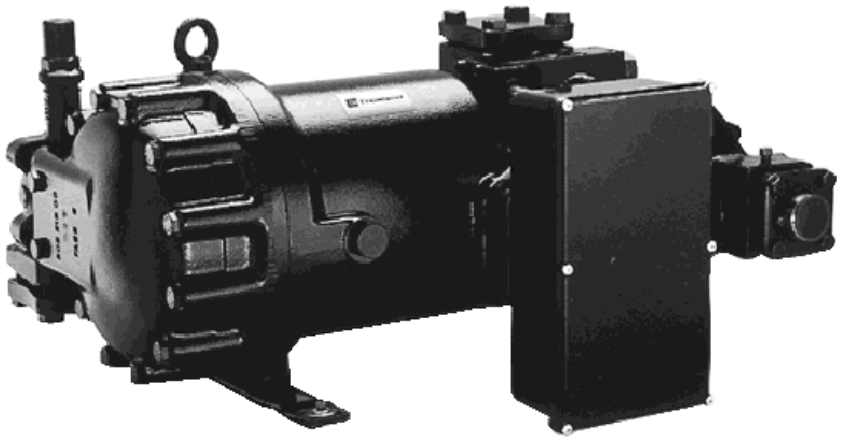
Contour™ Screw Compressors

Low and Medium Temperature Semi-Hermetic Operating Instructions

SHM/SHL Compressors



Contour

Form No. 99-107

1. Introduction

This series of semi-hermetic screw compressors is designed for medium and low temperature commercial and industrial applications including supermarket, cold storage, chillers, etc. These Compressor models are of a semi-hermetic design and operate with an external oil separator and oil cooler. Depending upon system design and application up to six compressors in parallel can operate with a single external oil separator and cooler.

Varying motor voltages for both 50 and 60 Hz are available as well as numerous accessories.

Safety Notes

- All work on compressors, air conditioning and refrigeration systems should be carried out by qualified and authorized personnel only.
- Compressors are shipped with a holding charge that is approximately 7.0 to 14.0 psi above atmospheric pressure.
- During normal operation of the compressor surface temperatures in excess of 212°F and below 32°F can be obtained, adequate personnel protection measures need to be taken.

2. Lubricant Types

Refrigerant	Application Range	Oil type	Oil Manufacturer
HFC	M / L	Solest 170	CPI
R22	M / L	CP4214-150	CPI

M – Medium Temperature
L – Low Temperature

3. Installing Equipment

3.1 Mounting

The compressor must be installed horizontally. The use of anti-vibration mounting pads is recommended to reduce the transmission of noise or vibrations. The anti-vibration mounting pads are included but packed separately from the compressor.

With direct mounting on water-cooled condensers the use of anti-vibration mounting is essential in order to prevent possible stress fracturing of the heat exchanger tubes.

The installation of the anti-vibration mounting pads is shown in Figure 1. The bolts should only be tightened so that deformation of the upper rubber disc is just visible.

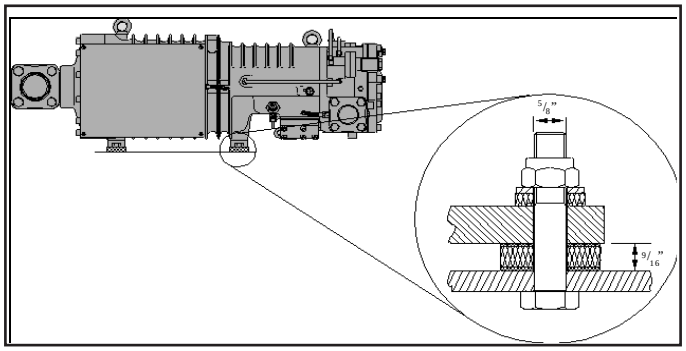


Figure 1
Mounting Pad Installation

3.2 Piping Considerations

Pipe Connections

The pipe connections are designed for tubing having nominal “SI” or “Imperial” dimensions. Solder connections have stepped inside diameters, the size of the tubing determines how far it can be inserted into the fitting. If desired, the unused (larger diameter) sections of the fitting can be trimmed off.

Pipe Runs

Use only tubing and components that are delivered with an airtight seal which are clean and dry

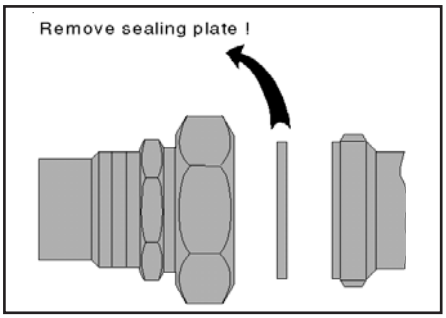


Figure 2
Economizer/Direct Refrigerant Injection Connection

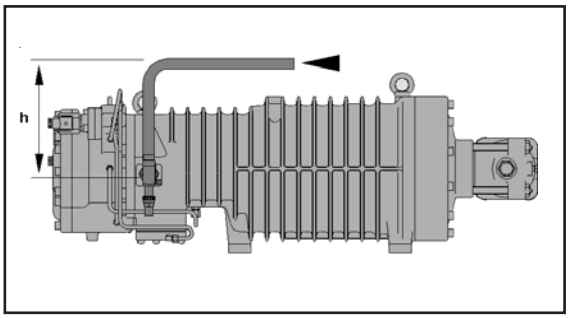


Figure 3
Recommended Economizer Piping

inside, free from oxidation, slag and phosphate coatings.

The recommendations in the technical bulletin must be observed. Pipelines should be run so that they cannot be flooded with oil or liquid refrigerant during shut down periods.

Connecting piping for the optional refrigerant injection in to the ECO port must initially include a vertical riser (minimum 6-in.) from the injection port on the compressor to avoid oil migration and damage of components through hydraulic peaks. See Figure 2 and recommendations in the technical bulletin.

It is recommended, with larger volume systems, that generously sized connections (evacuation points) with shut-off valves be installed in the suction and discharge lines, as well as sections that are isolated by a check valve.

When installing the oil filter, the aluminum gaskets for the connection adapter should be lubricated with refrigeration oil.

Caution

The compressor is shipped with a holding charge, the suction and discharge service valves should remain closed until you evacuate the system.

Start Unloading/Capacity Control

Control is accomplished electrically via the solenoid valves located on the discharge flange of the compressor (see Figure 4).

Capacity Control

Compressor Model	Full Load (100%)	Step 1 (approx. 75%)*	Step 2 (approx. 50%)*	Start Unloading
SHM1-3000/3500/4000 SHL1-2000/2500/3000	CR= ●	CR= O		CR= O
SHM2-3000/3500/4000 SHL2-2000/2500/3000	CR1= ● CR2= ●	CR1= O CR2= ●	CR1= O CR2= O	CR1= O CR2= O
SHM1-5000/6000 SHL1-4000/5000	CR1= ● CR2= ●	CR1= O CR2= ●	CR1= O CR2= O	CR1= O CR2= O
SHM1-7000/8000/9000 SHL1-6000/7000/7500	CR1= ● CR2= ●	CR1= ● CR2= O	CR1= O CR2= O	CR1= O CR2= O

* Effective capacity stages are dependent on operating conditions
O= Solenoid valve de-energized
● = Solenoid valve energized

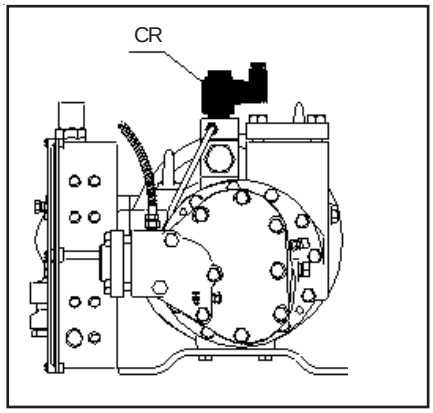


Figure 4a
Location of Capacity Solenoid
SHM1 3000, 3500, 4000
SHL1 2000, 2500, 3000

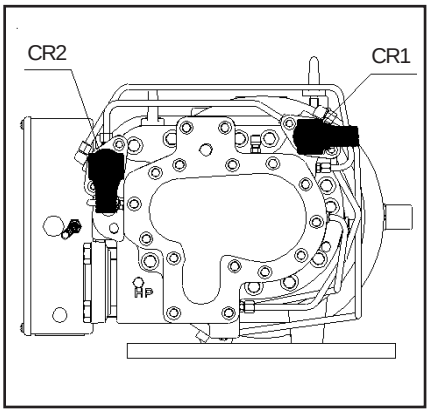


Figure 4b
Location of Capacity Solenoids
SHM1 5000, 6000, 7000, 8000, 9000
SHL1 4000, 5000, 6000, 7000, 7500

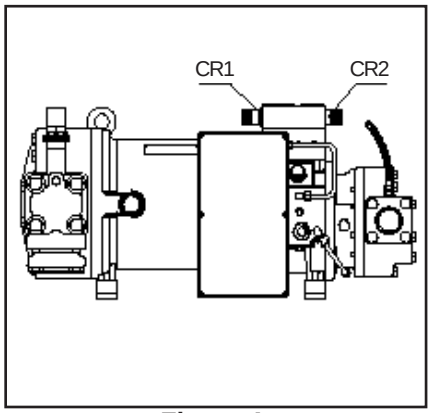


Figure 4c
Location of Capacity Solenoids
SHM2 3000, 3500, 4000
SHL2 2000, 2500, 3000

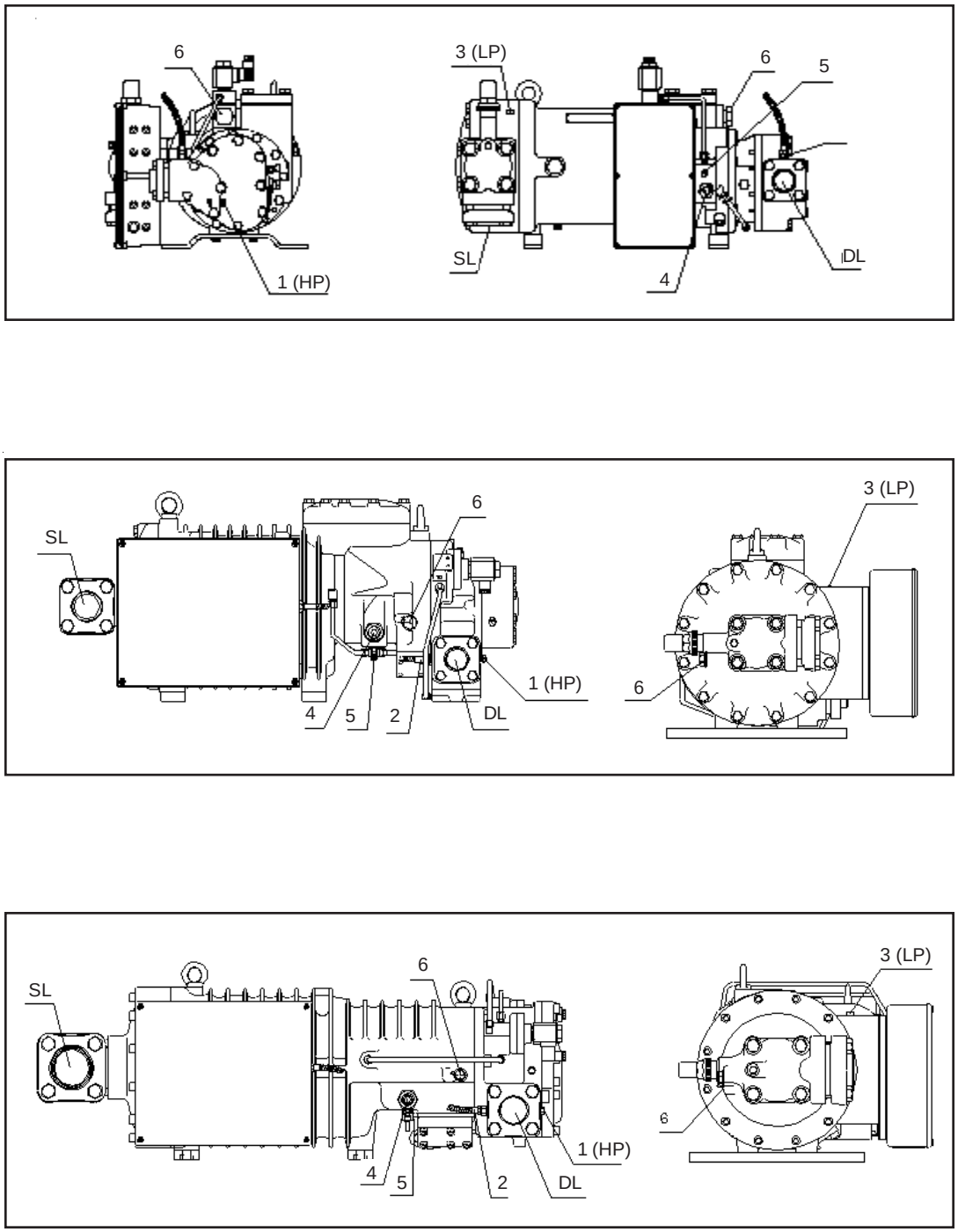


Figure 5
Connection Locations
1. High Pressure Control Connection
2. Discharge Gas Temperature Sensor
3. Low Pressure Control Connection
4. Oil Injection
5. Oil Pressure (Schrader Connection)
6. Direct Refrigeration Injection/Economizer Connection

4. Electrical Connection

4.1 General Recommendations

The electrical installation should be done in accordance to the wiring diagram shown in the terminal box and in the technical manual, with consideration given to safety standards and local codes and regulations.

- Voltage and frequency data on the nameplate should be compared to the electrical supply data, the motor may only be connected when these agree.
- The wiring of the motor terminals should be made according to the instructions on the terminal box cover.

Caution

Screw compressors may only be operated in one direction of rotation otherwise substantial mechanical damage will occur.

- Incorrect wiring of part-winding motors results in opposing or displaced phase fields that lead to locked rotor conditions and the possibility of damage to the motor.
- The terminals 1-5/B1-B2/T1-T2 on the compressor and motor protection device must not come into contact with the supply or control voltage.

Safety Note

The selection of the motor contactors, cables and fuses should be based on the maximum running current and maximum power consumption (see name plate and application manual).

4.2 Safety Devices

Compressor Protection Device ESC 200 & ESC 200E The ESC 200 & ESC 200E monitor and control:

- Compressor rotation
- Direction of rotation / phase sequence
- Discharge gas temperature
- Oil level
- Oil flow
- Dirty oil filter
- Motor over load
- Compressor sequence and short cycle function
- Compressor loader delay
- Oil solenoid/Economizer control

For additional information please refer to the ESC 200 & ESC 200E Installation and Instruction Manual.

Electronic Overload Relay Furnas 958 (SHL 4000 – 7500, SHM 5000 - 9000)

The Furnas 958-overload relay is a self-powered, heaterless design with phase loss protection (trips within 3 seconds upon loss one phase of a three-phase motor branch circuit)

Additional Features:

- Manual reset
- “Must hold amps” adjustment dial
- Rated 50/60 Hz

High and Low Pressure Controls

These are safety switches that are necessary to maintain the system operating pressures within desirable operating limits. For setting these switches see section 5.

Safety Note

Follow manufacturers installation guide, additional safety devices may be required.

Components for Oil Separator

The installation of oil heating prevents dilution of the oil with refrigerant (reduced lubrication properties) during long off-periods. Connect according to the schematic wiring diagram.

Additional insulation of the oil separator may be required with low ambient temperatures and for plants with a high temperature level on the high-pressure side during off periods (e.g. heat pumps).

The oil level monitor and the oil thermostat are included with the oil separator and are packaged separately for installation on site.

5. Commissioning

Pre-commissioning and commissioning checks and testing should be carried out.

5.1 Charging with Oil

Oil Type: See section 2. Observe recommendations in applications manual

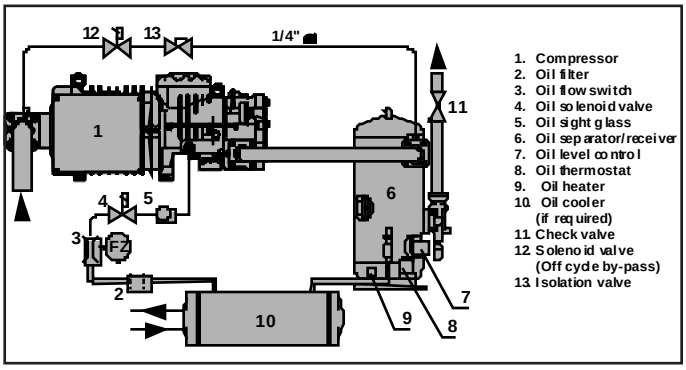


Figure 5
Oil Circuit

Oil Charge: See technical data in application manual. Due to the oil migration in the refrigeration circuit add an additional amount of oil equal to approximately 1 to 2% of the total refrigerant charge. With flooded evaporators a slightly higher percentage may be required. Charge the oil separator and oil cooler plus volume of the oil pipes.

Caution

Do not fill oil directly into the compressor.

Procedure: Charge the oil directly into the oil separator and oil cooler before evacuation. Keep the solenoid valve in the oil injection line closed (remove coil) and open the hand shut-off valves on the oil separator/oil cooler. The oil level in the oil separator should be within the sight glass range. Additional oil for systems with flooded evaporators should be mixed directly with the refrigerant.

5.2 Pressure Test/Evacuation/Leak Testing

Pressure test the system with dry nitrogen. If the refrigeration system is tested with dry air the compressor must be isolated and not included in the test.

Evacuate the entire system including the compressor and sections isolated by check valves.

- The crankcase heater should be switched on during evacuation.
- The solenoid valve in the oil injection line should be closed (coil removed), all other shut-off valves open.
- 1000 micron standing vacuum should be attained and held.
- Repeat several times if required.

Leak test the system once it is charged with refrigerant (static and dynamic tests).

Caution

Never start the compressor under vacuum.

5.3 Refrigerant Charging

- Switch on the crankcase heater.
- Following the correct codes of practice charge the system with refrigerant as a vapor, liquid or blend, by whichever method is necessary accord ing to type of refrigerant, system design and size of the system.

Caution

Refrigerant blend charging can cause “wet” compression therefore controlled charging is necessary with a discharge temperature at least 50°F above condensing temperature.

Insufficient refrigerant charge causes low suction pressure and high superheating (Be careful to remain within the operating limits of the compressor).

5.4 Checks Before Starting

- Visual (safety) check of compressor/system.
- Oil level (within the sight glass range).
- Safety features/devices are all in position, calibrated and tested.
- Service valves are in the correct running position.
- Checking of the set point values of the timing relays
- Oil temperature in the oil separator should be more than 27°F above the ambient temperature (measured at a point approximately 2 in. below the sight glass)

Caution

If the compressor is accidentally flooded with oil it must be drained. In order to do this close the compressor service valves relieve the pressure and loosen the nut of the oil injection line. The oil can then flow out via this connection.

5.5 Starting

Check the Direction of Rotation

Caution

Screw compressors may only be operated in one direction of rotation otherwise substantial mechanical damage will occur.

Although the phase field and rotation is monitored by the ESC 200/ESC 200E, the following test is recommended:

- Connect a compound gauge to the suction service valve, fully front seat the suction service valve and then open one full turn.
- Close the solenoid valve in the oil injection line (remove coil).
- Bump start the compressor - switch on then off quickly (approximately 0.5 to 1 second).

If the direction of rotation is correct the suction pressure will drop immediately. A rise in suction pressure or a cut-out of the rotation protection device will indicate a wrong direction of rotation. If this happens change over two electrical phases at the terminals of the common supply line.

Start

Reconnect the oil solenoid valve, start the compressor again and slowly open the suction service valve. Observe the sight glass in the oil injection line, if no oil flow can be seen within 5 seconds switch off immediately. Check that the solenoid valve opens and that the service valves are open.

Check the Oil Flow Switch

Test the oil flow after the time delay period has expired (15 to 20 seconds after start). Turn off the oil solenoid valve, remove the coil, the compressor must then switch off within 2 to 3 seconds.

Oil Level Check (Oil Separator)

- Maximum recommended oil level during operation is within the sight glass range (minimum oil level is monitored by the oil level switch).
- Oil foam can be generated during the starting phase, but should dissipate after 2 to 3 minutes. If it does not this can indicate excessive liquid refrigerant in the suction gas.

Caution

The discharge gas temperature must be at least 54°F above the condensing temperature.

If the oil flow switch cuts out during the start up or the oil level switch opens after the time delay (120 seconds), this indicates a lack of lubrication. Possible reasons are too low oil pressure differential or excessive refrigerant in the oil (check suction gas superheat).

Setting the Oil Cooler Temperature Control

Oil cooling must not be started until the discharge gas temperature is approximately 54°F above the condensing temperature. The maximum setting is 176°F with R404A/R507/R22/R407C, and 203°F with R134a when condensing temperature is higher than 131°F

Setting the High and Low Pressure Switches

These devices should be set in accordance with the application limits. They should be set based on specific system operating parameters.

Check Operating Data

- Evaporation temperature
- Suction gas temperature
- Condensing temperature
- Discharge gas temperature, minimum 54°F above condensing temperature maximum 212°F
- Oil temperature maximum 212°F

For application limits see application manual.

Setting the Condenser Pressure Control

The setting must be made so that the minimum pressure differential (see application limits in Application Manual) is reached within 20 seconds. A rapid reduction in pressure must be avoided by employing a finely calibrated pressure control.

Vibrations

The entire system as well as the pipe runs (especially the small diameter tubes) must be checked for abnormal vibrations. If necessary, additional supports or dampers must be installed.

6. Maintenance

Oil Filter

An initial filter change is recommended after 50 to 100 running hours. In the event of the flow switch alarm or as a routine check, the pressure differential between the oil separator (gauge connection on the oil shut-off valve) and the compressor injection point (see page 5) should be checked. If the pressure drop is greater than 7.5 psi this indicates a dirty oil filter. Change the cartridge with the pressure released and the oil shut-off valve closed. The cartridge should be hand tightened and then loosened by a quarter of a turn.

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