expansion valve may be operating badly or is adjusted incorrectly, which results in a too low superheat of the suction gases or delayed injection of refrigerant
- The oil temperature could be too high.

##### Failure of the compressor may occur if

- The oil circulation circuit becomes blocked with dirt.
- The oil pump fails.

#### **If the oil pressure differential and level are OK but the pressure switch trips!**

- If the oil pressure safety control is energized during standstill, when there is no oil differential pressure, this security device will trip, and the compressor will not manage to start.
- The oil pressure safety control may be faulty.

After having solved the problem the control has to be reset manually.

## 2 OPS1 Oil Pressure Differential Switch

### 2.1 Application:

Monitoring the oil differential pressures in refrigeration compressors. OPS1 consists of two parts: a pressure sensor and an electronic switch. It is easy to apply and due to the pre-assembled sensor environmentally friendly, the risks of refrigerant leakage are minimized.

The pressure sensor of the oil differential switch is directly screwed into the pump housing of the compressor. Internal channels link the switch to the suction and discharge ports of the oil pump. No capillary connections are necessary. The electronic switch can be fitted or removed without opening the refrigeration circuit.

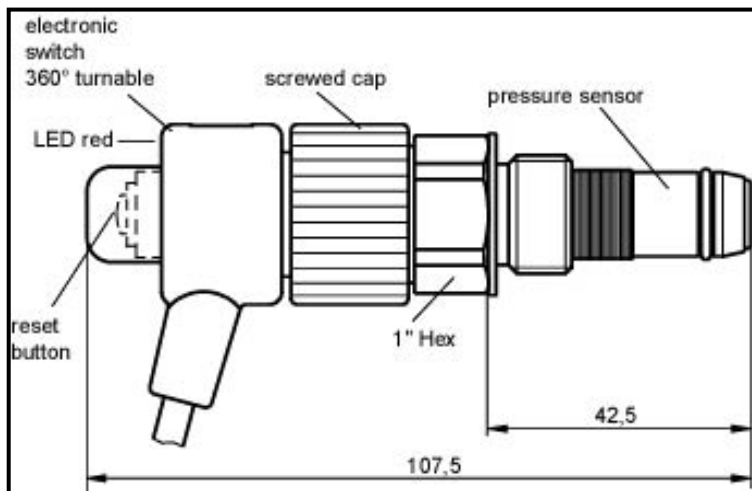


Figure 1: OPS1

### 2.2 Functional description:

The differential pressure monitor is activated when the supply voltage is applied via an auxiliary contact of the motor contactor K1. A red LED signals insufficient differential oil pressure immediately. Once the pre-set value has been reached, the LED is extinguished. The output contact remains closed when the set value is reached/exceeded. If the oil differential pressure remains or drops below the set value for longer than the time delay time, the output contact opens and locks out mechanically. Depressing the reset button can reactivate the switch. Shorter periods of insufficient differential pressure are also recognised by the internal microprocessor circuitry and lead to a trip and lockout after correspondingly extended delay time (integration).

#### IMPORTANT

- Trained electrical personnel must connect the unit. All valid standards for connecting electrical and refrigeration equipment must be observed. Limit values for the supply voltage of the unit may not be exceeded. The oil differential switch needs no maintenance.

2.3 Technical data Oil Pressure Switch 1 (OPS1)

Supply voltage	AC 50/60 Hz 230V +/- 10% 10VA
Ambient temperature range	-30.....+60°C
Time delay	120 s
Cut-in pressure (fixed)	0,95 bar +/- 0,15 bar
Cut-out pressure (fixed)	0,63 bar +/- 0,15 bar
Switching capacity	AC 250 V, max. 2,5A, 720 VA ind.
Refrigerant compatibility	yes (brass)
Protection class according EN 60529	IP54
Reset	manual
Connection cable	4xAWG20 (0,5 mm <sup>2</sup> ), L=1m colour coded cores
Weight	ca. 200 g

Table 1: Technical data

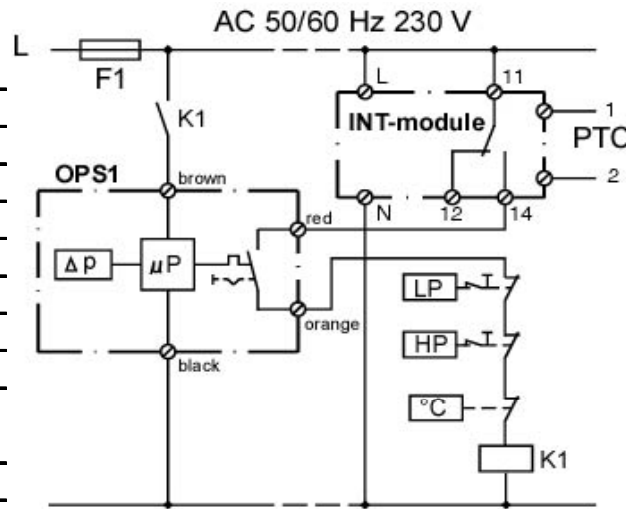


Figure 2: Wiring

2.4 Wiring Diagram OPS1 with Auxillary Relay KD (Alarm Integration)

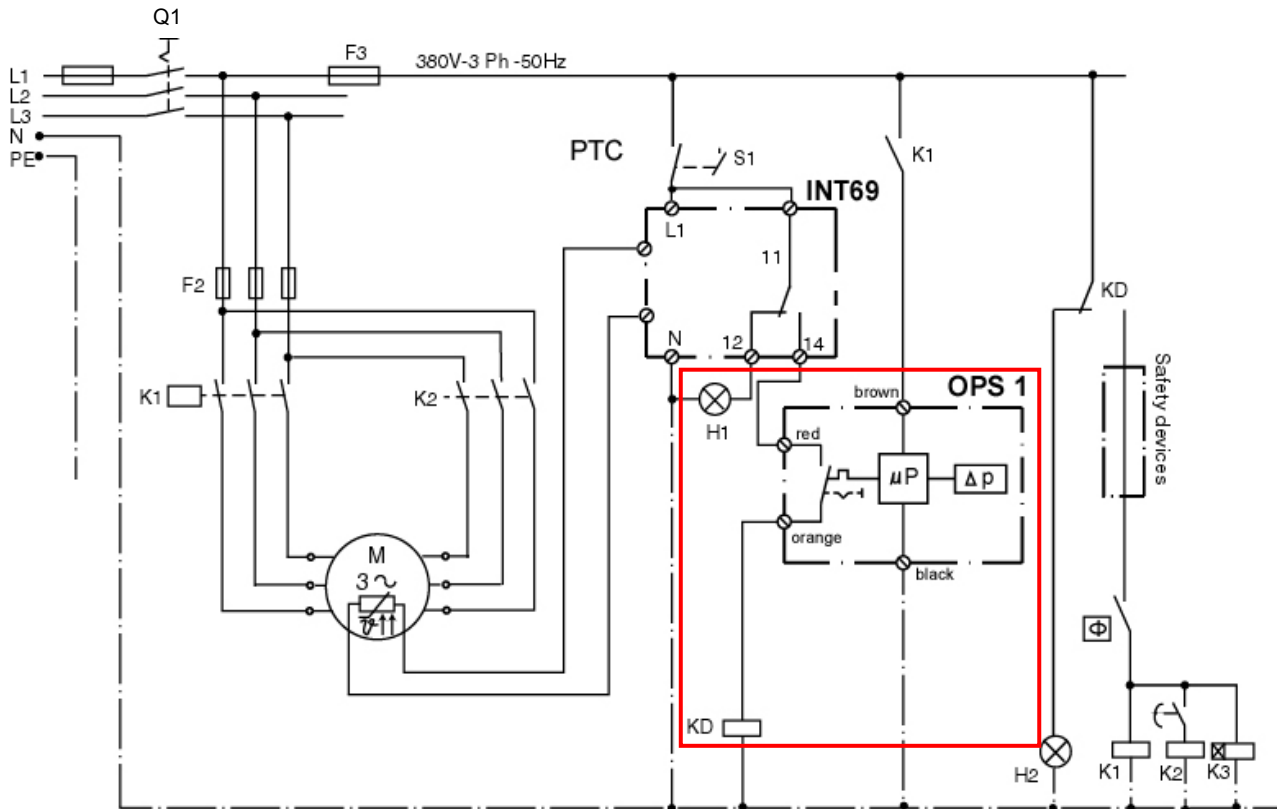


Figure 3: Wiring diagram

### 3 SENTRONIC™ Oil Pressure Safety System

All Standard compressors have an oil pump that is compatible with the electronic oil pressure safety system – SENTRONIC<sup>+</sup>. This can be delivered as an option. It consists of:

1x	module (1)	2x	bolts
1x	sensor (2)	2x	lock washers
1x	mounting bracket	1x	O-ring (3)
2x	self locking nuts	1x	gasket (4)

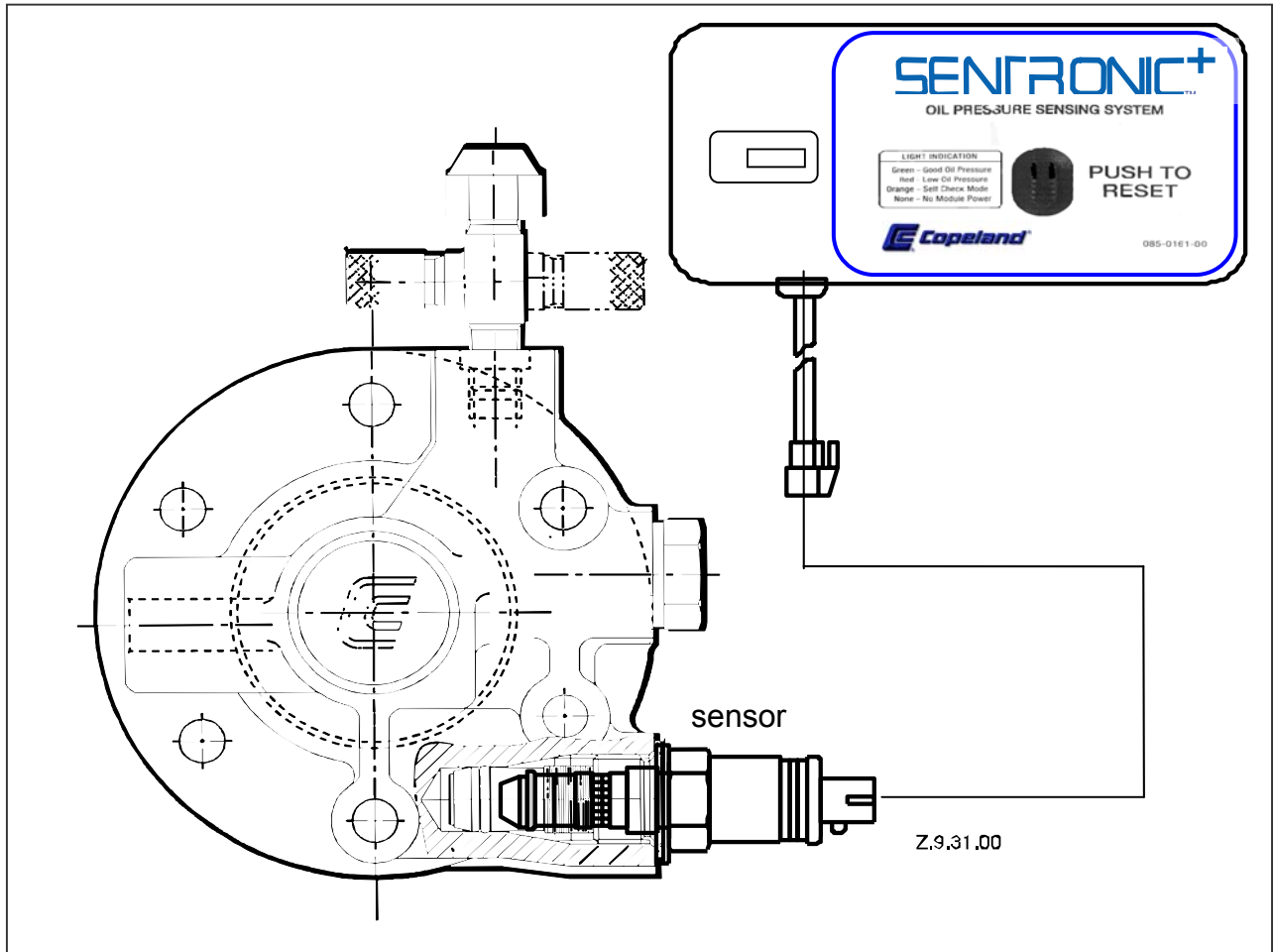


Figure 4: Sentronic<sup>+</sup>

#### Technical Data

Cut-out pressure:	0.55	±	0.1 bar
Cut-in pressure:	0.90	±	0.1 bar
Time delay:	120	±	15 s
maximum switching current:	720 VA 120/240 V		
maximum ambient temperature:	66°C		
manual reset			
built-in alarm connection			



### 3.1 Operation

The differential pressure between the pump outlet and the crankcase is measured by the sensor and converted to an electronic signal. If the net oil pressure of a running compressor drops to  $0.55 \pm 0.1$  bar the compressor will be shut down after a time delay of  $120 \pm 15$  seconds. During periods of erratic oil pressure the module will monitor the pressure and add the periods of time when it is under the cut-in point of  $0.9 \pm 0.1$  bar. When these periods of inadequate oil pressure total 2 minutes the module will shut down the compressor. When 4 minutes of adequate pressure are measured the timer resets to zero. In case of interruption of the power supply the SENTRONIC<sup>+</sup> module holds stored information for one minute.

**NOTE:** Proper oil-pressure safety control with an approved switch is a condition of warranty!

### 3.2 Mounting

The module is fitted to the bracket using two screws and lock washers (torque 2.5 Nm). The assembly is then mounted on the bearing housing cover studs, using self-locking nuts (torque 25 Nm). When not under pressure, remove the lower oil pump plug, the O-ring, the gasket and discard. Fit the sensor using a new O-ring and gasket and torque to 105 Nm. Connect the sensor to the module.

### 3.3 Electrical Connection

Power is supplied to the module on terminals “240V” or “120V” and “2”. Neutral must be connected to terminal “2”. The control circuit is to be connected on terminal “L” and “M”. The “A” terminal can be used to power an external alarm. An earth connection is also provided.

The module operation is powered by an internal transformer which is connected across terminal “2” and “120” or “240” depending on voltage.

D2S, D3S & D9R/T

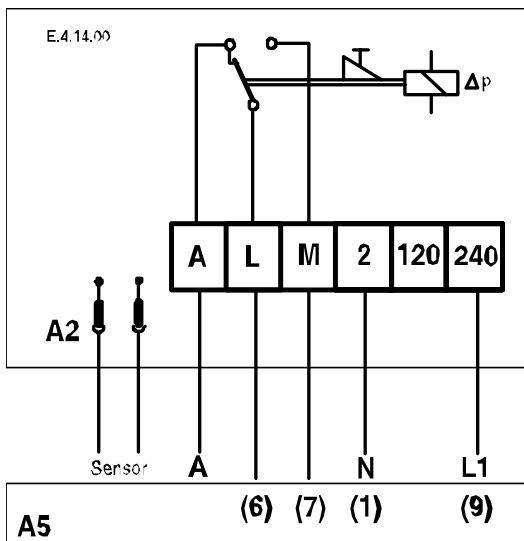


Figure 5

D4S, D6S/T, D8S

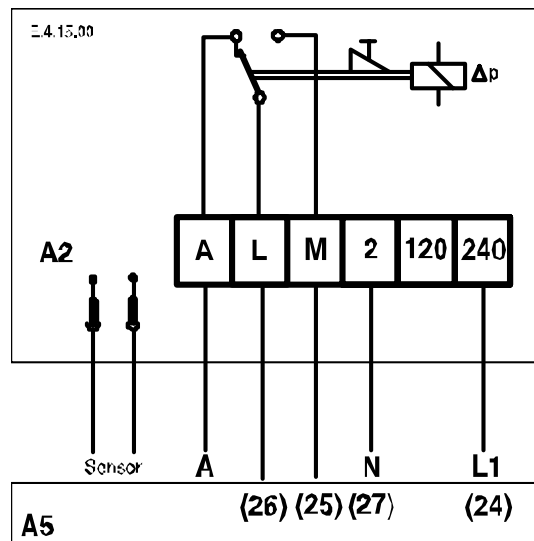


Figure 6

- |   |                            |    |                     |                         |                                |
|---|----------------------------|----|---------------------|-------------------------|--------------------------------|
| A | alarm connection           | 2  | neutral connection  | <b>A5</b>               | <b>compressor terminal box</b> |
| L | control voltage connection | L1 | voltage connection  | Protection class: IP 31 |                                |
| M | control circuit            | A2 | oil pressure switch |                         |                                |

### 3.4 Operation Test

- 1) The SENTRONIC<sup>+</sup> module can be tested as follows:
- 2) Turn off the power supply.
- 3) Remove the sensor connection.
- 4) Turn on power supply.
- 5) After 2 mins.  $\pm$  15 s (time delay) the contact between “L” and “M” should be open and the contact between “L” and “A” closed (shutdown test).

While power is off connect the sensor connections in the module in a short circuit. Put the module back in operation using the reset button. On restart the module should not switch after the allowed time has elapsed.

The sensor can be checked with an ohmmeter. Disconnect the cable and measure the sensor resistance at the sensor connections. This should show infinity when the compressor is stopped and 0  $\Omega$  when the compressor is running with sufficient oil pressure. The oil pressure can be checked by measuring the differential pressure between the Schraeder valve and the compressor crankcase. This is approximately the same as the pressure measured by the SENTRONIC sensor.

The Sentronic<sup>+</sup>™ features Copeland’s LED diagnostics to allow for easier evaluation of oil pressure conditions. The system also features improvements to several component parts to reduce the frequency of nuisance trips caused by electromagnetic noise sensitivity. These improvements also eliminate the requirement for shielded cable and allow for splicing of the sensor cable up to a total length of 6 m. It also provides the same reliable oil flow pressure differential monitoring capability of the previous Sentronic™; however, there are a few new features worth noting as shown in the following list.

- 1) The Sentronic<sup>+</sup> module features a “new look” plastic cover that will allow it to be distinguishable from the previous model.  
It will have a new sensor and module that includes a standard 60 cm cable. An optional 3m cable extension is available.
- 2) The terminal strip will accommodate bare wire connections and does not use a “spade” type terminal. The reset button must be pressed and released to activate the control. The oil pressure control will be momentarily by-passed while the reset button is pressed and the compressor could be running during this brief period without adequate oil pressure. It is recommended that the reset button be held at full depression for no longer than 2 seconds during the reset procedure.
- 3) Since the control system is by-passed when the Sentronic+ reset button is pressed and will continue to run, the reset button cannot be used to “jog” the compressor to clear liquid during start-up. The system control on/ off must be used to clear liquid during start-up.
- 4) The new Sentronic+ module cable is not compatible with the previous used (“old style”) sensor. Use of the new module with the old style sensor requires adapting the old style cable to the new module (as described in the Interchangeability pages following).
- 5) The cable on the old style module will not connect properly to the new sensor. Copeland recommends upgrading to the complete Sentronic<sup>+</sup> system if the old Sentronic™ sensor must be replaced.

### 3.5 Interchangeability of Sentronic™ & Sentronic<sup>+</sup>™ Modules & Sensors

The new Sentronic<sup>+</sup>™ oil pressure control uses both a new module and a new sensor. The sensors and module can be made compatible with older generation components if the following steps are taken:

- To use a Sentronic<sup>+</sup> module with an older Sentronic™ sensor, the original Sentronic sensor cable must be wired to the new Sentronic<sup>+</sup> module.
- To use an older Sentronic module with a Sentronic<sup>+</sup> sensor the new Sentronic<sup>+</sup> cable must be wired to the Sentronic module.

There is an older generation Sentronic module that is fully compatible with the new Sentronic<sup>+</sup> sensor. It is supplied with the new (Sentronic<sup>+</sup>) cable that is gray for identification purposes, see illustration below.

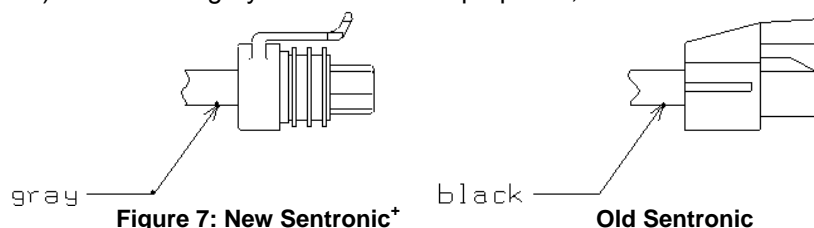


Figure 7: New Sentronic<sup>+</sup>

Old Sentronic

### 3.6 Connecting the Sentronic<sup>+</sup> module to an old Sentronic sensor

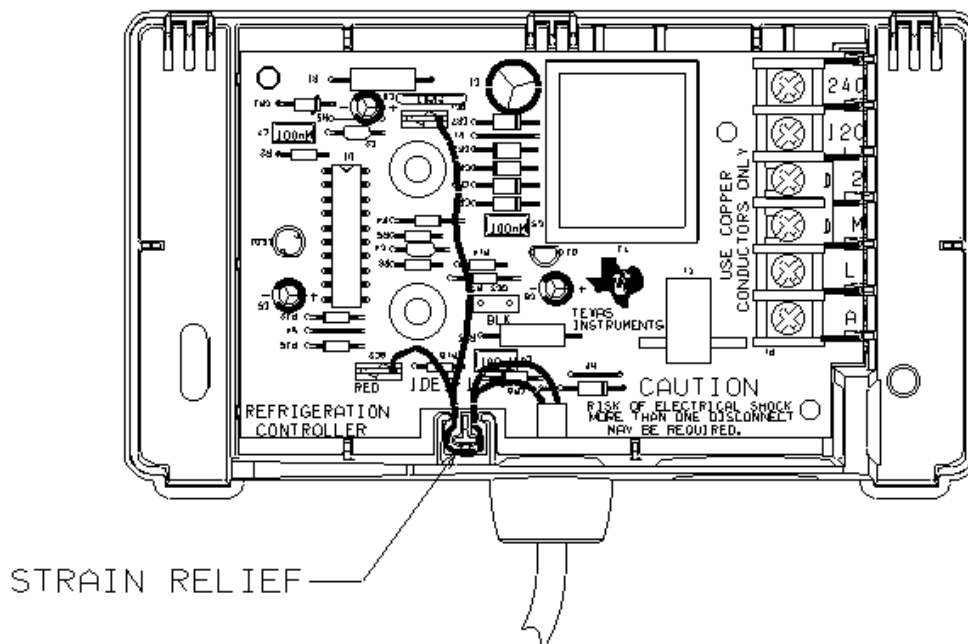


Figure 8

#### Removing the cable from the old Sentronic module:

- Disconnect power to the old module
- Disconnect the cable from the sensor
- Remove the cover from the old module
- Remove the two cable quick connections from the circuit board
- Using pliers, squeeze the strain relief slots and pull to remove the cable from the module
- Remove the old module from the compressor

#### Removing the cable from the new Sentronic<sup>+</sup> module:

- Remove the cover from the Sentronic<sup>+</sup> module
- Pull the 2 cable quick connects from the circuit board (these are labeled “Org” and “Red”)
- Remove the wires from the strain relief (note the routing of the wires for future reference) and lift the wires out
- Remove the wire cable from the module by twisting the conduit counterclockwise and gently pulling

#### Connecting the old cable to the Sentronic<sup>+</sup> module:

- Trim approximately 2” of cable sheathing from the module end of the old cable, taking care not to nick the wire insulation
- Feed the wires into the module through the hole in the bottom of the case
- Leaving enough lead length to reach the quick connects, push the wires into the strain relief.
- Connect the 2 quick-connects to the “ORG” and “RED” spades. (Note: the connections may be interchanged; there is no polarity on these wires).
- Install the module to the compressor and make wiring and sensor connections per the general instructions.

### 3.7 Connecting the old Sentronic module to a new Sentronic<sup>+</sup> sensor

Removing the cable from the new Sentronic<sup>+</sup> module:

- Disconnect power to the module
- Disconnect the cable from the sensor
- Remove the cover from the Sentronic<sup>+</sup> module
- Pull the 2 cable quick connects from the circuit board (these are labeled “Org” and “Red”)
- Remove the wires from the strain relief by lifting the wires out
- Remove the wire cable from the module by twisting the conduit counterclockwise and gently pulling

Removing the cable from the old Sentronic module:

- Remove the cover from the old module
- Remove the two cable quick connections from the circuit board
- Using pliers, squeeze the strain relief slots and pull to remove the cable from the module
- Retain the strain relief from the cable for use on the Sentronic<sup>+</sup> cable

Connecting the new cable to the old Sentronic module:

- Position the strain relief on the new cable at the termination of the conduit
- Feed the wires into the module through the hole in the bottom of the case
- Push the strain relief into position to lock it
- Connect the two quick connects to the circuit board. There is no polarity on the leads.
- Install the module on the compressor and make wiring and sensor connections per the general instructions supplied with the module.

#### Sentronic<sup>+</sup> Terminal Strip

- The Sentronic<sup>+</sup> module terminal strip is designed to accept a bare wire end instead of a spade terminal
- If a Sentronic<sup>+</sup> module is being retrofitted to a system with spade connections, the spade may be clipped off and ¼” of the wire end stripped or one leg of the spade may be clipped off for insertion into the terminal strip



#### 4 Oil-Pressure Differential Switch

The oil-pressure switch breaks the control circuit when the pressure difference between the oil pump outlet and the crankcase is too low. The switch must be properly adjusted and tamper proof. If the oil differential pressure falls below the minimum acceptable value the compressor will be stopped after a 120 sec. delay. After having eliminated the cause of the malfunction, a manual reset is required.

**NOTE** Proper oil-pressure safety control with an approved switch is a condition of warranty!

Specifications for electro-mechanical oil –pressure switches follow:

Cut-out pressure: 0.63 ± 0.14 bar  
 cut-in pressure: 0.90 ± 0.1 bar  
 time delay: 120 ± 15 sec

The bracket for this switch is supplied loose with 4 and 6 cylinder compressors.



##### 4.1 Oil Pressure Switch - ALCO FD 113 ZU (A22 - 057) DLH, D2S, D3S & D9R/T

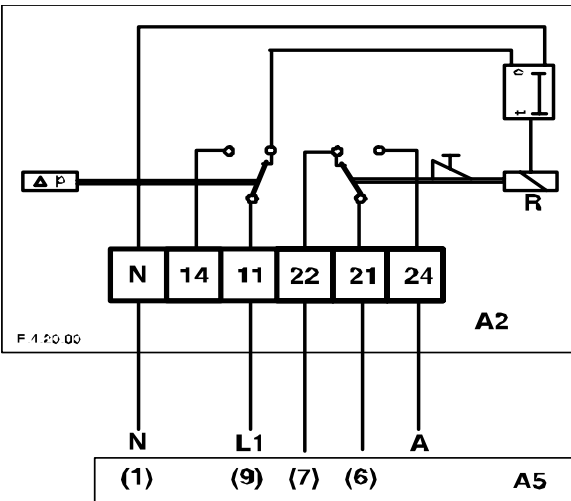


Figure 9

N neutral connection  
 11 voltage connection  
 21 control voltage connection  
 Protection class: IP 30

22 control circuit  
 24 alarm connection  
 A2 oil pressure switch

##### D4S, D6S/T, D8S

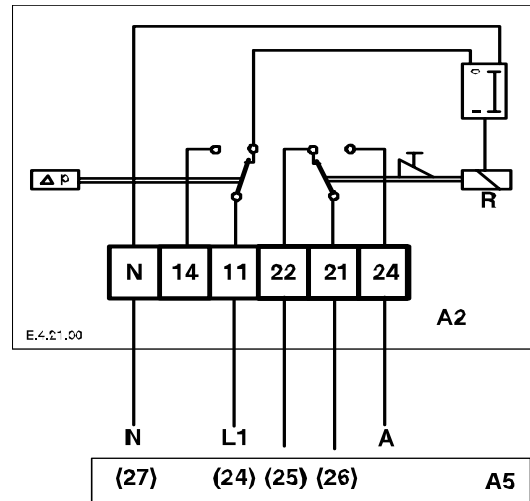


Figure 10

A5 compressor terminal box  
 R relay  
 t time delay

4.2 Oil Pressure Differential Switch Alco FD 113 ZU DLH – D8

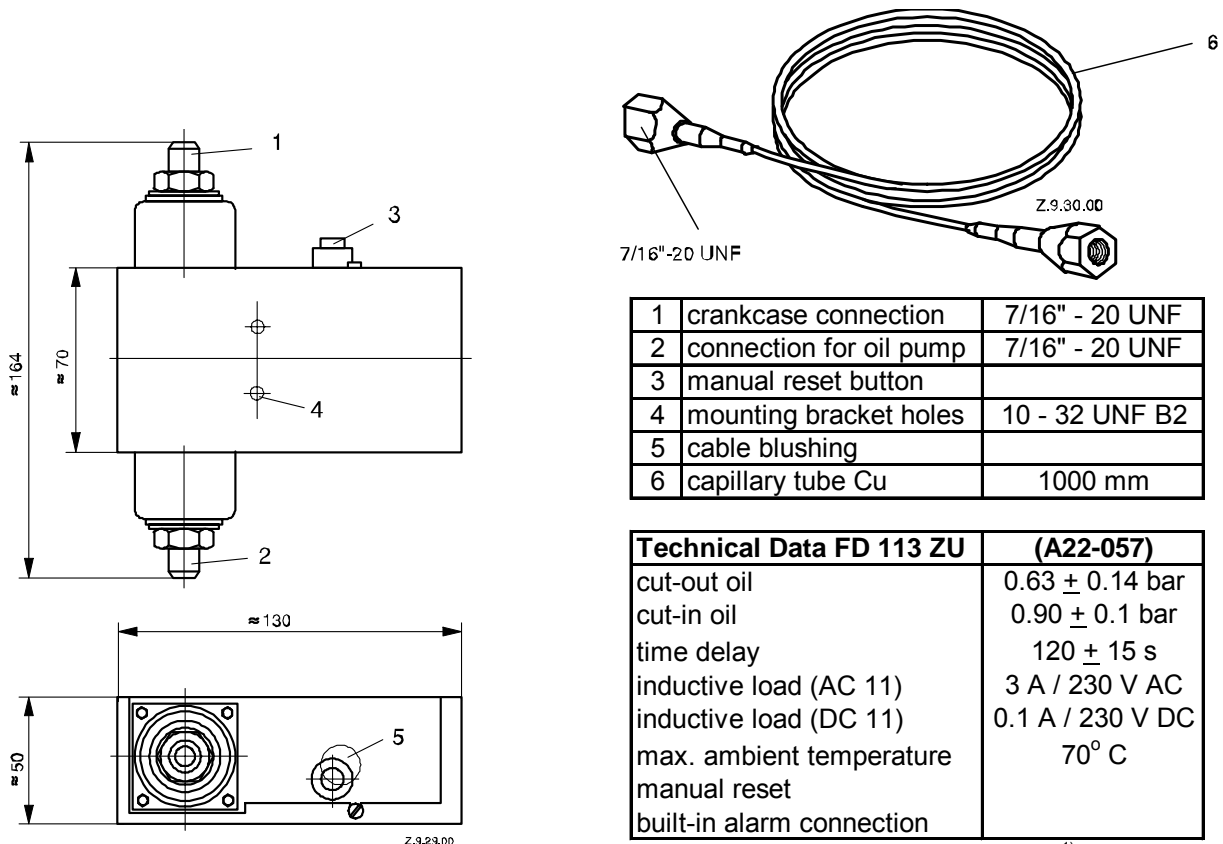


Figure 11

Approved oil-pressure switches can be taken from the following table.

Supplier	Model No.	for Compressor	Voltage	Alarm Contact	Protection Class <sup>1)</sup>
Alco Controls	FD 113 ZU (A22-057)	DLH, D2 - D8	24..240 V AC/DC	yes	IP 30
Ranco	P 30 - 5842	DLH, D2 - D8	120/240 V	yes	IP 20
Danfoss	MP 55	DLH, D2 - D8	110/220 V	yes	
	P 45 NCA - 12	DLH, D2 - D8	120/240 V	no	IP 30
Penn	P 45 NCB - 3	DLH, D2 - D8	120/240 V	yes	
	P 45 NAA - 3	DLH, D2 - D8	24 V	no	
	P 45 NCA - 9104	DLH, D2 - D8	110/220 V	yes	

1) Evaluation according to IEC 34

Table 2 : Approved oil pressure switches

Information in this document are subject to change without notification.