# Technical Bulletin (TB-0033-02)

## R22 Low Temp Applications

Revision – April 2012

This document serves as a guideline when using refrigerant R22 under low temperature conditions with Bitzer semi-hermetic reciprocating compressors.

The use of R22 in low temp applications can place a high demand on the compressor and lubricant. Discharge gas temperatures can reach very high values that are not sustainable for the compressor. The maximum discharge temperature measured at the discharge line should not exceed 250°F. It is necessary to cool the return gas to ensure that the performance of the compressor will prevail. **Note**: Bitzer reciprocating compressors that are run with R22 need to use Bitzer Oil: B5.2 or Alkyl benzene SUS 150 oil (AB 150).

**<u>Installing a Discharge Gas Temperature Sensor</u> (Only for C3, C4, 4B and 6B series compressors)**

The use of a discharge temperature sensor as a backup safety is recommended as an additional step to protect the compressor from damage. This safety device has proved especially useful when using R22 in low temperature applications, even when an injection device is in place to cool the return gas.
**The discharge temperature sensor can only be used with the C3, C4, 4B and 6B series compressors. For C3 compressors it will only monitor the temperature of one of the heads – a port is available on both of the heads.**

BITZER offers a discharge gas temperature sensor (part #: 347023-03) that will open the SE-B INT module at 140°C / 284°F.

**Installation:** Apply Teflon tape sealant to the threads of the sensor and install into port 2 (see Figure 2). The sensor must not be installed further downstream (e.g. at discharge piping) due to the ability of the gas to lose heat quickly; doing so would allow unsafe temperatures in the head.

Wire the sensor according to Figure 1 below:

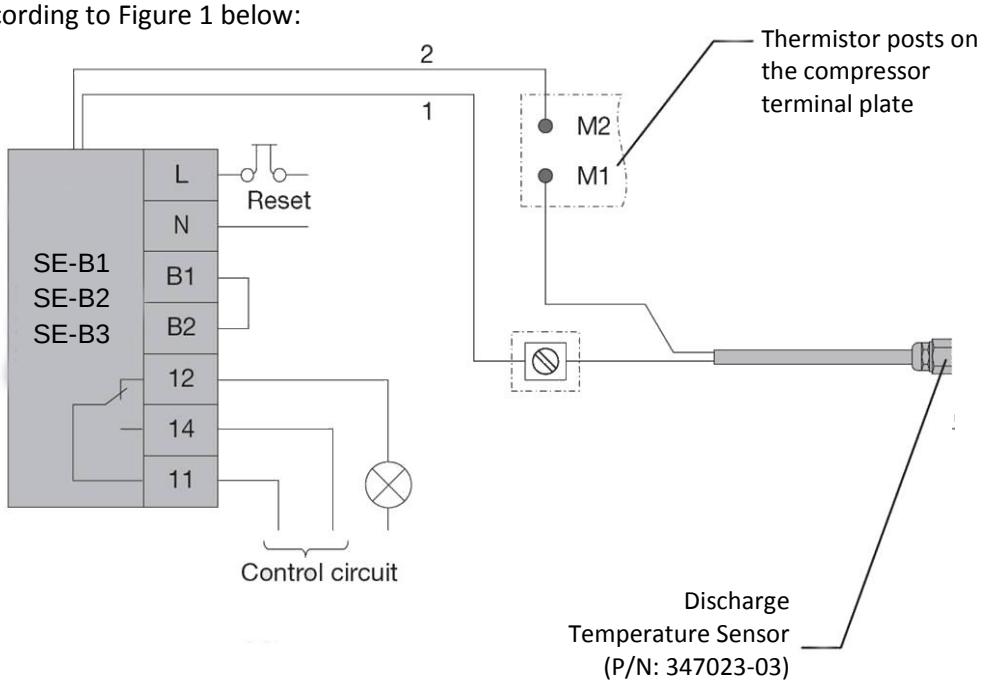
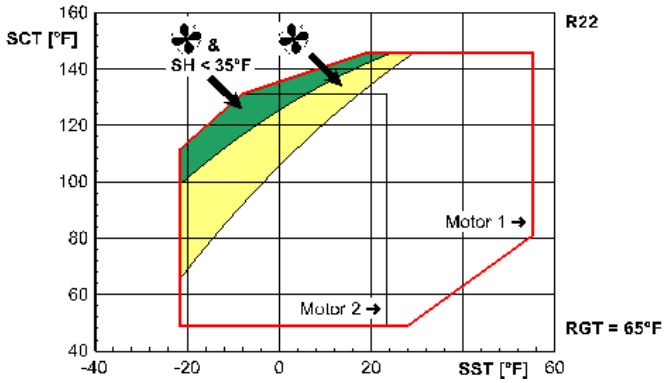



**Figure 1:** Discharge temp sensor installation

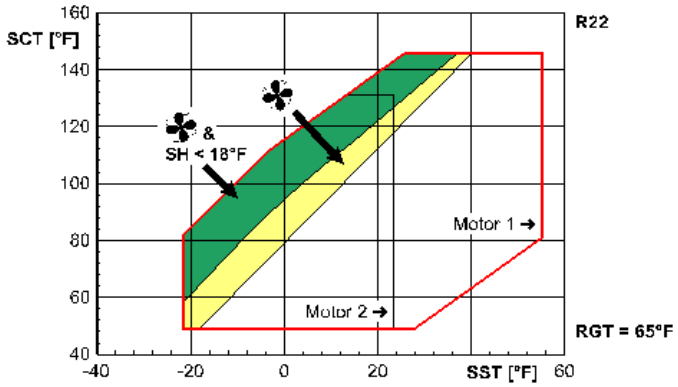
**Application Limits: Explanation of when special cooling methods are required**

To obtain application limit diagrams at various conditions, use the Bitzer software (download free from www.bitzerus.com). The yellow and green areas below indicate the conditions where additional cooling is required. Note the areas that indicate head fan, superheat settings, varicool, and liquid injection requirements. Head fan cooling can be done by an air cooled condenser fan blowing over the compressor.

**R22 at 100%**

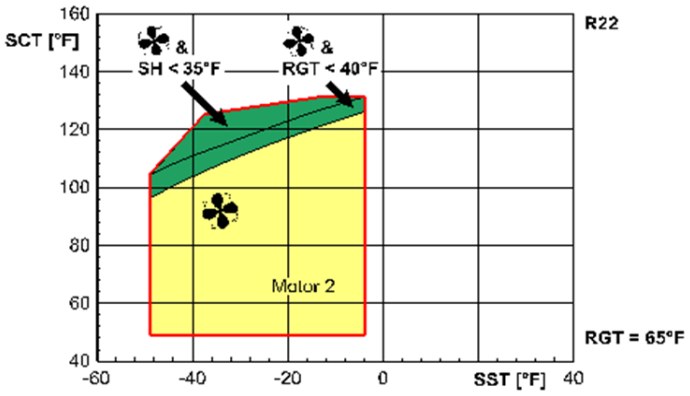



**R22 50%**



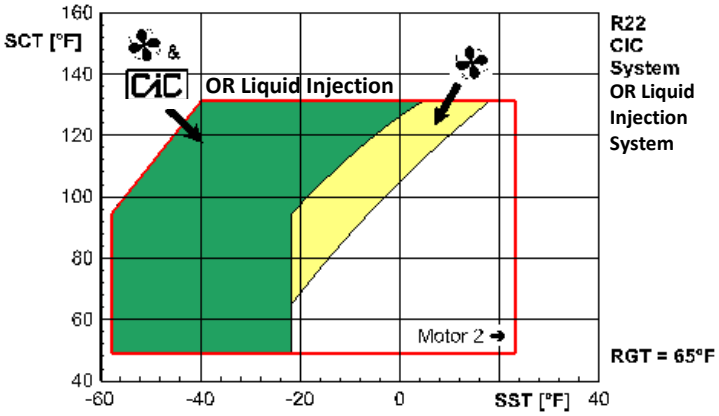

**R22 VARICOOL SL(B)**

2C0173SH .. 4C1385SH




**R22 LIQUID INJECTION SYSTEM**

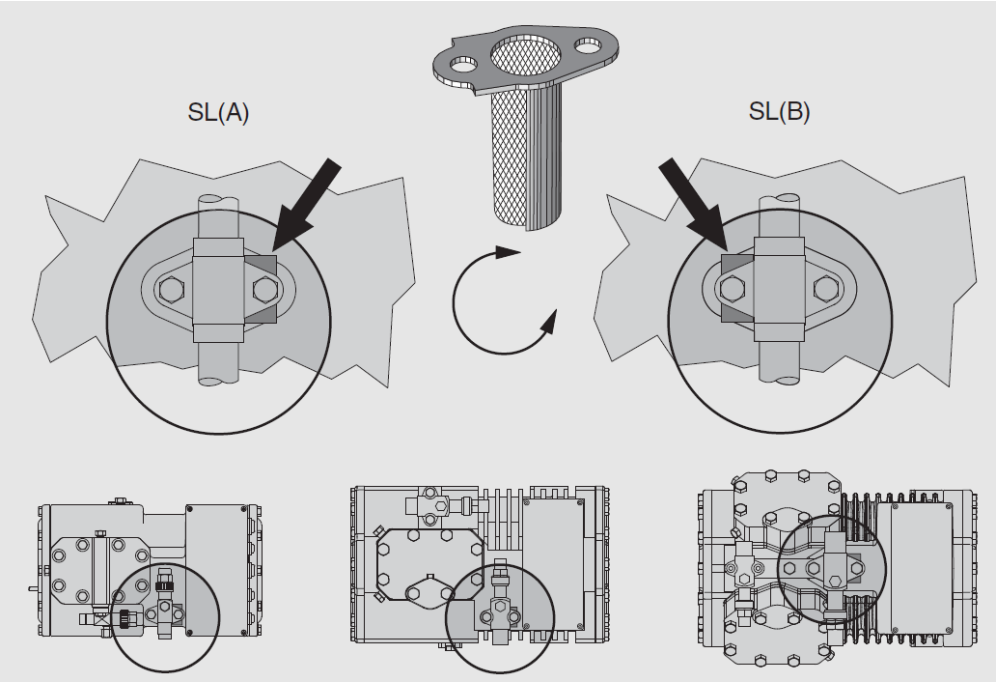
4C1480SL .. 6B6462PH



**Setting up VARICOOL SL(B) on C1-C3 compressors (2C0173-4C1385)**

The C1-C3 model compressors cannot be used with liquid injection. A special setup called VARICOOL SL(B) is utilized to keep the discharge gas temperature low (the suction gas goes straight to the heads instead of through the motor compartment). The factory default build of these compressors is for SL(A) operation (suction gas goes through the motor compartment first). To set up VARICOOL SL(B) operation, follow these steps:

1. Remove suction valve
2. Turn suction strainer 180° so that the metal block on the strainer is stopping gas from entering the motor side of the compressor, i.e. the tabs on the top are pointing to/on the same side as the cylinder heads.
3. Replace suction valve.
4. Torque the suction bolts to:
   C1 & C2: 18 lb-ft (25 Nm)
   C3: 37 lb-ft (50 Nm)




The refrigerant will now go straight to the heads without passing through the motor area. This prevents the motor from additionally superheating the refrigerant; thus, preventing the discharge gas temperature from increasing.

**Note: A head fan is required for VARICOOL operation. Additional cooling/head fan cooling can be done by an air cooled condenser fan blowing over the compressor.**

**Note: Capacity control cannot be used when the compressor is set up for VARICOOL SL(B) operation.**

| **Head Fan Bracket Part Numbers:** |
|---|
| C1 Models (2C0173-2C0407): **0705468** |
| C2 Models (2C0484-2C0692): **0705468** |
| C3 Models (4C0770-4C1385): **0705467** |

| **Head Fan Part Numbers:** |
|---|
| 110V: **415-2100-15KIT** |
| 220V: **415-2100-28KIT** |
| 460V: **415-2100-46KIT** |

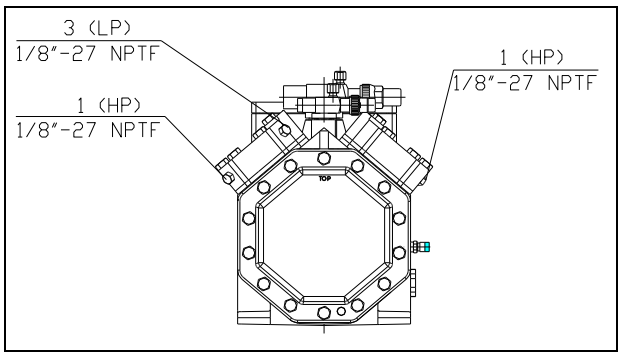



**Figure 2: Port locations for discharge temp sensor (347023-03) installation on C3 models– #1 (HP), 1/8"-27 NPTF**

**CIC (Controlled Injection Cooling) System for C4, B5 and B6** (For more detailed information refer to KT-130)

The CIC system is a reliable electronically controlled refrigerant injection device for limiting the temperature of 4 and 6 cylinder single stage reciprocating compressors operating in low temperature systems with R22. For improved cooling in the thermal limit area, Bitzer developed a system, where suction gas cooling, external forced air cooling and controlled refrigerant injection are combined.

**CIC-System Kit Selection Table**

| Compressor Model Number | CIC-System Kit |
|---|---|
| 4C1480P(S)L / 4C1761P(S)L / 4C2067P(S)L / 4C2397P(S)L | **347702-16** |
| 4B2707PL / 4B3139PL | **347702-03** |
| 4B3604PL | **347702-04** |
| 6B4060PL / 6B4709PL / 6B5406PL | **347702-09** |
| 6B6462PL | **347702-10** |

**Head Fan Bracket Part Numbers:**
C4 Models (4C1480-4C2397): **0705466-KIT**
4B Models (4B2707-4B3606): **0705465-KIT**
6B Models (6B4060-6B6462): **0705464-KIT**

**Head Fan Part Numbers:**
110V: **415-2100-15KIT**
220V: **415-2100-28KIT**
460V: **415-2100-46KIT**

The central unit of this combined method of cooling is the electronic CIC system with control module, temperature sensor and pulse injection valve. The primary function of these components is the continuous control of the discharge gas temperature, as evaluated by the control module.
When a defined preset value is exceeded, liquid refrigerant is injected into the suction chamber of the compressor (after the motor) and directed against the hot cylinder walls by means of a special spray nozzle. The pulse injection valve ensures exactly dosed quantity regulation.
The liquid refrigerant cools the cylinder area, due to evaporation, and at the same time reduces the temperature of the (superheated) suction gas transported from the motor. This measure combined with external forced air cooling also maintains the discharge gas temperature with single stage compression at a level considered as safe under practical conditions.

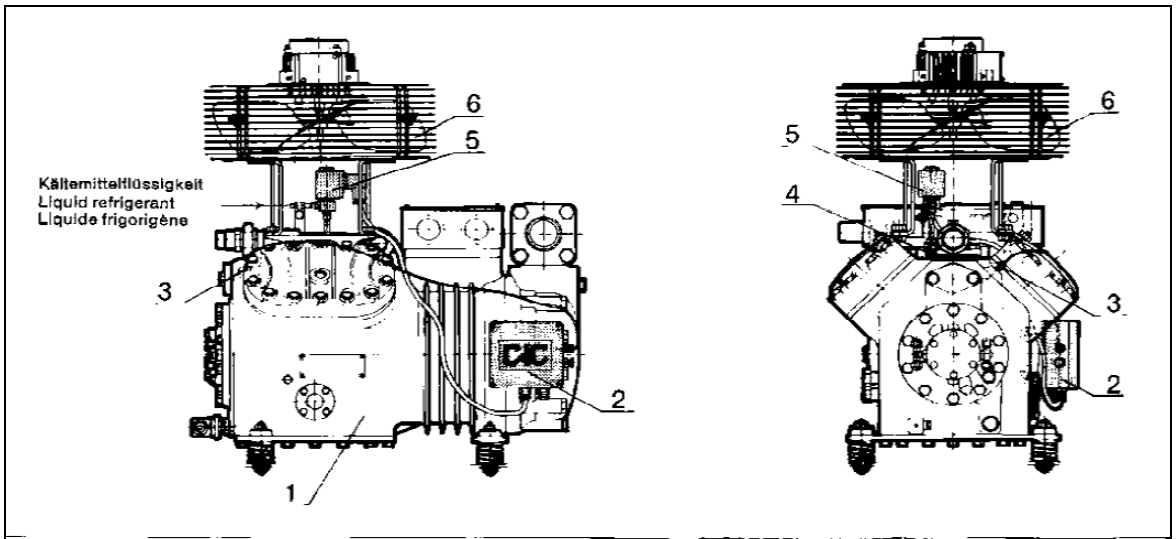



**Figure 3. Semi-hermetic reciprocating compressor with CIC System and fan**

**Installing a Temperature Responsive Expansion Valve for C4, B5 and B6**

The C4, B5 and B6 model compressors can be run with TREVs to lower the temperature of the refrigerant inside the compressor.

**Installing  a Y1037 Valve**

The Sporlan TREV Y1037 valves are available from various refrigeration wholesalers and have a variety of set points. Valves suitable for BITZER compressors are also available directly through BITZER US.  These valves regulate the discharge gas temperature to 240°F.  Most valves have 3/8" SAE connections and the bulb sensor is 5 feet long.  The only exception is the 1/3 ton valve which has 3/8 sweat connection and a 30 inch long sensor.  See the selection section below for valve sizes and part numbers.

BITZER recommends injecting into the low pressure port of the compressor after the motor.  These ports are shown in the figure below as port 4.  For 6 cylinder compressors, install a manifold to the low pressure (bottom) side of the left head so that it has two injection ports (4 and 4a).

Be sure to install the TREV bulb 4-8 inches away from the discharge valve and properly insulate it to prevent influence from the ambient and head fan air.

It is also recommended to install a solenoid valve before the Y-1037 valve to ensure the liquid feed is off when the compressor is off.
**Note: Capacity control cannot be used when the compressor is set up for operation with liquid injection.**

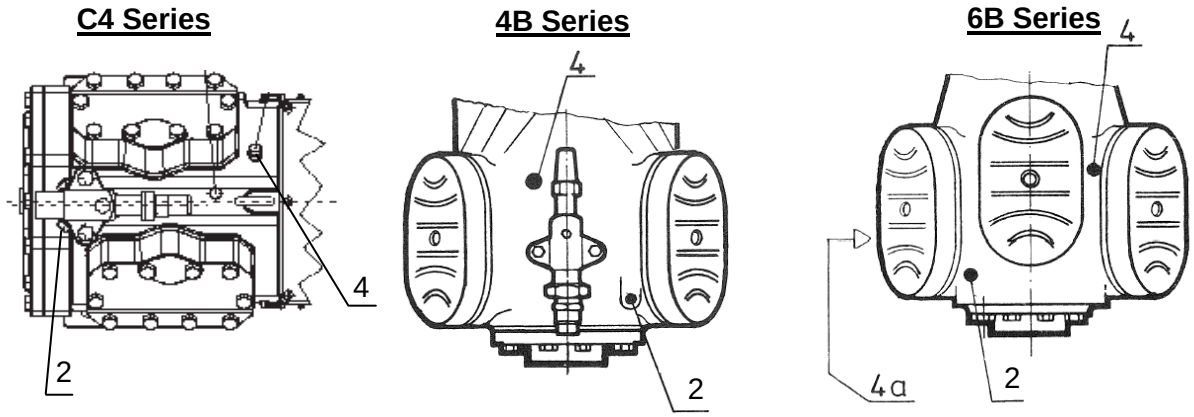



**Figure 4: Port locations for Y1037 valve and discharge temp sensor**

**Selection of parts with Y1037 Valve:**

**1. Head Fan Bracket Part Numbers:**
C4 Models (4C1480-4C2397): **0705466-KIT**
4B Models (4B2707-4B3606): **0705465-KIT**
6B Models (6B4060-6B6462): **0705464-KIT**

**2. Head Fan Part Numbers:**
110V: **415-2100-15KIT**
220V: **415-2100-28KIT**
460V: **415-2100-46KIT**

**3. Sporlan Y1037 Valve**
(Select appropriate size based on chart below)**:**

1/3 Ton, 240°F: **873-0407-13**
1/2 Ton, 240°F: **873-0109-05**
1 Ton, 240°F: **873-0109-11**
1-1/2 Ton, 240°F: **873-0109-15**
2 Ton, 240°F: **873-0109-12**
3 Ton, 240°F: **873-0109-03**
5 Ton 240°F: **873 0109 04**

**Temperature Responsive Expansion Valve Table: Y1037 Sizing Chart (Tons)**

| **SST (Evap Temp)⟶** | **-10F** | | **-20F** | | **-30F** | |
|---|---|---|---|---|---|---|
| ***Return Gas Temp⟶*** | ***20F*** | ***40F*** | ***20F*** | ***40F*** | ***20F*** | ***40F*** |
| **4C1480PL** | 1/5 | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 |
| **4C1761PL** | 1/3 | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 |
| **4C2067PL** | 1/3 | 1/2 | 1/2 | 1 | 1/2 | 1 |
| **4C2397PL** | 1/3 | 1/2 | 1/2 | 1 | 1/2 | 1 |
| **4B2707PL** | 1/2 | 1/2 | 1/2 | 1 | 1 | 1 |
| **4B3139PL** | 1/2 | 1 | 1 | 1 | 1 | 1 |
| **4B3604PL** | 1/2 | 1 | 1 | 1 | 1 | 1 1/2 |
| **6B4060PL** | 1/2 | 1 | 1 | 1 1/2 | 1 1/2 | 1 1/2 |
| **6B4709PL** | 1/2 | 1 | 1 | 1 1/2 | 1 1/2 | 1 1/2 |
| **6B5406PL** | 1 | 1 1/2 | 1 1/2 | 2 | 1 1/2 | 2 |
| **6B6462PL** | 1 1/2 | 2 | 2 | 3 | 2 | 3 |

**Saturated Condensing / Liquid Temp = 110°F**

**4. Discharge gas temperature sensor:** 347023-03 (Optional)