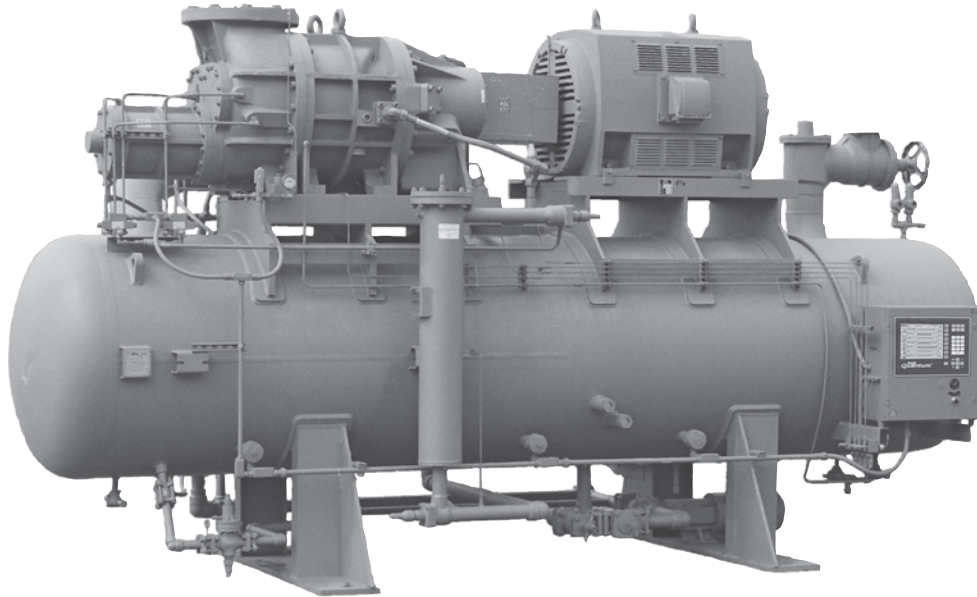


# **RWB II**

## **ROTARY SCREW COMPRESSOR UNITS ALL REFRIGERANTS**

### **MODELS 496 through 1080**



**THIS MANUAL CONTAINS RIGGING, ASSEMBLY, START-UP,  
AND MAINTENANCE INSTRUCTIONS. READ THOROUGHLY  
BEFORE BEGINNING INSTALLATION. FAILURE TO FOLLOW THESE  
INSTRUCTIONS MAY RESULT IN PERSONAL INJURY OR DEATH,  
DAMAGE TO THE UNIT, OR IMPROPER OPERATION.**

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**PREFACE**

This manual has been prepared to acquaint the owner and serviceman with the INSTALLATION, OPERATION, and MAINTENANCE procedures as factory recommended for Frick RWB II Rotary Screw Compressor Units.

For information about the functions of the electrical control panel, communications, specifications, and wiring diagrams, see S90-010 M (*Quantum* panel) or S70-200 OM (Plus panel).

It is most important that these units be properly applied to an adequately controlled refrigeration system. Your authorized Frick representative should be consulted for his expert guidance in this determination.

Proper performance and continued satisfaction with these units is dependent upon:

- CORRECT INSTALLATION**
- PROPER OPERATION**
- REGULAR, SYSTEMATIC MAINTENANCE**

To ensure correct installation and application, the equipment must be properly selected and connected to a properly designed and installed system. The Engineering plans, piping layouts, etc. must be detailed in accordance with the best practices and local codes, such as those outlined in ASHRAE literature.

A refrigeration compressor is a VAPOR PUMP. To be certain that it is not being subjected to liquid refrigerant carryover it is necessary that refrigerant controls are carefully selected and in good operating condition; the piping is properly sized and traps, if necessary, are correctly arranged; the suction line has an accumulator or slugging protection; that load surges are known and provisions made for control; operating cycles and defrosting periods are reasonable; and that high side condensers are sized within system and compressor design limits.

It is recommended that the entering vapor temperature to the compressor be superheated to 10°F above the refrigerant saturation temperature. This assures that all refrigerant at the compressor suction is in the vapor state.

**DESIGN LIMITATIONS**

The compressor units are designed for operation within the pressure and temperature limits as shown in Frick Pub. E70-200 SED.

**JOB INSPECTION**

Immediately upon arrival examine all crates, boxes and exposed compressor and component surfaces for damage. Unpack all items and check against shipping lists for any possible shortage. Examine all items for damage in transit.

**TRANSIT DAMAGE CLAIMS**


All claims must be made by consignee. This is an ICC requirement. Request immediate inspection by the agent of the carrier and be sure the proper claim forms are executed.

Report damage or shortage claims immediately to Johnson Controls Inc, Frick, Sales Administration Department, in Waynesboro, PA.

**COMPRESSOR and UNIT IDENTIFICATION**

Each compressor unit has 2 identification data plates. The **compressor data plate** containing compressor model and serial number is mounted on the compressor body. The **unit data plate** containing unit model, serial number and Johnson Controls-Frick sales order number is mounted on the side of the motor base.

**NOTE: When inquiring about the compressor or unit, or ordering repair parts, provide the MODEL, SERIAL, and Johnson Controls-FRICK SALES ORDER NUMBERS from these data plates.**

  
BY JOHNSON CONTROLS  
**ROTARY SCREW COMPRESSOR UNIT**

---

SALES ORDER NUMBER:

MODEL NO:

SERIAL NO:

REFRIGERANT:

MAX DESIGN PRESSURE: PSIG  kPa

100 CV AVENUE, WAYNESBORO, PA. 17268  
PHONE: 717-762-2121

**UNIT DATA PLATE**

**SAFETY PRECAUTION DEFINITIONS**



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation or practice which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation or practice which, if not avoided, will result in damage to equipment and/or minor injury.

**NOTE:**

Indicates an operating procedure, practice, etc., or portion thereof which is essential to highlight.

### COMPRESSOR IDENTIFICATION

Each compressor has an identification data plate (see below), containing compressor model and serial number mounted on the compressor body.

### COMPRESSOR DATA PLATE

Rotary screw compressor serial numbers are defined by the following information:

EXAMPLE: 10240A90000015Z

| PLANT | DECADE | MONTH | YEAR | GLOBAL SEQ NO. | ADDITIONAL REMARKS |
|-------|--------|-------|------|----------------|--------------------|
| 1024  | 0      | A     | 9    | 0000015        | Z                  |

Month: A = JAN, B = FEB, C = MAR, D = APR, E = MAY, F = JUN, G = JUL, H = AUG, K = SEP, L = OCT, M = NOV, N = DEC.

Additional Remarks: R = Remanufactured; Z = Deviation from Standard Configuration.

### GEOMETRICAL SWEEPED VOLUME TABLE

| Compressor Model | Rotor Diameter mm | Rotor L/D | Max Speed RPM | Geometrical Swept Volume Drive Shaft End |                     | CFM 3550 RPM | m <sup>3</sup> /h 2950 RPM |
|------------------|-------------------|-----------|---------------|------------------------------------------|---------------------|--------------|----------------------------|
|                  |                   |           |               | ft <sup>3</sup> / Rev                    | m <sup>3</sup> /Rev |              |                            |
| TDSH/B 355S      | 355               | 1.1       | 4200          | 0.89858                                  | 0.025430            | 3190         | 4501                       |
| TDSH/B 355L      | 355               | 1.5       | 4200          | 1.12154                                  | 0.031739            | 3981         | 5618                       |
| TDSH/B 355XL     | 355               | 1.9       | 4200          | 1.42748                                  | 0.040398            | 5068         | 7150                       |
| TDSB 355U        | 355               | 2.4       | 4200          | 1.80328                                  | 0.051033            | 6402         | 9033                       |

**INSTALLATION**

**FOUNDATION**

Each **RWB II** Rotary Screw Compressor Unit is shipped mounted on a wooden skid which must be removed prior to unit installation.



**Allow space for servicing the unit. A minimum of 36 inches around the package is recommended.**

The first requirement of the compressor foundation is that it must be able to support the weight of the compressor package including coolers, oil, and refrigerant charge. Screw compressors are capable of converting large quantities of shaft power into gas compression in a relatively small space and a mass is required to effectively dampen these relatively high frequency vibrations.

Firmly anchoring the compressor package to a suitable foundation by proper application of grout and elimination of piping stress imposed on the compressor is the best insurance for a trouble free installation. Use only the certified general arrangement drawings from Frick to determine the mounting foot locations and to allow for recommended clearances around the unit for ease of operation and servicing. Foundations must be in compliance with local building codes and materials should be of industrial quality.

The floor should be a minimum of 6 inches of reinforced concrete and housekeeping pads are recommended. Anchor bolts are required to firmly tie the unit to the floor. Once the unit is rigged into place (See **RIGGING** and **HANDLING**), the feet must then be shimmed in order to level the unit. The shims should be placed to position the feet roughly one inch above the housekeeping pad to allow room for grouting. An expansion-type epoxy grout must be worked under all areas of the base with no voids and be allowed to settle with a slight outward slope so oil and water can run off of the base.

When installing on a steel base, the following guidelines should be implemented to properly design the system base:

1. Use I-beams in the skid where the screw compressor will be attached to the system base. They should run parallel to the package feet and support the feet for their full length.
2. The compressor unit feet should be continuously welded to the system base at all points of contact.
3. The compressor unit should not be mounted on vibration isolators in order to hold down package vibration levels.
4. The customer's foundation for the system base should fully support the system base under all areas, but most certainly under the I-beams that support the compressor package.

When installing on the upper floors of buildings, extra precautions should be taken to prevent normal package vibration from being transferred to the building structure. It may be necessary to use rubber or spring isolators, or a combination of both, to prevent the transmission of compressor vibration directly to the structure. However, this may increase package vibration levels because the compressor is not in contact with any damping mass. The mounting and support of suction and discharge lines is also very important. Rubber or spring pipe supports may be required to avoid exciting the building structure at any pipe supports close to the compressor package. It is best to employ a vibration expert in the design of a proper mounting arrangement.

In any screw compressor installation, suction and discharge lines should be supported in pipe hangers (preferably within 2 ft. of vertical pipe run) so that the lines won't move if disconnected from the compressor. See table for Allowable Flange Loads.

| ALLOWABLE FLANGE LOADS |                  |                |                |            |                |                |
|------------------------|------------------|----------------|----------------|------------|----------------|----------------|
| NOZ.<br>SIZE<br>NPS    | MOMENTS (ft-lbf) |                |                | LOAD (lbf) |                |                |
|                        | AXIAL            | VERT.          | LAT.           | AXIAL      | VERT.          | LAT.           |
|                        | M <sub>R</sub>   | M <sub>C</sub> | M <sub>L</sub> | P          | V <sub>C</sub> | V <sub>L</sub> |
| 1                      | 25               | 25             | 25             | 50         | 50             | 50             |
| 1.25                   | 25               | 25             | 25             | 50         | 50             | 50             |
| 1.5                    | 50               | 40             | 40             | 100        | 75             | 75             |
| 2                      | 100              | 70             | 70             | 150        | 125            | 125            |
| 3                      | 250              | 175            | 175            | 225        | 250            | 250            |
| 4                      | 400              | 200            | 200            | 300        | 400            | 400            |
| 5                      | 425              | 400            | 400            | 400        | 450            | 450            |
| 6                      | 1000             | 750            | 750            | 650        | 650            | 650            |
| 8                      | 1500             | 1000           | 1000           | 1500       | 900            | 900            |
| 10                     | 1500             | 1200           | 1200           | 1500       | 1200           | 1200           |
| 12                     | 1500             | 1500           | 1500           | 1500       | 1500           | 1500           |
| 14                     | 2000             | 1800           | 1800           | 1700       | 2000           | 2000           |

A licensed architect should be consulted to determine the proper foundation requirements for any large engine or turbine drive.

When applying screw compressors at high pressures, the customer must be prepared for package vibration and noise higher than the values predicted for normal refrigeration duty. Proper foundations and proper installation methods are vital; and even then, sound attenuation or noise curtains may be required to reduce noise to desired levels.

For more detailed information on Screw Compressor Foundations, please request Frick publication S70-210 IB.

**RIGGING and HANDLING**



**This screw compressor package may be top-heavy. Use caution in rigging and handling.**

The unit can be moved with rigging, using a crane or forklift, by hooking into the four lifting eyes on the compressor and motor bases. If no motor is mounted, the lifting ring should be moved to the compressor side of the center of the unit because 60 percent of the weight is toward the compressor end. If a motor is mounted appropriate adjustment in the lifting point should be made to compensate for motor weight. Adjustment of the lifting point must also be made for any additions to the standard package such as an external oil cooler, etc., as the center of balance will be effected.

The unit can be moved with a forklift by forking under the skid, or it can be skidded into place with pinch bars by pushing against the skid. **NEVER MOVE THE UNIT BY PUSHING OR FORKING AGAINST THE SEPARATOR SHELL OR ITS MOUNTING SUPPORTS.**

**SKID REMOVAL**

On horizontal packages that are rigged into place, the wooden skid can be removed by taking off the nuts and bolts that are fastening the unit mounting supports to the skid before lowering the unit onto the mounting surface.

If the unit is skidded into place remove the cross members from the skid and remove the nuts anchoring the unit to the skid. Using a 5 ton jack under the separator raise the unit at the compressor end until it clears the two mounting bolts. Spread the skid to clear the unit mounting support, then lower the unit to the surface. Repeat procedure on opposite end.

### MOTOR MOUNTING

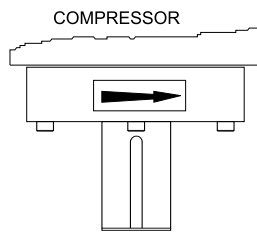
The following procedure is required only when the motor is mounted at the job site.

1. Thoroughly clean the motor feet and mounting pads of grease, burrs, and other foreign matter to ensure firm seating of the motor.
2. Attach the motor to the base using the bolts and motor-raising blocks, if required. Bolt snugly through the base.
3. Weld the four kick bolts into place so that they are positioned to allow movement of the motor feet.
4. Now that the motor has been set, check to see that the shafts are properly spaced for the coupling being used. Refer to the coupling data tables on these pages for the applicable dimension.

### CHECKING MOTOR/COMPRESSOR ROTATION

**WARNING** Make sure coupling hubs are tightened to the shaft before rotating the motor to prevent them from flying off and possibly causing serious injury or death.

**COMPRESSOR ROTATION IS CLOCKWISE WHEN FACING THE END OF THE COMPRESSOR SHAFT.** Under NO conditions should the motor rotation be checked with the coupling center installed as damage to the compressor may result. Bump the motor to check for correct compressor rotation. After verification, install gear or disk drive spacer, as applicable.



### COMPRESSOR/MOTOR COUPLINGS INSTALLATION

RWB II units are arranged for direct motor drive and require a flexible drive coupling to connect the compressor to the motor. Before installing, perform the following:

1. Inspect the shaft of the motor and compressor to ensure that no nicks, grease, or foreign matter is present.
2. Inspect the bores in the coupling hubs to make sure that they are free of burrs, dirt, and grit.
3. Check that the keys fit the hubs and shafts properly. **NOTE: Coupling keyways must be 180° opposed.**

**DBZ-B COUPLING** – The Thomas DBZ-B coupling is used on applications above 600 HP and with sleeve bearing motors that do not have axial end float constraint. The DBZ-B coupling consists of two drive hubs and a flexible metal disc drive spacer that is bolted to both hubs. A flexible steel disc

pack serves as the drive element. This disc pack is bolted to the coupling hubs and prevents axial end float between the compressor and motor shafts which may occur with sleeve bearing motors. On sleeve bearing motors, the magnetic center must be determined and maintained by securing the coupling to the motor shaft with the shaft properly located.

**CAUTION** Injury may occur if loose clothing, etc. becomes entangled on the spinning motor shaft.

If the motor is coupled to the compressor using a fixed-end-play coupling, such as a DBZ-B coupling, and the motor is not properly centered, additional thrust loads will be transmitted to the compressor bearings that could result in premature bearing failure. Install as follows:

1. Remove the eight locknuts and long bolts attaching the center member to the disc pack.
2. Slide the disc pack and coupling hub assemblies on their respective shafts.
3. Adjust the distance between hub faces as specified in the DBZ-B Data Table by sliding the hubs. Key and secure hubs to the shafts by tightening setscrews.
4. Reinstall the eight previously removed bolts and locknuts. Alternately tighten each locknut as you would the lug nuts on an automobile. **NOTE: ALWAYS TURN THE NUT. NEVER TURN THE BOLT.**
5. Torque the locknuts to the value shown in the DBZ-B Data Table for the size coupling being installed.

**CAUTION** Lubricated and/or plated bolts and locknuts develop higher bolt tension with less tightening than those that are dry and not plated.

Torques for lubricated and/or plated bolts and locknuts will generally fall in the lower range; while those that are dry or as received from the factory fall into the upper range. Torque readings should be observed while locknut is being turned.

6. Proceed to coupling alignment.

**SERIES 52 COUPLING** – The Thomas Series 52 coupling is also used on applications above 600 HP. It has two drive hubs, a center spool, and disc packs which are bolted between the center spool and each drive hub. A center spool and two flexible steel disc packs serve as the drive element. These three parts, situated between the motor and compressor hubs, prevent axial end float between the motor and compressor shafts. End float tends to occur with sleeve bearing motors. The magnetic center of the sleeve bearing motors must be determined and maintained by securing the coupling hub to the motor shaft with the shaft properly located.

**CAUTION** Injury may occur if loose clothing, etc. becomes entangled on the spinning motor shaft.

If the motor is coupled to the compressor using a fixed-end-play coupling such as the Series 52 coupling and the motor

DBZ-B COUPLING DATA TABLE

| DBZ-B<br>COUPLING<br>SIZE | HUB FACE |       |      |     | MAXIMUM TOTAL<br>INDICATOR READING |      | CLAMP BOLT TORQUE |     |       |       |
|---------------------------|----------|-------|------|-----|------------------------------------|------|-------------------|-----|-------|-------|
|                           | SPACING  |       | +/-  |     | in.                                | mm   | ft-lb             |     | Nm    |       |
|                           | in.      | mm    | in.  | mm  |                                    |      | LUB               | DRY | LUB   | DRY   |
| 226                       | 3-13/16  | 96.8  | 1/64 | .40 | .003                               | .076 | 22                | 43  | 29.8  | 58.3  |
| 263                       | 4-5/16   | 109.5 | 1/32 | .79 | .004                               | .102 | 33                | 63  | 44.7  | 85.4  |
| 301                       | 4-7/8    | 123.8 | 1/32 | .79 | .004                               | .102 | 50                | 95  | 67.8  | 128.8 |
| 351                       | 5-7/8    | 149.2 | 1/32 | .79 | .004                               | .102 | 95                | 175 | 128.8 | 237.3 |
| 401                       | 6-11/16  | 169.9 | 1/32 | .79 | .004                               | .102 | 120               | 200 | 162.7 | 271.2 |

is not properly centered, the additional thrust loads will be transmitted to the compressor bearings. This additional thrust could result in premature bearing failure. Install as follows:

1. Before proceeding with the alignment process, following this section, disassemble the Series 52 coupling **noting the arrangement of bolts, washers, and nuts as THEY MUST BE REPLACED IN THE SAME ORDER**. Mark the adjoining bolt holes of each part, the two hubs, the two disc packs, and the center spool, so they are put back together in the same position.

2. Mount the coupling hubs on their respective shafts. The hub is bored for an interference fit on the shaft. Heating of the coupling hub may be necessary for assembly. **DO NOT SPOT HEAT THE HUB** as it may cause distortion. Heat in water, oil, or use a SOFT open flame and quickly position on the shaft.

3. Adjust the distance between hub faces, as specified in the Series 52 Coupling Data Table, by sliding the hubs. Key and secure the hubs to the shafts by tightening the set screws.

4. Reassemble the coupling with the disc packs and the center spool. Ensure that they are reassembled exactly as they were disassembled.

**WOODS BP SERIES COUPLING** – is also used on applications above 600 HP. It utilizes a center spool and two flexible steel disc packs as the drive element. These three parts, situated between the motor and compressor hubs, prevent axial end float between the motor and compressor shafts. End float tends to occur with sleeve bearing motors.



**Injury may occur if loose clothing, etc. becomes entangled on the spinning motor shaft.**

If the motor is coupled to the compressor using a fixed-end-play coupling and the motor is not properly centered, the additional thrust loads will be transmitted to the compressor bearings. This additional thrust could result in premature bearing failure. Install the BP Series coupling using the following instructions:

1. Before proceeding with the alignment process, following this section, disassemble the BP Series coupling **noting the arrangement of bolts, washers, and nuts as THEY MUST BE REPLACED IN THE SAME ORDER**. Mark the adjoining bolt holes of each part, the two hubs, the two disc packs, and the center spool, so they are put back together in the same position.

2. Slide the coupling hubs on their respective shafts.

3. Reassemble the coupling with the disc packs and the center spool. Ensure that they are reassembled exactly as they were disassembled. Torque disc pack hardware to specification in BP Series Coupling Data Table.

4. Key and secure the hubs to the shafts by tightening the clamping bolts. Make sure that the keyways are offset 180° to maintain balance.

5. Torque the clamping bolts of both hubs to the torque value given in the Data Table. **DO NOT USE ANY LUBRICANT ON THESE BOLTS.**

6. Proceed to Coupling Alignment.

**COUPLING ALIGNMENT PROCEDURE**

The life of the compressor shaft seal and bearings, as well as the life of the motor bearings, is dependent upon proper coupling alignment. Couplings may be aligned at the factory but realignment **MUST ALWAYS** be done on the job site after the unit is securely mounted on its foundation. Initial alignment must be made prior to start-up and rechecked after a few hours of operation. Final (HOT) field alignment can only be made when the unit is at operating temperature. After final (HOT) alignment has been made and found to be satisfactory for approximately one week, the motor may be dowelled to maintain alignment.

**NOTE: Frick recommends cold aligning the motor .005" high. This cold misalignment compensates for thermal growth when the unit is at operating temperature.**

The following procedure is applicable to both the CH and DBZ-B couplings. Dial indicators are to be used to measure the angular and parallel shaft misalignment. Coupling alignment is attained by alternately measuring angular and parallel misalignment and repositioning the motor until the misalignment is within specified tolerances.

**BP SERIES COUPLING DATA TABLE**

| BP SERIES SIZE | HUB FACE * SPACING |     | DISC PACK BOLT TORQUE |     | CLAMP BOLT TORQUE DRY |     |
|----------------|--------------------|-----|-----------------------|-----|-----------------------|-----|
|                | in.                | mm  | ft-lb                 | Nm  | ft-lb                 | Nm  |
| BP48           | 4.88               | 124 | 40                    | 54  | 41                    | 56  |
| BP53           | 5.88               | 150 | 60                    | 81  | 65                    | 88  |
| BP58           | 6.00               | 152 | 120                   | 163 | 100                   | 136 |
| BP58           | 6.69               | 170 | 120                   | 163 | 100                   | 136 |
| BP63           | 7.00               | 179 | 120                   | 163 | 100                   | 136 |

\* Max total indicator reading .003 in. or .076 mm for all sizes.

**SERIES 52 COUPLING DATA TABLE**

| COUPLING SIZE | HUB FACE |       |      |       | MAX TOTAL INDICATOR READING |       |          |       | SETSCREW      |       |              | CLAMP BOLT TORQUE (LUBE) |       |
|---------------|----------|-------|------|-------|-----------------------------|-------|----------|-------|---------------|-------|--------------|--------------------------|-------|
|               | SPACING  |       | +/-  |       | ANGULAR                     |       | PARALLEL |       | TORQUE (LUBE) |       | SIZE         | ft-lb                    | Nm    |
|               | in.      | mm    | in.  | mm    | in.                         | mm    | in.      | mm    | ft-lb         | Nm    |              |                          |       |
| 225           | 5        | 127   | 1/32 | 0.914 | 0.004                       | 0.102 | 0.004    | 0.102 | 7.5           | 10.5  | 1/4-20 UNRF  | 25                       | 33.9  |
| 262           | 5        | 127   | 1/32 | 0.914 | 0.004                       | 0.102 | 0.004    | 0.102 | 22            | 30.6  | 3/8-24 UNRF  | 30                       | 40.7  |
| 312           | 5½       | 139.7 | 3/64 | 1.295 | 0.004                       | 0.102 | 0.004    | 0.102 | 37            | 51.5  | 7/16-20 UNRF | 40                       | 54.2  |
| 350           | 6        | 152.4 | 3/64 | 1.295 | 0.004                       | 0.102 | 0.004    | 0.102 | 55            | 76.5  | 1/2-20 UNRF  | 95                       | 128.8 |
| 375           | 7        | 177.8 | 1/16 | 1.574 | 0.004                       | 0.102 | 0.004    | 0.102 | 55            | 76.5  | 1/2-20 UNRF  | 130                      | 176.3 |
| 425           | 7        | 177.8 | 1/16 | 1.574 | 0.004                       | 0.102 | 0.004    | 0.102 | 96            | 133.6 | 5/8-18 UNRF  | 175                      | 237.3 |
| 450           | 8        | 203.2 | 1/16 | 1.574 | 0.004                       | 0.102 | 0.004    | 0.102 | 96            | 133.6 | 5/8-18 UNRF  | 200                      | 271.2 |
| 500           | 9        | 228.6 | 5/64 | 2.083 | 0.004                       | 0.102 | 0.004    | 0.102 | 250           | 348   | 7/8-14 UNRF  | 260                      | 352.5 |



**All rotating power transmission equipment is potentially dangerous. Ensure that the couplings are properly guarded prior to turning on the power. Coupling guards are provided with the equipment and must be in place and secured properly while the equipment is in operation.**



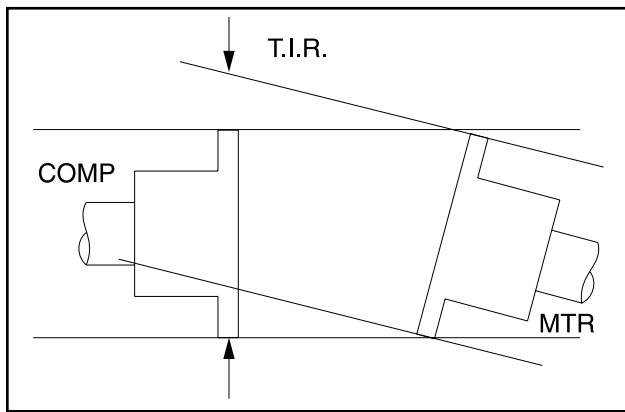
**ALWAYS LOCK OUT MAIN MOTOR DISCONNECT BEFORE TOUCHING MOTOR SHAFT. MISALIGNMENT**

**MUST NOT EXCEED .004" FOR ALL CH, DBZ-B AND SERIES 52 COUPLINGS EXCEPT DBZ-B 226 WHICH SHALL NOT EXCEED .003".**

### ANGULAR ALIGNMENT

1. To check angular alignment, as shown in Figure 1, attach dial indicator rigidly to the motor hub. Move indicator stem so it is in contact with the outside face of compressor hub, as shown in Figure 2.

**NOTE: When DBZ-B couplings are used on motors with sleeve bearings, it is necessary to secure the two coupling hubs with a bolt to prevent them from drifting apart when rotating.**

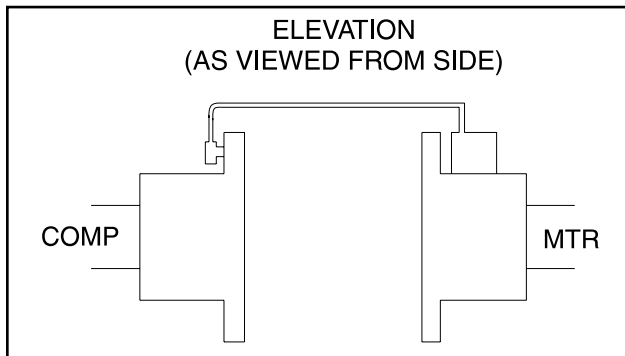


**Figure 1 - Angular Misalignment**

2. Rotate both coupling hubs several revolutions until they seek their normal axial positions.

Check the dial indicator to be sure that the indicator stem is slightly loaded so as to allow movement in both directions.

3. Set the dial indicator at zero when viewed at the 12 o'clock position, as shown in Figure 2.



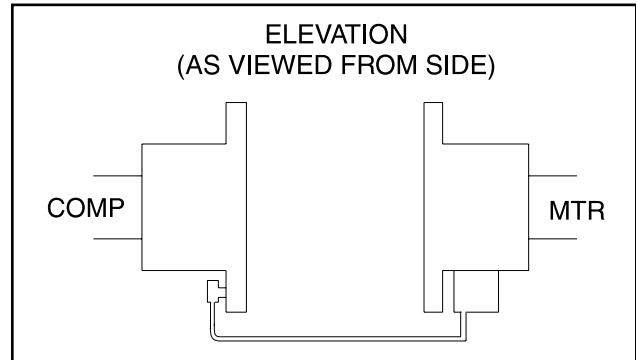
**Figure 2 - Dial Indicator Attached (At 12 O'clock)**

4. Rotate both coupling hubs together 180° (6 o'clock position), as shown in Figure 3. At this position the dial indicator will show TOTAL angular misalignment.

**NOTE: The use of a mirror is helpful in reading the indicator dial as coupling hubs are rotated.**

5. Loosen motor anchor bolts and move or shim motor to correct the angular misalignment.

After adjustments have been made for angular misalignment retighten anchor bolts to prevent inaccurate readings. Repeat Steps 3 through 5 to check corrections. Further adjustments and checks shall be made for angular misalignment until the total indicator reading is within the specified tolerance.

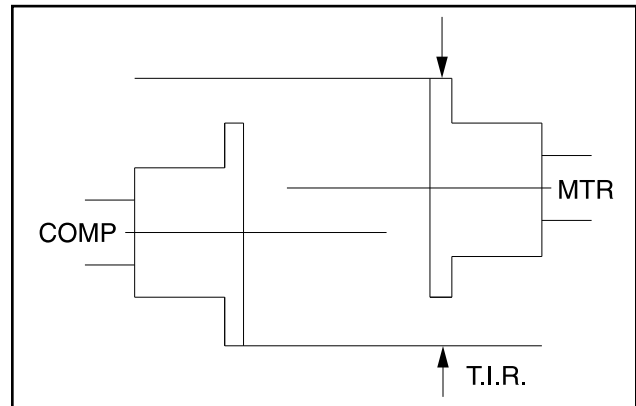


**Figure 3 - Dial Indicator At 6 O'clock**

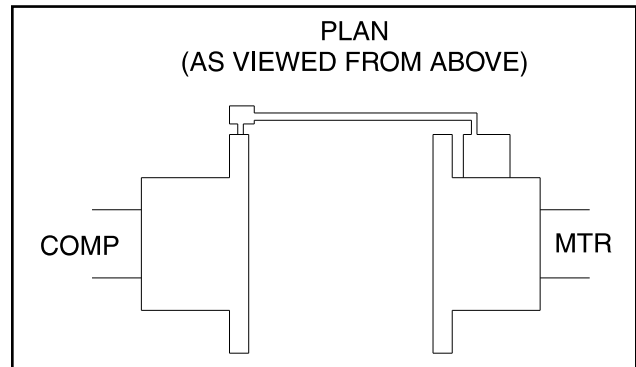
### PARALLEL ALIGNMENT

6. To check parallel alignment, as shown in Figure 4, reposition dial indicator so the stem is in contact with the rim of the compressor hub, as shown in Figure 5.

Check the dial indicator to be sure that the indicator stem is slightly loaded so as to allow movement in both directions.



**Figure 4 - Parallel Misalignment**



**Figure 5 - Dial Indicator Attached (At 9 O'clock)**

7. Check parallel height misalignment by setting dial indicator at zero when viewed at the 12 o'clock position. Rotate both coupling hubs together 180° (6 o'clock position). At this position the dial indicator will show TWICE the amount of parallel height misalignment.

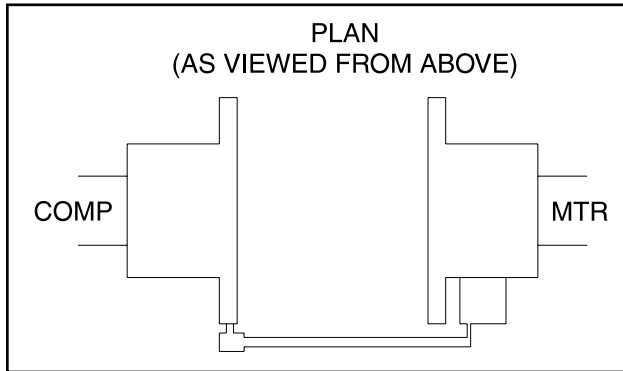


8. Loosen motor anchor bolts and add or remove shims under the four motor feet until parallel height misalignment is within specified tolerance when anchor bolts are retightened.

**CAUTION** CARE MUST BE USED WHEN CORRECTING FOR PARALLEL MISALIGNMENT TO ENSURE THAT THE AXIAL SPACING AND ANGULAR MISALIGNMENT IS NOT SIGNIFICANTLY DISTURBED.

9. After the parallel height misalignment is within tolerance, repeat Steps 1 through 5 until angular misalignment is within specified tolerance.

10. Check parallel lateral misalignment by positioning dial indicator so the stem is in contact with the rim of the compressor hub at 3 o'clock, as shown in Figure 6.



**Figure 6 - Dial Indicator At 3 O'clock**

Set indicator at zero and rotate both coupling hubs together 180° (9 o'clock position), as shown in Figure 5.

Adjust parallel lateral misalignment using the motor adjusting screws until reading is within specified tolerance.

11. Recheck angular misalignment and realign if necessary.

12. Tighten motor anchor bolts and rotate both coupling hubs together, checking the angular and parallel misalignment through the full 360° travel at 90° increments. If dial readings are in excess of specified tolerance realign as required.

13. When the coupling hubs have been aligned to within specified tolerance, a recording of the cold alignment must be made for unit records and usage during hot alignment.

**CAUTION** Install the coupling guard before operating the compressor.

**CAUTION** When installing drive spacer, make sure that hub spacing is within limits shown on the Coupling Data Table applicable to the coupling being installed and that the clamping bolt(s) are properly torqued.

**HOT ALIGNMENT OF COMPRESSOR/MOTOR**

**WARNING** Hot alignments can only be made after the unit has operated for several hours and all components are at operating temperatures.

Shut down the unit (proper lockout/tagout procedures should be followed) and QUICKLY affix dial indicator to coupling motor hub, then take readings of both the face and rim of the compressor hub. If these readings are within tolerance, record reading, attach coupling guard and restart unit.

However, if the reading is not within limits, compare the hot reading with the cold alignment and adjust for this difference; i.e. if the rim at 0° and 180° readings indicates that the motor rises .005" between its hot and cold state, .005" of shims should be removed from under the motor.

After the initial hot alignment adjustment is made, restart unit and bring to operating temperature. Shut down and recheck hot alignment. Repeat procedure unit hot alignment is within specified tolerance.

**CAUTION** INSTALL COUPLING GUARD BEFORE OPERATING COMPRESSOR.

**OIL PUMP COUPLING**

Compressor units with prelube and direct motor/pump coupled pumps need no pump/motor coupling alignment since this is maintained by the close-coupled arrangement.

Some units utilize full and cycling lube pumps which have the motor separate from the pump. These must be checked for alignment due to possible misalignment which may be caused by shipping and handling. Adjustments for that maximum misalignment is less than 0.010" Total Indicator Runout (T.I.R.). Failure to align the coupling may cause serious damage to the pump, shaft seal, coupling, and motor bearings. Use the same procedure as compressor/motor coupling alignment.

**HOLDING CHARGE AND STORAGE**

Each RWB II compressor unit is pressure and leak tested at the Frick factory and then thoroughly evacuated and charged with dry nitrogen to ensure the integrity of the unit during shipping and short term storage prior to installation.

**NOTE: Care must be taken when entering the unit to ensure that the nitrogen charge is safely released.**

**WARNING** Holding charge shipping gauges on separator and external oil cooler are rated for 30 PSIG and are for checking the shipping charge only. They must be removed before pressure testing the system and before charging the system with refrigerant. Failure to remove these gauges may result in catastrophic failure of the gauge and uncontrolled release of refrigerant resulting in serious injury or death.

All units must be kept in a clean, dry location to prevent corrosion damage. Reasonable consideration must be given to proper care for the solid-state components of the microprocessor.

Unit which will be stored for more than two months must have the nitrogen charge checked periodically.

**COMPRESSOR OIL**

**WARNING** DO NOT MIX OILS of different brands, manufacturers, or types. Mixing of oils may cause excessive oil foaming, nuisance oil level cutouts, oil pressure loss, gas or oil leakage and catastrophic compressor failure.

**NOTE: The oil charge shipped with the unit is the best suited lubricant for the conditions specified at the time of purchase. If there is any doubt due to the refrigerant, operating pressures, or temperatures, refer to Frick Pub. E160-802 SPC for guidance.**

TABLE - BASIC OIL CHARGE

| RWB II PLUS MODEL | BASIC* CHARGE (gal.) | ADDITIONAL FOR OIL COOLER |               |
|-------------------|----------------------|---------------------------|---------------|
|                   |                      | SIZE (in.)                | REQ'D. (gal.) |
| 496               | (1)                  | 6 X 60                    | 6             |
| 676               | (1)                  | 8 X 60                    | 10            |
| 856               | (1)                  | 6 X 120                   | 12            |
| 1080              | (1)                  | 8 X 120                   | 20            |
|                   |                      | 10 X 120                  | 28            |
|                   |                      | 12 X 120                  | 39            |
|                   |                      | 16 X 120                  | 45            |

| Oil Sep. Dia. | Basic Oil Charge Gallons |            |
|---------------|--------------------------|------------|
|               | Vertical                 | Horizontal |
| 42"           | 165                      | 245        |
| 48"           | 220                      | 330        |
| 54"           | 275                      | —          |
| 60"           | 385                      | —          |
| 66"           | 385                      | —          |
| 72"           | 385                      | —          |

\* Includes total in oil separator and piping. Add additional for oil cooler.

Add oil by attaching the end of a suitable pressure type hose to the oil charging valve, located on the top of the oil separator on the compressor end of the separator. Using a pressure-type pump and the recommended Frick oil, open the charging valve and pump oil into the separator. **NOTE: Fill slowly because oil will fill up in the separator faster than it shows in the sight glass.**

Oil distillers and similar equipment which act to trap oil must be filled prior to unit operation to normal design outlet levels. The same pump used to charge the unit may be used for filling these auxiliary oil reservoirs.

**NOTE: The sight glass located in the coalescing end of the separator near the discharge connection should remain empty.**

### OIL HEATER(S)

Standard units are equipped with 2 or 3 500 or 1000 watt oil heaters, providing sufficient heat to maintain the oil temperature for most indoor applications during shutdown cycles to permit safe start-up. Should additional heating capacity be required because of low ambient, contact Frick. The heater(s) is energized only when the unit is not in operation.



**Do not energize the heater(s) when there is no oil in the unit, the heater(s) will burn out. The oil heater(s)**

**will be energized whenever 120 volt control power is applied to the unit and the compressor is not running, unless the 16 amp circuit breaker in the micro enclosure is turned off.**

### OIL FILTER(S)



**Use of filter elements other than Frick may cause warranty claim may to be denied.**

The oil filter(s) and coalescer filter element(s) shipped with the unit are best suited to ensure proper filtration and operation of the system.

### LIQUID INJECTION OIL COOLING

The liquid injection system provided on the unit is self-contained but requires the connection of the liquid line sized as shown in the table and careful insertion of the expansion valve bulb into the thermowell provided in the separator.

There are two forms of liquid injection cooling, balanced pressure and temperature/pressure-compensated.

- In the TXV balance pressure valve, the high-pressure connection is made through the regulator to the external port on the liquid injection valve to control oil temperature.
- In the Jordan temperature pressure compensated valve, no external high-pressure connection is required. The thermal bulb supplies all necessary pressure to the valve for increasing or decreasing the required amount of refrigerant.

**NOTE: For booster applications the high pressure gas connection must be taken from a high side source (high stage compressor discharge). This should be a 3/8" line connected into the solenoid valve provided. This gas is required by the expansion valve external port to control oil temperature.**

It is **IMPERATIVE** that an uninterrupted supply of high pressure liquid refrigerant be provided to the injection system at all times. Two items of **EXTREME IMPORTANCE** are the design of the receiver/liquid injection supply and the size of the liquid line.

It is recommended that the receiver be oversized sufficiently to retain a **5 minute supply** of refrigerant for oil cooling. The evaporator supply must be secondary to this consideration. Two methods of accomplishing this are shown.

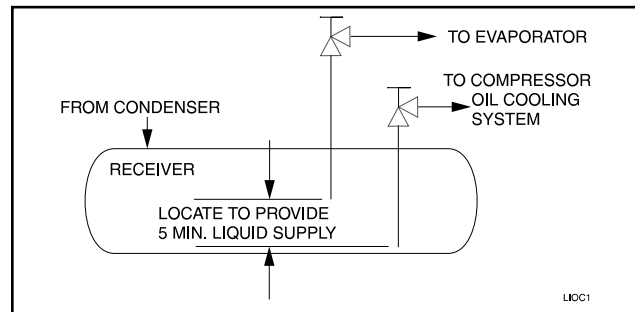


Figure 7 - Dual Dip Tube Method

The Dual Dip Tube method uses two dip tubes in the receiver. The liquid injection tube is below the evaporator tube to ensure continued oil cooling when the receiver level is low.

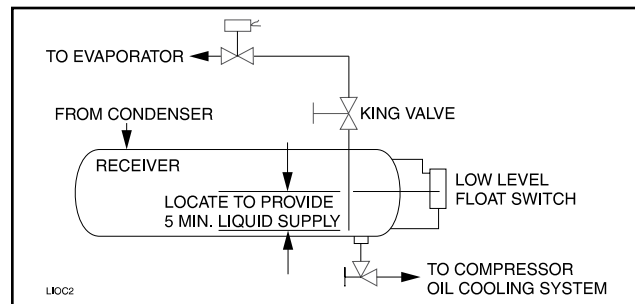


Figure 8 - LEVEL CONTROL METHOD

The Level Control method utilizes a float level control on the receiver to close a solenoid valve feeding the evaporator when the liquid falls below that amount necessary for **5 minutes of liquid injection oil cooling**.

**LIQUID LINE SIZES/RECEIVER VOLUME**

Liquid line sizes and the additional receiver volume (quantity of refrigerant required for **5 minutes of liquid injection oil cooling**) are given in the following table:

**LIQUID LINE SIZE and RECEIVER VOLUME**

| RWB II MODEL             | LINE SIZE*  |           | 5 MINUTE SUPPLY POUNDS | LIQUID VOLUME CU FT |
|--------------------------|-------------|-----------|------------------------|---------------------|
|                          | SCH 80 PIPE | OD TUBING |                        |                     |
| <b>R-717 HIGH STAGE*</b> |             |           |                        |                     |
| 496                      | 2           | –         | 310                    | 8.5                 |
| 676                      | 2           | –         | 420                    | 11.5                |
| 856                      | 2           | –         | 650                    | 18                  |
| <b>R-717 BOOSTER*</b>    |             |           |                        |                     |
| 496                      | 1           | –         | 50                     | 1.5                 |
| 676                      | 1           | –         | 70                     | 2.0                 |
| 856                      | 1-1/4       | –         | 125                    | 3.5                 |
| 1080                     | 1-1/4       | –         | 155                    | 4.4                 |

\* Based on 100 foot liquid line. For longer runs, increase line size accordingly.

**WATER-COOLED OIL COOLING (OPTIONAL)**

The plate and shell type water-cooled oil cooler is mounted on the unit complete with all oil piping. The customer must supply adequate water connections. Determine the size of the water-cooled oil cooler supplied with the unit, as outlined on the Frick P&I diagram and arrangement drawings. **The water supply must be sufficient to meet the required flow.**

Frick recommends a closed-loop system for the waterside of the oil cooler. Careful attention to water treatment is essential to ensure adequate life of the cooler if cooling tower water is used. **It is imperative that the condition of cooling water and closed-loop fluids be analyzed regularly and as necessary and maintained at a pH of 7.4, but not less than 6.0 for proper heat exchanger life.** After initial start-up of the compressor package, the strainer at the inlet of the oil cooler should be cleaned several times in the first 24 hours of operation.

In some applications, the plate and shell oil cooler may be subjected to severe water conditions, including high temperature and/or hard water conditions. This causes accelerated scaling rates which will penalize the performance of the heat exchanger. A chemical cleaning process will extend the life of the Plate and Shell heat exchanger. It is important to establish regular cleaning schedules.

**Cleaning:** A 3% solution of Phosphoric or Oxalic Acid is recommended. Other cleaning solutions can be obtained from your local distributor, but they must be suitable for stainless steel. The oil cooler may be cleaned in place by back flushing with recommended solution for approximately 30 minutes. After back flushing, rinse the heat exchanger with fresh water to remove any remaining cleaning solution.

**TABLE 2 - OIL COOLER DATA**

| RWB II MODEL |          | TYP COOLER |        | CONNECTION |        |
|--------------|----------|------------|--------|------------|--------|
|              |          | DIA        | PLATES | INLET      | OUTLET |
| 496 - 676    | Hi Stage | 24 in.     | 188    | 4 in.      | 5 in.  |
| 496 - 856    | Booster  | 24 in.     | 72     | 3 in.      | 3 in.  |
| 1080         | Booster  | 24 in.     | 136    | 4 in.      | 5 in.  |

**THERMOSYPHON OIL COOLING (OPTIONAL)**

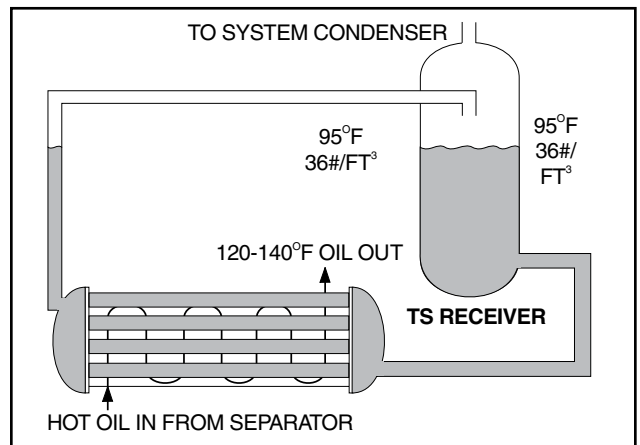
Thermosyphon oil cooling is an economical, effective method for cooling oil on screw compressor units. Thermosyphon cooling utilizes liquid refrigerant at condenser pressure and temperature which is partially vaporized at the condenser temperature in a shell and tube vessel cooling the oil. The vapor, at condensing pressure, is vented to the condenser inlet and reliquified. This method is the most cost effective of all currently applied cooling systems since no compressor capacity is lost or compressor power penalties incurred. The vapor from the cooler need only be condensed, not compressed. Refrigerant flow to the cooler is automatic, driven by the thermosyphon principle and cooling flow increases as the oil inlet temperature rises.

**EQUIPMENT** - The basic equipment required for a thermosyphon system consists of:

1. A source of liquid refrigerant at condensing pressure and temperature located in close proximity to the unit to minimize piping pressure drop. The liquid level in the refrigerant source must be 6 to 8 feet minimum above the center of the oil cooler.
2. A shell and tube oil cooler with:
  - Shell Side: Oil 400 lb design
  - Tube Side: Refrigerant 400 lb design

Due to the many variations in refrigeration system design and physical layout, several systems for assuring the above criteria are possible.

**SYSTEM OPERATION** - Liquid refrigerant fills the cooler tube side up to the Thermosyphon receiver liquid level (Figure 9).



**Figure 9**

Hot oil (above the liquid temperature) flowing through the cooler will cause some of the refrigerant to boil and vaporize in the tubes. The vapor rises in the return line. The density of the refrigerant liquid/vapor mixture in the return line is considerably less than the density of the liquid in the supply line. This imbalance provides a differential pressure that sustains a flow condition to the oil cooler. This relationship involves:

1. Liquid height above the cooler.
2. Oil heat of rejection.
3. Cooler size and piping pressure drops.

Current thermosyphon systems are using single-pass oil coolers and flow rates based on 3:1 overfeed.

The liquid/vapor returned from the cooler is separated in the receiver. The vapor is vented to the condenser inlet and need only be reliquified since it is still at condenser pressure (Figure 10).

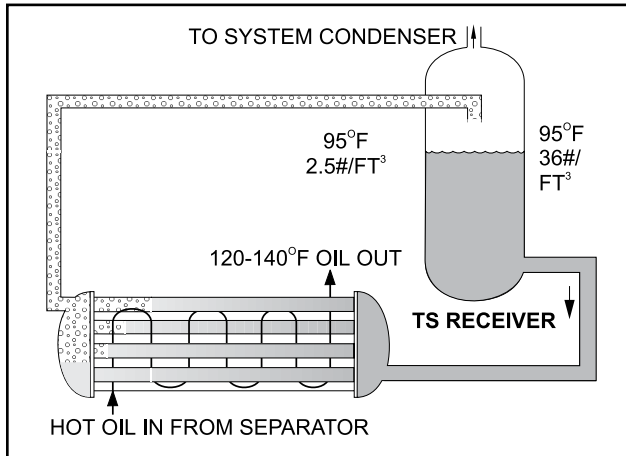


Figure 10

**OIL TEMPERATURE CONTROL** - Oil temperature will generally run about 15 - 35°F above condensing temperature. In many cases, an oil temperature control is not required if condensing temperature is above 65°F as oil temperature can be allowed to float with condenser temperature.

|                         |              |
|-------------------------|--------------|
| Condensing Temperature: | 65°F - 105°F |
| Oil Temperature:        | 80°F - 140°F |

**INSTALLATION** - The shell and tube-type thermosyphon oil cooler with oil-side piping and a thermostatically controlled

mixing valve (if ordered) are factory mounted and piped. The customer must supply and install all piping and equipment located outside of the shaded area on the piping diagram with consideration given to the following:

1. The refrigerant source, thermosyphon or system receiver, should be in close proximity to the unit to minimize piping pressure drop.
2. The liquid level in the refrigerant source must be **6 to 8 feet minimum** above the center of the oil cooler.
3. A safety valve should be installed if refrigerant isolation valves are used for the oil cooler.

**TSOC AND WCOC OIL SIDE SAFETY RELIEF** - Compressor units assembled after January 1995, which have valves in the oil piping to isolate the oil cooler from the oil separator for servicing, may have factory installed piping to relieve the shell side (oil side) safety valve directly into the oil separator, as shown in the P & I diagrams section.

This arrangement uses a special UV stamped safety valve rated for liquid and vapor relief. The safety valve is designed for 500 psi DWP and is set to relieve at 75 psi delta P. The safety valve piping contains flanged connections should the valve require maintenance or replacement.

**CAUTION** EXTRA CAUTION SHOULD BE USED WHEN SERVICING AN OIL SEPARATOR WITH THIS ARRANGEMENT. IF THE OIL COOLER IS VALVED OFF FROM AN OIL SEPARATOR WHICH HAS BEEN EVACUATED FOR SERVICING, THEN THE OIL COOLER COULD RELIEVE INTO THE SEPARATOR VESSEL IF THE 75 PSI DELTA P SETPOINT IS EXCEEDED.

Other units, which do not use this special safety valve arrangement, will have factory mounted safety valves on the shell side of the oil cooler which the installing contractor should pipe into house safety systems designated suitable for oil relief.

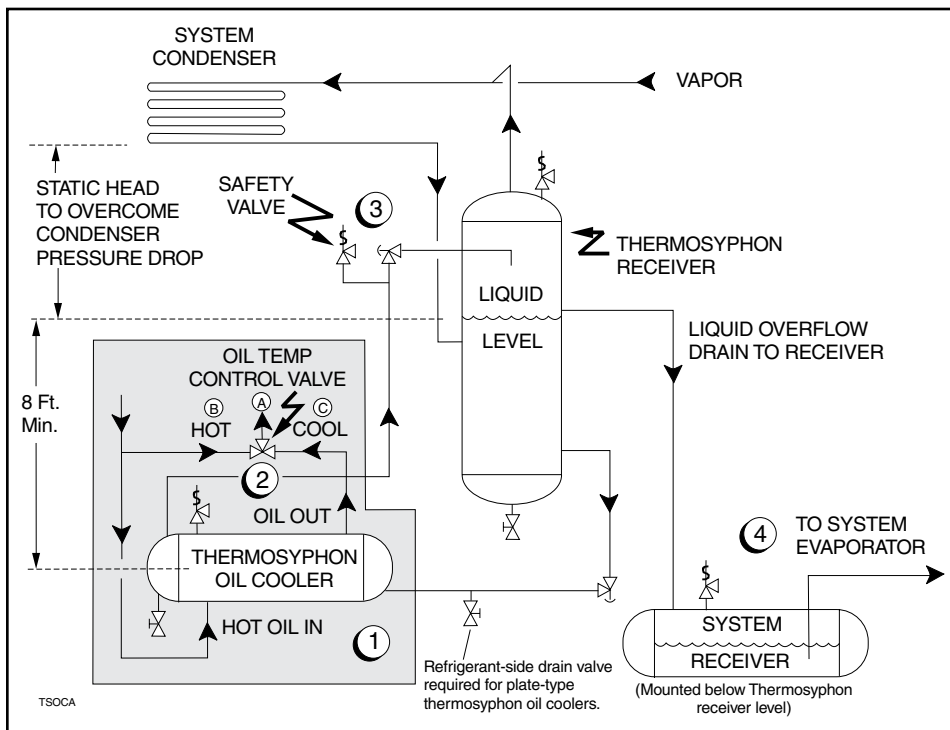


Figure 11

1. The thermosyphon oil cooler is supplied with oil side piped to the compressor unit and stub ends supplied on refrigerant side.
2. A three-way oil temperature control valve is required where condensing temperature is expected to go below 65°F.
3. A refrigerant-side safety valve is required in this location only when refrigerant isolation valves are installed between the cooler and thermosyphon receiver. If no valves are used between the cooler and TSOC receiver, the safety valve on the TSOC receiver must be sized to handle the volume of both vessels. Then, the safety valve on the cooler vent (liquid refrigerant side) can be eliminated.
4. The system receiver must be below the thermosyphon receiver in this arrangement.

The component and piping arrangement shown in Figure 11 is intended only to illustrate the operating principles of thermosyphon oil cooling. Other component layouts may be better suited to a specific installation. Refer to publication 070.900-E for additional information on Thermosyphon Oil Cooling.

**ECONOMIZER - HIGH STAGE (OPTIONAL)**

The economizer option provides an increase in system capacity and efficiency by subcooling liquid from the condenser through a heat exchanger or flash tank before it goes to the evaporator. The subcooling is provided by flashing liquid in the economizer cooler to an intermediate pressure level. The intermediate pressure is provided by a port located part way down the compression process on the screw compressor.

As the screw compressor unloads, the economizer port will drop in pressure level, eventually being fully open to suction. Because of this, an output from the microprocessor is generally used to turn off the supply of flashing liquid on a shell and coil or DX economizer when the capacity falls below approximately 45%-60% (85%-90% slide valve position). This is done because the compressor will be more efficient operating at a higher slide valve position with the economizer turned off, than it will at a low slide valve position with the economizer turned on. Please note, however, that shell and coil and DX economizers can be used at low compressor capacities in cases where efficiency is not as important as ensuring that the liquid supply is subcooled. In such cases, the economizer liquid solenoid can be left open whenever the compressor is running.

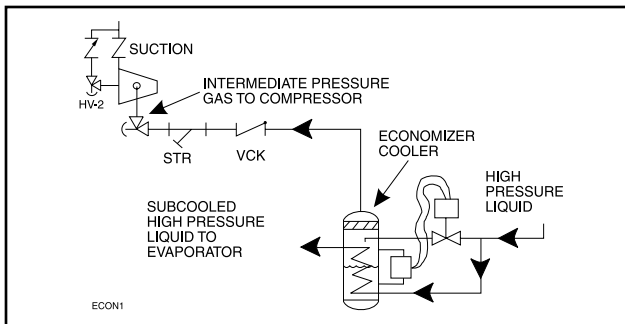
Due to the tendency of the port pressure to fall with decreasing compressor capacity, a back-pressure regulator valve (BPR) is generally required on a flash economizer system (Fig. 14) in order to maintain some preset pressure difference between the subcooled liquid in the flash vessel and the evaporators. If the back-pressure regulator valve is not used on a flash economizer, it is possible that no pressure difference will exist to drive liquid from the flash vessel to the evaporators, since

the flash vessel pressure will approach suction pressure at a decreased slide valve position. In cases where wide swings in pressure are anticipated in the flash economizer vessel, it may be necessary to add an outlet pressure regulator to the flash vessel outlet to avoid overpressurizing the economizer port, which could result in motor overload. Example: A system feeding liquid to the flash vessel in batches.

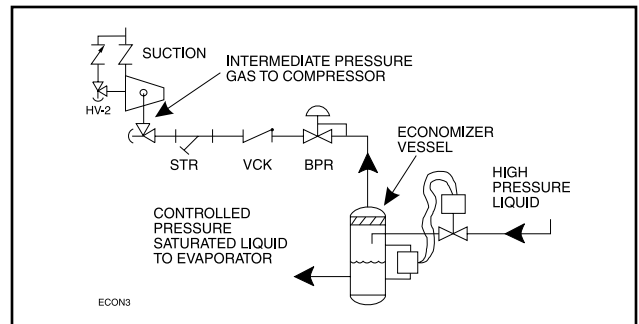
The recommended economizer systems are shown below. Notice that in all systems there should be a strainer (STR) and a check valve (VCK) between the economizer vessel and the economizer port on the compressor. The strainer prevents dirt from passing into the compressor and the check valve prevents oil from flowing from the compressor unit to the economizer vessel during shutdown.

**CAUTION** Other than the isolation valve needed for strainer cleaning, it is essential that the strainer be the last device in the economizer line before the compressor. Also, piston-type check valves are recommended for installation in the economizer line, as opposed to disc-type check valves. The latter are more prone to gas-pulsation-induced failure. The isolation and check valves and strainer should be located as closely as possible to the compressor, preferably within a few feet.

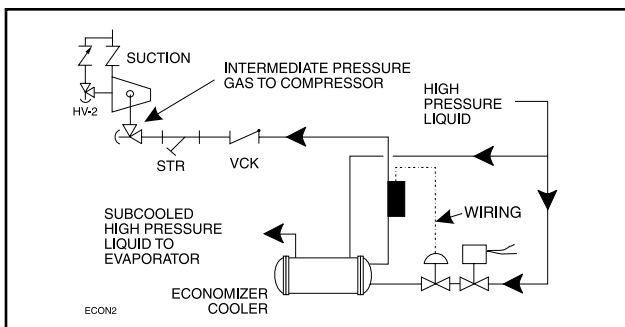
For refrigeration plants employing multiple compressors on a common economizing vessel, regardless of economizer type, each compressor must have a back-pressure regulating valve in order to balance the economizer load, or gas flow, between compressors. The problem of balancing load becomes most important when one or more compressors run at partial load, exposing the economizer port to suction pressure. In the case of a flash vessel, there is no need for the redundancy of a back-pressure regulating valve on the vessel and each of the multiple compressors. Omit the BPR valve on the flash economizer vessel and use one on each compressor, as shown in Fig. 15. It is also recommended that the back-pressure regulating valves, used on economizer lines, should be specified with electric shutoff option. The electric shutoff feature is necessary to prevent flow from the



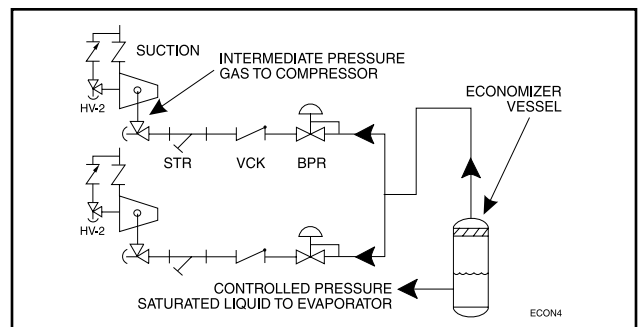
**FIG. 12 - Shell and Coil Economizer System**



**FIG. 14 - Flash Economizer System**



**FIG. 13 - Direct Expansion Economizer System**



**FIG. 15 - Multiple Compressor Economizer System**

common economizer vessel to the suction side of a stopped compressor, through the suction check valve bypass line, if the other compressors and the common economizer vessel are still operating and the HV2 valve on the suction bypass is open.

For refrigeration plants using a Packaged Refrigerant Recirculation (PRR) unit and a direct expansion (DX) economizer system it is necessary to operate the liquid feed solenoid on the PRR unit and the liquid feed solenoid on the DX vessel off of a common signal to avoid liquid overfeed on the DX economizer system.

## ECONOMIZER LOAD BALANCING

The most energy efficient manner to operate an economizer system, when using multiple compressors on a common economizer vessel, is to take as much of the flash gas as possible to the compressors that are fully loaded. This can be done in at least two ways.

1. Use the economizer output from the microprocessor to turn off a solenoid, or to actuate the electric shutoff option on a back-pressure regulator, based on percent of slide valve travel. This will direct all the flash vapor to the other loaded compressors.

2. A dual-setpoint back-pressure regulator valve can be used in each of the individual economizer vapor lines. When a compressor is running near full load, the BPR valve will operate on the desired setpoint, or basically wide open, to minimize pressure drop in the line. When one compressor unloads below the slide valve position where the economizer output on the microprocessor turns on, the dual-setpoint feature of the regulator can be actuated by this output to control the pressure, on the vessel side of the regulator, to be a few psi higher. Consequently, the flash gas will be sent to the loaded compressors first, until they can't handle all the vapor and the pressure in the vessel starts to rise. Then, some of the vapor will go to the unloaded compressor to help maintain the vessel at the desired pressure. An example of a back-pressure regulator with electric shutoff and the dual-setpoint feature is an R/S A4ADS.

## ELECTRICAL

**NOTE: Before proceeding with electrical installation, read the instructions in the section "Proper Installation of Electronic Equipment in an Industrial Environment".**

RWB II units are supplied with a **QUANTUM** control system. Care must be taken that the controls are not exposed to physical damage during handling, storage, and installation. The single-box control door must be kept tightly closed to prevent moisture and foreign matter from entry.

**NOTE: All customer connections are made in the single-box control mounted on the oil separator. This is the ONLY electrical enclosure and it should be kept tightly closed whenever work is not being done in it.**

## VOLTAGE PROTECTION

Frick® does not advise nor support the use of UPS power systems in front of the Quantum™ panel. With a UPS power system providing shutdown protection for the Quantum™, the panel may not see the loss of the 3-phase voltage on the motor because the UPS could prevent the motor starter contactor from dropping out. With the starter contactor still energized, the compressor auxiliary will continue to feed an "Okay" signal to the panel. This will allow the motor to be subjected to a fault condition on the 3-phase bus. Some fault scenarios are:

1. The 3-phase bus has power "on" and "off" in a continuous cyclic manner which may cause the motor to overheat due to repeated excessive in-rush currents.
2. Motor cycling may damage the coupling or cause other mechanical damage due to the repeated high torque motor "bumps".
3. Prolonged low voltage may cause the motor to stall and overheat before the motor contactor is manually turned off.

Under normal conditions, the loss of 3-phase power will shut the Quantum™ panel down, and it will restart upon power return. If the panel was in:

- **Auto** – Compressor motor will return to running as programmed.
- **Remote** – The external controller would reinitialize the panel and proceed to run as required.
- **Manual** – The compressor will have to be restarted manually after the 3-phase bus fault has been cleared.

If the local power distribution system is unstable or prone to problems, there are other recommendations to satisfy these problems. If power spikes or low or high line voltages are the problem, then Frick® recommends the use of a Sola® constant voltage (CV) transformer with a line suppression feature. If a phase loss occurs, then you will typically get a high motor amp shutdown. If problems continue to exist, then an examination of the plant's power factor may be in order.

Unless careful design failure analysis is considered in the implementation of power systems, the alternative solutions provide a safer and less expensive implementation. In either case, only one Sola® may be used per compressor. Each compressor needs to be individually isolated from each other through a dedicated control transformer. Sharing a common control power source is an invitation for ground loops and the subsequent unexplainable problems.

## MOTOR STARTER PACKAGE

Motor starter and interlock wiring requirements are shown in the wiring diagram above. All the equipment shown is supplied by the installer unless a starter package is purchased from Frick. Starter packages should consist of:

1. The compressor motor starter of the specified HP and voltage for the starting method specified (across-the-line, autotransformer, wye-delta, or solid-state).

**NOTE: If starting methods other than across-the-line are desired, a motor/compressor torque analysis must be done to ensure that sufficient starting torque is available, particularly in booster applications. Contact FRICK if assistance is required.**

2. If specified, the starter package can be supplied as a combination starter with circuit breaker disconnect. However, the motor overcurrent protection/disconnection device can be applied by others, usually as a part of an electrical power distribution board.

3. The oil pump starter with fuses, or in the case where the compressor motor is a different voltage from the oil pump motor, with a circuit breaker disconnect suitable for separate power feed.

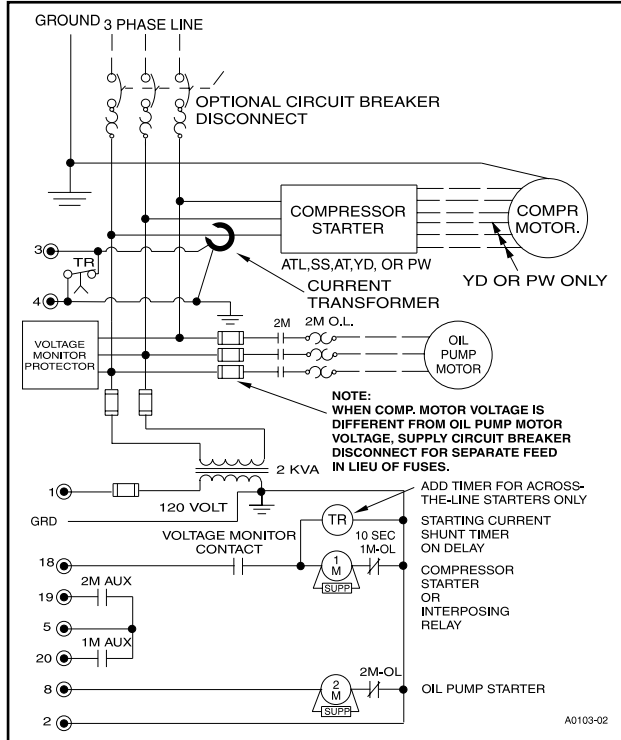
4. A 2.0 KVA control power transformer (CPT) to supply 120 volt control power to the microprocessor control system and



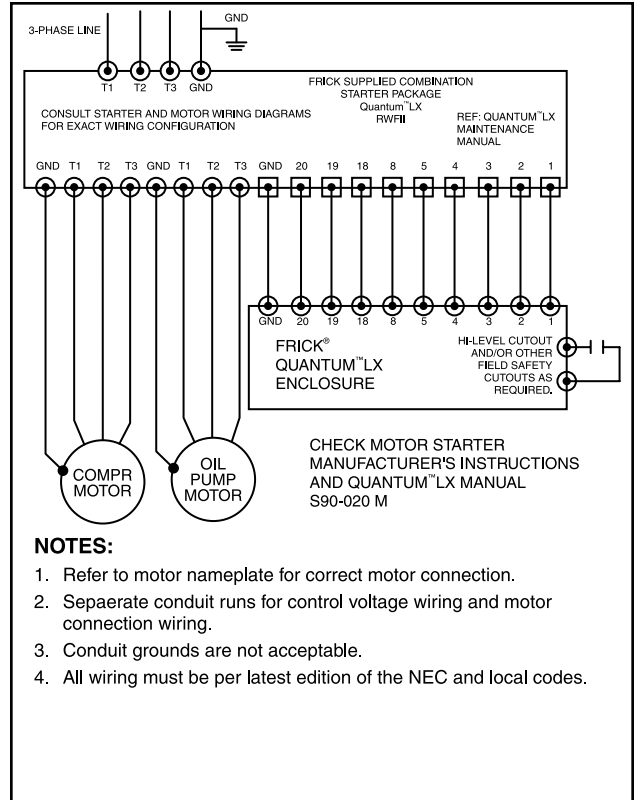
separator oil heaters is included. If environmental conditions require more than the usual two 500 watt oil heaters, an appropriately oversized control transformer will be required. If frequent power fluctuations are anticipated or extremely noisy power lines are encountered, a regulating control transformer should be considered. Contact FRICK for assistance.

5. For customer-supplied across-the-line starters, a shunting device must be installed across the Current Transformer (terminals 3 & 4).

**If the shunting device is not installed, the SBC board may be severely damaged at start-up (see Figure 16).**



**Figure 16 - Starter Wiring Diagram**



**Figure 17 - Point-To-Point Wiring Diagram**

**NOTES:**

1. Refer to motor nameplate for correct motor connection.
2. Separate conduit runs for control voltage wiring and motor connection wiring.
3. Conduit grounds are not acceptable.
4. All wiring must be per latest edition of the NEC and local codes.

**CURRENT TRANSFORMER (CT) RATIOS**

The CT ratio for various motor sizes (with a 5 amp secondary) is given in the following table:

| HP   | VOLTAGE |        |        |        |        |        |       |
|------|---------|--------|--------|--------|--------|--------|-------|
|      | 200     | 230    | 380    | 460    | 575    | 2300   | 4160  |
| 100  | 400:5   | 300:5  | 200:5  | 200:5  | 200:5  | -      | -     |
| 125  | 500:5   | 400:5  | 300:5  | 200:5  | 200:5  | -      | -     |
| 150  | 600:5   | 500:5  | 300:5  | 300:5  | 200:5  | -      | -     |
| 200  | 800:5   | 600:5  | 400:5  | 300:5  | 300:5  | 100:5  | 50:5  |
| 250  | 800:5   | 800:5  | 500:5  | 400:5  | 300:5  | 100:5  | 50:5  |
| 300  | 1000:5  | 1000:5 | 600:5  | 500:5  | 400:5  | 100:5  | 50:5  |
| 350  | -       | 1000:5 | 800:5  | 500:5  | 500:5  | 100:5  | 100:5 |
| 400  | -       | -      | 800:5  | 600:5  | 500:5  | 200:5  | 100:5 |
| 450  | -       | -      | 1000:5 | 800:5  | 600:5  | 200:5  | 100:5 |
| 500  | -       | -      | 1000:5 | 800:5  | 600:5  | 200:5  | 100:5 |
| 600  | -       | -      | 1200:5 | 1000:5 | 800:5  | 200:5  | 100:5 |
| 700  | -       | -      | -      | 1200:5 | 1000:5 | 200:5  | 200:5 |
| 800  | -       | -      | -      | -      | 1000:5 | 300:5  | 200:5 |
| 900  | -       | -      | -      | -      | 1200:5 | 300:5  | 200:5 |
| 1000 | -       | -      | -      | -      | -      | 300:5  | 200:5 |
| 1250 | -       | -      | -      | -      | -      | 400:5  | 200:5 |
| 1500 | -       | -      | -      | -      | -      | 500:5  | 300:5 |
| 2000 | -       | -      | -      | -      | -      | 600:5  | 300:5 |
| 2500 | -       | -      | -      | -      | -      | 700:5  | 400:5 |
| 3000 | -       | -      | -      | -      | -      | 800:5  | 500:5 |
| 3500 | -       | -      | -      | -      | -      | 900:5  | 500:5 |
| 4000 | -       | -      | -      | -      | -      | 1000:5 | 600:5 |

6. The compressor motor Current Transformer (CT) is installed on any one phase of the compressor leads.

**NOTE: The CT must see all the current of any one phase, therefore in wye-delta applications BOTH leads of any one phase must pass through the CT.**

7. One each normally open compressor motor and oil pump motor starter auxiliary contact should be supplied and in addition to the compressor and oil pump motor starter coils, the CT and CPT secondaries wired as shown on the starter package wiring diagram. The load on the control panel for the compressor motor starter coil should not exceed 1 Nema size 3 starter. For larger starters, an interposing relay must be used to switch the compressor motor starter coil(s).

**NOTE: Do not install a compressor HAND/OFF/AUTO switch in the starter package as this would bypass the compressor safety devices.**

### MINIMUM BURDEN RATINGS

The following table gives the minimum CT burden ratings. This is a function of the distance between the motor starting package and the compressor unit.

| BURDEN RATING |      | MAXIMUM DISTANCE FROM FRICK PANEL USING |         |         |
|---------------|------|-----------------------------------------|---------|---------|
| ANSI          | VA   | #14 AWG                                 | #12 AWG | #10 AWG |
| B-0.1         | 2.5  | 15 ft                                   | 25 ft   | 40 ft   |
| B-0.2         | 5    | 35 ft                                   | 55 ft   | 88 ft   |
| B-0.5         | 12.5 | 93 ft                                   | 148 ft  | 236 ft  |

### CONTROL POWER REGULATOR

Compressor units that will be used in areas that suffer brown-outs and other significant power fluctuations can be supplied with a control power regulator. See Figure 18, Recommended Regulator Installation.

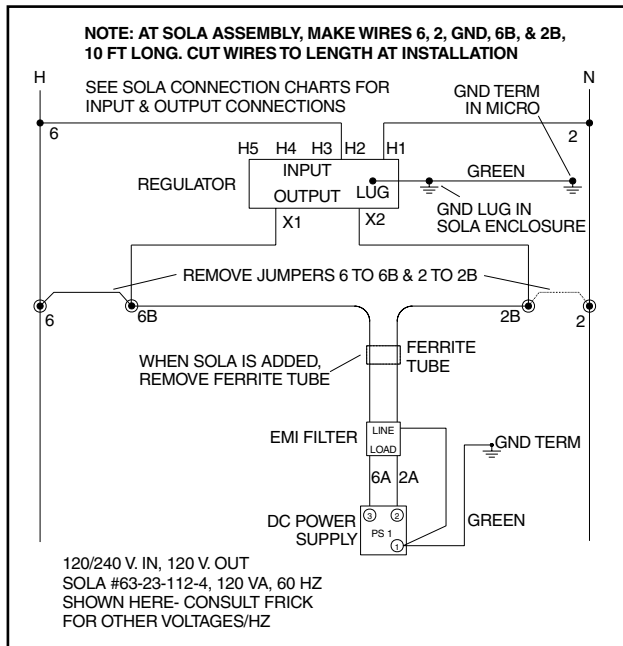


Figure 18 - Recommended Regulator Installation

### BATTERY BACKUP

The battery backup is used only for date and time retention during power interruption. All setpoints and other critical information are saved to onboard flash memory. **It is not necessary to disconnect the battery during extended downtime.**



## OPERATION

### and START-UP INSTRUCTIONS

The Frick RWB II Rotary Screw Compressor Unit is an integrated system consisting of six major subsystems:

1. Control Panel (See publications S90-010 O,M, & CS for Quantum Panel and S70-200 OM for the Plus panel).
2. Compressor
3. Compressor Lubrication System
4. Compressor Oil Separation System
5. Compressor Hydraulic System
6. Compressor Oil Cooling System

The information in this section of the manual provides the logical step-by-step instructions to properly start up and operate the RWB II Rotary Screw Compressor Unit.

**THE FOLLOWING SUBSECTIONS MUST BE READ AND UNDERSTOOD BEFORE ATTEMPTING TO START OR OPERATE THE UNIT.**

### TDSH COMPRESSOR

The Frick RWB II rotary screw compressor utilizes mating asymmetrical profile helical rotors to provide a continuous flow of refrigerant vapor and is designed for both high pressure and low pressure applications. The compressor incorporates the following features:

1. High capacity roller bearings to carry radial loads at both the inlet and outlet ends of the compressor.
2. Heavy-duty, four-point angular contact ball bearings to carry axial loads are mounted at the discharge end of compressor.
3. Balance pistons located in the inlet end of the compressor to reduce axial loads on the axial load bearings and increase bearing life.
4. Moveable slide valve to provide infinite step capacity control from 100 to approximately 10%.
5. VOLUMIZER® volume ratio control to allow infinitely variable volume ratio from 2.4 to 4.5 during compressor operation for all models.
6. A hydraulic unloader cylinder to operate the slide stop and slide valve.
7. Bearing and casing design for 350 PSI discharge pressure. **This PSI rating applies only to the compressor and does not reflect the design pressure of the various system components.**
8. All bearing and control oil vented to closed thread in the compressor instead of suction port to avoid performance penalties from superheating suction gas.
9. Shaft seal design to maintain operating pressure on seal well below discharge pressure, for increased seal life.
10. Oil injected into the rotors to maintain good volumetric and adiabatic efficiency even at very high compression ratios.
11. Shaft rotation clockwise facing compressor, suitable for all types of drives. **SEE CAUTION.**
12. Dual compressor casing design for very low airborne noise transmission.



**CAUTION** COMPRESSOR ROTATION IS CLOCKWISE WHEN FACING THE COMPRESSOR DRIVE SHAFT. THE COMPRESSOR SHOULD NEVER BE OPERATED IN REVERSE ROTATION AS BEARING DAMAGE WILL RESULT WHICH CAN CAUSE CATASTROPHIC FAILURE OF THE COMPRESSOR.

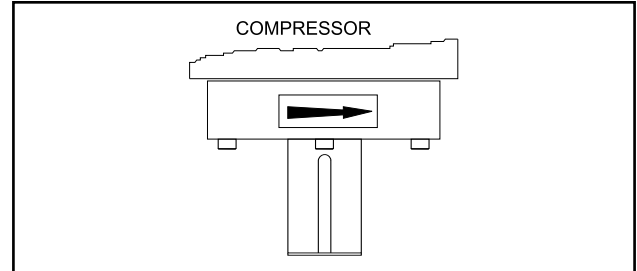


Figure 19 - Compressor Rotation Direction

### COMPRESSOR LUBRICATION SYSTEM

The lubrication system on an RWB II screw compressor unit performs several functions:

1. Provides lubrication to bearings and seal.
2. Provides a cushion between the rotors to minimize noise and vibrations.
3. Helps keep the compressor cool and prevents overheating.
4. Provides an oil supply to hydraulically actuate the slide valve and slide stop.
5. Provides oil pressure to the balance pistons to help increase bearing life.
6. Provides an oil seal between the rotors to prevent rotor contact or gas bypassing.

The compressor unit may be equipped with either a prelube, full-lube or cycling full-lube lubrication system. Additionally, either system may contain dual oil filters and liquid injection, water-cooled, or thermosyphon oil cooler for compressor oil cooling.

### PRELUBE OIL SYSTEM

The RWB II screw compressor unit is designed to be self-lubricating. Oil being supplied to the compressor from the oil separator is at system head pressure. Within the compressor, oil porting to all parts of the compressor is vented back to a point in the compressor's body that is at a pressure lower than compressor discharge pressure. The compressor's normal operation makes the compressor unit operate essentially as its own oil pump. All oil entering the compressor is moved by the compressor rotors out the compressor outlet and back to the oil separator.

For normal operation an oil pump is not required except to lubricate the compressor during start-up. During the period from start-up to normal operation, the oil pressure alarm and oil pressure cutout setpoints will vary according to formulas built into the microprocessor control program. On start-up the PRELUBE pump has 30 seconds to produce over five pounds of oil pressure over registered discharge pressure or a cutout will occur. When the compressor starts, oil pressure will be ignored for two minutes. After 25 PSID pressure dif-

ferential has been reached between suction and discharge, the PRELUBE pump will shut down and the lubrication oil will be supplied by the pressure differential. If after five minutes 25 PSID has not been reached, the unit will shutdown on DCO cutout.

**NOTE: For alarm descriptions and shutdown or cutout parameters, see S90-010 O (Quantum).**

### CYCLING FULL-LUBE OIL SYSTEM

This system is designed to provide those high stage applications that operate with normal to low differential pressure across the compressor suction and discharge with adequate compressor lubrication.

During the period from start-up to normal operation the oil pressure alarm and oil pressure cutout setpoints will vary according to formulas built into the microprocessor control program. On start-up, the solenoid valve in the main injection feed is closed to allow oil to feed into the slide valve and bearing ports only. After the compressor starts and the pressure is between 5 PSI and 10 PSI differential, the prealarm signal is activated. If the oil pressure is above 10 PSI, the alarm can be cleared. The pump will continue to run until the discharge pressure is 55 PSI over suction pressure, then it will shut down. When the pressure differential falls below 45 PSI, the pump will start again.

**NOTE: For alarm and shutdown or cutout values, see S90-010 O (Quantum) or S70-200 OM (Plus).**

### FULL-LUBE OIL SYSTEM

RWB II booster compressors and high stage compressors that operate with very low differential pressures across the compressor suction and compressor discharge require a full time oil pump to produce the oil flow and pressures required. Oil is pumped from the oil separator through the oil filter to the main oil injection feed and the compressor. An oil pressure regulating valve downstream of the pump is used to regulate oil pressure at the compressor by returning excess oil to the separator. During the start-up sequence, the solenoid valve in the main oil injection feed is closed to allow oil to feed into the slide valve and bearing ports only.

Oil pressure on RWB II compressors with full time oil pumps should be adjusted to provide 20 - 25 PSI (high stage) or 30 - 35 PSI (booster) pounds of oil pressure at the highest normal head pressure or intermediate pressure expected with the compressor fully loaded. The compressor will require maximum oil flow under these conditions.

### COMPRESSOR OIL SEPARATION SYSTEM

The RWB II is an oil flooded screw compressor. Most of the oil discharged by the compressor separates from the gas flow in the oil charge reservoir. Some oil, however, is discharged as a mist which does not separate readily from the gas flow and is carried past the oil charge reservoir. One or more coalescer filter elements then COALESCE the oil mist into droplets, the droplets of oil fall to the bottom of the coalescer section of the oil separator. The return of this oil to the compressor is controlled by a needle valve on both high stage and booster applications (see Figures 19 and 20).

**NOTE: Open needle valve only enough to keep coalescer end of separator free of oil.**

The sight glass located near the bottom of the coalescer section of the oil separator should remain empty during

normal operation. If an oil level develops and remains in the sight glass, a problem in the oil return separation system or compressor operation has developed. Refer to Maintenance for information on how to correct the problem.

**NOTE: Normal Operating Level is midway between the two sight glasses as shown in Figures 20 and 21.**

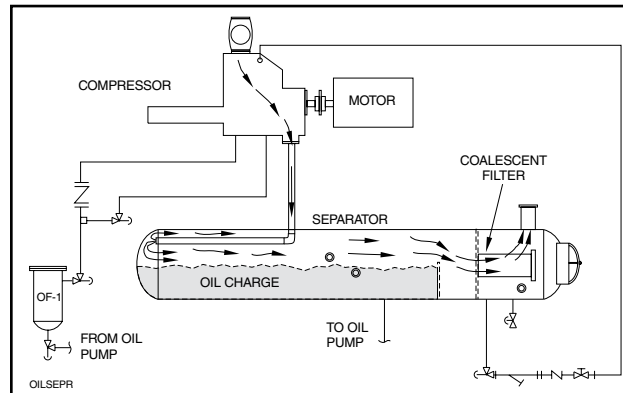


Figure 20

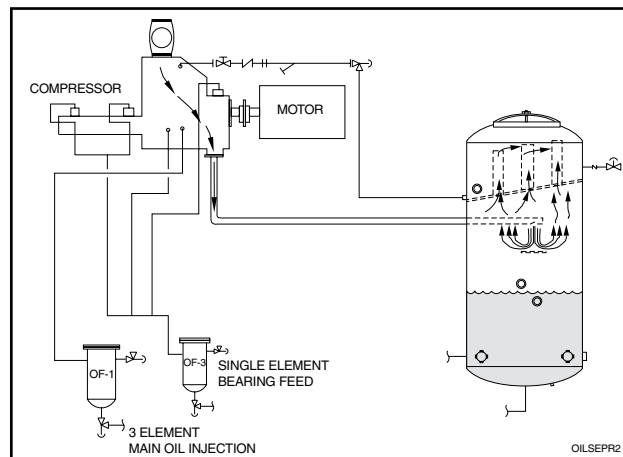


Figure 21

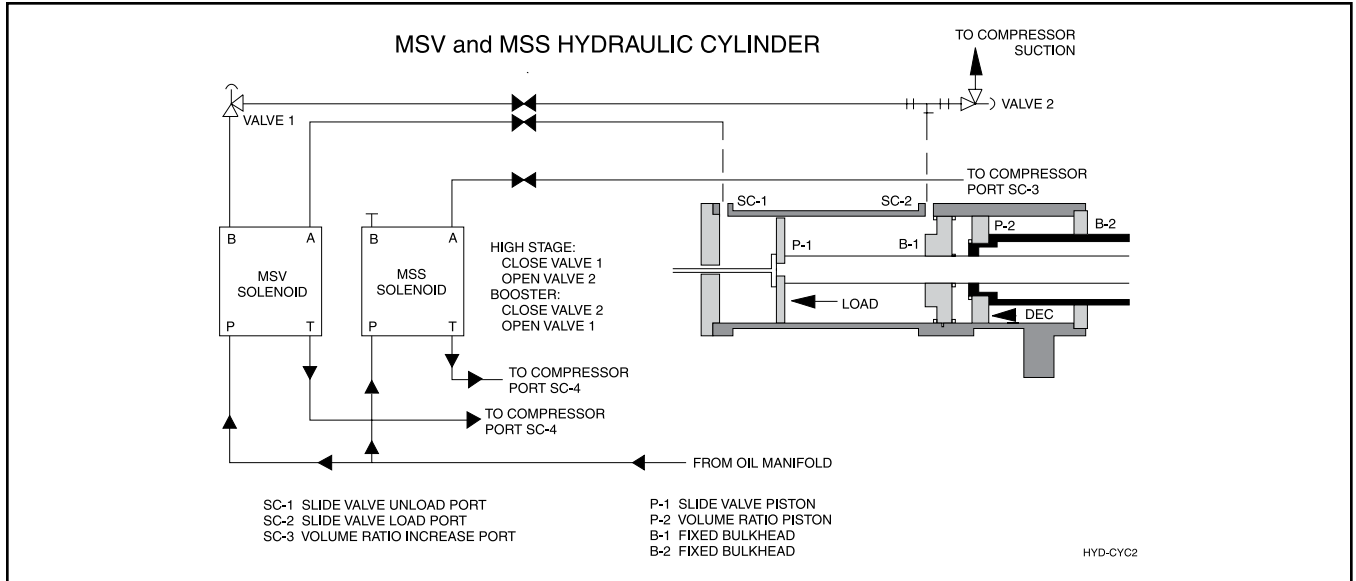
### COMPRESSOR HYDRAULIC SYSTEM

The compressor hydraulic system moves the movable slide valve (MSV) to load and unload the compressor. It also moves the movable slide stop (MSS) to increase or decrease the compressor's volume ratio (Vi).

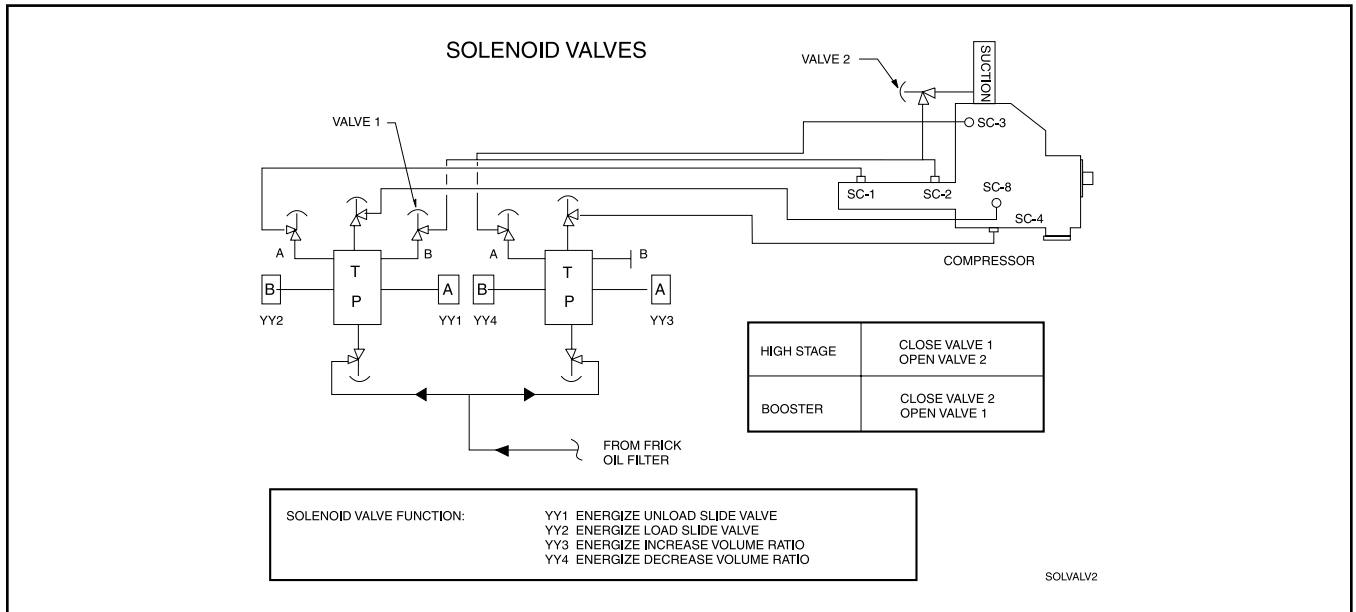
The hydraulic cylinder located at the inlet end of the TDS compressor serves a dual purpose. It is separated by a fixed bulkhead into two sections. The movable slide valve (MSV) section is to the left of the bulkhead and the movable slide stop (MSS) to the right. Both sections are considered double acting hydraulic cylinders as oil pressure moves the pistons in either direction.

Both sections are controlled by double-acting, four-way solenoid valves which are actuated when a signal from the appropriate microprocessor output energizes the solenoid valve. See Figures 22 and 23.

**Compressor Loading:** The compressor loads when MSV solenoid YY2 is energized and oil flows from the oil manifold through valve ports P and B to cylinder port SC-2 and enters the load side of the cylinder. Simultaneously, oil contained in the unload side of the cylinder flows out cylinder port SC-1 through valve ports A and T to compressor closed thread port.



**Figure 22**



**Figure 23**

**Compressor Unloading:** The compressor unloads when MSV solenoid YY1 is energized and oil flows from the oil manifold through valve ports P and A to cylinder port SC-1 and enters the unload side of the cylinder. Simultaneously, oil contained in the load side of the cylinder flows out compressor port SC-2 through valve ports B and T to compressor closed thread port.

**NOTE: High Stage Operation: An alternative piping arrangement has been provided to increase slide valve response time during high stage operation.**

Higher operating pressures will slow the compressor unloading response time. Unloading response time can be increased by closing valve 1 (oil manifold pressure) and opening valve 2 to compressor suction pressure. See illustrations. **NEVER OPEN VALVE 1 AND VALVE 2 AT THE SAME TIME DURING COMPRESSOR OPERATION.**

**VOLUMIZER VOLUME RATIO CONTROL**

**Vi Increase**

The volume ratio  $V_i$  is increased when the MSS solenoid valve YY3 is energized and oil flows from oil manifold through valve ports P and A to compressor port SC-3, enters the increase side of the cylinder and overcomes the decrease spring tension.

**Vi Decrease**

The volume ratio  $V_i$  is decreased when the MSS solenoid valve YY4 is energized and oil flows from the cylinder through compressor port SC-3, through valve ports A and T, to compressor Port SC-4.

## COMPRESSOR OIL COOLING SYSTEMS

The RWB II unit can be equipped with one of several systems for controlling the compressor oil temperature. They are single or dual-port liquid injection, or thermosyphon and water-cooled oil coolers. Each system is automatically controlled, independent of compressor loading or unloading.

Oil cooling systems should maintain oil temperature within the following ranges for R-717:

|                                 |                          |
|---------------------------------|--------------------------|
| Liquid Injection<br>Oil Cooling | External*<br>Oil Cooling |
| 130 - 170°F                     | 120 - 170°F              |

\* Thermosyphon oil cooling (TSOC) or Water-cooled oil cooling (WCOC).

### SINGLE-PORT LIQUID INJECTION

The single-port liquid injection system is designed to permit liquid refrigerant injection into one port on the compressor at any given moment and operates as outlined.

Solenoid valve SV5 is energized by the microprocessor when the temperature sensor, installed in the oil manifold, exceeds the LICO set point. High pressure liquid refrigerant is then supplied to the temperature control valve (TCV). The temperature control valve is equalized to a constant back pressure by the differential pressure control valve (PDCV). The differential pressure control valve uses discharge gas to maintain downstream pressure. The gas downstream of the differential pressure control valve is bled off to the compressor suction to ensure steady and constant operation of the valve.

### RWB II BOOSTER OR SWING DUTY APPLICATION

Discharge gas from the high stage compressor is required to assist the differential pressure control valve (PDCV) in providing the temperature control valve (TCV) with a constant back pressure.

A solenoid valve SV6 is installed before the differential pressure control valve (PDCV) to prevent migration of high pressure gas during shutdown. A Frick-installed timer limits the high pressure gas to only thirty seconds duration, since intermediate gas pressure and spring tension are sufficient to maintain closure on unit shutdown. A metering valve is also provided for use as a service valve and to allow discharge gas flow regulation to prevent excessive force and resulting closure "hammering".

A field-installed 1/4 inch OD tubing connection is required between the high stage compressor discharge piping line (or receiver) and the check valve.

### DUAL-PORT LIQUID INJECTION

The dual-port liquid injection system is designed to obtain the most efficient compressor performance at high and low compression ratios by permitting injection of liquid refrigerant into one of two ports optimally located on the compressor. This minimizes the performance penalty incurred with liquid injection oil cooling.

The dual-port system contains all the components of the single-port system with the addition of a double acting solenoid valve SV7 and operates as outlined.

Solenoid valve SV5 is energized by the microprocessor when the temperature sensor, installed in the oil manifold, exceeds

the LICO set point. Liquid refrigerant is then passed through the temperature control valve (TCV) to the double-acting solenoid valve SV7. Depending on the compressor's operating volume ratio (Vi), the microprocessor will select the flow of the liquid refrigerant to either compressor port SL-1 or SL-2, whichever is more efficient.

When the compressor operates BELOW 3.5 Vi, compressor port SL-1 supplies the liquid cooling. When the (Vi) rises ABOVE 3.5 Vi, port SL-2 supplies the liquid cooling.

The temperature control valve is equalized to a constant back pressure by the differential pressure control valve (PDCV).

Both the differential pressure control valve (PDCV) and the double-acting solenoid valve SV7 use discharge gas to maintain downstream pressure. The gas downstream of both valves is bled off to the compressor suction to ensure steady and constant operation of the valves.

### LIQUID INJECTION ADJUSTMENT PROCEDURE

Adjustments must be made to ensure the oil is at the proper temperature. When the adjustments have been made correctly, the oil temperature, the discharge temperature and the temperature of the oil in the separator should all be approximately the same. (Refer to P&I Diagram)

Carefully insert The bulb from the thermal expansion valve ( TXV ) into the well in the discharge pipe between the compressor and the oil separator. Then open the valve to the oil separator high pressure connection.

Next, open the refrigerant supply valve, remove the cap on the pressure regulating valve (PCV ), and close the adjusting valve.

#### For low temperature oil – 125° to 135°F

After the unit has been started, wait for the oil temperature to reach 122°F. This is the preprogrammed temperature to open the liquid feed solenoid in the liquid injection supply line.

Open the adjusting valve only until the needle on the gauge begins to move a very small amount.

Next, adjust the pressure regulating valve to approximately 80 psig by turning the adjustment ring inside the top of the valve with a 5/16" Allen wrench. Turn the wrench clockwise to raise the oil temperature, and counterclockwise to lower the oil temperature.

After the adjustment s been, made wait until the oil and discharge temperatures have had a chance to stabilize before readjusting. The end result should be between 135° and 140°F.

#### For high temperature oil – 160° to 170°F

After the unit has been started, wait for the oil temperature to reach 122°F. This is the preprogrammed temperature to open the liquid feed solenoid in the liquid injection supply line.

Open the adjusting valve only until the needle on the gauge begins to move a very small amount.

Next, adjust the pressure regulating valve to approximately 30 psig by turning the adjustment ring inside the top of the valve with a 5/16" Allen wrench . Turn the wrench clockwise to raise the oil temperature, and counter-clockwise to lower the oil temperature. After the adjustment has been made wait until the oil and discharge temperatures have had a

chance to stabilize before readjusting. The end result should be between 160° and 170°F.

**Liquid Injection Oil Cooling - Ammonia**

To tell if the unit you are starting has a low or high temperature liquid injection valve, look at the power head of the Thermal Expansion Valve.

If the unit is using Ammonia as a refrigerant and is for low temperature the Sporlan number on the power head should be Y764 or Y830. Set the oil temperature for 135°F.

If the unit is using Ammonia as a refrigerant and is for high temperature the Sporlan number on the power head should be Y1199 or Y1201. Set the oil temperature for 160°F.

**Liquid Injection Oil Cooling - Halocarbon**

To tell if the unit you are starting has a low or high temperature liquid injection valve, look at the power head of the Thermal Expansion Valve.

If the unit is using Halocarbon as a refrigerant and is for low temperature, the Sporlan number on the power head should be L3. Set the oil temperature for 135°F.

If the unit is using Halocarbon as a refrigerant and is for high temperature, the Sporlan number on the power head should be Y1200 or Y1202. Set the oil temperature for 160°F.

When the unit has high temperature liquid injection oil cooling, set the oil temperature alarm for 170°F.

Set the oil temperature cutout for 180°F.

When the unit has low temperature liquid injection oil cooling, set the oil temperature alarm and cutout at the default values set in the microprocessor.

**SUCTION CHECK VALVE**

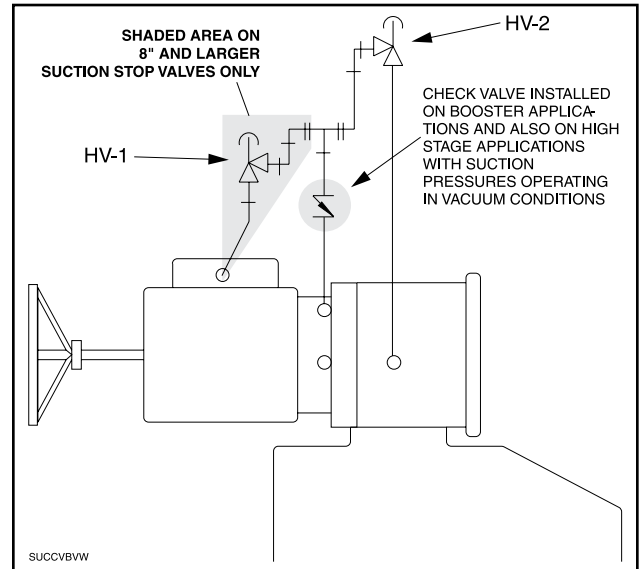
Low temperature booster compressor operations require a more positive suction check valve closure. This is accomplished by allowing the high stage discharge pressure gas to assist the spring tension and intermediate pressure closing force.

Frick provides a power assist kit consisting of a mounted and wired solenoid valve and timer on all RWB II booster compressors. High stage compressors are supplied with a power assist kit when the design suction temperature is less than or equal to 0°F. The wiring diagram in S90-010 M (Quantum) or S70-200 OM (Plus) shows the wiring included when required. Introduction of high discharge pressure gas is made to the check valve. A timer limits the high pressure gas to only thirty seconds duration since intermediate gas pressure and spring tension are sufficient to maintain closure on unit shutdown. A metering valve is also provided for use as a service valve and to allow discharge gas flow regulation to prevent excessive force and resulting closure "hammering".

**SUCTION CHECK VALVE BYPASS**

During normal operation, valve HV1 is closed. This is a pump-out connection to allow refrigerant removal to the system suction prior to evacuation for servicing. Valve HV-2 must be open in most systems at all times. It should normally be cracked open to allow the oil separator to slowly bleed down to system suction pressure when the unit is stopped (having this valve cracked open allows the compressor drive motor to have an easier start, and the discharge check valve will seat more tightly). If the drive coupling backspins, the valve should

be adjusted open until the backspin stops. If the separator oil level foams excessively on shutdown, HV-2 should be closed slightly. If the separator takes more than 20 – 30 minutes to equalize to suction pressure after shutdown, HV-2 can be opened slightly. See Figure 24.



**Figure 24**

**NOTE: HV-2 should be closed on systems with suction pressures below atmospheric pressure, to avoid the possibility of air leakage into the system during shutdown. However, on high-stage or booster systems with check valve, HV-2 can remain open.**

HV-2 also should be closed on systems that utilize autcycle to restart the compressor, based on increase in system suction pressure during shutdown, if slowly bleeding the oil separator gas to suction will raise the suction pressure enough to cause short cycling of the compressor.

Also it is important to close HV-2, if the oil pump is to be run for long periods of time with the compressor stopped, to avoid oil being pumped up the suction line.

If multiple compressors are operated with a common economizer vessel, it is necessary to install a back-pressure regulator valve with an electric shut-off option in the vapor line piped to the compressor's economizer port. If an electric shut-off is not installed in the economizer vapor line, valve HV-2 must remain closed to avoid a gas bypass from the economizer line through the suction check valve bypass, back to the suction line on a compressor that is shut down.

**LOW AMBIENT OPERATION**

It is recommended that oil separators be insulated as a minimum requirement to preserve the heat generated by the oil heaters. It is important that the coalescer end of the separator be insulated to prevent refrigerant condensation.

On systems located outdoors or in unheated buildings where the ambient temperature could drop below +40°F, insulating and/or heat tracing of the compressor lube oil systems is highly recommended.

When low ambient temperatures (below +20°F) are a possibility, it is recommended that lube oil lines, oil filters, oil pumps and oil coolers be heat traced and insulated.

Freeze-up protection must also be provided for all water-cooled equipment

## POWER ASSIST KIT

The power assist kit provides extra force to help close the suction check valve quickly, as well as provide some local heating to help move any cold oil out of the check valve components. See Figure 25.

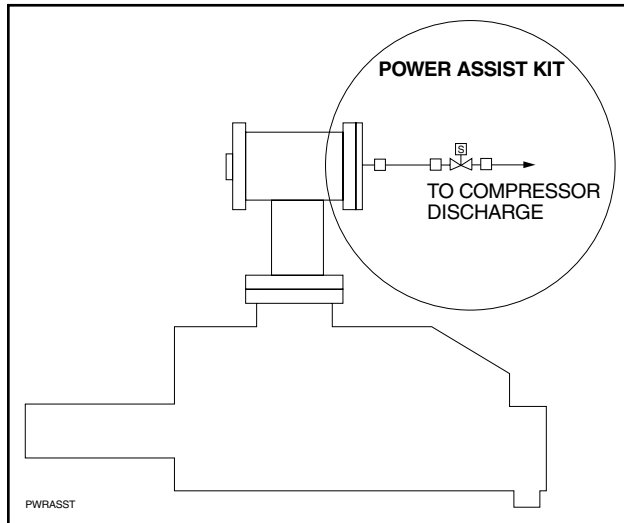


Figure 25

## INITIAL START-UP

Initial start-up must be performed under the supervision of a FRICK authorized start-up representative to prevent voiding the compressor warranty. Prior to the start-up, the prestart check must be accomplished.

### INITIAL START-UP PROCEDURE

Having performed the checkpoints on the prestart check list the compressor unit is ready for start-up. It is important that an adequate refrigerant load be available to load test the unit at normal operating conditions. The following points should be kept in mind during initial start-up.

1. In 1994 we made a change in the piping to include a hand expansion valve on the main oil injection line.

**It is imperative that during the initial start-up of the package that this valve is fully open to ensure adequate oil flow.** There is still an orifice installed in the compressor to control maximum oil flow. At initial start-up of the package the hand expansion valve must be fully open. After initial start-up of the package the hand expansion valve should be adjusted. There are two methods of determining the correct adjustment of this valve.

The best method to determine target discharge temperature is to run CoolWare. Run CoolWare or ScrewSelect with the operating conditions of the compressor. The program will give you a theoretical discharge temperature of the compressor. Once this temperature is known, you may adjust the hand expansion valve. The ideal discharge temperature is within 5°F + or – of the theoretical discharge temperature. Adjust the valve to achieve the theoretical discharge temperature. If you do not have access to CoolWare or ScrewSelect, 180°F is a good target discharge temperature for a high stage ammonia compressor. Booster applications and compressors using

HFC and HCFC refrigerants may run cooler. Compressors with high discharge pressure may run hotter.

The first method is used for compressors with External Oil Cooling (Thermosyphon, Water Cooled, and Glycol Cooled). Before the initial startup of the compressor close the hand expansion valve completely. Open the valve back up and count the turns that it takes to fully open the valve. After the initial startup close the valve to achieve approximately 180° F discharge temperature or the theoretical temperature from CoolWare. Do not fully close the valve at any time while the compressor is running.

The second method is used for compressors with Liquid Injection Oil Cooling. Because the discharge temperature is controlled by the Liquid Injection Thermal Expansion Valve you will not be able adjust for the correct oil flow by using the discharge temperature. Before the initial startup of the compressor close the hand expansion valve completely. Open the valve back up and count the turns that it takes to fully open the valve. After the initial startup close the valve ½ way. If it took 10 turns to open the valve completely, then turn it in 5 turns. If it took 7 turns to open, then close the valve 3 ½ turns. Do not close the valve any further than ½ the number of turns required to fully open it.

Failure to properly adjust this valve can lead to excessive noise and vibration of the compressor and package, premature failure of the bearings, liquid loading of the rotors, liquid starvation of the rotors and catastrophic failure of the compressor.

2. For proper and safe operation the compressor must be run at the proper speed and discharge pressure. Exceeding design conditions creates a potential hazard.

**3. Rotate and lubricate motor bearings according to manufacturer's recommendations PRIOR to start-up as required.**

4. On units with prelube system a differential pressure of 55 PSI between suction and discharge pressures must be achieved within five minutes of start-up or the unit will shut-down on "Comp. Differential".

5. After running the unit for approximately three hours, adjust liquid injection oil cooling if applicable. If unit has thermosyphon or water cooled oil cooling, adjust water control valve to cooler.

The compressor slide valve and slide stop potentiometers should be calibrated.

6. Stop the unit, lock out the motor main disconnect, check the hot alignment, and adjust as necessary.

## NORMAL START-UP PROCEDURE

1. Confirm system conditions permit starting the compressor.
2. Press the **[RUN]** key.
3. Allow the compressor to start-up and stabilize. Press the **[AUTO]** key immediately below the V ratio label on the operating display screen. Press the **[AUTO]** key immediately below the SV POS label on the operating display. The compressor is now operating in the automatic mode.
4. Observe the compressor unit for mechanical tightness of the external piping, bolts and valves. Ensure that the machine is clean from oil and refrigerant leaks. If any of these occur, shutdown the compressor and correct the problem as necessary using good safety precautions.
5. **RETIGHTEN MANWAY BOLTS** at condenser design pressure (while system is running).

## RESTARTING COMPRESSOR UNIT AFTER CONTROL POWER INTERRUPTION (PLANT POWER FAILURE)

1. Check variable setpoints.
2. Follow normal start-up procedure.

## MAINTENANCE

### GENERAL INFORMATION

This section provides instructions for normal maintenance, a recommended maintenance program, troubleshooting and correction guides, and typical P and I diagrams. For typical wiring diagrams and control panel information, consult S90-010 M for the *Quantum™* panel.

**WARNING** THIS SECTION MUST BE READ AND UNDERSTOOD BEFORE ATTEMPTING TO PERFORM ANY MAINTENANCE OR SERVICE TO THE UNIT.

### NORMAL MAINTENANCE OPERATIONS

When performing maintenance you must take several precautions to ensure your safety:

### CAUTION

1. IF UNIT IS RUNNING, PRESS STOP KEY.
2. DISCONNECT POWER FROM UNIT BEFORE PERFORMING ANY MAINTENANCE.
3. WEAR PROPER SAFETY EQUIPMENT WHEN COMPRESSOR UNIT IS OPENED TO ATMOSPHERE.
4. ENSURE ADEQUATE VENTILATION.
5. TAKE NECESSARY SAFETY PRECAUTIONS REQUIRED FOR THE REFRIGERANT BEING USED.

**WARNING** CLOSE ALL COMPRESSOR PACKAGE ISOLATION VALVES PRIOR TO SERVICING THE UNIT. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY.

### GENERAL MAINTENANCE

Proper maintenance is important in order to ensure long and trouble-free service from your screw compressor unit. Some areas critical to good compressor operation are:

1. Keep refrigerant and oil clean and dry, avoid moisture contamination. After servicing any portion of the refrigeration system, evacuate to remove moisture before returning to service. Water vapor condensing in the compressor while running, or more likely while shut down, can cause rusting of critical components and reduce life.

2. Keep suction strainer clean. Check periodically, particularly on new systems where welding slag or pipe scale could find its way to the compressor suction. Excessive dirt in the suction strainer could cause it to collapse, dumping particles into the compressor.

3. Keep oil filters clean. If filters show increasing pressure drop, indicating dirt or water, stop the compressor and change filters. Running a compressor for long periods with high filter pressure drop can starve the compressor for oil and lead to premature bearing failure.

4. Avoid slugging compressor with liquid refrigerant. While screw compressors are probably the most tolerant to ingestion of some refrigerant liquid of any compressor type available today, they are not liquid pumps. Make certain to maintain adequate superheat and properly size suction accumulators to avoid dumping liquid refrigerant into compressor suction.

Keep liquid injection valves properly adjusted and in good condition to avoid flooding compressor with liquid. Liquid can cause a reduction in compressor life and in extreme cases can cause complete failure.

5. Protect the compressor during long periods of shut down. If the compressor will be setting for long periods without running it is advisable to evacuate to low pressure and charge with dry nitrogen or oil, particularly on systems known to contain water vapor.

6. Preventive maintenance inspection is recommended any time a compressor exhibits a noticeable change in vibration level, noise or performance.

### COMPRESSOR SHUTDOWN and START-UP

For seasonal or prolonged shutdowns the following procedure should be followed:

1. Reduce the system pressure to the desired condition.
2. Press [STOP] key to cease operation of the compressor.
3. Open disconnect switches for compressor motor and oil pump starters.
4. Turn on oil heater circuit breaker.
5. Close suction and discharge service valves, also liquid injection and economizer service valves, if applicable. **Attach CLOSED TAGS.**
6. Shut off cooling water supply valve to oil cooler, if applicable. **Attach CLOSED TAG.**
7. Protect oil cooler from ambient temperatures below freezing or remove water heads.

To start-up after a seasonal or prolonged shutdown the following procedure should be followed:

1. Any water necessary for the operation of the system that may have been drained or shut off should be restored and turned on. If oil cooler heads were removed, reinstall and remove tags.
2. Open suction and discharge service valves, also liquid injection and economizer service valves, if applicable. Remove tags.
3. Close disconnect switches for compressor, motor and oil pump starters.
4. Turn off oil heater circuit breaker.
5. Perform checkpoints on prestart check list, then start the unit.



## GENERAL INSTRUCTIONS FOR REPLACING COMPRESSOR UNIT COMPONENTS.

When replacing or repairing components which are exposed to refrigerant pressure proceed as follows:

1. Push **[STOP]** key on control panel to shutdown unit.
2. Open disconnect switches for compressor and pump motor starters.
3. Close suction and discharge service valves, also liquid injection and economizer service valves, if applicable.
4. **SLOWLY** vent separator to low-side system pressure using the bypass line on the suction trap. **NOTE: Recover or transfer all refrigerant vapor, in accordance with local ordinances, before opening to atmosphere.** The separator **MUST** be equalized to atmospheric pressure.

**Oil entrained refrigerant may vaporize, causing a separator pressure increase. Repeat venting and recovery procedure, if necessary.**



5. Make replacement or repair.
6. Isolate the low pressure transducer, PE-4, to prevent damage during pressurization and leak test.
7. Pressurize unit and leak test.
8. Evacuate unit.
9. Open suction and discharge service valves, low pressure transducer, and also liquid injection and economizer service valves, if applicable.
10. Close disconnect switches for compressor and oil pump motor starters.
11. Unit is ready to put into operation.
12. Perform checkpoints on prestart check list, then start unit.

## OIL FILTER (OF-1) MAIN SINGLE/DUAL

RWB II compressor units are furnished with one (1) main oil filter (OF-1). A second oil filter (OF-2) is installed as optional equipment to facilitate the changing of the filter cartridge(s) without unit shutdown.

*RWB II compressor units with a prelude oil pump are furnished with one (1) main oil injection filter (OF-1) and one (1) bearing oil filter (OF-3). Secondary oil filters are installed as optional equipment to facilitate the changing of the filter cartridges without unit shutdown.*



**Use of filter elements other than Frick may cause warranty claim to be denied.**

The procedure to change filter cartridge(s) is as follows:

1. If a single oil filter is installed, push **STOP** key on microprocessor panel to shutdown unit, then open disconnect switches for compressor and oil pump motor starters.

If dual oil filters are installed, open the outlet, then inlet service valves of the standby filter.



**Open inlet service valve slowly to prevent a sudden pressure drop which could cause an oil filter differential alarm.**

2. Close outlet then inlet service valves of filter being serviced.

3. Open bleed valve and purge pressure from the oil filter cartridge. **NOTE: Recover or transfer all refrigerant vapor, in accordance with local ordinances, before opening to atmosphere.**

4. Remove the plug from the bottom of the filter canister and drain the oil. Remove the canister cover and discard the gasket. Remove the screws securing the filter assembly. Pull the filter assembly from the canister and discard the gasket and the element.

5. Flush the canister with clean Frick refrigeration oil; wipe dry with a clean, lint-free cloth; and replace the plug.

6. Install a new one-piece filter element.\* Tighten the six 3/8" hex head cap screws to 10 ft-lb torque.

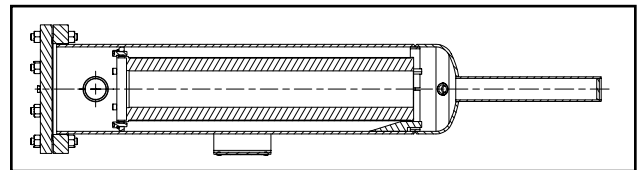


Figure 26 SuperFilter II - Design 2010 & After

\*Before January 2010, the SuperFilter™II elements were separate pieces. Follow step 6a in lieu of step 6 for this design. (After January 2010, the rod and nuts were eliminated and the end plate and gasket became part of the filter. Refer to the Oil Filter page in the SPL for a detailed graphic.)

- 6a. Install the new element(s) on the rod with all necessary hardware. Tighten the nut on the end plate to 10 ft-lb torque. Then, while holding the nut with a wrench, apply a second nut to act as a locknut. Replace the gasket and reinstall the filter assembly into the canister, securing with screws tightened to 30 ft-lb torque.

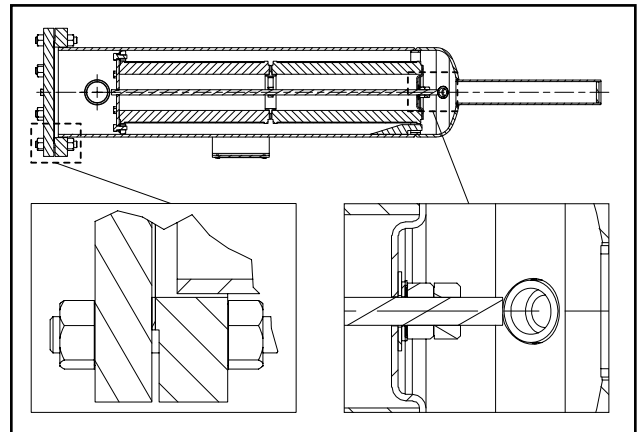


Figure 27 SuperFilter II - Design Pre-2010

7. Close purge valve.
8. Open outlet service valve and leak test.
9. Filter is ready to place in service.

## OIL FILTER/STRAINER - PRELUDE OIL PUMP



**Use of filter elements other than Frick may cause warranty claim to be denied.**

On compressor units with the prelude pump system the oil filter (F-2) and strainer may be changed with the unit operat-

ing, after the prelube pump has stopped and the lubrication is being supplied by system head pressure.

When changing the filter, also clean the strainer located upstream of the prelube pump. Use the following procedure:

1. Close service valves before the pump and after the prelube oil filter (OF-3).
2. Purge the oil lines to atmospheric pressure by venting through the strainer. Containers should be used to catch the oil drainage.
3. Remove socket head capscrews securing the bottom of the filter canister to the top. **GENTLY SEPARATE** the bottom from the top.
4. Remove and discard used filter cartridge. Wash filter canister with clean oil and wipe with a clean lint free cloth.
5. Install new cartridge and reassemble using retained capscrews.
6. Unscrew bottom cap from the oil strainer. Wash both strainer basket and cap in solvent and blow clean with dry air.
7. Reassemble cap, basket and strainer.
8. Open the closed service valve gradually while checking for leaks.

### STRAINER - FULL LUBE OIL PUMP

To clean the full-lube oil pump strainer, the unit must be shut down. The procedure is as follows:

1. Push STOP key on microprocessor panel to shutdown unit, then open disconnect switches for compressor and oil pump motor starters.
2. Close strainer inlet service valve.
3. Open drain valve located in the strainer cover and drain oil into a container.
4. Remove capscrews securing strainer cover, strainer cover, gasket and element. Retain gasket.
5. Wash element in solvent and blow clean with air.
6. Wipe strainer body cavity clean with a lint free clean cloth.
7. Replace cleaned element, gasket and reattach cover using retained capscrews.
8. Close drain valve and open strainer inlet service valve.
9. Check for leakage.
10. Close disconnect switches for compressor and oil pump motor starters.
11. Start unit.

### STRAINER - LIQUID INJECTION

To clean the liquid injection strainer the unit must be shut down. The procedure is as follows:

1. Push [STOP] key on microprocessor panel to shutdown unit, then open disconnect switches for compressor and oil pump motor starters.
2. Close liquid supply service valve located before liquid

solenoid.

3. **IMMEDIATELY SCREW IN THE MANUAL SOLENOID VALVE STEM TO RELIEVE LIQUID REFRIGERANT PRESSURE TRAPPED BETWEEN THE SOLENOID AND THE SERVICE VALVE.**
4. Close service valve located between the compressor and the liquid injection thermovalve.
5. Carefully loosen capscrews securing the strainer cover to the strainer. Allow pressure to relieve slowly.
6. When all entrapped refrigerant has been relieved, carefully remove loosened capscrews (as liquid refrigerant is sometimes caught in the strainer), strainer cover and strainer basket.
7. Wash the strainer basket and cover in solvent and blow clean with air.
8. Reassemble strainer.
9. Open service valve between compressor and liquid injection thermovalve and check for leakage.
10. Screw out manual solenoid valve stem.
11. Carefully open liquid supply service valve.
12. Leak test.
13. Close disconnect switches for compressor and oil pump motor starters.
14. Start unit.

### COALESCER FILTER ELEMENT(S)



**Use of filter elements other than Frick may cause warranty claim may to be denied.**

When changing the coalescer filter element(s) it is recommended that the oil be changed, cartridge(s) in oil filters OF-1, OF-2, and OF-3 if applicable be changed and the following applicable strainer elements be removed and cleaned.

1. Refer to oil changing Steps 1 through 8.
2. Loosen manway cover retainer bolts, remove retainers, manway cover and cover gasket. Discard cover gasket.
3. Remove and retain nut securing coalescer filter retainer.
4. Remove retainer, coalescer filter element and 2 O-rings. Discard filter elements.
5. Install new coalescer filter element(s).



**Seat element in center of locating tabs on separator bulkhead.**

6. Replace coalescer filter retainer and nut. Torque nut to 21 ft-lb. **DO NOT OVERTIGHTEN NUT.**
7. Install a new manway gasket and replace manway cover.
8. Tighten manway bolts. **NOTE: RETIGHTEN AFTER THE COMPRESSOR UNIT IS REPRESSURIZED, SINCE MANWAY BOLTS WILL LOOSEN.**
9. Refer to oil changing Steps 9 through 14.

**CHANGING OIL**



**DO NOT MIX OILS of different brands, manufacturers, or types. Mixing of oils may cause excessive oil foaming, nuisance oil level cutouts, oil pressure loss, gas or oil leakage and catastrophic compressor failure.**



**Use of filter elements other than Frick may cause warranty claim may to be denied.**

Shut down the unit when changing oil. At the same time all oil filter cartridges must be changed and all oil strainer elements removed and cleaned. The procedure is as follows:

1. Press the [STOP] key on the microprocessor panel to stop the compressor unit.
2. Open the disconnect switch for the compressor motor starter.
3. Close the suction and discharge service valves; also close the liquid-injection and economizer service valves, if applicable.
4. **SLOWLY** vent separator to low-side system pressure using the bypass line on the suction trap. **NOTE: Recover or transfer all refrigerant vapor, in accordance with local ordinances, before opening to atmosphere. The separator MUST be equalized to atmospheric pressure.**



**Oil entrained refrigerant may vaporize, causing a separator pressure increase. Repeat venting and recovery procedure, if necessary.**

5. Open the drain valve(s) located on the underside of the separator and drain the oil.
6. Drain oil filter(s) OF-1 and OF-2 and, if applicable, the oil coolers and secondary oil filters.
7. Remove the old filter cartridges, then install new ones (as previously described in the section **OIL FILTER (OF-1) MAIN SINGLE/DUAL**).

8. Remove, clean, and reinstall strainer elements in the strainers.
9. Evacuate the unit to 28" Hg vacuum.
10. Open the suction service valve and pressurize the unit to system suction pressure. Close the suction valve and leak test.
11. Add oil by attaching a suitable pressure-type hose to the oil-charging valve located on top of the separator. Using a pressure-type oil pump and recommended Frick oil, open the charging valve and fill the separator until the oil level is midway in the top sight glass. **NOTE: Fill slowly because the oil will fill up in the separator faster than it shows in the sight glass.** Refer to the table in the OIL CHARGE section for approximate oil charge quantities.
12. Open the suction and discharge service valves, and also the liquid injection and economizer service valves, if applicable.
13. Close the disconnect switch for the compressor motor starter.
14. Start the unit.

**RECOMMENDED MAINTENANCE PROGRAM**

In order to obtain maximum compressor unit performance and ensure reliable operation, a regular maintenance program should be followed.

The compressor unit should be checked daily for leaks, abnormal vibration, noise, and proper operation. A log should also be maintained. There should be continued monitoring of oil quality and oil analysis testing. In addition, an analysis of the unit's vibration should be periodically made.

**VIBRATION ANALYSIS**

Periodic vibration analysis can be useful in detecting bearing wear and other mechanical failures. If vibration analysis is used as a part of your preventive maintenance program, take the following guidelines into consideration.

**MAINTENANCE SCHEDULE**

This schedule should be followed to ensure trouble-free operation of the compressor unit.

| MAINTENANCE                    | HOURS OPERATION (MAXIMUM)                     |                                                    |                     |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------------------------|-----------------------------------------------|----------------------------------------------------|---------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                | 200                                           | 1000                                               | 5000                | 8000 | 10000 | 15000 | 20000 | 25000 | 30000 | 35000 | 40000 | 45000 | 50000 | 55000 | 60000 | 65000 | 70000 | 75000 | 80000 | 85000 | 90000 | 95000 |
| CHANGE OIL                     | As directed by oil analysis                   |                                                    |                     |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| OIL ANALYSIS                   |                                               | ■                                                  | Then every 6 months |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| CHANGE FILTERS                 | ■                                             |                                                    | ■                   |      | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       |
| CLEAN OIL STRAINERS            | ■                                             |                                                    | ■                   |      | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       |
| CLEAN LIQUID STRAINERS         | ■                                             |                                                    | ■                   |      | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       |
| CHANGE COALESCERS              |                                               |                                                    |                     |      |       |       |       |       | ■     |       |       |       |       |       | ■     |       |       |       |       |       | ■     |       |
| CHECK AND CLEAN SUCTION SCREEN | ■                                             | ■                                                  | ■                   |      | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       |
| CHECK ALIGNMENT                | ■                                             |                                                    | ■                   |      | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       |
| CHECK COUPLING                 | ■                                             |                                                    | ■                   |      | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       | ■     |       |
| VIBRATION ANALYSIS             | ■                                             | Every 6 months, more frequently if levels increase |                     |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| REPLACE SEAL                   | When leak rate exceeds 7 - 8 drops per minute |                                                    |                     |      |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |

1. Always take vibration readings from exactly the same places and at exactly the same percentage of load.
2. Use vibration readings taken from the new unit at start-up as the base line reference.
3. Evaluate vibration readings carefully as the instrument range and function used can vary. Findings can be easily misinterpreted.
4. Vibration readings can be influenced by other equipment operating in the vicinity or connected to the same piping as the unit.

### OIL QUALITY and ANALYSIS

High quality refrigeration oil is necessary to ensure compressor longevity and reliability. Oil quality will rapidly deteriorate in refrigeration systems containing moisture, air, or other contaminants. In order to ensure the quality of the refrigeration oil in the compressor unit.



**DO NOT MIX OILS** of different brands, manufacturers, or types. Mixing of oils may cause excessive

oil foaming, nuisance oil level cutouts, oil pressure loss, gas or oil leakage and catastrophic compressor failure.

**NOTE:** The Frick oil charge shipped with the unit is the best suited lubricant for the conditions specified at the time of purchase. If there is any doubt due to the refrigerant, operating pressures, or temperatures, refer to Frick Oil publication E160-802 SPC for guidance.

1. Only use Frick filter elements or warranty claim may be denied.

2. Participate in a regular, periodic oil analysis program to maintain oil and system integrity.

### OPERATING LOG

The use of an operating log as included in this manual (see Table of Contents) permits thorough analysis of the operation of a refrigeration system by those responsible for its maintenance and servicing. Continual recording of gauge pressures, temperatures, and other pertinent information, enables the observer and serviceman to be constantly familiar with the operation of the system and to recognize immediately any deviations from normal operating conditions. It is recommended that readings be taken at least every four hours.

### MOTOR BEARINGS

Follow the motor manufacturer's maintenance recommendations. See Figure 26.



**Ensure that the motor bearings are properly lubricated before start-up as required by motor manufacturer.**

### GREASE COMPATIBILITY

If it becomes necessary to mix greases, be careful not to combine different oil bases or thickeners. DO NOT mix a mineral oil-base grease with a synthetic oilbase grease. Also, a grease with a lithium thickener should not be mixed with one containing a sodium thickener. The table illustrates the compatibility of various types of grease based on results by National Lubricating Grease Institute (NLGI). The chart indicates a great variance in compaibility with the greases tested.

## LUBRICATION SCHEDULE / INSTRUCTIONS

| SYNC. RPM | FRAME SERIES | SERVICE CYCLE* - BALL BEARING** |                     |
|-----------|--------------|---------------------------------|---------------------|
|           |              | 8 HR/DAY OPERATION              | 24 HR/DAY OPERATION |
| 3600      | 360-5800     | 150 DAYS (1200 HRS)             | 50 DAYS (1200 HRS)  |
| 1800      | 360          | 390 DAYS (3120 HRS)             | 130 DAYS (3120 HRS) |
|           | 400-440      | 270 DAYS (2160 HRS)             | 90 DAYS (2160 HRS)  |
|           | 5000-5800    | 210 DAYS (1680 HRS)             | 70 DAYS (1680 HRS)  |
| 1200      | 360-440      | 390 DAYS (3120 HRS)             | 130 DAYS (3120 HRS) |
|           | 5000-5800    | 270 DAYS (2160 HRS)             | 90 DAYS (2160 HRS)  |

- LUBRICATE BEARINGS WITH POWER IN THE OFF CONDITION.
- CLEAR AND CLEAN THE GREASE FITTINGS AND SURROUNDING AREA.
- REMOVE THE PIPE PLUG FROM THE VENTING PORT OPPOSITE THE GREASE FITTING.
- USING A LOW PRESSURE GREASE GUN APPLY 2 OZS. (60 GRAMS) OF GREASE AT EACH FITTING. DO NOT OVERGREASE.
- WITH THE VENT PORTS OPEN, OPERATE THE MOTOR FOR A MINIMUM OF 15 MINUTES AND UNTIL ANY GREASE FLOW HAS CEASED AT THE VENTING PORTS.
- REMOVE POWER.
- REPLACE THE VENT PIPE PLUGS.
- REPLACE ANY AND ALL GUARDS AND COVERS THAT MAY HAVE BEEN REMOVED TO ACCESS THE MOTOR.

\* LUBRICATION SCHEDULE FOR SEVERE SERVICE (VIBRATION, SHOCK AND/OR ENVIRONMENTAL EXTREME) = 1/3 OF THE ABOVE INTERVALS.

\*\* LUBRICATION SCHEDULE FOR ROLLER BEARINGS = 1/3 OF ABOVE INTERVALS.

THE FACTORY INSTALLED, RECOMMENDED LUBRICANT IS LISTED ON THE MOTOR DATA PLATE. THIS IS A POLYUREA GREASE, AS ARE THE PRODUCTS LISTED BELOW. THE INTRODUCTION OF LUBRICANTS OF ALTERNATE CHEMICAL MAKEUP IS NOT RECOMMENDED AND WILL CAUSE MECHANICAL FAILURE WITHOUT THE COMPLETE PURGE OF THE FACTORY PRODUCT FROM THE BEARING AND RESERVOIR. WHEREVER POSSIBLE, APPLY THE POLYUREA PRODUCT.

CHEVRON OIL CO. - SRI#2      EXXON CORP. - POLYREX EM      SHELL OIL CO. - DOLIUM R

Figure 28

**NLGI Grease Compatibility Chart**

|                    | Aluminum Complex | Barium | Calcium | Calcium 12-hydroxy | Calcium Complex* | Clay | Lithium | Lithium 12-hydroxy | Lithium Complex | Polyurea |
|--------------------|------------------|--------|---------|--------------------|------------------|------|---------|--------------------|-----------------|----------|
| Aluminum Complex   | -                | I      | I       | C                  | I                | I    | I       | I                  | C               | I        |
| Barium             | I                | -      | I       | C                  | I                | I    | I       | I                  | I               | I        |
| Calcium            | I                | I      | -       | C                  | I                | C    | C       | B                  | C               | I        |
| Calcium 12-hydroxy | C                | C      | C       | -                  | B                | C    | C       | C                  | C               | I        |
| Calcium Complex    | I                | I      | I       | B                  | -                | I    | I       | I                  | C               | C        |
| Clay               | I                | I      | C       | C                  | I                | -    | I       | I                  | I               | I        |
| Lithium            | I                | I      | C       | C                  | I                | I    | -       | C                  | C               | I        |
| Lithium 12-hydroxy | I                | I      | B       | C                  | I                | I    | C       | -                  | C               | I        |
| Lithium Complex    | C                | I      | C       | C                  | I                | C    | C       | C                  | -               | I        |
| <b>Polyurea*</b>   | I                | I      | I       | I                  | <b>C</b>         | I    | I       | I                  | I               | -        |

B = Borderline Compatibility  
C = Compatible  
I = Incompatible  
\* Standard

**TROUBLESHOOTING GUIDE**

Successful problem solving requires an organized approach to define the problem, identify the cause, and make the proper correction. Sometimes it is possible that two relatively obvious problems combine to provide a set of symptoms that can mislead the troubleshooter. Be aware of this possibility and avoid solving the “wrong problem”.

**ABNORMAL OPERATION  
ANALYSIS and CORRECTION**

Four logical steps are required to analyze an operational problem effectively and make the necessary corrections:

1. Define the problem and its limits.
2. Identify all possible causes.
3. Test each cause until the source of the problem is found.
4. Make the necessary corrections.

The first step in effective problem solving is to define the limits of the problem. If, for example, the compressor periodically experiences high oil temperatures, do not rely on this observation alone to help identify the problem. On the basis of this information the apparent corrective measure would appear to be a readjustment of the liquid injection system. Lowering the equalizing pressure on the thermal expansion valve would increase the refrigerant feed and the oil temperature should drop.

If the high oil temperature was the result of high suction superheat, however, and not just a matter of improper liquid injection adjustment, increasing the liquid feed could lead to other problems. Under low load conditions the liquid injection system may have a tendency to overfeed. The high suction superheat condition, moreover, may only be temporary. When system conditions return to normal the units' liquid injection will overfeed and oil temperature will drop. In solving the wrong problem a new problem was created.

When an operating problem develops compare all operating information on the MAIN OPERATING SCREEN with normal operating conditions. If an Operating Log has been maintained the log can help determine what constitutes normal operation for the compressor unit in that particular system.

The following list of abnormal system conditions can cause abnormal operation of the RWB II compressor unit:

1. Insufficient or excessive refrigeration load.
2. Excessively high suction pressure.
3. Excessively high suction superheat.
4. Excessively high discharge pressure.
5. Inadequate refrigerant charge or low receiver level.
6. Excessively high or low temperature coolant to the oil cooler.
7. Liquid return from system (slugging).
8. Refrigerant underfeed or overfeed to evaporators.
9. Blocked tubes in water cooled oil cooler from high mineral content of water.
10. Insufficient evaporator or condenser sizing.
11. Incorrect refrigerant line sizing.
12. Improper system piping.
13. Problems in electrical service to compressor unit.
14. Air and moisture present in the system.

Make a list of all deviations from normal plant operation and normal compressor unit operation. Delete any items which do not relate to the symptom and separately list those items that might relate to the symptom. Use the list as a guide to further investigate the problem.

The second step in problem solving is to decide which items on the list are possible causes and which items are additional symptoms. High discharge temperature and high oil temperature readings on a display may both be symptoms of a problem and not casually related. High suction superheat or a low receiver level, however, could cause both symptoms.

The third step is to identify the most likely cause and take action to correct the problem. If the symptoms are not relieved move to the next item on the list and repeat the procedure until you have identified the cause of the problem. Once the cause has been identified and confirmed make the necessary corrections.

## PRESSURE TRANSDUCERS - TESTING

Pressure transducers are located on a covered manifold directly behind the microprocessor console See Figure 27. For pressure data conversions, refer to the table following the Testing and Replacement procedures.

1. Shut down the compressor and allow pressures to equalize.
2. Isolate suction transducer PE-4 from the unit and depressurize. **NOTE: Recover or transfer all refrigerant vapor, in accordance with local ordinances, before opening to atmosphere.**
3. Measure the voltage of PE-4 on connector P4 (terminals WHT and BLK) on the SBC with a digital voltmeter.
4. The voltage reading should be 1.48 VDC to 1.72 VDC at standard atmospheric pressure (14.7 PSIA or 0 PSIG). When checking transducers at higher elevations, an allowance in the readings must be made by subtracting approximately 0.02 VDC per 1000 feet of elevation above sea level. Therefore, if PE-4 is measured at 5000 feet elevation under relatively normal weather conditions, the output voltage should differ by 0.10 VDC to read between 1.38 VDC and 1.62 VDC.
5. Isolate the oil pressure transducer PE-1 from the package and open it to atmosphere.
6. Measure the voltage of PE-1 on connector P4 (terminals WHT and BLK) on the SBC.
7. The voltage reading should be between 1.1 VDC and 1.29 VDC at standard atmospheric pressure. PE-1, PE-2, and PE-3 all have a span of 300 PSI as compared to PE-4 with a span of 100 PSI. Therefore, atmospheric pressure changes have a lesser effect which is 0.0067 VDC per 1000 feet of elevation and 0.00067 VDC per 0.1 inch Hg barometric deviation.

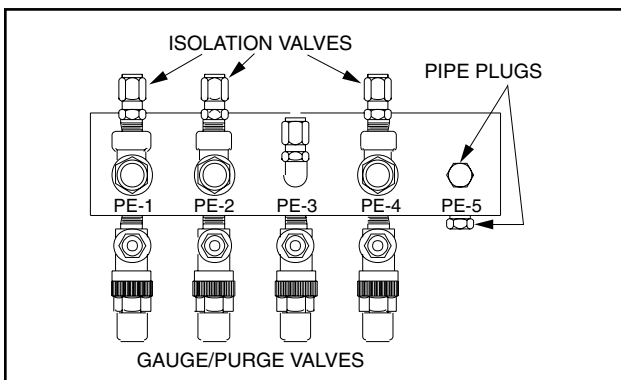


Figure 29 - Pressure Transducer Manifold

8. Isolate transducer PE-2 from the package and depressurize. **NOTE: Recover or transfer all refrigerant vapor, in accordance with local ordinances, before opening to atmosphere.**
9. Measure the voltage of PE-2 on connector P4 (terminals WHT and BLK) on the SBC.
10. The voltage reading should be between 1.1 VDC and 1.29 VDC at standard atmospheric pressure (see Step 12).

11. Since the discharge pressure, PE-3, cannot be closed off from its sensing point (code requirements), close all transducers from atmosphere and open them to their sensing points so all transducers can equalize to separator pressure.

12. Measure the voltage of PE-3 on connector P4 (terminals WHT and BLK) on the SBC.
13. Measure the voltage of PE-1 on connector P4 (terminals WHT and BLK) on the SBC.
14. These two voltages should be within .04 VDC of one another.
15. Test is complete.

## PRESSURE TRANSDUCERS - REPLACEMENT

1. Shut off control power.
2. Close the applicable transducer isolation valve. **NOTE: To change discharge pressure transducer (PE-3), it will be necessary to depressurize the entire compressor package. Follow "General Instructions For Replacing Compressor Unit Components" before going to step 3.**
3. Open the microprocessor control panel.
4. Use the chart to identify transducer terminals of the Analog Board (Quantum panel) or SBC Board (Plus panel).

| TRANSDUCER                 | MANIFOLD CONNECTION |
|----------------------------|---------------------|
| Oil Pressure               | PE-1                |
| Oil Before Filter (PSID) * | PE-2                |
| Discharge Pressure         | PE-3                |
| Suction Pressure           | PE-4                |
| Balance Piston Pressure ** | PE-5                |

\* Used for Full and Cycling pumps and ext. oil cooler.  
\*\* High Stage Units ONLY.

5. Disconnect transducer leads by loosening the terminal screws for the transducer to be changed.
6. Tape a 3 ft. length of pull wire to the leads of the transducer to be removed.
7. Pull the transducer leads through the conduit until pull wire extends out of the conduit hole in the transducer manifold. Separate the transducer leads from the pull wire.
8. Unscrew the transducer using a wrench on the metal hex at the base of the transducer. **DO NOT ATTEMPT TO LOOSEN OR TIGHTEN TRANSDUCERS BY THEIR TOP CASING.**
9. Install new transducer and tape leads to the pull wire.
10. Pull new transducer leads into the control panel and reconnect them to the terminal strip. See Analog Board layouts in S90-010 M (Quantum panel) or SBC wiring diagram in S70-200 OM (Plus panel) .
11. Close the microprocessor control panel.
12. Reopen the transducer isolation valve.
13. Turn on control power.

| <b>PRESSURE TRANSDUCER CONVERSION DATA</b> |                      |                |                      |                |                      |                |                      |                |
|--------------------------------------------|----------------------|----------------|----------------------|----------------|----------------------|----------------|----------------------|----------------|
| <b>Sensor Voltage</b>                      | <b>100 psi</b>       |                | <b>200 psi</b>       |                | <b>300 psi</b>       |                | <b>500 psi</b>       |                |
|                                            | <b>Range - PSIG*</b> |                | <b>Range - PSIG*</b> |                | <b>Range - PSIG*</b> |                | <b>Range - PSIG*</b> |                |
|                                            | <b>low</b>           | <b>high</b>    | <b>low</b>           | <b>high</b>    | <b>low</b>           | <b>high</b>    | <b>low</b>           | <b>high</b>    |
| 1.0                                        | 29.92"               | 19.74"         | 29.92"               | 9.57"          | 29.92"               | 7.0"           | 29.92"               | 4.10           |
| 1.1                                        | 29.92"               | 14.65"         | 29.92"               | 0.30           | 29.92"               | 4.10           | 29.92"               | 16.60          |
| 1.2                                        | 29.92"               | 9.57"          | 29.92"               | 5.30           | 22.3"                | 11.60          | 17.1"                | 29.10          |
| 1.3                                        | 24.83"               | 4.48"          | 19.74"               | 10.30          | 7.0"                 | 19.10          | 4.10                 | 41.60          |
| 1.4                                        | 19.74"               | 0.30           | 9.57"                | 15.30          | 4.10                 | 26.60          | 16.60                | 54.10          |
| 1.5                                        | 14.65"               | 2.80           | 0.30                 | 20.30          | 11.60                | 34.10          | 29.10                | 66.60          |
| 1.6                                        | 9.57"                | 5.30           | 5.30                 | 25.30          | 19.10                | 41.60          | 41.60                | 79.10          |
| 1.7                                        | 4.48"                | 7.8            | 10.3                 | 30.30          | 26.60                | 49.10          | 54.10                | 91.60          |
| 1.8                                        | 0.30                 | 10.30          | 15.30                | 35.30          | 34.10                | 56.60          | 66.60                | 104.10         |
| 1.9                                        | 2.80                 | 12.80          | 20.30                | 40.30          | 41.60                | 64.10          | 79.10                | 116.60         |
| 2.0                                        | 5.30                 | 15.30          | 25.30                | 45.30          | 49.10                | 71.60          | 91.60                | 129.10         |
| 2.1                                        | 7.80                 | 17.80          | 30.30                | 50.30          | 56.60                | 79.10          | 104.10               | 141.60         |
| 2.2                                        | 10.30                | 20.30          | 35.30                | 55.30          | 64.10                | 86.60          | 116.60               | 154.10         |
| 2.3                                        | 12.80                | 22.80          | 40.30                | 60.30          | 71.60                | 94.10          | 129.10               | 166.60         |
| 2.4                                        | 15.30                | 25.30          | 45.30                | 65.30          | 79.10                | 101.60         | 141.60               | 179.10         |
| 2.5                                        | 17.80                | 27.80          | 50.30                | 70.30          | 86.60                | 109.10         | 154.10               | 191.60         |
| 2.6                                        | 20.30                | 30.30          | 55.30                | 75.30          | 94.10                | 116.60         | 166.60               | 204.10         |
| 2.7                                        | 22.80                | 32.80          | 60.30                | 80.30          | 101.60               | 124.10         | 179.10               | 216.60         |
| 2.8                                        | 25.30                | 35.30          | 65.30                | 85.30          | 109.10               | 131.60         | 191.60               | 229.10         |
| 2.9                                        | 27.80                | 37.80          | 70.30                | 90.30          | 116.60               | 139.10         | 204.10               | 241.60         |
| 3.0                                        | 30.30                | 40.30          | 75.30                | 95.30          | 124.10               | 146.60         | 216.60               | 254.10         |
| 3.1                                        | 32.80                | 42.80          | 80.30                | 100.30         | 131.60               | 154.10         | 229.10               | 266.60         |
| 3.2                                        | 35.30                | 45.30          | 85.30                | 105.30         | 139.10               | 161.60         | 241.60               | 279.10         |
| 3.3                                        | 37.80                | 47.80          | 90.30                | 110.30         | 146.60               | 169.10         | 254.10               | 291.60         |
| 3.4                                        | 40.30                | 50.30          | 95.30                | 115.30         | 154.10               | 176.60         | 266.60               | 304.10         |
| 3.5                                        | 42.80                | 52.80          | 100.30               | 120.30         | 161.60               | 184.10         | 279.10               | 316.60         |
| 3.6                                        | 45.30                | 55.30          | 105.30               | 125.30         | 169.10               | 191.60         | 291.60               | 329.10         |
| 3.7                                        | 47.80                | 57.80          | 110.30               | 130.30         | 176.60               | 199.10         | 304.10               | 341.60         |
| 3.8                                        | 50.30                | 60.30          | 115.30               | 135.30         | 184.10               | 206.60         | 316.60               | 354.10         |
| 3.9                                        | 52.80                | 62.80          | 120.30               | 140.30         | 191.60               | 214.10         | 329.10               | 366.60         |
| 4.0                                        | 55.30                | 65.30          | 125.30               | 145.30         | 199.10               | 221.60         | 341.60               | 379.10         |
| 4.1                                        | 57.80                | 67.80          | 130.30               | 150.30         | 206.60               | 229.10         | 354.10               | 391.60         |
| 4.2                                        | 60.30                | 70.30          | 135.30               | 155.30         | 214.10               | 236.60         | 366.60               | 404.10         |
| 4.3                                        | 62.80                | 72.80          | 140.30               | 160.30         | 221.60               | 244.10         | 379.10               | 416.60         |
| 4.4                                        | 65.30                | 75.30          | 145.30               | 165.30         | 229.10               | 251.60         | 391.60               | 429.10         |
| 4.5                                        | 67.80                | 77.80          | 150.30               | 170.30         | 236.60               | 259.10         | 404.10               | 441.60         |
| 4.6                                        | 70.30                | 80.30          | 155.30               | 175.30         | 244.10               | 266.60         | 416.60               | 454.10         |
| 4.7                                        | 72.80                | 82.80          | 160.30               | 180.30         | 251.60               | 274.10         | 429.10               | 466.60         |
| 4.8                                        | 75.30                | 85.30          | 165.30               | 185.30         | 259.10               | 281.60         | 441.60               | 479.10         |
| 4.9                                        | 77.80                | 87.80          | 170.30               | 190.30         | 266.60               | 289.10         | 454.10               | 491.60         |
| 5.0                                        | 80.30                | 90.30          | 175.30               | 195.30         | 274.10               | 296.60         | 466.60               | 504.10         |
| <b>At 0 psig</b>                           | <b>1.388 V</b>       | <b>1.788 V</b> | <b>1.094 V</b>       | <b>1.494 V</b> | <b>1.046 V</b>       | <b>1.346 V</b> | <b>0.968 V</b>       | <b>1.268 V</b> |

\* Below 0 PSIG measured in inches of mercury.

## SV POSITION POTENTIOMETER REPLACEMENT AND ADJUSTMENT

The Slide Valve Position potentiometer is located on the end of the compressor unloader cylinder.

1. Shut off control power.
2. Remove the four socket head cap screws securing the potentiometer cover to the unloader cylinder.
3. Unsolder leads to the potentiometer and remove.
4. Loosen the setscrew on the potentiometer side of the flexible coupling.
5. Remove the three retainer clips securing the potentiometer to the base plate. The potentiometer should slip out of the coupling.
6. Install the new potentiometer and reassemble.
7. Adjustment (see Figure 30):

**ROUGH ADJUSTMENT** is made with the slide valve fully unloaded and the control power off. Remove connector P5. With a digital voltmeter, measure the resistance across the red and white wires, having removed them from the SBC. The resistance should be 1000 +/- 50 ohms. If adjustment is necessary, loosen the locknut and rotate the potentiometer clockwise or counterclockwise until the resistance reading is a close to a 1000 ohms as possible. Retighten the locknut and replace wires. **NOTE: Mechanical travel of the slide valve potentiometer is 300 degrees rotation when the slide stop is confirmed to be in the 2.2 Vi position. The travel will be less than 300 degrees if the slide stop is in any position above 2.2 Vi.**

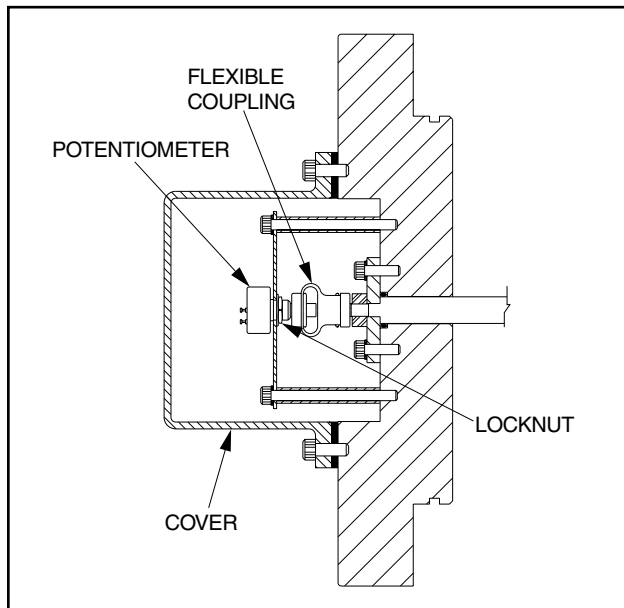


Figure 30 - Potentiometer Adjustment

## VOLUMIZER POTENTIOMETER REPLACEMENT

The VOLUMIZER potentiometer is located under a cover on the right side of the compressor (facing shaft) at the inlet end.

1. Shut off control power.
2. Remove the potentiometer cover and gasket.
3. Remove the potentiometer and mounting bracket.
4. Install new potentiometer and bracket.

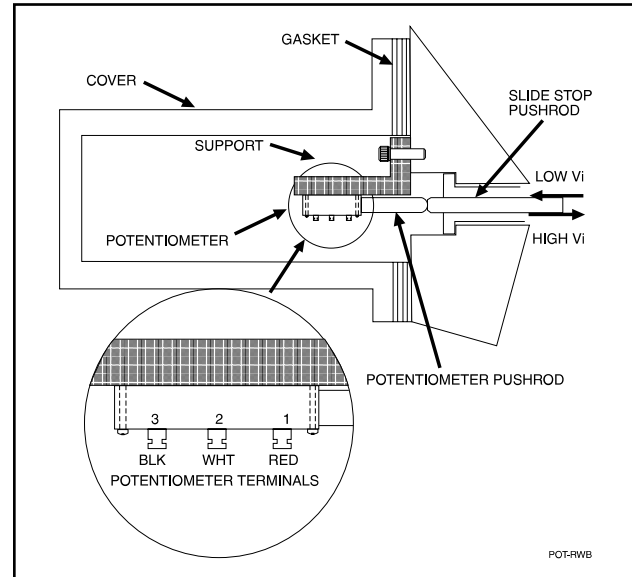


Figure 31

## TEMPERATURE and/or PRESSURE ADJUSTMENT

All temperature and pressure sensors are factory set. If calibration is required, refer to Analog Calibration for temperature or pressure in S90-010 O (*Quantum* panel) or Analog Offset Display in S70-200 OM (*Plus* panel).



**TROUBLESHOOTING THE RWB II COMPRESSOR**

| SYMPTOM                                     | PROBABLE CAUSES and CORRECTIONS                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EXCESSIVE NOISE and VIBRATION               | <p>Main oil injection valve may be closed. Open valve.</p> <p>Bearing damage or excessive wear. CONTACT Frick Factor or Frick.</p> <p>Coupling loose on shaft. Tighten coupling. Replace if damaged.</p> <p>Misalignment between motor and compressor. Realign motor and compressor.</p> <p>Refrigerant flood back. Correct system problem.</p>                                                                                                                    |
| SLIDE VALVE and/or SLIDE STOP WILL NOT MOVE | <p>4-way hydraulic control valve failed - repair or replace.</p> <p>Slide stop indicator rod stuck. Contact Frick Factor or Frick for assistance.</p> <p>Check both S.V. and S.S. potentiometer for wiring and resistance.</p> <p>Compressor must be running with sufficient oil pressure.</p> <p>Unloader piston stuck. Contact Frick Factor or Frick for assistance.</p> <p>Slipper seals worn out or damaged. Contact Frick Factor or Frick for assistance.</p> |

**NOTE: Troubleshooting the compressor is limited to identifying the probable cause. If a mechanical problem is suspected contact the Service Department, Frick. DO NOT ATTEMPT TO DISASSEMBLE COMPRESSOR.**

**TROUBLESHOOTING THE OIL SEPARATION SYSTEM**

| SYMPTOM                                                                 | PROBABLE CAUSES and CORRECTIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GRADUAL OIL LOSS WITH AN OIL LEVEL IN THE COALESCER SECTION SIGHT GLASS | <p>Maintaining too high an oil level, lower level.</p> <p>Refrigerant carryover or liquid injection overfeeding, correct operation.</p> <p>Loss of suction superheat. Adjust evaporator feeds.</p> <p>Contaminated oil, damaged or not seated coalescer filter elements. Replace oil charge and coalescers.</p> <p>Oil float return valve closed, open return valve.</p> <p>Float equalizing valve closed, open valve.</p> <p>Coalescing oil return line strainer blocked, clean</p> <p>Clean and check needle valve.</p> |
| RAPID LOSS WITH NO OIL LEVEL IN THE COALESCER SECTION SIGHT GLASS       | <p>On shutdown, compressor unit suction check valve did not close, repair valve.</p> <p>Suction check valve bypass valve open, close valve.</p> <p>Coalescers loose or not seated properly, correct or replace.</p>                                                                                                                                                                                                                                                                                                       |

### TROUBLESHOOTING THE HYDRAULIC SYSTEM

| SYMPTOM                                       | PROBABLE CAUSES and CORRECTIONS                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SLIDE VALVE WILL NOT LOAD OR UNLOAD           | <p>Solenoid coils may be burned out, replace.</p> <p>Valve may be closed. Open hydraulic service valves.</p> <p>Solenoid spool may be stuck or centering spring broken, replace.</p> <p>Check outputs 2 and 3 and fuses.</p> <p>Solenoid may be mechanically actuated by inserting a piece of 3/16" rod against armature pin and pushing spool to opposite end. Push A side to confirm unload capability. If valve works, problem is electrical.</p> |
| SLIDE VALVE WILL LOAD BUT WILL NOT UNLOAD     | <p>A side solenoid coil may be burned out, replace.</p> <p>Dirt inside solenoid valve preventing valve from operating both ways, clean.</p> <p>Solenoid may be mechanically actuated by inserting a piece of 3/16" rod against armature pin and pushing spool to opposite end. Push A side to confirm unload capability. If valve works, problem is electrical.</p>                                                                                  |
| SLIDE VALVE WILL UNLOAD BUT WILL NOT LOAD     | <p>A side solenoid coil may be burned out, replace.</p> <p>Dirt inside solenoid valve preventing valve from operating both ways, clean.</p> <p>Solenoid may be mechanically actuated by inserting a piece of 3/16" rod against armature pin and pushing spool to opposite end. If valve works, problem is electrical.</p>                                                                                                                            |
| SLIDE STOP WILL NOT FUNCTION EITHER DIRECTION | <p>Solenoid coils may be burned out, replace.</p> <p>Solenoid service valves may be closed, open.</p> <p>Manually actuate solenoid. If slide stop will not move mechanical problems are indicated. Consult Frick factor or Frick.</p>                                                                                                                                                                                                                |

**TROUBLESHOOTING THE PRELUBE PUMP SYSTEM**

| SYMPTOM                                                                                    | PROBABLE CAUSES and CORRECTIONS                                                                                                                                                                                                                                                                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>PRELUBE PUMP WILL NOT GENERATE SUFFICIENT OIL PRESSURE TO ALLOW COMPRESSOR TO START</p> | <p>Filter cartridge in filter F-2 may be clogged, replace.</p> <p>Clean strainer before prelube pump inlet.</p> <p>Oil manifold check valve is leaking, repair.</p> <p>Check pump rotation.</p> <p>Check that service valves are open on both sides of the pump.</p> <p>Confirm oil pressure. Is transducer reading correct pressure? Install gauge on discharge side of prelube pump and measure pressure to determine transducer reliability.</p> |
| <p>PRELUBE PUMP IS NOISY</p>                                                               | <p>Oil level low, add oil.</p> <p>Pump worn or damaged, repair or replace.</p> <p>Pump inlet strainer is blocked, clean strainer.</p> <p>Pump running backwards, change wiring.</p> <p>Excessive oil foaming, check oil cooling system.</p> <p>Oil contamination or wrong oil being used.</p> <p>Pump worn out, repair or replace.</p>                                                                                                              |

**TROUBLESHOOTING THE FULL TIME PUMP SYSTEM**

| SYMPTOM                                                                                               | PROBABLE CAUSES and CORRECTIONS                                                                                                                                                         |
|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>PUMP WILL NOT PRODUCE ENOUGH OIL PRESSURE TO START COMPRESSOR</p>                                  | <p>Filter cartridges may be blocked. Check PSID across filters.</p> <p>Strainer may be blocked, clean.</p> <p>Oil pressure regulator set too low or stuck open. Readjust or repair.</p> |
| <p>OIL PRESSURE RAPIDLY DROPS OFF WHEN COMPRESSOR STARTS RESULTS IN COMPRESSOR DIFFERENTIAL ALARM</p> | <p>Main oil injection throttling valve too wide open or oil pressure regulating valve improperly adjusted. Readjust both valves.</p>                                                    |
| <p>OIL PRESSURE FLUCTUATES</p>                                                                        | <p>Liquid injection overfeeding or refrigerant flood back from system. Make necessary adjustments or corrections</p>                                                                    |
| <p>NOISE and VIBRATION</p>                                                                            | <p>Pump strainer blocked, clean.</p> <p>Liquid refrigerant overfeed. Adjust liquid injection.</p> <p>Pump worn out. Repair or replace.</p>                                              |
| <p>GREASE LEAKS FROM VENT PORT IN THE SIDE OF THE PUMP BODY</p>                                       | <p>Normal leakage which will cease after initial operation. Black oil leaking from this vent indicates oil seal wear or failure. Replace seal.</p>                                      |
| <p>OIL PRESSURE DROPS AS HEAD PRESSURE INCREASES</p>                                                  | <p>Normal behavior. Set main oil injection and oil pressure for maximum head pressure condition.</p>                                                                                    |
| <p>MAIN FILTER PSID IS TOO HIGH</p>                                                                   | <p>Filters clogged with dirt, replace.</p> <p>Oil is too cold. Allow oil to warm up and check again.</p> <p>Service valve on filter outlet is partially closed. Open valves fully.</p>  |

### TROUBLESHOOTING THE LIQUID INJECTION OIL COOLING SYSTEM

| SYMPTOM                    | PROBABLE CAUSES and CORRECTIONS                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HIGH OIL TEMPERATURE       | Insufficient liquid supply, check receiver level and pressure drop at injection solenoid.<br><br>Suction superheat too high, correct system problem.<br><br>Thermal valve power head lost charge, replace.<br><br>Liquid strainer blocked, clean.<br><br>Liquid solenoid coil failed, replace.<br><br>Excessive load. Thermovealve undersized. Reduce load or install larger thermovealve. |
| LOW OIL TEMPERATURE        | Suction superheat too low or liquid coming back on compressor, correct system problem.<br><br>Low load conditions. Valve oversized, increase load or use smaller thermovealve.                                                                                                                                                                                                             |
| OIL TEMPERATURE FLUCTUATES | System conditions rapidly fluctuate causing liquid injection system to over respond, stabilize system operation.                                                                                                                                                                                                                                                                           |

**THERMAL EXPANSION VALVES**

In situations where system load conditions increase or decrease over extended periods of time and the liquid injection thermal expansion valve is not adequate for the new conditions, an improvement in valve performance may be achieved by increasing or decreasing discharge tube size.

**NOTE: DO NOT ATTEMPT TO ADJUST SUPERHEAT ADJUSTMENT STEM ON BOTTOM OF VALVE IN AN EFFORT TO CHANGE THE VALVE'S PERFORMANCE. THIS ADJUSTMENT IS PRESET AT THE FACTORY.**

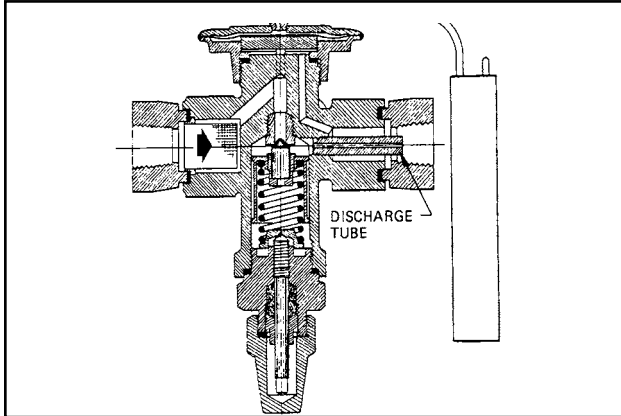


Figure 32 - Type D (1-15 TONS) R-717

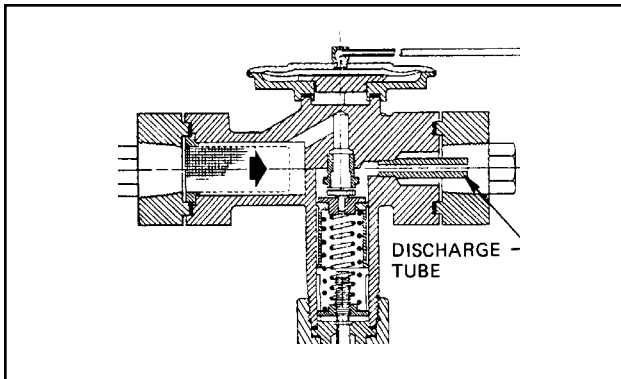


Figure 33 - Type A (20-100 TONS) R-717

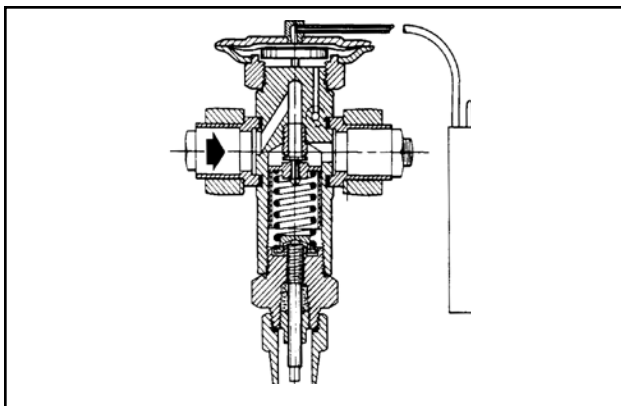


Figure 34 - Type H (2-1/2 - 16 TONS) R-22

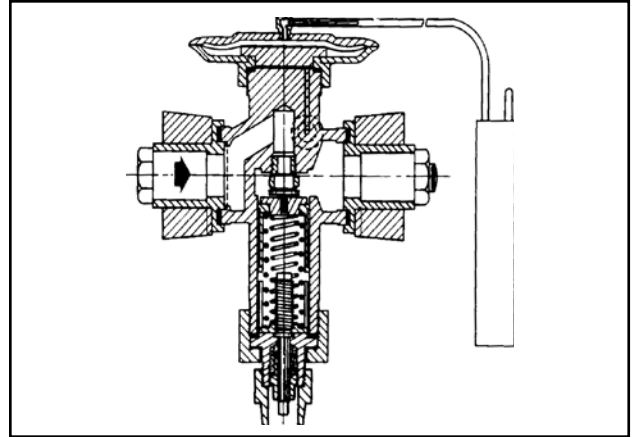


Figure 35 - Type M (12 - 34 Tons) R-22

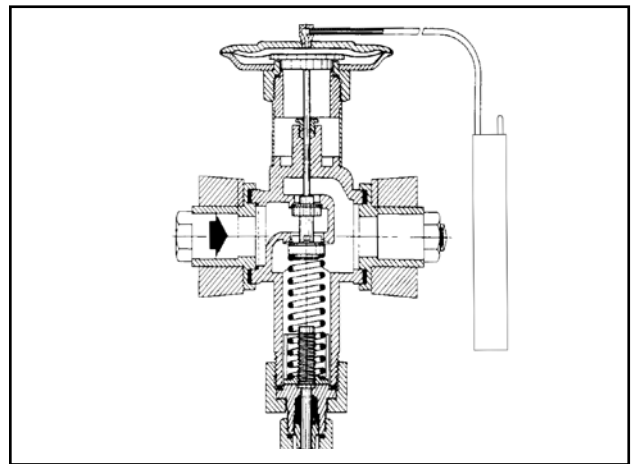


Figure 36 - Type V (52 - 100 TONS) R-22

**R-717 TX VALVE SIZES**

| TX VALVE MODE | PORT SIZE | DISCHARGE TUBE SIZE |
|---------------|-----------|---------------------|
| DAE - 1       | 1/16      | 1/32                |
| DAE - 2       | 1/16      | 1/16                |
| DAE - 5       | 7/64      | 5/64                |
| DAE - 10      | 3/16      | 7/64                |
| DAE - 15      | 3/16      | 5/32                |
| AAE - 20      | 5/16      | 1/8                 |
| AAE - 30      | 5/16      | 5/32                |
| AAE - 50      | 3/8       | 3/16                |
| AAE - 75      | 3/8       | NONE                |
| AAE - 100     | 7/16      | NONE                |

**R-22 TX VALVE SIZES**

| TX VALVE MODE | FPT CONNECTION |
|---------------|----------------|
| HVE - 2-1/2   | 1/2            |
| HVE - 5-1/2   | 1/2            |
| HVE - 11      | 1/2            |
| HVE - 16      | 1/2            |
| MVE - 12      | 1              |
| MVE - 21      | 1              |
| MVE - 34      | 1              |
| VVE - 52      | 1              |
| VVE - 70      | 1              |
| VVE - 100     | 1              |

## JORDAN TEMPERATURE REGULATOR VALVE

The Jordan valve is a high volume, temperature-regulating valve that requires minimal differential across the valve to ensure adequate flow for cooling.

The Jordan valve must be mounted on a horizontal line with the flow arrow pointing toward the direction of flow. However, the valve may be mounted at any angle perpendicular to the horizontal line, including inverted, if necessary.



### Sensing Bulb, Vertical Mounting -

When the sensing bulb is to be mounted vertically (pointing down), no special precaution is necessary. If the bulb is to be mounted vertically, in an inverted position, a special capillary is needed because the tip of the sensing bulb is higher than the capillary end.

**Sensing Bulb, Horizontal Mounting -** When mounting the sensing bulb horizontally it must be mounted so that the word "TOP" which is stamped on the capillary end of the bulb appears accordingly. **NOTE: No angular mounting of the sensing bulb is permitted.**

**Adjustment -** To increase the oil temperature, increase the spring tension by turning the knurled nut at the base of the spring. To decrease the oil temperature, decrease the spring tension by turning the knurled nut at the base of the spring (see Figure 37).

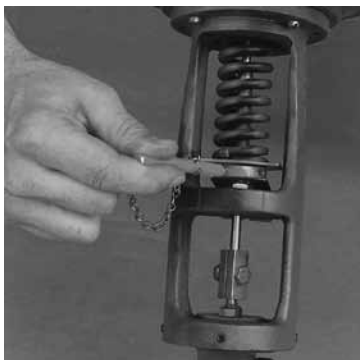


Figure 37

**Action -** The valve should be set as a reverse acting valve, however there are times when the valve may be set as a direct acting valve. If you experience what seems to be a total absence of oil cooling you will need to check the action of the valve. To check the action you will need to remove the cap-flange and disc-guide.



Figure 38

If the hole in the valve plate is to the left and the slot in the valve disc is on the top this valve is set for Direct Acting (see figure 38). To change the action of the valve to Reverse Acting simply rotate the valve plate and the valve disc 180° so that the hole on the plate is on the right and the slot on the disk is at the bottom (see figure 39).

**Stroke Adjustment -** After the valve action has been

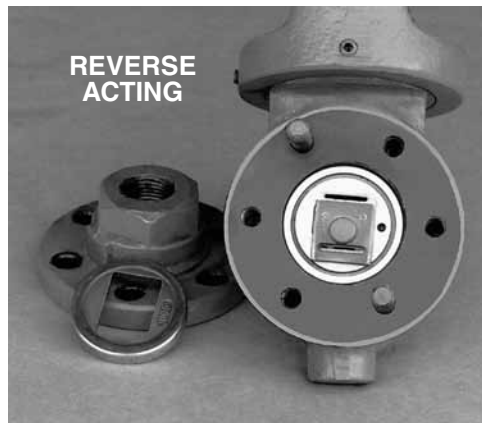


Figure 39

changed it may be necessary to make a stroke adjustment. This ensures that the full capacity of the valve is available, if necessary, to keep the oil at the predetermined temperature.

To prepare for a stroke adjustment do the following.

- Remove the disc-guide, valve-disc, and valve-plate.
- Expose the sensing bulb in a vertical position to an ambient temperature of about 80°F.
- Release all spring tension by loosening the knurled nut.
- Loosen the disc-pin locking nut and allow at least 10 minutes for the valve to react (see figure 40).

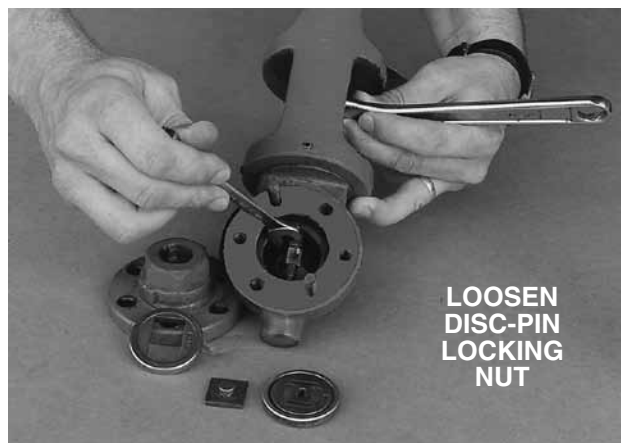


Figure 40

- Rotate the disc-pin so that when the valve-plate is installed the bottom of the pin is between the middle and the bottom of the slot.
- Hold the coupling with a wrench and tighten the disc-pin locking nut.
- Install the valve-plate and valve-disk for reverse action (see figure 39).
- Install the disk-guide and cap-flange.
- Increase the spring tension to about 30% by turning the knurled nut at the base of the spring approximately 20 quarter turns.

Install the valve and adjust the spring tension accordingly to maintain the predetermined oil temperature. The recommended oil temperature is 130°F for ammonia. Check with Frick service for recommended oil temperatures for other refrigerants.

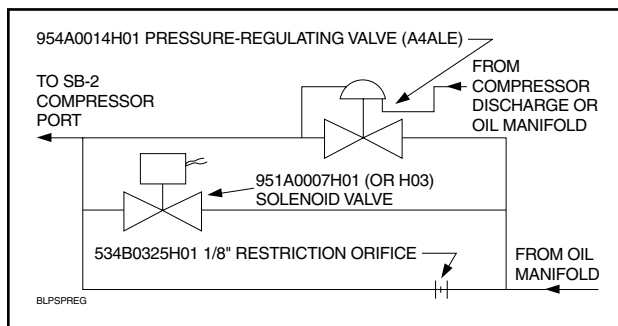
If all of the above steps have been properly performed and the desired oil temperature can not be achieved, contact Frick Service.

### BARE COMPRESSOR MOUNTING

The following procedure is required only when a bare compressor is replaced in the field.

1. Thoroughly clean the compressor feet and mounting pads of burrs and other foreign matter to ensure firm seating of the compressor.
2. Clean the discharge flange surfaces on the compressor and separator.
3. Install a gasket on the compressor discharge connection of the separator.
4. Set the compressor on its base and tighten the discharge flange bolts. **The feet of the compressor should lift off the mounting base. If the compressor feet do not raise off the mounting base install a thicker discharge gasket and reinstall the discharge flange bolts.** Check the clearance between the feet and the base with a feeler gauge. Shim the compressor feet (gauge reading plus .002").
5. Tighten compressor hold down bolts.
6. Complete compressor/motor coupling alignment (see INSTALLATION section).
7. Complete tubing, piping and wiring per the P & I and wiring diagrams.

### BALANCE PISTON PRESSURE REGULATOR



**High-Stage SB-2 Oil Supply Line Diagram:** Shows the three additions described below arranged in parallel.

A Balance Piston Pressure Regulator is required to reduce the extended overbalance from the thrust balance piston at part load.

**PRESSURE-REGULATING VALVE:** Discharge pressure determines compressor thrust balance. The proper setting for the pressure-regulating valve is 50 psi below DISCHARGE pressure.

**SOLENOID VALVE:** Energizing, or opening, the solenoid valve pressurizes the balance piston with full oil pressure from the oil manifold, bypassing the A4ALE Pressure Regulating Valve. De-energizing, or closing, the solenoid valve pressurizes the balance piston with oil pressure regulated by the A4ALE Pressure Regulating Valve.

Signals from the control panel operate the solenoid valve (output module 12 on micro panel). The solenoid valve should open when the slide valve position is 70% or greater, and close when the slide valve position is 65% or less.

**ORIFICE:** The orifice ensures oil supply to the inlet end bearings during upset conditions such as start-up.

### SHUTDOWN DUE TO IMPROPER OIL PRESSURE (HIGH STAGE and BOOSTER)

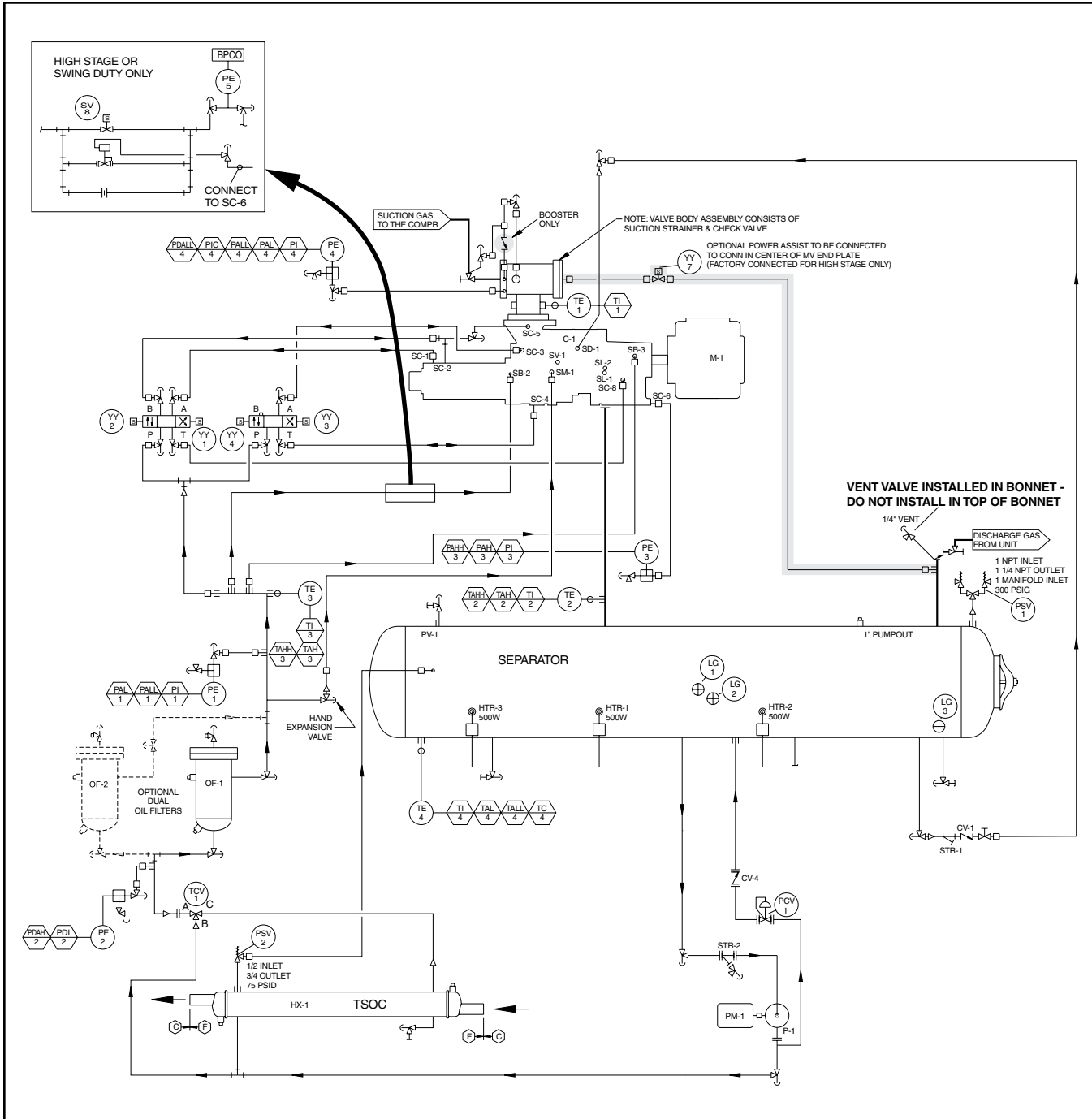
**The compressor must not operate with incorrect oil pressure.**

1. For units with *Quantum* Control Panels, refer to CONTROL SETUP - "OIL SETPOINTS DISPLAY" in S90-010 O.
2. For units with *Microprocessor* Control Panels, install a pressure transducer to monitor the pressure of the oil supply to the balance piston. The correct pressure with the solenoid closed is 50 psi below discharge pressure (+/-15 psi). The correct pressure with the solenoid valve open is within 20 psi of oil pressure as measured at the oil manifold.

At 60 psi and less differential pressures, with the solenoid valve closed, the oil pressure should be 1.1 times suction pressure (+/-15 psi). Differential pressure is defined as discharge pressure minus suction pressure.

The shutdown should occur if the condition persists for 2 minutes. For the first 5 minutes after compressor start has been confirmed, this safety shutdown may be ignored.

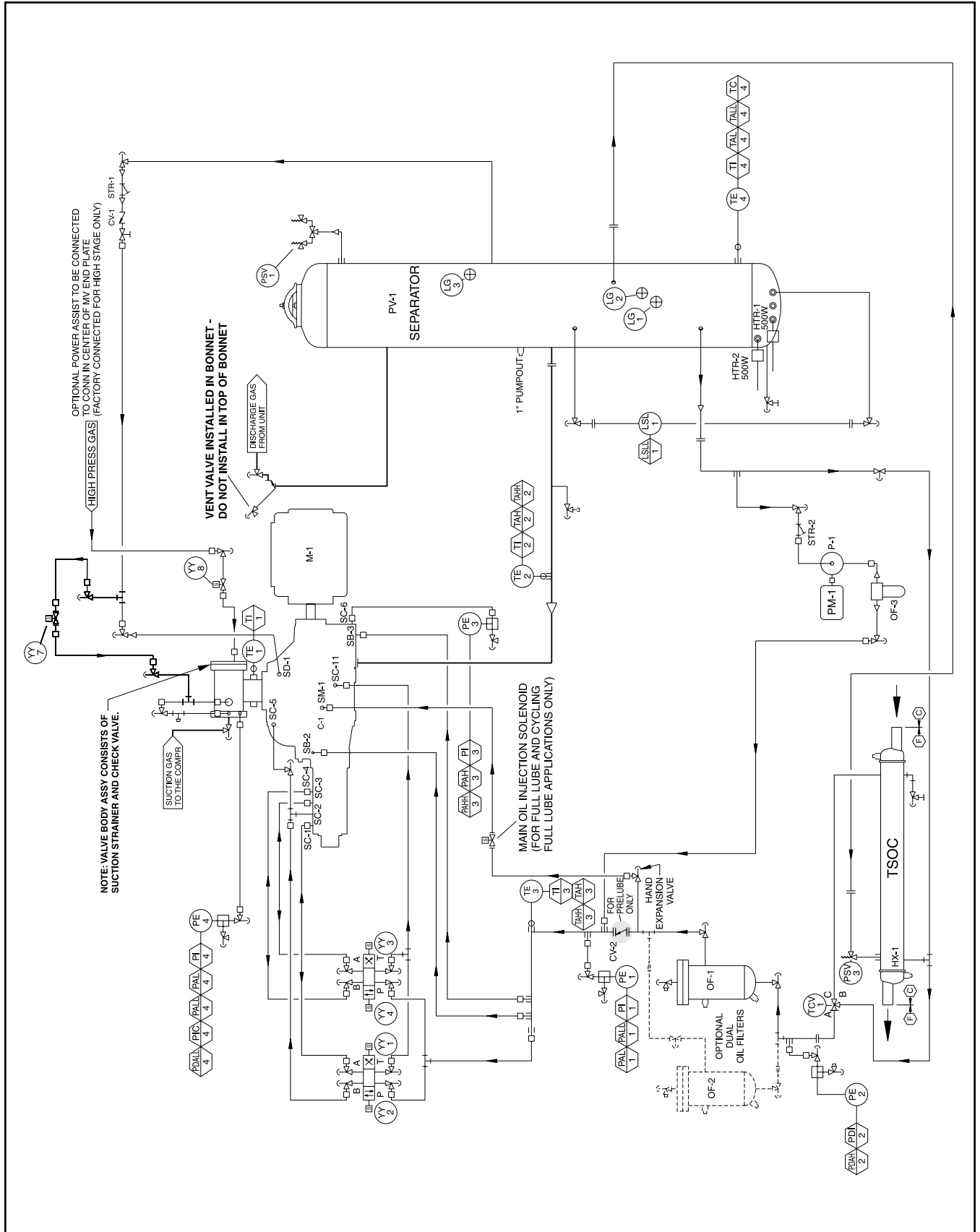
**P & I DIAGRAM - HORIZONTAL SEPARATOR**



**NOTE:** See Legend for symbol explanations.

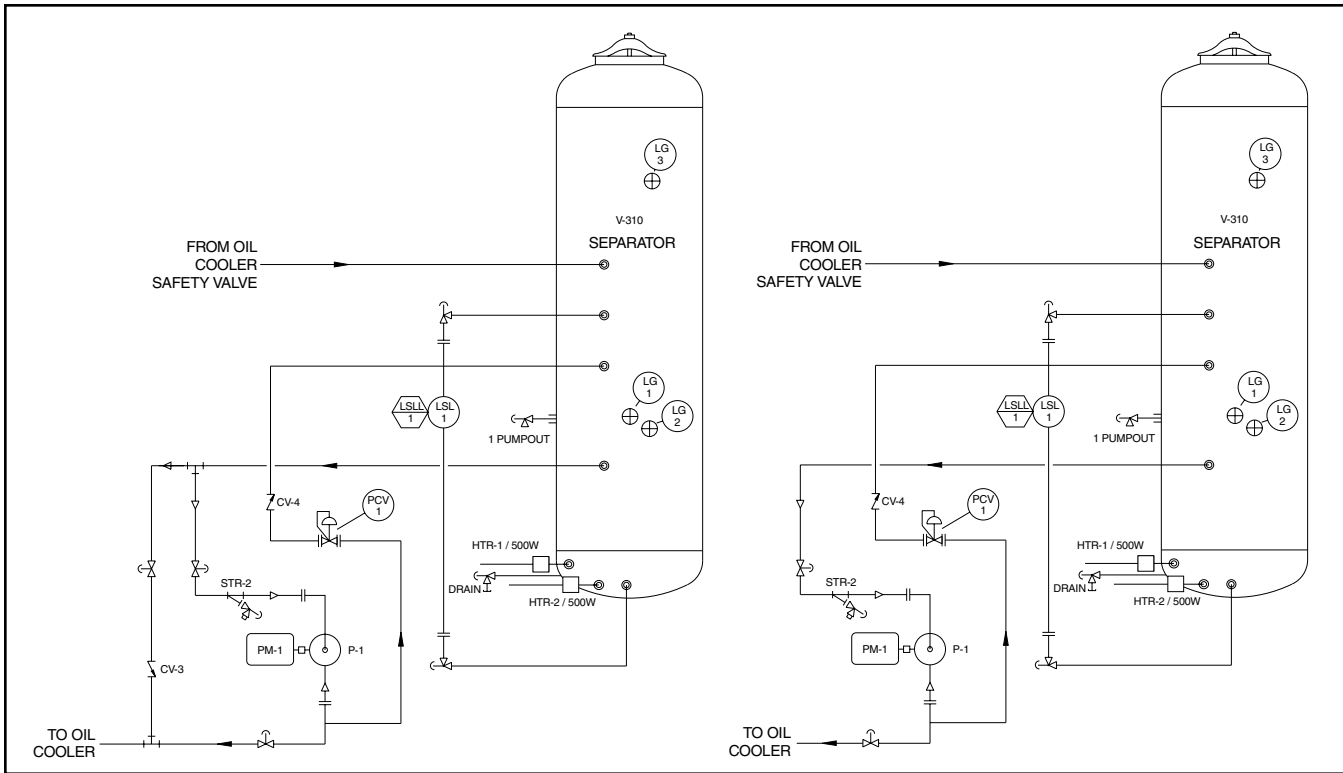


**P & I DIAGRAM - VERTICAL SEPARATOR (w/prelube oil pump)**



**NOTE: See Legend for symbol explanations.**

**P & I DIAGRAM - OIL PUMPS**



**CYCLING FULL LUBE OIL PUMP**

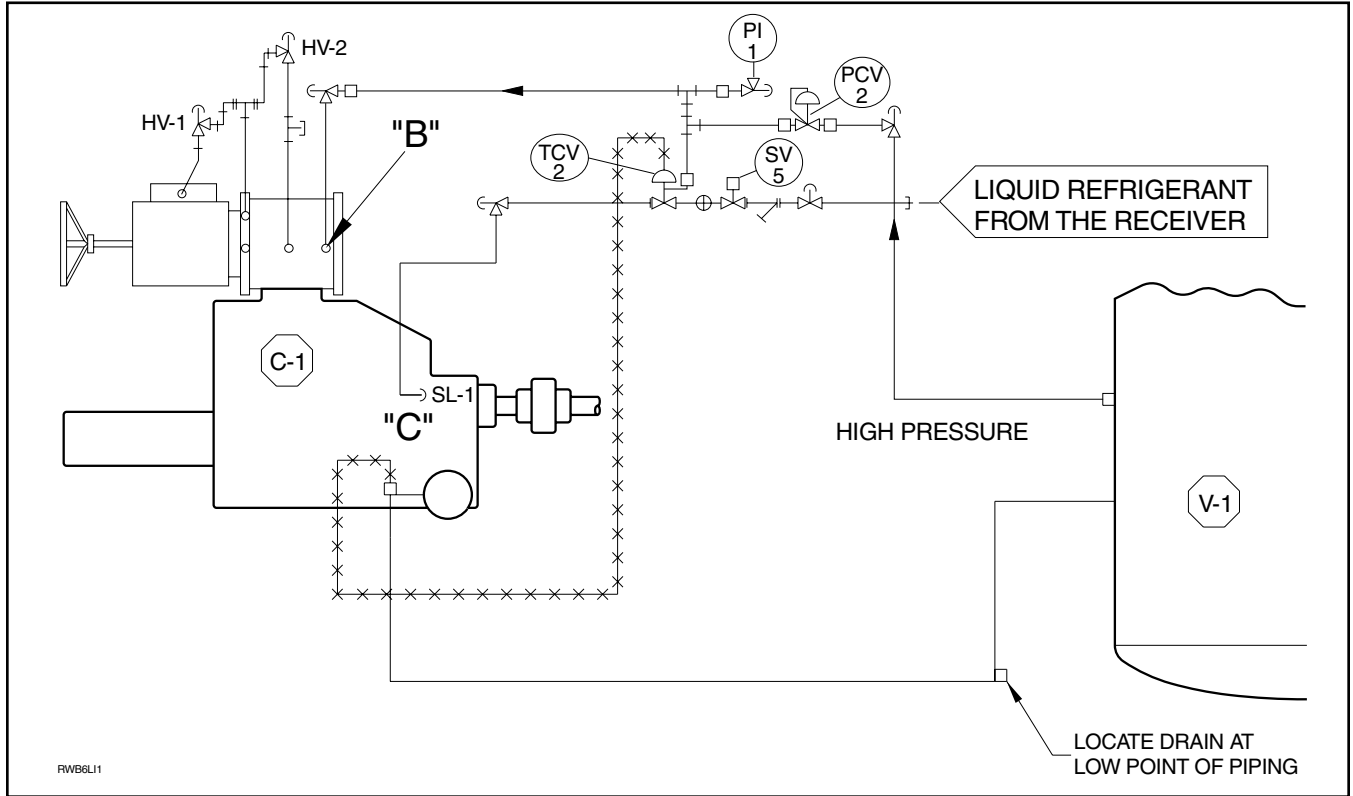
**FULL LUBE OIL PUMP**

**LEGEND FOR P & I DIAGRAMS**

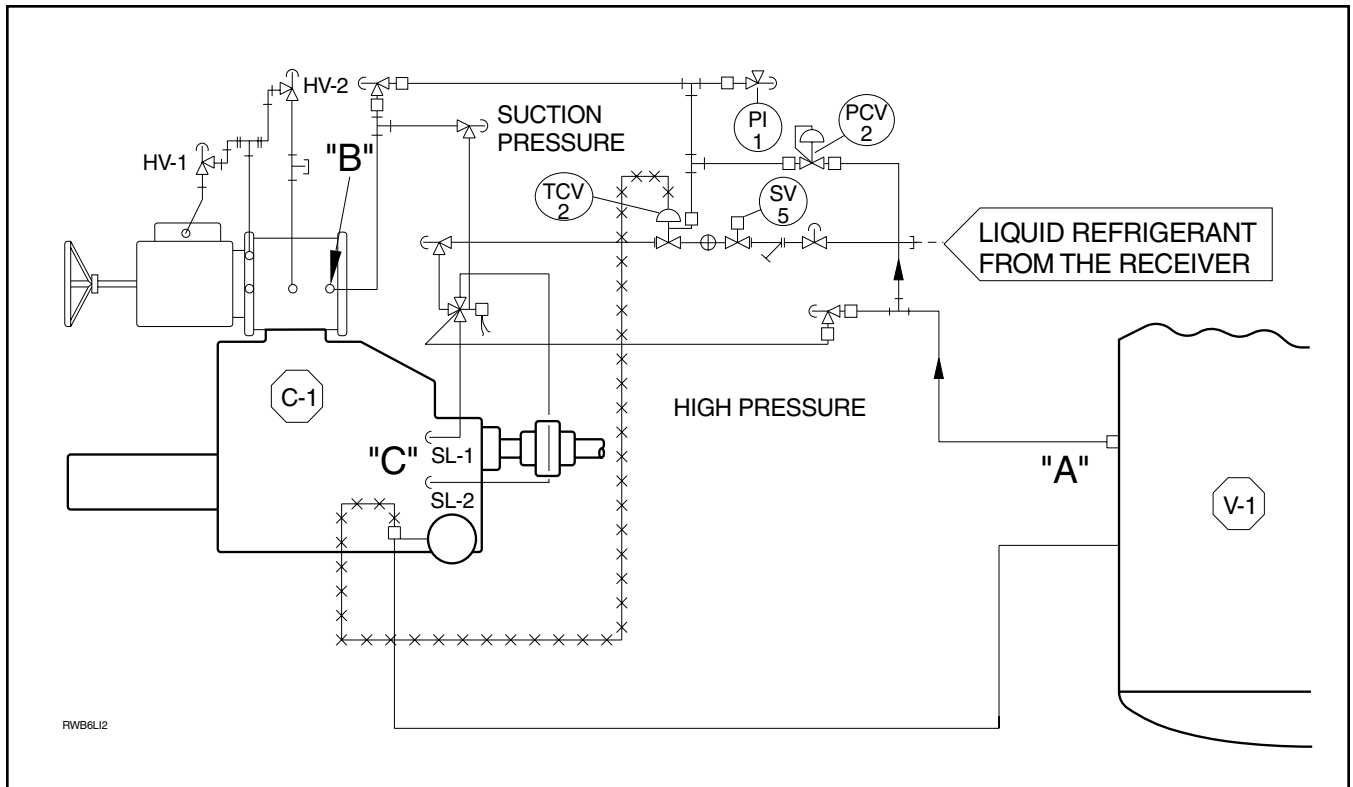
|       |                                             |
|-------|---------------------------------------------|
| AS    | AIR SUPPLY                                  |
| BPCO  | BALANCE PISTON CUTOUT                       |
| C     | COMPRESSOR                                  |
| CV    | CHECK VALVE                                 |
| DP    | DISCHARGE PRESSURE                          |
| E     | GAS ENGINE                                  |
| F     | FILTER OR FILTER DRIER                      |
| FG    | FLOW GLASS                                  |
| HV    | HAND VALVE                                  |
| HTR   | HEATER                                      |
| LG    | LEVEL GLASS                                 |
| LSL   | LOW OIL LEVEL SWITCH                        |
| LSLL  | SEPARATOR LOW OIL LEVEL SHUTDOWN            |
| M     | MOTOR                                       |
| 1MC   | MOTOR CONTROL CENTER                        |
| 2MC   | MOTOR CONTROL CENTER                        |
| OP    | OIL PRESSURE                                |
| P     | PUMP                                        |
| PAH   | HIGH DISCHARGE PRESSURE ALARM               |
| PAHH  | HIGH DISCHARGE PRESSURE SHUTDOWN            |
| PAL   | LOW PRESSURE ALARM                          |
| PALL  | LOW PRESSURE SHUTDOWN                       |
| PCCV  | PRESSURE CONTROL VALVE                      |
| PDSLL | COMPRESSOR LOW DIFFERENTIAL PRESSURE CUTOUT |
| PE    | PRESSURE TRANSDUCERS                        |
| PI    | PRESSURE INDICATOR                          |
| PIC   | PRESSURE INDICATION CONTROLLER              |
| PM    | PUMP MOTOR                                  |
| PS    | PRESSURE SWITCH CONTROL                     |
| PSV   | HIGH PRESSURE SAFETY VALVE                  |
| TAH   | HIGH TEMPERATURE ALARM                      |
| TAHH  | HIGH TEMPERATURE SHUTDOWN                   |
| TAL   | LOW OIL TEMPERATURE ALARM                   |
| TALL  | LOW OIL TEMPERATURE SHUTDOWN                |
| SP    | SUCTION PRESSURE                            |
| STR   | STRAINER                                    |
| TCV   | THERMAL CONTROL VALVE                       |
| TE    | TEMPERATURE ELEMENT                         |
| TI    | TEMPERATURE INDICATOR                       |
| TS    | TEMPERATURE SWITCH                          |
| TSH   | TEMPERATURE SWITCH HIGH ALARM               |
| TW    | THERMOWELL                                  |

|                                |                                     |
|--------------------------------|-------------------------------------|
| YY                             | SOLENOID VALVE                      |
| VI                             | VI CONTROL                          |
| WS                             | WATER SUPPLY                        |
| SB-2                           | INLET BEARING & BALANCE PISTON      |
| SB-3                           | DISCHARGE BEARINGS & SEAL           |
| SC-1                           | SLIDE VALVE - UNLOAD                |
| SC-2                           | SLIDE VALVE - LOAD                  |
| SC-3                           | MOVEABLE SLIDE STOP                 |
| SC-4                           | MOVEABLE SLIDE STOP                 |
| SC-5                           | INLET PRESSURE                      |
| SC-6                           | DISCHARGE PRESSURE                  |
| SC-7                           | SEAL WEEPAGE                        |
| SC-8                           | OIL DRAIN CONNECTION                |
| SC-9                           | INLET OIL DRAIN                     |
| SC-10                          | DISCHARGE BEARINGS PRELUBE (OPT)    |
| SC-11                          | OIL DRAIN CONNECTION (OPT)          |
| SC-12                          | DISCHARGE BEARING PRELUBE (OPT)     |
| SC-13                          | OIL DRAIN CYLINDER                  |
| SE-1                           | ELECTRICAL CONNECTION               |
| SE-2                           | ELECTRICAL CONNECTION               |
| SL-1                           | LIQUID INJECTION LOW VI             |
| SL-2                           | LIQUID INJECTION HIGH VI            |
| SM-1                           | MAIN OIL INJECTION                  |
| SV-1                           | VAPOR INJECTION TONGUE & GROOVE     |
| SD-1                           | COALESCER BLEED STR THD O-RING PORT |
| TW-1                           | THERMOWELL                          |
| PRESSURE TRANSDUCERS INDICATE: |                                     |
| PE-1                           | OIL PRESSURE (MANIFOLD)             |
| PE-2                           | OIL PRESSURE BEFORE FILTER          |
| PE-3                           | DISCHARGE PRESSURE                  |
| PE-4                           | SUCTION PRESSURE                    |
| TEMPERATURE PROBES INDICATE:   |                                     |
| TE-1                           | SUCTION GAS TEMPERATURE             |
| TE-2                           | DISCHARGE GAS TEMPERATURE           |
| TE-3                           | LUBE OIL TEMPERATURE                |
| TE-4                           | SEPARATOR OIL TEMPERATURE           |
| TE-5                           | TEMPERATURE CAPACITY CONTROL        |
| SOLENOID VALVE FUNCTION:       |                                     |
| YY-1                           | ENERGIZE UNLOAD SLIDE VALVE         |
| YY-2                           | ENERGIZE LOAD SLIDE VALVE           |
| YY-3                           | ENERGIZE INCREASE VOLUME RATIO      |
| YY-4                           | ENREGIZE DECREASE VOLUME RATIO      |

**P & I DIAGRAM - LIQUID INJECTION OIL COOLING**



**LIQUID INJECTION, SINGLE PORT**



**LIQUID INJECTION, DUAL PORT**

**NOTE:** See Legend for symbol explanations.

## PROPER INSTALLATION OF ELECTRONIC EQUIPMENT IN AN INDUSTRIAL ENVIRONMENT

In today's refrigeration plants, electronic controls have found their way into almost every aspect of refrigeration control. Electronic controls have brought to the industry more precise control, improved energy savings, and operator conveniences. Electronic control devices have revolutionized the way refrigeration plants operate today.

The earlier relay systems were virtually immune to radio frequency interference (RFI), electromagnetic interference (EMI), and ground loop currents. Therefore installation and wiring were of little consequence and the wiring job consisted of hooking up the point-to-point wiring and sizing the wire properly. In an electronic system, improper installation will cause problems that may outweigh the benefits of electronic control. Electronic equipment is susceptible to RFI, EMI, and ground loop currents which can cause equipment shutdowns, processor memory and program loss, as well as erratic behavior and false readings. Manufacturers of industrial electronic equipment take into consideration the effects of RFI, EMI, and ground loop currents and incorporate protection of the electronics in their designs. However, these design considerations do not make the equipment immune, so manufacturers require that certain installation precautions be taken to protect the electronics from these effects. All electronic equipment must be viewed as sensitive instrumentation and therefore requires careful attention to installation procedures. These procedures are well known to instrumentation, networking, and other professions but may not be followed by general electricians.

There are a few basic practices that if followed, will minimize the potential for problems resulting from RFI, EMI and/or ground loop currents. The National Electric Code (NEC) is a guideline for safe wiring practices, but it does not necessarily deal with procedures used for electronic control installation. Use the following procedures for electronic equipment installation. These procedures do not override any rules by the NEC, but are to be used in conjunction with the NEC code and any other applicable codes.

With exclusion of the three phase wire sizing, Frick drawing 649D4743 should be used as a reference for properly sizing control wires and other wiring specifications.

Throughout this document the term Electronic Control Panel is used to refer to the microprocessor mounted on the compressor package or a Central Control System panel.

### NOTICE

It is very important to read the installation instructions thoroughly before beginning the project. Make sure you have drawings and instructions with your equipment. If not, call the manufacturer and request the proper instructions and drawings. Every manufacturer of electronic equipment should have a knowledgeable staff, willing to answer your questions or provide additional information. Following correct wiring procedures will ensure proper installation and consequently, proper operation of your electronic equipment.

### WIRE SIZING

Control power supply wires should be sized one size larger than required for amperage draw to reduce instantaneous voltage dips caused by large loads such as heaters, contactors, and solenoids. These sudden dips in voltage can cause the electronic control panel, whether it is a micropro-

cessor, a computer, or a PLC, to malfunction momentarily or cause a complete reset of the control system. If the wire is loaded to its maximum capacity, the voltage dips are much larger, and the potential of a malfunction is very high. If the wire is sized one size larger than required, the voltage dips are smaller than in a fully loaded supply wire and the potential for malfunction is much lower. The NEC code book calls for specific wire sizes to be used based on current draw. An example of this would be to use #14 gauge wire for circuits up to 15 amps or #12 gauge wire for circuits of up to 20 amps. Therefore, when connecting the power feed circuit to an electronic control panel, use #12 gauge wire for a maximum current draw of 15 amp and #10 wire for a maximum current draw of 20 amp. Use this rule of thumb to minimize voltage dips at the electronic control panel.

### VOLTAGE SOURCE

Selecting the voltage source is extremely important for proper operation of electronic equipment in an industrial environment. Standard procedure for electronic instrumentation is to provide a clean, isolated, separate-source voltage in order to prevent EMI (from other equipment in the plant) from interfering with the operation of the electronic equipment. Connecting electronic equipment to a breaker panel (also known as lighting panels or utility panels) subjects the electronic equipment to noise generated by other devices connected to the breaker panel. This noise is known as electromagnetic interference (EMI). EMI flows on the wires that are common to a circuit. EMI cannot travel easily through transformers and therefore can be isolated from selected circuits. Use a control power transformer of the proper VA rating, usually provided in the compressor drive motor starter, to isolate the electronic control panel from other equipment in the plant that generate EMI. See Figure below.

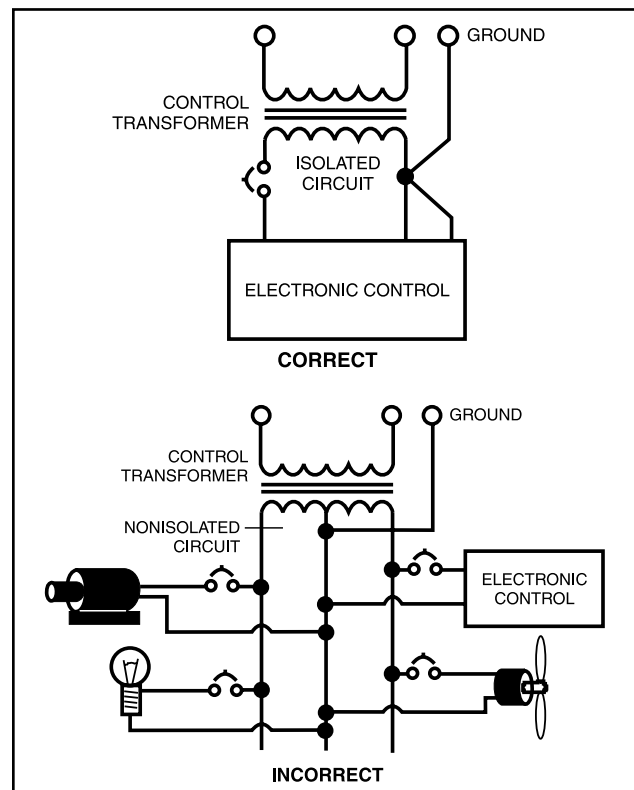
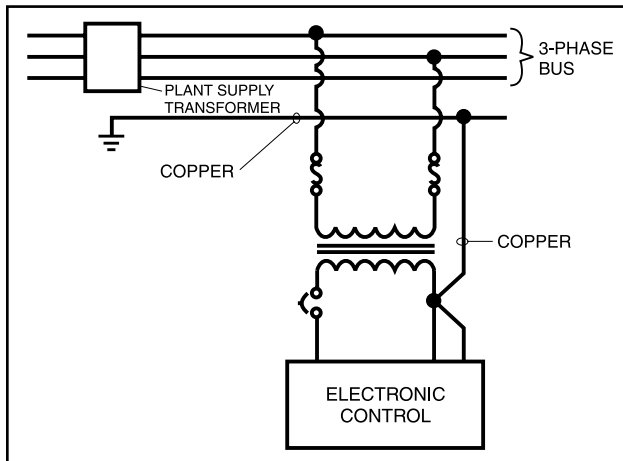


Figure 41. Voltage Source Circuit To Prevent EMI

## GROUNDING

Grounding is the most important factor for successful operation and is typically the most overlooked. The NEC states that control equipment may be grounded by using the rigid conduit as a conductor. This worked for the earlier relay systems, but it is in no way acceptable for electronic control equipment. Conduit is made of steel and is a poor conductor relative to an insulated stranded copper wire. Electronic equipment reacts to very small currents and must have a proper ground in order to operate properly; therefore, stranded copper grounds are required for proper operation.

For proper operation, the control power ground circuit must be a single continuous circuit of the proper sized insulated stranded conductor, from the electronic control panel to the plant supply transformer (See Figure below). Driving a ground stake at the electronic control may also cause additional problems since other equipment in the plant on the same circuits may ground themselves to the ground stake causing large ground flow at the electronic control panel. Also, running multiple ground conductors into the electronic control panel from various locations can create multiple potentials resulting in ground loop currents. A single ground wire (10 AWG or 8 AWG) from the electronic control panel, that is bonded to the control power neutral at the secondary side of the control power transformer in the starter and then to the 3-phase ground point, will yield the best results.



**Figure 42. Control Power Ground Circuit**

### NOTICE

**Structural grounding can also result in multiple ground potentials and is also a relatively poor conductor. Therefore, this is not an acceptable method for proper operation of electronic equipment.**

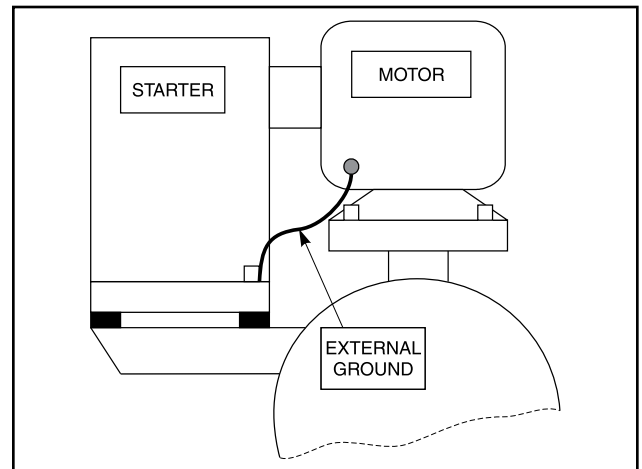
There must be a ground for the three-phase power wiring. This must be sized in accordance to the NEC and any local codes relative to the highest rated circuit overload protection provided in the circuit. The manufacturer may require a larger ground conductor than what is required by the NEC for proper steering of EMI from sensitive circuits. This conductor must also be insulated to avoid inadvertent contact at multiple points to ground, which could create Ground Loops. In many installations that are having electronic control problems, this essential wire is usually missing, is not insulated, or improperly sized.

NEC size ratings are for safety purposes and not necessarily for adequate relaying of noise (EMI) to earth ground to avoid possible interference with sensitive equipment. Therefore sizing this conductor 1 – 2 sizes larger than required by code will provide better transfer of this noise.

Johnson Controls-Frick® requires that the ground conductor meet the following:

- Stranded Copper
- Insulated
- One size larger than NEC requirements for conventional starters
- Two sizes larger than NEC requirements for VFD starters
- Conduit must be grounded at each end
- This circuit must be complete from the motor to the starter continuing in a seamless manner back to the plant supply transformer (power source).

For Direct Coupled, Package Mounted Starters, the ground between the motor and the starter may need to be made externally (See Figure below). The connection on the starter end must be on the starter side of the vibration isolators. Be certain the connection is metal to metal. Paint may need to be removed to ensure a proper conductive circuit. The use of counter-sunk star washers at the point of connection at each end will maximize metal to metal contact.



**Figure 43. Motor And Starter Grounding**

## VFD APPLICATIONS

The primary ground conductor that accompanies the three-phase supply must be stranded copper, insulated and two sizes larger than the minimum required by the NEC or any other applicable codes. This is necessary due to the increased generation of EMI which is a characteristic of a VFD output to the motor when compared to a conventional starter.

For VFD applications, isolation of the control power, analog devices, and communications ground from the 3-phase ground within the starter and the electronic control panel may be necessary. This is due to the higher noise (RFI/EMI) levels generated between the VFD output and the motor, relative to a conventional starter. If these grounds are left coupled by a common back-plate in the starter/drive, this noise can be direct coupled to the control power, analog device, and communications grounding and may cause unexplained behavior and possible damage to components.

To install correctly, run a separate, properly sized (10 or 8 AWG typically) insulated ground along with and taken to ground with, the 3-phase ground at the 3-phase supply transformer (plant). This will require that the 3-phase ground and the control power ground be electrically isolated except for the connection at the plant supply transformer.

This style of grounding should steer the noise (EMI/RFI) to earth ground, reducing the potential for it to affect the sensitive equipment, which could occur if the grounds were left coupled.

## NOTICE

If all other recommendations for grounding are followed, this process should not be necessary.

### CONDUIT

All national and local codes must be followed for conduit with regard to materials, spacing and grounding. In addition, **Johnson Controls-Frick requirements must be followed where they exceed or match national or local codes. Conversely, there is no allowance for any practices that are substandard to what is required by national or local codes.**

Johnson Controls-Frick conduit requirements:

- For *variable frequency drives* (VFDs) of any type, threaded metallic or threaded PVC-coated metallic is required for both the power feed (line side) from the source and between the VFD output and the motor (load side).
- PVC conduit is acceptable **only** when *VFD rated cable* of the proper conductor size and ground is used. This applies to both the line side and load side of the drive. When VFD rated cable is not used, threaded metallic or threaded PVC-coated metallic must be used.
- When threaded metallic or threaded PVC-coated metallic is used, it must be grounded at both ends.
- When not required to be in metal or other material by national or local codes, conduits for the power feed (3-phase) of constant speed starters may be PVC.
- When not required to be in metal or other material by national or local codes, conduits between a constant speed starter and the motor (3-phase) may be PVC.
- Any unshielded control voltage, signal, analog, or communication wiring that does not maintain 12 inches of separation from any 3-phase conductors for every 33 feet (10 meters) of parallel run must be in metal conduit which will be grounded.

Separation: (0-33 feet, 0-10 meters – 12 inches, .3 meters), (33-66 feet, 10-20 meters – 24 inches, .6 meters)

- Since PVC conduit does absolutely nothing to protect lower voltage lines from the magnetic field effects of higher voltage conductors, running either the lower or the higher voltage lines in PVC, does not reduce these requirements on separation. Only running in metal conduit can relieve these requirements.
- Due to the level of EMI that can be induced onto lower voltage lines when running multiple feeders in a trench, control power, communications, analog, or signal wiring cannot be run in trenches that house multiple conduits/electrical ducts carrying 3-phase power to starters/vfd or motors.

- Control power, communications, analog, or signal wiring should be run overhead (preferred) or in a separate trench. If these lines are not in threaded metallic or threaded PVC-coated metallic, abiding by the separation requirements noted above is necessary.
- Though not recommended, if cable trays are used, *metallic* dividers must be used for separation of conductors of unlike voltages and types (AC or DC).

## NOTICE

When in doubt contact the factory or use threaded metallic or threaded PVC coated metallic conduit.

### WIRING PRACTICES

Do not mix wires of different voltages in the same conduit. An example of this would be the installation of a screw compressor package where the motor voltage is 480 volts and the electronic control panel power is 120 volts. The 480 volt circuit must be run from the motor starter to the motor in its own conduit. The 120 volt circuit must be run from the motor starter control transformer to the electronic control panel in its own separate conduit. If the two circuits are run in the same conduit, transients on the 480 volt circuit will be induced onto the 120 volt circuit causing functional problems with the electronic control panel. Metallic dividers must be used in wire way systems (conduit trays) to separate unlike voltages. The same rule applies for 120 volt wires and 220 volt wires. Also, never run low voltage wires for DC analog devices or serial communications in the same conduit with any AC wiring including 120 volt wires. See Figure below.

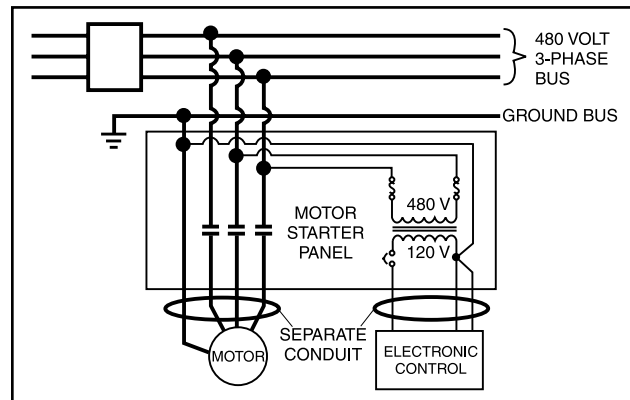


Figure 44. Separation Of Different Voltage Circuits

**Never run any wires through an electronic control panel that do not relate to the function of the panel.** Electronic control panels should never be used as a junction box. These wires may be carrying large transients that will interfere with the operation of the control panel. **An extreme example of this would be to run 480 volts from the starter through the electronic control panel to an oil pump motor.**

When running conduit to the electronic control panel, use the access holes (knockouts) provided by the manufacturer. These holes are strategically placed so that the field wiring does not interfere with the electronics in the panel. Never allow field wiring to come in close proximity with the controller boards since this will almost always cause problems.

Do not drill into an electronic control panel to locate conduit connections. You are probably not entering the panel where the manufacturer would like you to since most manufacturers recommend or provide prepunched conduit connections. You may also be negating the NEMA rating of the enclosure. Drilling can cause metal filings to land on the electronics and create a short circuit when powered is applied. If you must drill the panel, take the following precautions:

- First, call the panel manufacturer before drilling into the panel to be sure you are entering the panel at the right place.
- Take measures to avoid ESD (electrostatic discharge) to the electronics as you prep the inside of the Electronic control panel. This can be done by employing an antistatic wrist band and mat connected to ground.
- Cover the electronics with plastic and secure it with masking or electrical tape.
- Place masking tape or duct tape on the inside of the panel where you are going to drill. The tape will catch most of the filings.
- Clean all of the remaining filings from the panel before removing the protective plastic.

When routing conduit to the top of an electronic control panel, condensation must be taken into consideration. Water can condense in the conduit and run into the panel causing catastrophic failure. Route the conduit to the sides or bottom of the panel and use a conduit drain. If the conduit must be routed to the top of the panel, use a sealable conduit fitting which is poured with a sealer after the wires have been pulled, terminated, and the control functions have been checked. A conduit entering the top of the enclosure must have a NEMA-4 hub type fitting between the conduit and the enclosure so that if water gets on top of the enclosure it cannot run in between the conduit and the enclosure. This is extremely important in outdoor applications.

NOTICE

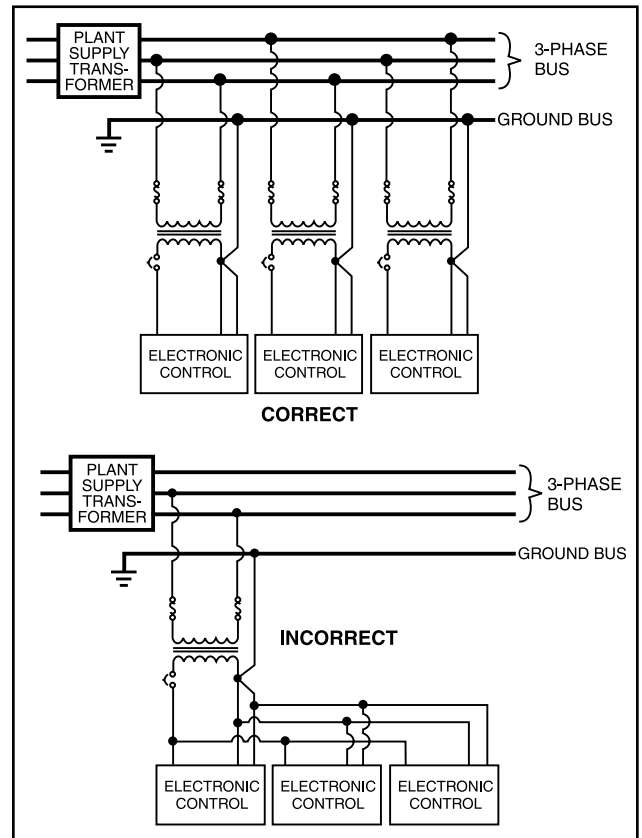
**It is simply NEVER a good practice to enter through the top of an electronic control panel or starter panel that does not already have knockouts provided. If knockouts are not provided for this purpose it is obvious this is not recommended and could VOID WARRANTY.**

**Never add relays, starters, timers, transformers, etc. inside an electronic control panel without first contacting the manufacturer.** Contact arcing and EMI emitted from these devices can interfere with the electronics. Relays and timers are routinely added to electronic control panels by the manufacturer, but the manufacturer knows the acceptable device types and proper placement in the panel that will keep interference to a minimum. If you need to add these devices, contact the manufacturer for the proper device types and placement.

**Never run refrigerant tubing inside an electronic control panel.** If the refrigerant is ammonia, a leak will totally destroy the electronics.

**If the electronic control panel has a starter built into the same panel, be sure to run the higher voltage wires where indicated by the manufacturer.** EMI from the wires can interfere with the electronics if run too close to the circuitry.

**Never daisy-chain or parallel-connect power or ground wires to electronic control panels.** Each electronic control panel must have its own control power supply and ground wires back to the power source (Plant Transformer). Multiple electronic control panels on the same power wires create current surges in the supply wires, which may cause controller malfunctions. Daisy-chaining ground wires, taking them to ground at each device, allows ground loop currents to flow between electronic control panels which also causes malfunctions. See Figure below.



**Figure 45. Electronic Control Panel Power Supplies**



## COMMUNICATIONS

The use of communications such as serial and ethernet in industrial environments are commonplace. The proper installation of these networks is as important to the proper operation of the communications as all of the preceding practices are to the equipment.

Serial communications cable needs to be of the proper gauge based on the total cable distance of the run. Daisy-chaining is the only acceptable style of running the communications cable. While Star Networks may use less cable, they more often than not cause problems and interruptions in communications, due to varying impedances over the varying lengths of cable. Ground or drain wires of the communications cable are to be tied together at each daisy-chain connection and only taken to ground in the central control system panel.

It is important to carefully consider the type of cable to be used. Just because a cable has the proper number of conductors and is shielded does not mean it is an acceptable cable. Johnson Controls-Frick recommends the use of Belden #9829 for RS-422 communications and Belden # 9841 for RS-485 up to 2000 feet (600 Meters) total cable length. Refer to Frick drawing 649D4743 for more detail

**Comm Port Protection:** Surge suppression for the comm ports may not be the best method, since suppression is required to divert excess voltage/current to ground. Therefore, the success of these devices is dependent on a good ground (covered earlier in this section). This excess energy can be quite high and without a proper ground, it will access the port and damage it.

Isolation or Optical Isolation is the preferred comm port protection method. With optical isolation, there is no continuity between the communications cable and the comm port. There is no dependence on the quality of the ground. Be sure to know what the voltage isolation value of the optical isolator is before selecting it. These may range from 500 to 4000 Volts.

Frick® Optical Isolation Kits are offered under part number 639C0133G01. One kit is required per comm port.

## UPS POWER AND QUANTUM™HD PANELS

Johnson Controls, Inc. does not advise nor support the use of uninterrupted power supply systems for use with the Quantum™HD panel. With a UPS system providing shutdown protection for a Frick Quantum panel, the panel may not see the loss of the 3-phase voltage on the motor because the UPS may prevent the motor starter contactor from dropping out. With the starter contactor still energized, the compressor auxiliary will continue to feed an "okay" signal to the Quantum™HD panel. This may allow the motor to be subjected to the fault condition on the 3-phase bus.

A couple of fault scenarios are: 1. The 3-phase bus has power "on" and "off" in a continuous cycle manner which may cause the motor to overheat due to repeated excessive in-rush current experiences. 2. The motor cycling may damage the coupling or cause other mechanical damage due to the repeated high torque from rapid sequential motor "bumps." 3. Prolonged low voltage may cause the motor to stall and possibly overheat before the motor contactor is manually turned off.

Under normal conditions, the loss of 3-phase power will shut down the Quantum™HD panel and it will reboot upon proper power return. If the panel was in "Auto," it will come back and return to running as programmed. If the unit was in "Remote," the external controller will re-initialize the panel and proceed to run as required. If the panel was in "Manual" mode, the compressor will have to be restarted manually after the 3-phase bus fault/interruption has been cleared / restored.

If the local power distribution system is unstable or prone to problems there are other recommendations to satisfy these problems. If power spikes or low or high line voltages are the problem, then a constant voltage (CV) transformer with a noise suppression feature is recommended. Johnson Controls, Inc. can provide these types of transformers for this purpose. Contact Johnson Controls for proper sizing (VA Rating) based on the requirement of the job. If a phase loss occurs, then you will typically get a high motor amp shutdown. If the problem continues, an analysis of the facility's power supply quality may be necessary.

## NOTICE

**It is very important to read the installation instructions thoroughly before beginning the project. Make sure you have drawings and instructions for the equipment being installed. If not, call the manufacturer to receive the proper instructions and drawings. Every manufacturer of electronic equipment should have a knowledgeable staff, willing to answer your questions or provide additional information. Following correct wiring procedures will ensure proper installation and consequently, proper operation of your electronic equipment.**





## RWB II COMPRESSOR PRESTART CHECKLIST

The following items **MUST** be checked and completed by the installer prior to the arrival of the Frick Field Service Supervisor. Details on the checklist can be found in this manual. Certain items on this checklist will be reverified by the Frick Field Service Supervisor prior to the actual start-up.

### Mechanical Checks

- \_\_\_ Confirm that motor disconnect is open
- \_\_\_ Isolate suction pressure transducer
- \_\_\_ Pressure test and leak check unit
- \_\_\_ Evacuate unit
- \_\_\_ Remove compressor drive coupling guard
- \_\_\_ Remove coupling center and **DO NOT reinstall** (motor rotation must be checked without center)
- \_\_\_ Check for correct position of all hand, stop, and check valves **PRIOR** to charging unit with **OIL** or **REFRIGERANT**
- \_\_\_ Charge unit with correct type and quantity of oil
- \_\_\_ Lubricate electric drive motor bearings **PRIOR** to checking motor rotation
- \_\_\_ Check oil pump alignment (if applicable)
- \_\_\_ Check for correct economizer piping (if applicable)
- \_\_\_ Check separate source of liquid refrigerant supply (if applicable, liquid injection oil cooling)
- \_\_\_ Check water supply for water-cooled oil cooler (if applicable, water cooled oil cooling)
- \_\_\_ Check thermosyphon receiver refrigerant level (if applicable, thermosyphon oil cooling)
- \_\_\_ Check for **PROPER PIPE SUPPORTS** and correct foundation
- \_\_\_ Check to ensure **ALL** piping **INCLUDING RELIEF VALVES** is completed

### Electrical Checks

- \_\_\_ Confirm that main disconnect to motor starter and micro is open
- \_\_\_ Confirm that electrical contractor has seen this sheet, **ALL PERTINENT WIRING** information, and drawings
- \_\_\_ Confirm proper power supply to the starter package
- \_\_\_ Confirm proper motor protection (breaker sizing)
- \_\_\_ Confirm that all wiring used is stranded copper and is 14 AWG or larger (sized properly)
- \_\_\_ Confirm all 120 volt control wiring is run in a separate conduit from all high voltage wiring
- \_\_\_ Confirm all 120 volt control wiring is run in a separate conduit from oil pump and compressor motor wiring
- \_\_\_ Confirm no high voltage wiring enters the micro panel at any point
- \_\_\_ Check current transformer for correct sizing and installation
- \_\_\_ Check all point-to-point wiring between the micro and motor starter
- \_\_\_ Confirm all interconnections between micro, motor starter, and the system are made and are correct
- \_\_\_ Ensure all electrical panels are free from installation debris, **METAL PARTICLES**, and moisture

### After the above items have been checked and verified:

- \_\_\_ Close the main disconnect from the main power supply to the motor starter
- \_\_\_ Close the motor starter disconnect to energize the micro
- \_\_\_ Manually energize oil pump and check oil pump motor rotation
- \_\_\_ Manually energize compressor drive motor and check motor rotation
- \_\_\_ Leave micro energized to ensure oil heaters are on and oil temperature is correct for start-up

**Summary: The Frick Field Service Supervisor should arrive to find the above items completed. He should find an uncoupled compressor drive unit (to verify motor rotation and alignment) and energized oil heaters with the oil at the proper standby temperatures. Full compliance with the above items will contribute to a quick, efficient and smooth start-up.**

### The Start-up Supervisor will:

1. Verify position of all valves
2. Verify all wiring connections
3. Verify compressor motor rotation
4. Verify oil pump motor rotation
5. Verify the % of FLA on the micro display
6. Verify and finalize alignment (if applicable)
7. Calibrate slide valve and slide stop
8. Calibrate temperature and pressure readings
9. Correct any problem in the package
10. Instruct operation personnel

**NOTE: Customer connections are to be made per the electrical diagram for the motor starter listed under the installation section and per the wiring diagram in the Quantum maintenance manual.**

**Please complete and sign this form & fax to 717-762-8624 as confirmation of completion.**

Frick Sales Order Number: \_\_\_\_\_  
Compressor Model Number: \_\_\_\_\_  
Unit Serial Number: \_\_\_\_\_  
End User Name: \_\_\_\_\_  
Address of Facility: \_\_\_\_\_  
City, State, Zip: \_\_\_\_\_

Print Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Job Site Contact: \_\_\_\_\_  
Contact Phone Number: \_\_\_\_\_  
Signed: \_\_\_\_\_

## Start-up Report

Frick Order No: \_\_\_\_\_

Sold To: \_\_\_\_\_ Contact Name: \_\_\_\_\_ Date: \_\_\_\_\_  
 End User: \_\_\_\_\_ Contact Name: \_\_\_\_\_ Phone: \_\_\_\_\_  
 End User Address: \_\_\_\_\_ Fax No: \_\_\_\_\_  
 City, State, Zip: \_\_\_\_\_ Start-up Representative \_\_\_\_\_

### Unit General Information

Unit Model # \_\_\_\_\_ Customer Package Identification # \_\_\_\_\_  
 Compressor Serial # \_\_\_\_\_ Separator National Board # \_\_\_\_\_  
 Unit Serial # \_\_\_\_\_ Oil Cooler National Board # \_\_\_\_\_  
 Evaporator National Board # \_\_\_\_\_ Serial # \_\_\_\_\_ Condenser National Board # \_\_\_\_\_ Serial # \_\_\_\_\_  
 Oil Pot National Board # \_\_\_\_\_ H.P. Receiver National Board # \_\_\_\_\_  
 Economizer National Board # \_\_\_\_\_ Suction Accumulator National Board # \_\_\_\_\_  
 Refrigerant \_\_\_\_\_ Oil Filters \_\_\_\_\_ Lube Oil Type \_\_\_\_\_ Design Operating Conditions \_\_\_\_\_  
 Oil Cooling \_\_\_\_\_ ° Suct. / \_\_\_\_\_ ° Disch.

### Micro Information

Micro Type \_\_\_\_\_ Program Software Ver # \_\_\_\_\_ and Date \_\_\_\_\_ UL Serial # \_\_\_\_\_  
 Digital I/O Board #1 Serial # \_\_\_\_\_ Software Ver # \_\_\_\_\_ and Date \_\_\_\_\_  
 Digital I/O Board #2 Serial # \_\_\_\_\_ Software Ver # \_\_\_\_\_ and Date \_\_\_\_\_  
 Analog Board #1 Serial # \_\_\_\_\_ Software Ver # \_\_\_\_\_ and Date \_\_\_\_\_  
 Analog Board #2 Serial # \_\_\_\_\_ Software Ver # \_\_\_\_\_ and Date \_\_\_\_\_

### Compressor Motor Starter / Drive Information

Manufacturer \_\_\_\_\_ Part # \_\_\_\_\_ Model # \_\_\_\_\_  
 Starter Type \_\_\_\_\_ Serial # \_\_\_\_\_  
 Input Voltage \_\_\_\_\_ Voltage Range \_\_\_\_\_ Phase \_\_\_\_\_ Hz \_\_\_\_\_ Current \_\_\_\_\_  
 Output Voltage \_\_\_\_\_ Phase \_\_\_\_\_ Hz \_\_\_\_\_ Max FLA \_\_\_\_\_ Max LRA \_\_\_\_\_ Min Load FLA \_\_\_\_\_ Job FLA \_\_\_\_\_  
 Logic Board Serial # \_\_\_\_\_ U33 Prog. Ver. \_\_\_\_\_ Date \_\_\_\_\_ P/N \_\_\_\_\_  
 U34 Prog. Ver. \_\_\_\_\_ Date \_\_\_\_\_ P/N \_\_\_\_\_  
 U45 Prog. Ver. \_\_\_\_\_ Date \_\_\_\_\_ P/N \_\_\_\_\_  
 Harmonic Filter Serial # \_\_\_\_\_ Prog. Ver. \_\_\_\_\_ Date \_\_\_\_\_ P/N \_\_\_\_\_  
 Frick Interface Serial # \_\_\_\_\_ Prog. Ver. \_\_\_\_\_ Date \_\_\_\_\_ P/N \_\_\_\_\_  
 CT Location Checked  CT Phase \_\_\_\_\_ CT Ratio \_\_\_\_\_ Transition Time \_\_\_\_\_ DBS Ver.# \_\_\_\_\_

### Oil Pump Information

Pump Mfg. \_\_\_\_\_ Model # \_\_\_\_\_ Serial # \_\_\_\_\_ Motor Mfg. \_\_\_\_\_ H.P. \_\_\_\_\_  
 Motor RPM \_\_\_\_\_ Service Factor \_\_\_\_\_ Volt \_\_\_\_\_ HZ \_\_\_\_\_ FLA \_\_\_\_\_ Design \_\_\_\_\_ Code \_\_\_\_\_ Starter Size \_\_\_\_\_

### Cooling Fan Information

Motor HP \_\_\_\_\_ RPM \_\_\_\_\_ Service Factor \_\_\_\_\_ Volt \_\_\_\_\_ Hz \_\_\_\_\_ FLA \_\_\_\_\_ Cooling Fans \_\_\_\_\_

### Special Options

\_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_

### Prestart Checks

- |                                                                                                                     |                                                             |                                                       |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------------------|
| <input type="checkbox"/> Installation, Foundation                                                                   | <input type="checkbox"/> Compressor PHD Setup               | <input type="checkbox"/> Coolant Installed            |
| <input type="checkbox"/> Position of all valves                                                                     | <input type="checkbox"/> Motor PHD Setup                    | <input type="checkbox"/> 4-20 Coolant Loop Pump Setup |
| <input type="checkbox"/> Proper oil charge                                                                          | <input type="checkbox"/> Motor Winding RTD's Setup          | <input type="checkbox"/> Coolant Loop Temp Setup      |
| <input type="checkbox"/> All wiring connections                                                                     | <input type="checkbox"/> Motor Bearing RTD's Setup          | <input type="checkbox"/> Cooling Fan Motor I/O Setup  |
| <input type="checkbox"/> Starter Cleanliness                                                                        | <input type="checkbox"/> Motor Temperature Thermistor Setup | <input type="checkbox"/> Cooling Fan Rotation Checked |
| <input type="checkbox"/> All micro settings                                                                         | <input type="checkbox"/> 4-20 Motor Drive Signal Calibrated | <input type="checkbox"/> Oil pump motor rotation      |
| <input type="checkbox"/> 4-20 CT Channel 16 Setup                                                                   | <input type="checkbox"/> Cold alignment                     | <input type="checkbox"/> Motor rotation               |
| <input type="checkbox"/> 4-20 Output Calibration - Liquid Makeup Valve, Coolant Temp Valve, Economizer Makeup Valve |                                                             |                                                       |

### Configuration

| Capacity                | Channel | Direction | Package                          |
|-------------------------|---------|-----------|----------------------------------|
| Mode 1 _____            | _____   | _____     | Compressor _____                 |
| Mode 2 _____            | _____   | _____     | Pump _____                       |
| Mode 3 _____            | _____   | _____     | Dual Pump _____                  |
| Mode 4 _____            | _____   | _____     | Drive _____                      |
| VFD Hi & Low PI Control | _____   | _____     | Refrigerant _____ K-Factor _____ |
| Miscellaneous           | _____   | _____     | Filter _____                     |
| Sequencing _____        | _____   | _____     | PowerPac _____                   |
| Condenser _____         | _____   | _____     |                                  |
| Screen Saver _____      | _____   | _____     |                                  |



Page 2 Unit Serial # \_\_\_\_\_ Frick Order No: \_\_\_\_\_

| Mode _____ Capacity Control Setpoints |           |                          |  | Mode _____                |           |                          |  |
|---------------------------------------|-----------|--------------------------|--|---------------------------|-----------|--------------------------|--|
| Setpoint _____                        |           | Regulation Safeties      |  | Setpoint _____            |           | Regulation Safeties      |  |
| High                                  | Low       | Load Inhibit _____       |  | High                      | Low       | Load Inhibit _____       |  |
| Prop. Band _____                      |           | Force Unload _____       |  | Prop. Band _____          |           | Force Unload _____       |  |
| Dead Band _____                       |           | Warning _____            |  | Dead Band _____           |           | Warning _____            |  |
| Cycle Time _____ Sec                  | _____ Sec | Warning Delay _____ Sec  |  | Cycle Time _____ Sec      | _____ Sec | Warning Delay _____ Sec  |  |
| VFD Prop Band _____                   |           | Shutdown _____           |  | VFD Prop Band _____       |           | Shutdown _____           |  |
| VFD Integ. Time _____ Sec             | _____ Sec | Shutdown Delay _____ Sec |  | VFD Integ. Time _____ Sec | _____ Sec | Shutdown Delay _____ Sec |  |
| Channel _____                         |           |                          |  | Channel _____             |           |                          |  |
| Auto Cycle _____                      |           | Low Suction _____        |  | Auto Cycle _____          |           | Low Suction _____        |  |
| Start _____                           |           | Load Inhibit _____       |  | Start _____               |           | Load Inhibit _____       |  |
| Start Delay _____ Min                 |           | Force Unload _____       |  | Start Delay _____ Min     |           | Force Unload _____       |  |
| Stop _____                            |           | Warning _____            |  | Stop _____                |           | Warning _____            |  |
| Stop Delay _____ Min                  |           | Warning Delay _____ Sec  |  | Stop Delay _____ Min      |           | Warning Delay _____ Sec  |  |
|                                       |           | Shutdown _____           |  |                           |           | Shutdown _____           |  |
|                                       |           | Shutdown Delay _____ Sec |  |                           |           | Shutdown Delay _____ Sec |  |

| Compressor Safeties                        |                   |                                                  |  |
|--------------------------------------------|-------------------|--------------------------------------------------|--|
| <b>High Discharge Temperature</b>          |                   | <b>High Suction Pressure</b>                     |  |
| Load Inhibit _____                         |                   | Load Inhibit _____ PSIG                          |  |
| Force Unload _____                         |                   | Force Unload _____ PSIG                          |  |
| Warning _____                              |                   | Warning _____ PSIG                               |  |
| Warning Delay _____ Sec                    |                   | Warning Delay _____ Sec                          |  |
| Shutdown _____                             |                   | Shutdown _____ PSIG                              |  |
| Shutdown Delay _____ Sec                   |                   | Shutdown Delay _____ Sec                         |  |
| High Discharge Pressure _____              |                   | Economizer _____                                 |  |
| Regulation Modes 1 & 3 _____               | Modes 2 & 4 _____ | On When Above _____ %                            |  |
| Load Inhibit _____ PSIG                    | _____ PSIG        | Off When Below _____ %                           |  |
| Force Unload _____ PSIG                    | _____ PSIG        | Override Discharge Pressure _____                |  |
| Warning _____ PSIG                         | _____ PSIG        | Port Value _____                                 |  |
| Warning Delay _____ Sec                    | _____ Sec         | Pressure Input _____                             |  |
| Shutdown _____ PSIG                        | _____ PSIG        | Fixed Pressure Setpoint _____                    |  |
| Shutdown Delay _____ Sec                   | _____ Sec         |                                                  |  |
| Maximum Discharge Pressure _____ PSIG      |                   | Balance Piston _____                             |  |
| Highest Cap. To Permit Start _____ %       |                   | On _____ %                                       |  |
| Start Period Before Cap. Increase _____    |                   | Off _____ %                                      |  |
| Stopping Period For Cap. Unload _____      |                   | Ignore Delay _____ Min                           |  |
| Compressor Auto Mode Min. Cap. _____ %     |                   | Fail Delay _____ Min                             |  |
| Capacity Unload Assist. _____ Rate _____ % |                   | Oil Log _____ Delay _____ Sec.                   |  |
| Separator Velocity Ref. _____              |                   |                                                  |  |
| Compression Ratio _____                    |                   |                                                  |  |
| Liquid Slug Warning _____                  |                   | Main Oil Injection On When Discharge Temperature |  |
| Liquid Slug Shutdown _____                 |                   | Is Above _____ °F for _____ Sec                  |  |

| Package Safeties                             |  |                                                  |  |
|----------------------------------------------|--|--------------------------------------------------|--|
| <b>Low Compressor Oil Temperature</b>        |  | <b>Pull Down _____</b>                           |  |
| Warning _____ Delay _____ Sec                |  | Capacity Position _____ %                        |  |
| Shutdown _____ Delay _____ Sec               |  | Amount of Time _____ Sec                         |  |
| <b>High Compressor Oil Temperature</b>       |  | <b>Pump Down _____</b>                           |  |
| Warning _____ Delay _____ Sec                |  | On When Suction Above _____ PSIG Delay _____ Min |  |
| Shutdown _____ Delay _____ Sec               |  | DX Circuit _____                                 |  |
| <b>Low Compressor Oil Pressure</b>           |  | <b>#1 Action _____</b>                           |  |
| Warning _____ PSI Delay _____ Sec            |  | Off When Below _____ %                           |  |
| Shutdown _____ PSI Delay _____ Sec           |  | On When Above _____ %                            |  |
| <b>High Filter Pressure</b>                  |  | <b>#2 Action _____</b>                           |  |
| Warning _____ PSI Delay _____ Min            |  | Off When Below _____ %                           |  |
| Shutdown _____ PSI Delay _____ Min           |  | On When Above _____ %                            |  |
| <b>Main Oil Injection _____</b>              |  | <b>Liquid Injection _____</b>                    |  |
| Shutdown _____ PSI Delay _____ Sec           |  | On When Above _____ Delay _____ Sec              |  |
| Oil Heater Off Above _____                   |  | Dual Port Transition _____                       |  |
| High Level Shutdown Delay _____ Sec          |  |                                                  |  |
| Low Oil Level Delay _____ Sec                |  | Hot Gas Bypass _____ %                           |  |
| Oil Pump Lube Time Before Starting _____ Sec |  | Power Assist _____ Sec                           |  |
| Dual Pump Transition Time _____ Sec          |  |                                                  |  |

Page 3

Unit Serial # \_\_\_\_\_ Frick Order No: \_\_\_\_\_

**Compressor Motor Setpoints and Information**

|                               |                                             |                                                  |                                         |                      |
|-------------------------------|---------------------------------------------|--------------------------------------------------|-----------------------------------------|----------------------|
| <b>Motor Name Plate</b>       |                                             | <b>VFD</b>                                       |                                         | Manufacturer _____   |
| Motor Amps _____              | Volts _____                                 | Maximum Drive Output ____ %                      | Minimum Drive Output ____ %             | Frame Size _____     |
| Service Factor _____          | Horsepower _____                            | Remote Control _____                             | Rate Of Increase _____ % Delay ____ Sec | H.P. _____           |
| CT Factor _____               | Recycle Delay _____ Min                     | Rate Of Decrease _____ % Delay ____ Sec          | Capacity Control _____                  | RPM _____            |
| High Motor Amps _____         | Load Inhibit _____                          | When Slide Valve Reaches _____ %                 | Drive Speed Reaches _____ %             | Serial # _____       |
| Force Unload _____            | Warning _____ Delay ____ Sec                | Variable Speed Min. Slide Valve Position _____ % | Skip Frequency Bands                    | Service Factor _____ |
| Shutdown _____ Delay ____ Sec | Low Motor Amps                              | Bottom _____                                     | Top _____                               | Voltage _____        |
|                               | Shut Down _____ Delay ____ Sec              |                                                  |                                         | Hz _____             |
|                               | Confirmed Running Motor Amps _____          |                                                  |                                         | Design _____         |
|                               | Starting Motor Amps Ignore Period _____ Sec |                                                  |                                         | Code _____           |
|                               |                                             |                                                  |                                         | Bearing Type _____   |
|                               |                                             |                                                  |                                         | Motor Coupling _____ |

**Vyper Coolant Setpoints**

Vyper Standby Time \_\_\_\_\_ Vyper Coolant Low Temp. Alarm \_\_\_\_\_ Delay \_\_\_\_\_ Shutdown \_\_\_\_\_ Delay \_\_\_\_\_  
High Temp. Alarm \_\_\_\_\_ Delay \_\_\_\_\_ Shutdown \_\_\_\_\_ Delay \_\_\_\_\_

**PHD Monitoring Setpoints**

**Compressor Bearing** \_\_\_\_\_

|                                  |              |                                  |              |
|----------------------------------|--------------|----------------------------------|--------------|
| <b>Suction End</b>               | <b>Delay</b> | <b>Discharge End</b>             | <b>Delay</b> |
| High Warning _____ gF _____ Sec  |              | High Warning _____ gF _____ Sec  |              |
| High Shutdown _____ gF _____ Sec |              | High Shutdown _____ gF _____ Sec |              |

Motor Bearing \_\_\_\_\_

|                                 |              |                                 |              |
|---------------------------------|--------------|---------------------------------|--------------|
| <b>Shaft Side</b>               | <b>Delay</b> | <b>Opposite Shaft Side</b>      | <b>Delay</b> |
| High Warning _____ F _____ Sec  |              | High Warning _____ F _____ Sec  |              |
| High Shutdown _____ F _____ Sec |              | High Shutdown _____ F _____ Sec |              |

Motor Stator \_\_\_\_\_

|                                 |              |                                 |              |
|---------------------------------|--------------|---------------------------------|--------------|
| <b>Stator 1</b>                 | <b>Delay</b> | <b>Stator 2</b>                 | <b>Delay</b> |
| High Warning _____ F _____ Sec  |              | High Warning _____ F _____ Sec  |              |
| High Shutdown _____ F _____ Sec |              | High Shutdown _____ F _____ Sec |              |

|                                 |              |
|---------------------------------|--------------|
| <b>Stator 3</b>                 | <b>Delay</b> |
| High Warning _____ F _____ Sec  |              |
| High Shutdown _____ F _____ Sec |              |

**Condenser Control**

**Condenser Control Setpoint** \_\_\_\_\_

|                         |                   |
|-------------------------|-------------------|
| <b>Digital Controls</b> | <b>Step Order</b> |
| Module A _____          | _____             |
| Module B _____          | _____             |
| Module C _____          | _____             |
| Module D _____          | _____             |

Step Up Dead Band \_\_\_\_\_ PSI  
Step Up Delay \_\_\_\_\_ Sec  
Step Down Dead Band \_\_\_\_\_ PSI  
Step Down Delay \_\_\_\_\_ Sec  
High Pressure Override \_\_\_\_\_ PSI  
High Pressure Override Delay \_\_\_\_\_ Sec

Analog Controls Analog Output A \_\_\_\_\_  
Analog Output B \_\_\_\_\_  
Proportional Band \_\_\_\_\_ PSI  
Integration Time \_\_\_\_\_ Sec  
High Limit \_\_\_\_\_ PSI  
Low Limit \_\_\_\_\_ Sec

**Miscellaneous**

Remote Capacity Deadband \_\_\_\_\_ % Max Slide Valve Timer \_\_\_\_\_ 1/10 Sec  
High Compressor Oil Pressure \_\_\_\_\_ PSI Max Discharge Pressure \_\_\_\_\_ PSI  
Shutdown \_\_\_\_\_ PSI Delay \_\_\_\_ Sec Max Discharge and Oil Temp \_\_\_\_\_ °F

**P&ID Setpoints**

|                |       |       |       |       |
|----------------|-------|-------|-------|-------|
| Name           | _____ | _____ | _____ | _____ |
| Control        | _____ | _____ | _____ | _____ |
| Action         | _____ | _____ | _____ | _____ |
| Control Point  | _____ | _____ | _____ | _____ |
| Device Source  | _____ | _____ | _____ | _____ |
| Device Channel | _____ | _____ | _____ | _____ |
| Setpoint       | _____ | _____ | _____ | _____ |
| Dead Band      | _____ | _____ | _____ | _____ |
| Prop. Band     | _____ | _____ | _____ | _____ |
| Integral Gain  | _____ | _____ | _____ | _____ |

Page 4 Unit Serial # \_\_\_\_\_ Frick Order No: \_\_\_\_\_

**Communications**

Compressor ID \_\_\_\_\_

**Comm 1**

Baud Rate \_\_\_\_\_  
Data Bits \_\_\_\_\_  
Stop Bits \_\_\_\_\_  
Parity \_\_\_\_\_  
RS 485 Connection \_\_\_\_\_  
Protocol \_\_\_\_\_

**Comm 2**

Baud Rate \_\_\_\_\_  
Data Bits \_\_\_\_\_  
Stop Bits \_\_\_\_\_  
Parity \_\_\_\_\_  
RS 485 Connection \_\_\_\_\_  
Protocol \_\_\_\_\_

**Comm 3**

Baud Rate \_\_\_\_\_  
Data Bits \_\_\_\_\_  
Stop Bits \_\_\_\_\_  
Parity \_\_\_\_\_  
RS 485 Connection \_\_\_\_\_  
Protocol \_\_\_\_\_

Use Map File \_\_\_\_\_

**Ethernet**

**IP Data**

Address Type \_\_\_\_\_  
IP Address \_\_\_\_\_  
Gateway Address \_\_\_\_\_  
Subnet Mask \_\_\_\_\_  
Web Server Port \_\_\_\_\_

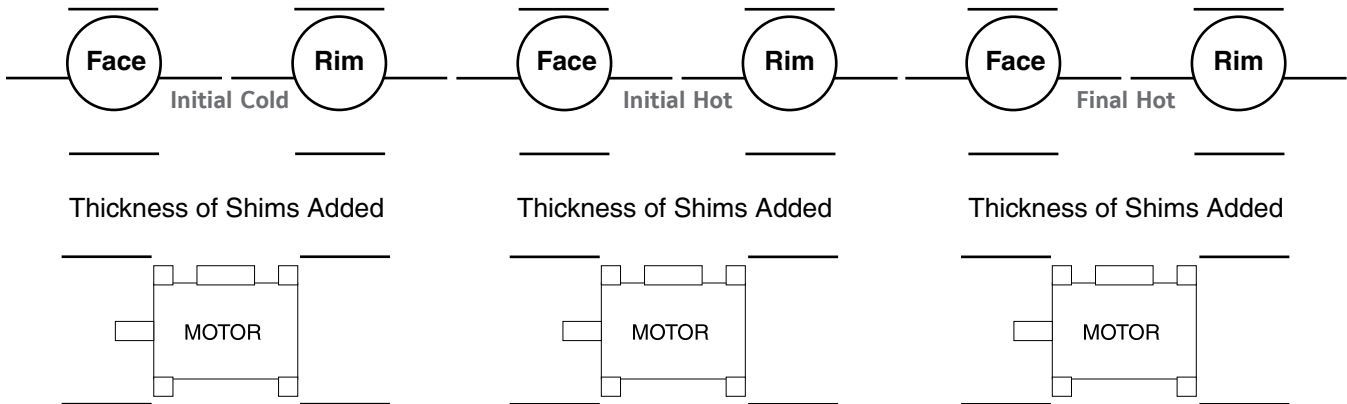
**Naming Data**

Host Name \_\_\_\_\_  
Work Group \_\_\_\_\_  
Comments \_\_\_\_\_

**Protocols**

ModBus TCP \_\_\_\_\_  
Ethernet I/P \_\_\_\_\_  
Profinet \_\_\_\_\_

**Drive Train Alignment**



| Compressor Operating Log Sheet |  |  |  | Starter Operating Log Sheet |  |  |  |
|--------------------------------|--|--|--|-----------------------------|--|--|--|
| Date                           |  |  |  | Average Current             |  |  |  |
| Time                           |  |  |  | Current Phase A             |  |  |  |
| Hour Meter Reading             |  |  |  | Current Phase B             |  |  |  |
| Equip. Room Temp.              |  |  |  | Current Phase C             |  |  |  |
| Suction Pressure               |  |  |  | Full Load Amps              |  |  |  |
| Suction Temperature            |  |  |  | Output Frequency            |  |  |  |
| Suction Superheat              |  |  |  | Output Voltage              |  |  |  |
| Discharge Pressure             |  |  |  | DC Bus Voltage              |  |  |  |
| Discharge Temperature          |  |  |  | Input Power kW              |  |  |  |
| Corresponding Temperature      |  |  |  | Actual Speed                |  |  |  |
| Oil Pressure                   |  |  |  | Speed Command               |  |  |  |
| Oil Temperature                |  |  |  | Ambient Temp F.             |  |  |  |
| Oil Filter Pressure Drop       |  |  |  | Convert Heatsink Temp. F.   |  |  |  |
| Separator Temperature          |  |  |  | Baseplate Temp. F.          |  |  |  |
| Slide Valve Position           |  |  |  | VSD Operating Mode          |  |  |  |
| Volume Ratio (VI)              |  |  |  | Harmonic Filter Present     |  |  |  |
| Motor Amps / FLA %             |  |  |  | Harmonic Filter Mode        |  |  |  |
| Capacity Control Setpoint      |  |  |  | Water Pump Energized        |  |  |  |
| Oil Level                      |  |  |  | Precharge Relay Energized   |  |  |  |
| Oil Added                      |  |  |  | Trigger SCR's Energized     |  |  |  |
| Seal Leakage (Drops/Min.)      |  |  |  | DC Inverter Link Current    |  |  |  |
| Evaporator. EWT F.             |  |  |  | Motor Winding Temp. F.      |  |  |  |
| Evaporator LWT F.              |  |  |  | Humidistat % RH             |  |  |  |
| Condenser EWT F.               |  |  |  | Vyper Coolant Temp. F.      |  |  |  |
| Condenser LWT F.               |  |  |  | Total kWh                   |  |  |  |

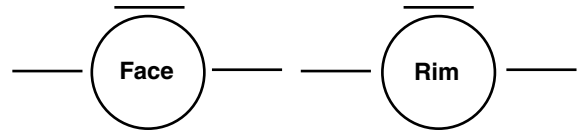
**VIBRATION DATA SHEET**

Date: \_\_\_\_\_  
End User: \_\_\_\_\_  
Address: \_\_\_\_\_

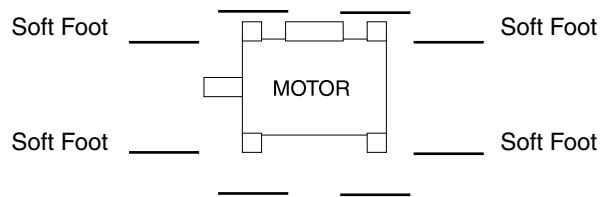
Sales Order Number: \_\_\_\_\_  
Installing Contractor: \_\_\_\_\_  
Service Technician: \_\_\_\_\_

Equipment ID (As in Microlog): \_\_\_\_\_  
Compressor Model Number: \_\_\_\_\_  
Compressor Serial Number: \_\_\_\_\_  
Unit Serial Number: \_\_\_\_\_  
National Board Number: \_\_\_\_\_  
Running Hours: \_\_\_\_\_  
Manufacturer and Size of Coupling: \_\_\_\_\_  
Motor Manufacturer: RAM \_\_\_\_\_  
Motor Serial Number: \_\_\_\_\_  
RPM: \_\_\_\_\_ Frame Size: \_\_\_\_\_ H.P. \_\_\_\_\_  
Refrigerant: \_\_\_\_\_  
Ambient Room Temperature: \_\_\_\_\_ °F  
Operating Conditions: \_\_\_\_\_

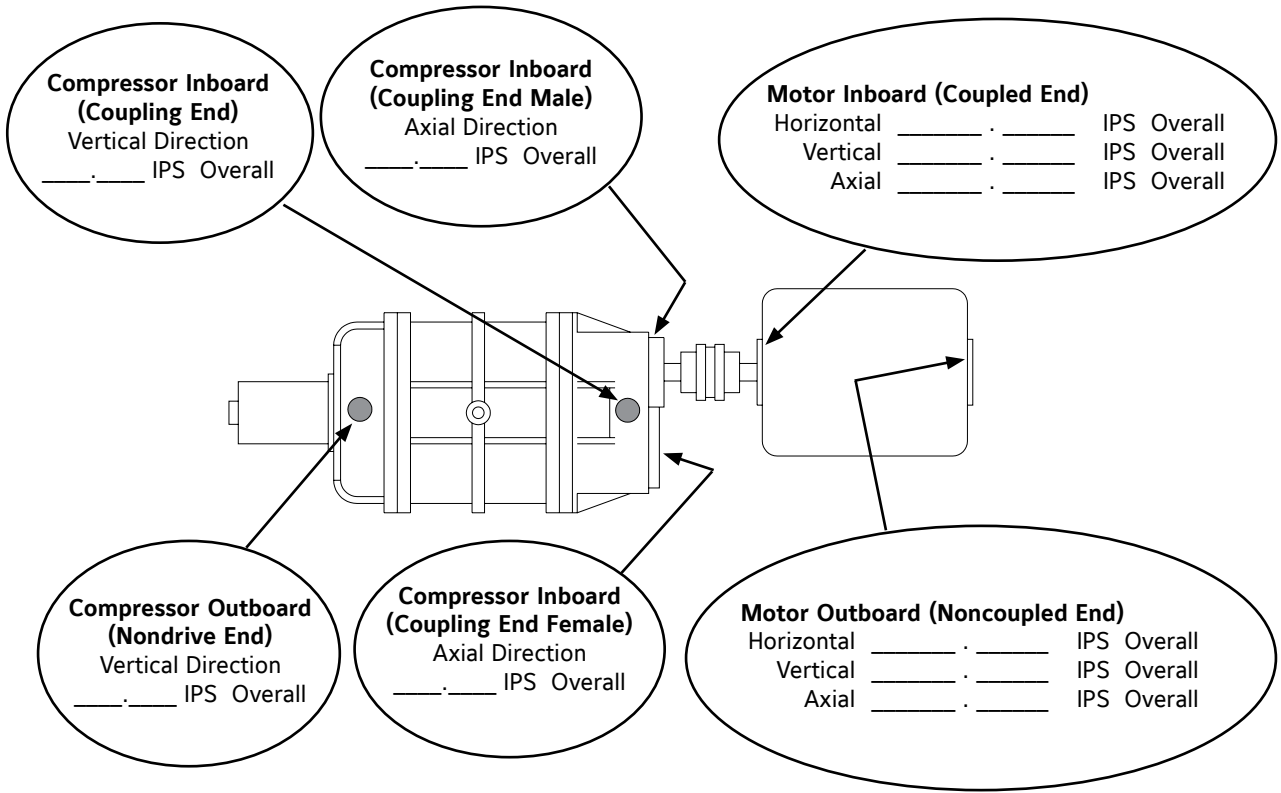
**Final Hot Alignment**



**Total Thickness of Shims Added**



| SUCTION |    | DISCHARGE |    | OIL   |    | SEPARATOR |    | Slide Valve Position | % |
|---------|----|-----------|----|-------|----|-----------|----|----------------------|---|
| Press   | #  | Press     | #  | Press | #  | Temp      | °F | Vi Ratio             |   |
| Temp    | °F | Temp      | °F | Temp  | °F |           |    | F.L.A.               | % |



**November 2014 Form Revisions**

- p.25 - Revised filter element text (6 & 6a); added figures to clarify 2010 change to filter elements
- p.44 - Updated "Proper Installation of Electronic Equipment" to current version and updated Table of Contents to match

**Form 070.210-IOM (2014-11)**  
Supersedes: 070.210-IOM (2013-01)  
Subject to change without notice  
Published in USA • PDF 11/14

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