



S70-200 IOM/MAR 99

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Installation - Operation - Maintenance

RWBII

ROTARY SCREW COMPRESSOR UNITS

ALL REFRIGERANTS

MODELS
60 through 856

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

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‡ - Designates changes or new information on referenced pages. See page and topic for matching symbol.

PREFACE

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

For information about the functions of the electrical control panel, communications, specifications, and wiring diagrams, see S90-010 OM (*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 Company 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

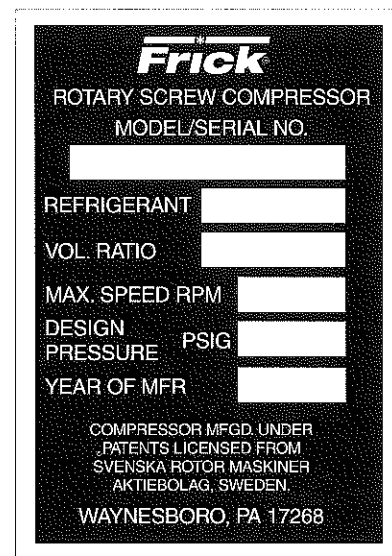
All claims must be made by consignee. This is an ICC requirement. Request immediate inspection by the agent of the carrier and be sure the proper claim forms are executed.

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

COMPRESSOR and UNIT IDENTIFICATION

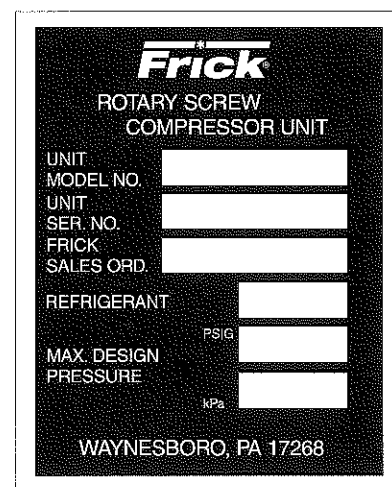
Each compressor unit has 2 identification data plates. The **compressor data plate** containing compressor model and serial number is mounted on the compressor body. The **unit data plate** containing unit model, serial number and Frick sales order number is mounted on the side of the motor base.

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



Frick
ROTARY SCREW COMPRESSOR
MODEL/SERIAL NO. [REDACTED]
REFRIGERANT [REDACTED]
VOL. RATIO [REDACTED]
MAX. SPEED RPM [REDACTED]
DESIGN PRESSURE PSIG [REDACTED]
YEAR OF MFR [REDACTED]
COMPRESSOR MFGD. UNDER PATENTS LICENSED FROM SVENSKA ROTOR MASKINER AKTIEBOLAG, SWEDEN.
WAYNESBORO, PA 17268

COMPRESSOR DATA PLATE



Frick
ROTARY SCREW COMPRESSOR UNIT
UNIT MODEL NO. [REDACTED]
UNIT SER. NO. [REDACTED]
FRICK SALES ORD. [REDACTED]
REFRIGERANT [REDACTED]
MAX. DESIGN PRESSURE PSIG [REDACTED]
[REDACTED] kPa [REDACTED]
WAYNESBORO, PA 17268

UNIT DATA PLATE

RXFUNTDI

FOUNDATION

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



Allow space for servicing both ends of the unit. A minimum of 36 inches 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 Co. 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 HANDLING and MOVING), 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 house-keeping 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.

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

ALLOWABLE FLANGE LOADS						
NOZ. SIZE NPS	MOMENTS (ft-lbf)			LOAD (lbf)		
	AXIAL	VERT.	LAT.	AXIAL	VERT.	LAT.
	M _R	M _C	M _L	P	V _C	V _L
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

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

If the unit is rigged into place the 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.

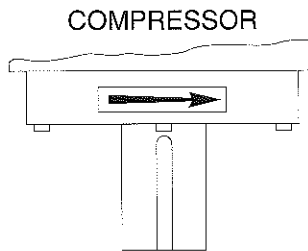
1. Thoroughly clean the motor feet and mounting pads of grease, burrs, and other foreign matter to ensure firm seating of the motor.
2. Attach the motor to the base using the bolts and motor-raising blocks, if required. Bolt snugly through the base.
3. Weld the four kick bolts into place so that they 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 for the applicable dimension (pages 5 and 6).

CHECKING MOTOR/COMPRESSOR ROTATION



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.

CH COUPLING – The T.B. Woods Elastomeric CH Coupling is used in most applications up to 600 HP. It consists of two drive hubs and a loose, gear-type Hytrel Drive Spacer. The split hub is clamped to the shaft by tightening the clamp screws. Torque is transmitted from the motor through the elastomeric gear which floats freely between the hubs. Install as follows:

1. Slide one hub onto each shaft as far as possible. It may be necessary to use a screwdriver as a wedge in the slot to open the bore before the hubs will slide on the shafts.
2. Hold the elastomeric gear between the hubs and slide both hubs onto the gear to fully engage the mating teeth. Center the gear and hub assembly so there is equal engagement on both shafts. Adjust the space between hubs as specified in the CH Coupling Data Table below.

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

4. Proceed to Coupling Alignment.

DBZ-B COUPLING – The Thomas DBZ-B coupling is used on applications above 600 HP and **MUST** be used with all 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.



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.

DBZ-B COUPLING DATA TABLE

DBZ-B COUPLING SIZE	HUB FACE				MAXIMUM TOTAL 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

CH COUPLING DATA TABLE

CH COUPLING SIZE	BETWEEN SHAFT SPACING				COUPLING HUB						MAX TOTAL INDICATOR READING	CLAMP BOLT TORQUE		KEYWAY SETScrew TORQUE		
	MIN*		MAX		SHAFT ENGAGEMENT				FACE SPACING			ft-lb	Nm	ft-lb	Nm	
	in.	mm	in.	mm	MIN	MAX	MIN	MAX	in.	mm						
8	3-13/16	96.8	4-0	101.6	1	25.4	1-13/16	46.0	1-1/8	28.6	.004	.104	35	47.5	13	17.6
9	4-5/16	109.5	5-7/16	138.1	1	25.4	2-3/16	61.9	1-7/16	36.5	.004	.104	35	47.5	13	17.6
10	4-5/16	109.5	6-3/8	161.9	1-1/4	31.8	2-9/16	65.1	1-11/16	42.9	.004	.104	80	108.5	13	17.6
11	4-7/8	123.8	5-7/8	149.2	2	50.8	2-7/8	73.0	1-7/8	47.6	.004	.104	80	108.5	13	17.6

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 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 found on pages 7 and 8 of this manual, 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.

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 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 found on pages 7 and 8 of this manual, 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.

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	160	40	54	41	56
BP53	5.88	170	60	81	65	88
BP63	7.00	170	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				CLAMP BOLT TORQUE (LUBE)	
	SPACING		+/-		ANGULAR		PARALLEL		ft-lb	Nm
	in.	mm	in.	mm	in.	mm	in.	mm		
225	5	127.0	1/32	.914	.004	.102	.004	.102	25	34.0
262	5	127.0	1/32	.914	.004	.102	.004	.102	30	40.7
312	5 1/2	139.7	3/64	1.295	.004	.102	.004	.102	40	54.2
350	6	152.4	3/64	1.295	.004	.102	.004	.102	95	128.8
375	7	177.8	1/16	1.574	.004	.102	.004	.102	130	176.3
425	7	177.8	1/16	1.574	.004	.102	.004	.102	175	237.3
450	8	203.2	1/16	1.574	.004	.102	.004	.102	200	271.2
500	9	228.6	5/64	2.083	.004	.102	.004	.102	260	352.5

WARNING 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.

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.



WARNING 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 Fig. 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 Fig. 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.

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 Fig. 2.

4. Rotate both coupling hubs together 180° (6 o'clock position), as shown in Fig. 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.

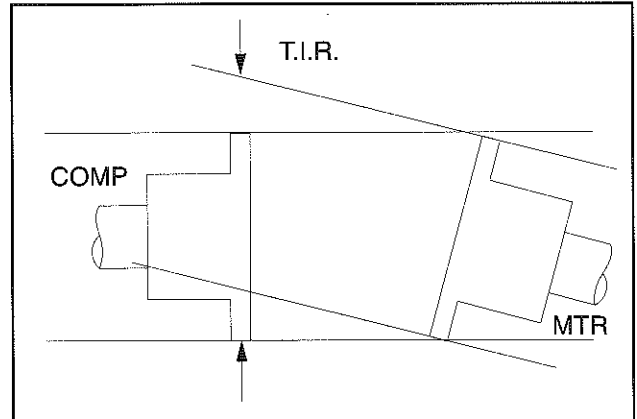


FIG. 1 - ANGULAR MISALIGNMENT

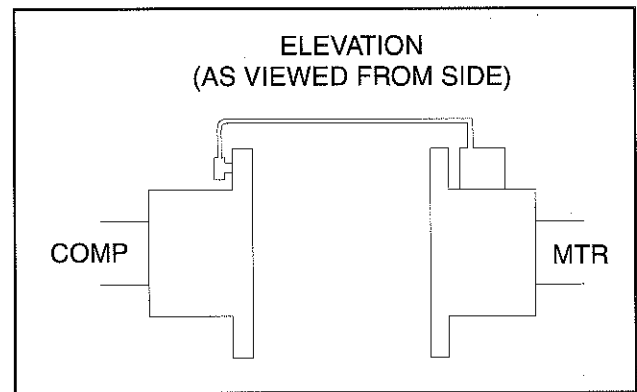


FIG. 2 - DIAL INDICATOR ATTACHED (AT 12 O'CLOCK)

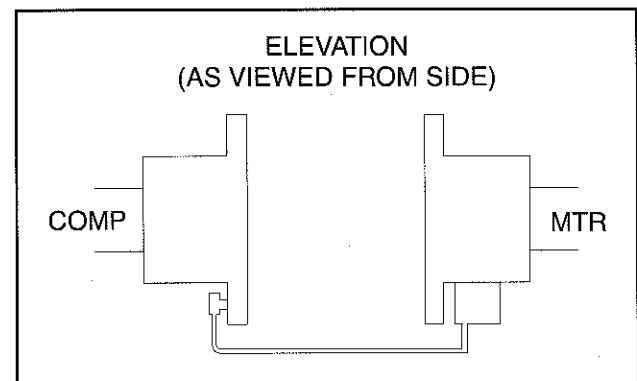


FIG. 3 - DIAL INDICATOR AT 6 O'CLOCK

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.

PARALLEL ALIGNMENT

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

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

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 Fig. 6.

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

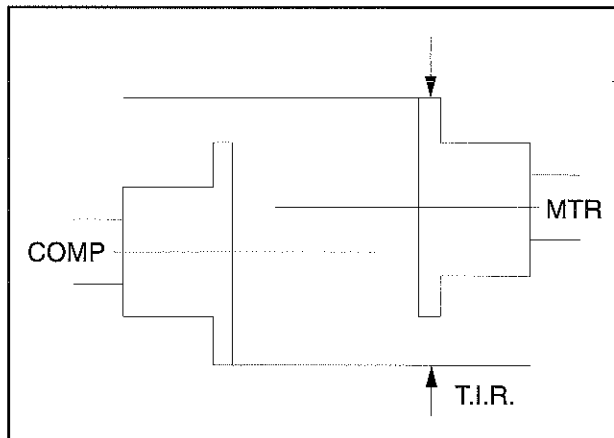


FIG. 4 - PARALLEL MISALIGNMENT

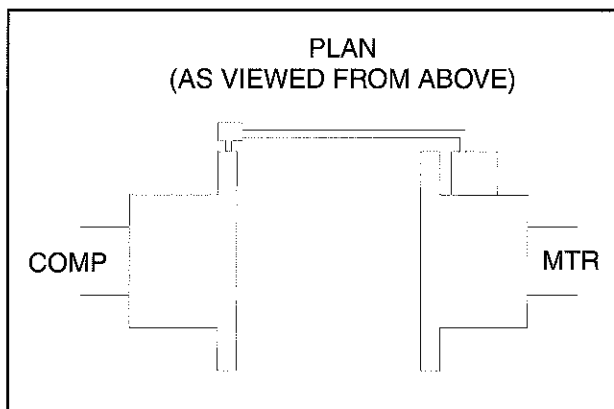


FIG. 5 - DIAL INDICATOR ATTACHED (AT 9 O'CLOCK)

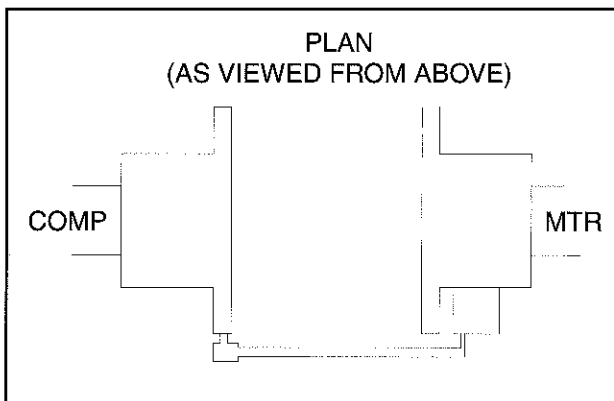


FIG. 6 - DIAL INDICATOR AT 3 O'CLOCK

HOT ALIGNMENT OF COMPRESSOR/MOTOR

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 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 micro-processor.

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.**

CAUTION **Use of oils other than Frick Oil in Frick compressors must be approved in writing by Frick engineering or warranty claim may be denied.**

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.

OIL CHARGE

The normal charging level is midway in the top sight glass located midway along the oil separator shell (**For 496 – 856, sight glass is located in the lower portion of the vertical separator**). Normal operating level is midway between the top sight glass and bottom sight glass. The following table gives the approximate oil charge quantity.

TABLE - BASIC OIL CHARGE (Gal)

RWB II PLUS MODEL	BASIC* CHARGE (gal.)	ADDITIONAL FOR OIL COOLER	
		SIZE (in.)	REQ'D. (gal.)
60	55	6 X 60	6
76	55	8 X 60	10
100	85	6 X 120	12
134	85	8 X 120	20
177	165	10 X 120	28
222	165	12 X 120	39
270	165	16 X 120	45
316	230		
399	230		
480	135		
496	(1)		
676	(1)		
856	(1)		

1.

Oil Sep. Dia.	Basic Oil Charge	
	Vertical	Horiz.
42"	165 gal.	245 gal.
48"	220 gal.	330 gal.
54"	275 gal.	–
60"	385 gal.	–
66"	385 gal.	–
72"	385 gal.	–

* 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.

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 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 Company. The heater(s) is energized only when the unit is not in operation.

WARNING 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 15 AMP FUSE IN THE JUNCTION BOX IS REMOVED.

LIQUID INJECTION OIL COOLING

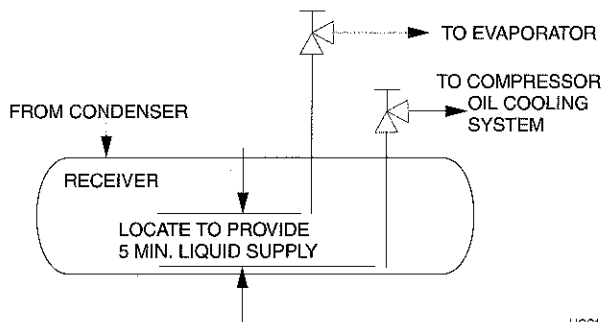
The liquid injection system provided on the unit is self-contained but requires the connection of the liquid line sized as shown in the table and careful insertion of the expansion valve bulb into the thermowell provided in the separator. High pressure gas is connected through the regulator to the external port on the liquid injection valve to control oil temperature. **NOTE: There is NO high pressure gas connection on models 496 – 856. Refer to the liquid injection piping diagram.**

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.

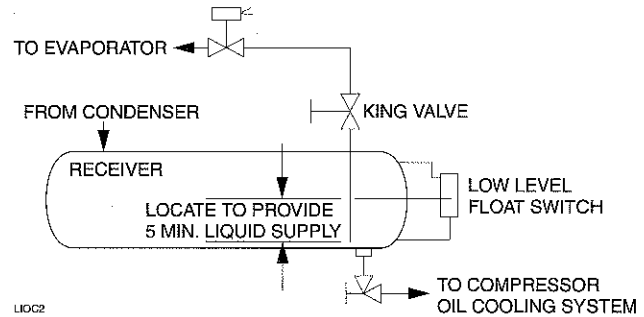
It is **IMPERATIVE** that an uninterrupted supply of high pressure liquid refrigerant be provided to the injection system at all times. Two items of **EXTREME IMPORTANCE** are the design of the receiver/liquid injection supply and the size of the liquid line.

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.

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.



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 PLUS MODEL	LINE SIZE *		POUND PER 5 MIN.	LIQUID VOLUME CU FT
	SCH 80 PIPE	OD TUBING		
R-717 HIGH STAGE *				
60-76	3/4	—	50	1.5
100-134	3/4	—	80	2.0
177-270	1	—	140	4.0
316-480	1-1/4	—	250	7.0
496-676	2	—	420	11.5
856	2	—	650	18.0
R-717 BOOSTER *				
60-76	1/2	—	10	0.5
100-134	1/2	—	20	0.5
177-270	3/4	—	30	1.0
316-480	1	—	40	1.5
496-676	1	—	70	2.0
856	1-1/4	—	125	3.5
R-22 HIGH STAGE *				
60-76	1	1-1/8	170	2.5
100-134	1-1/4	1-1/8	290	4.0
177-270	1-1/2	1-3/8	570	8.0
316-480	2	2-1/2	1050	14.0
496-676	3	2-5/8	1780	25.0
856	3	2-5/8	1960	27.0
R-22 BOOSTER *				
60-76	3/4	5/8	33	0.4
100-134	3/4	7/8	44	0.6
177-270	3/4	7/8	59	0.8
316-480	3/4	7/8	92	1.2
496-676	1-1/4	1-1/8	156	2.2
856	1-1/4	1-1/8	266	3.7

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

WATER-COOLED OIL COOLING (OPTIONAL)

The shell and tube type water-cooled oil cooler is mounted on the unit complete with all oil piping. The customer must supply adequate water connections and install the two-way water regulating valve. It is recommended that (local codes permitting) the water regulator be installed on the water outlet connection. Insert the water regulator valve bulb and well in the chamber provided on the oil outlet connection. Determine the size of the water-cooled oil cooler supplied with the unit, then refer to table for the water connection size and water flow range (GPM). **The water supply must be sufficient to meet the required flow.**

It is imperative that the condition of cooling water and closed loop fluids be analyzed and maintained regularly and as necessary to prevent corrosion of heat exchanger surfaces. The oxygen content of river water and some other cooling water sources will oxidize steel tubes and cause premature failure. Careful attention to water treatment is essential to ensure adequate life of steel cooler tubes if cooling tower water is used. The condition of heat exchanger tubes should be checked semiannually to minimize the potential for leaks.

NOTE: The water regulating valve shipped with the unit will be sized to the specific flow for the unit.

OIL COOLER DATA TABLE

SIZE - Inches		APPROX WATER FLOW RANGE (GPM)
COOLER	WATER CONN	
5 Feet and 10 Feet Lengths		
6"	1-1/2 NPT	22 - 57
6"(1)	1-1/2 NPT	11 - 29
8"	2-1/2 NPT	40 - 108
8"(1)	2-1/2 NPT	20 - 54
10 Feet Length		
10"	3 NPT	70 - 187
12"	4 NPT	100 - 279
16"	5 NPT	180 - 480

1. 4-pass design.

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 to within 15°F of that temperature. 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:

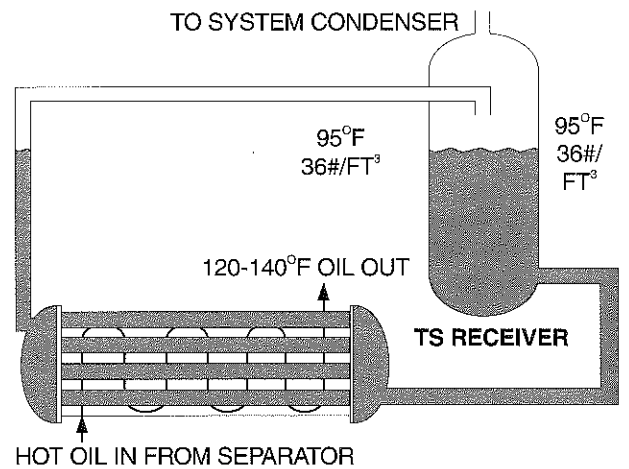
1. A source of liquid refrigerant at condensing pressure and temperature located in close proximity to the unit to minimize piping pressure drop. The liquid level in the refrigerant source must be 6 to 8 feet minimum above the center of the oil cooler.

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.

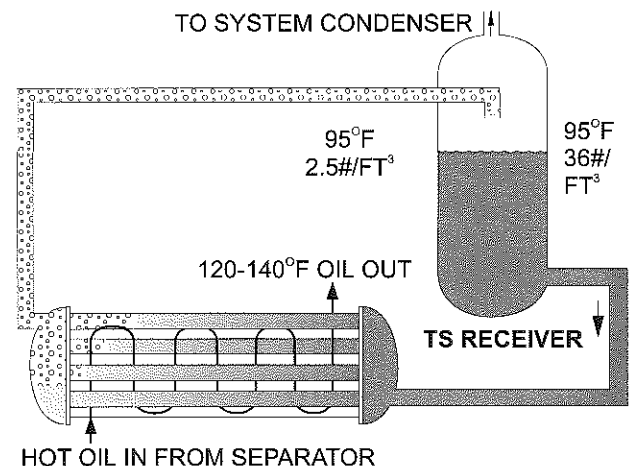


Hot oil (above the liquid temperature) flowing through the cooler will cause some of the refrigerant to boil and vaporize in the tubes. The vapor rises in the return line. The density of the refrigerant liquid/vapor mixture in the return line is considerably less than the density of the liquid in the 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.



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 WOC 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

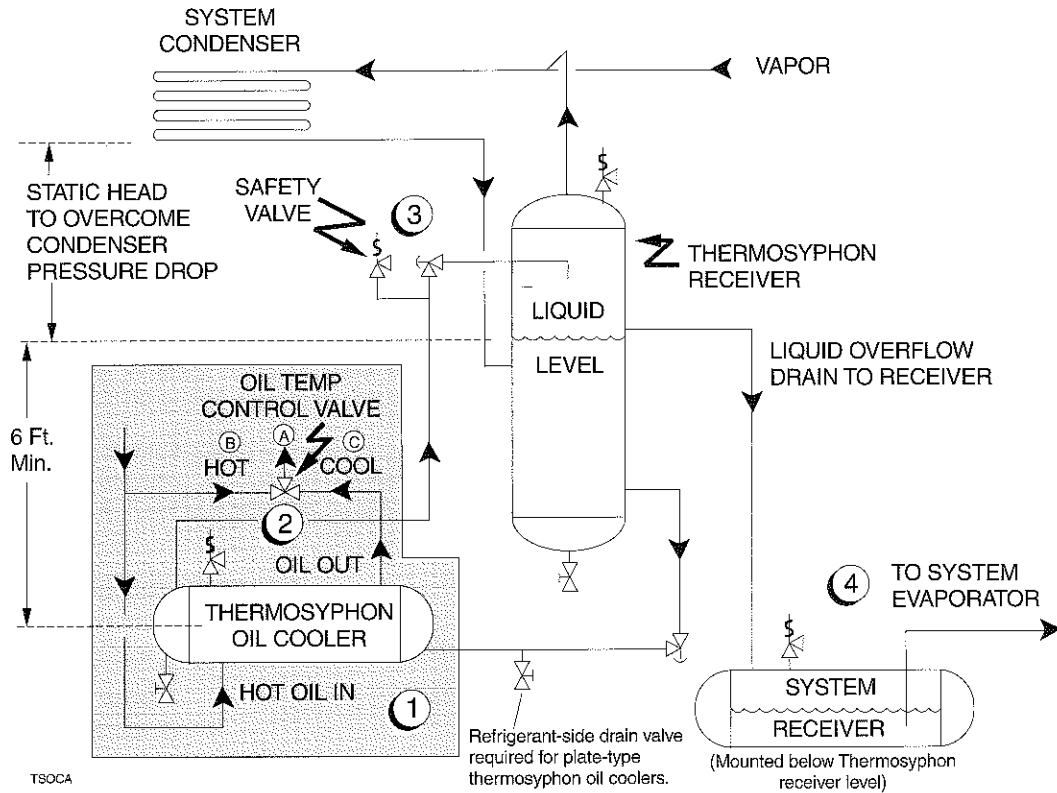
shell side (oil side) safety valve directly into the oil separator, as shown in the P & I diagrams section.

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.

The component and piping arrangement shown below 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 E70-900E for additional information on Thermosyphon Oil Cooling.



1. The thermosyphon oil cooler is supplied with the oil side piped to the compressor unit and stub ends supplied on the 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.

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% capacity (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 assuring 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. 3) 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.



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. 4. 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 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 sole-

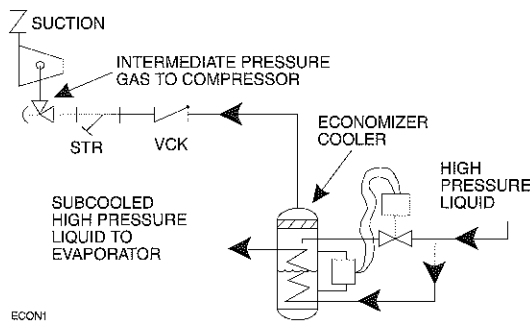


FIG. 1 - SHELL and COIL ECONOMIZER SYSTEM

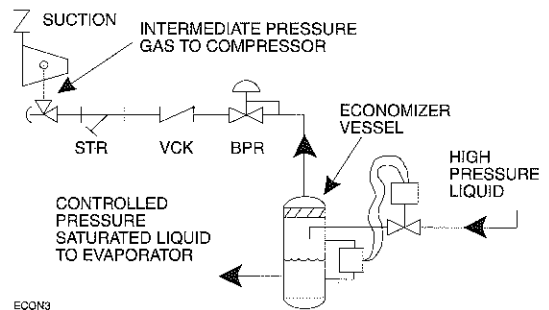


FIG. 3- FLASH ECONOMIZER SYSTEM

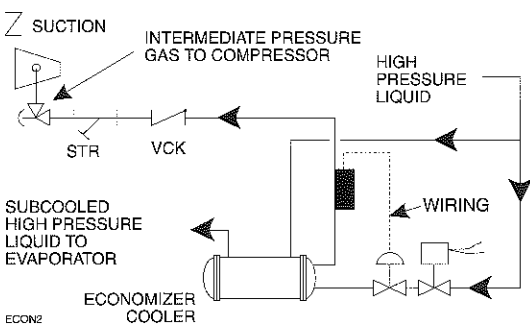


FIG. 2 - DIRECT EXPANSION ECONOMIZER SYSTEM

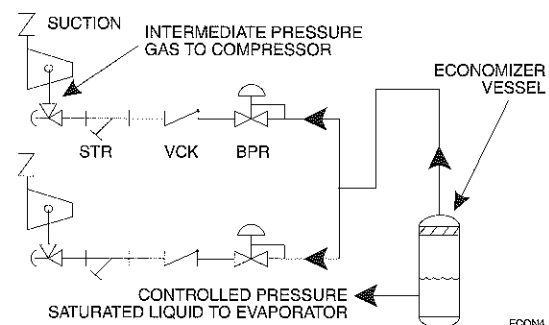


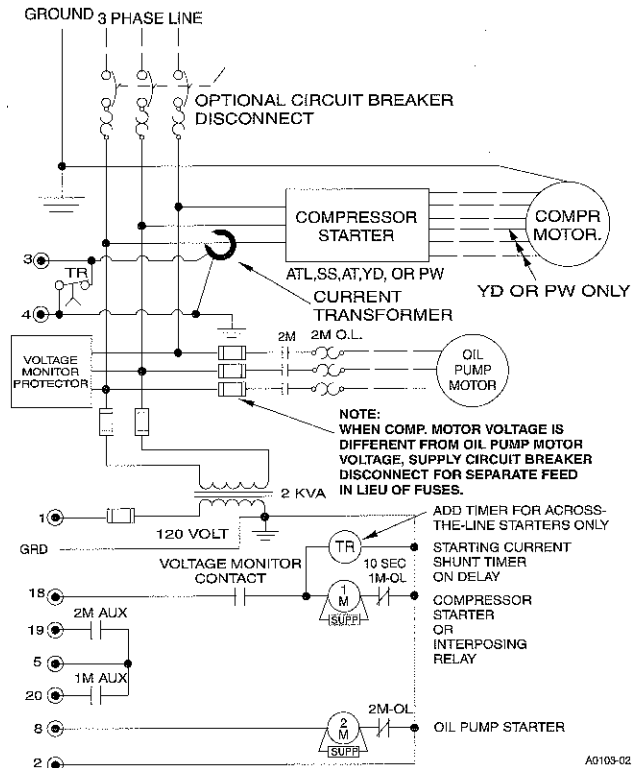
FIG. 4 - MULTIPLE COMPRESSOR ECONOMIZER SYSTEM

noid 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.



NOTE: Customer ground required; see the Micropanel Assembly Wiring Diagram.

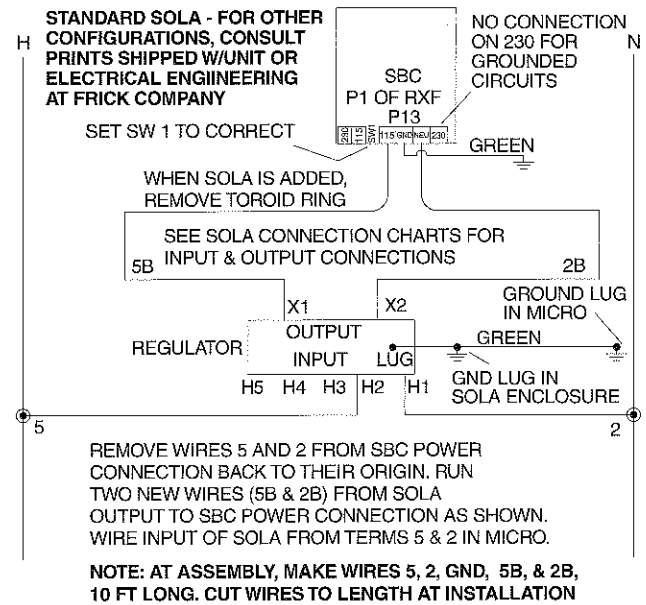
ELECTRICAL

NOTE: Before proceeding with electrical installation, read the instructions for "Proper Installation of Electronic Equipment in an Industrial Environment" on page 48.

RWB II PLUS units are supplied with a SBC (single board computer) microprocessor 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.

RECOMMENDED REGULATOR INSTALLATION



MOTOR STARTER PACKAGE

Motor starter and interlock wiring requirements are shown in the wiring diagram, below left. All the equipment shown is supplied by the installer unless a starter package is purchased from Frick Company. 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 Company 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 Company for assistance.

5. 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.

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
20	100:5	100:5	50:5	50:5	50:5	-	-
25	100:5	100:5	50:5	50:5	50:5	-	-
30	200:5	100:5	100:5	50:5	50:5	-	-
40	200:5	200:5	100:5	100:5	50:5	-	-
50	200:5	200:5	100:5	100:5	100:5	-	-
60	300:5	200:5	200:5	100:5	100:5	-	-
75	300:5	300:5	200:5	200:5	100:5	-	-
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

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		
ANSI	VA	USING # 14 AWG	USING # 12 AWG	USING # 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

6. 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.

In addition to the starter package interlocks shown on the starter package diagram, the following optional interlocks are on the typical RWB II Screw Compressor unit with the SBC Microprocessor Control System wiring diagram:

1. Remote LOAD, UNLOAD, and RUN interlocks in case the customer desire to operate the unit from a remote control device.
2. Alarm Horn output.
3. Control solenoid valve for the economizer option.

For customer control options, consult FRICK Company.

NOTE: The microprocessor will not operate without EPROM chips installed. When EPROM chips are not installed, the microprocessor display will typically indicate two dark lines across both the upper and lower display screens.

BATTERY BACKUP

The battery backup prevents data loss during power interruption. It will maintain the adjustable setpoints stored in RAM (Random Access Memory) for up to 1 year after power loss. Expected battery life is 10 years. A trickle charge maintains the battery backup at peak charge when control voltage is present.

To prevent power loss, the battery backup is shipped disabled. To enable the battery backup, a jumper pin located near the top of the microprocessor circuit board (see illustration in either S90-010 OM (*Quantum* panel) or S70-200 OM (Plus panel) must be moved from OFF (pins 1-2) to ON (pins 2-3).

NOTE: It is not necessary to disconnect the battery backup 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 publication S90-010 OM & 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

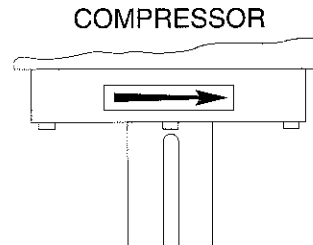
The Frick RWB II rotary screw compressor utilizes mating asymmetrical profile helical rotors to provide a continuous flow of refrigerant vapor and is designed for both high pressure and low pressure applications. The compressor incorporates the following features:

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 10%.
5. VOLUMIZER® volume ratio control to allow infinitely variable volume ratio from 2.2 to 5.0 during compressor operation for all models except 480 which is 2.2 to 4.2.
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.



COMPRESSOR ROTATION IS CLOCKWISE WHEN FACING THE COMPRESSOR DRIVE SHAFT. THE COMPRESSOR SHOULD NEVER BE OPERATED IN REVERSE ROTATION AS BEARING DAMAGE WILL RESULT.



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 pre-lube, 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 differential 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 OM (Quantum) or S70-200 OM (Plus).

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 oil pump has 30 seconds to produce over five pounds of oil pressure above registered discharge pressure or a cutout will occur. **During the start-up sequence models 496 – 856 only, 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 pres-

sure 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 OM (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 of the models 496 – 856 only, 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

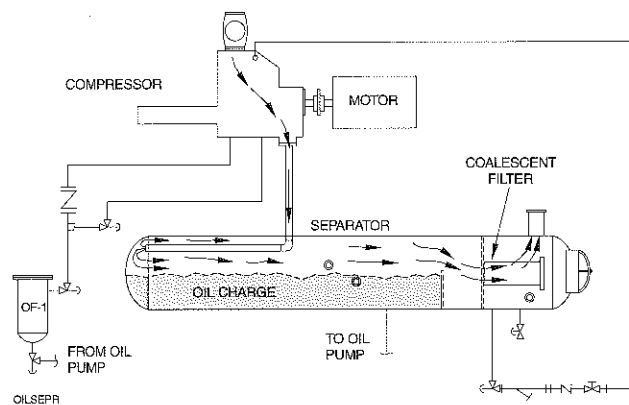
The RWB II is an oil flooded screw compressor. Most of the oil discharged by the compressor separates from the gas flow in the oil charge reservoir. Some oil, however, is discharged as a mist which does not separate readily from the gas flow and is carried past the oil charge reservoir. One or more coalescer 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.

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

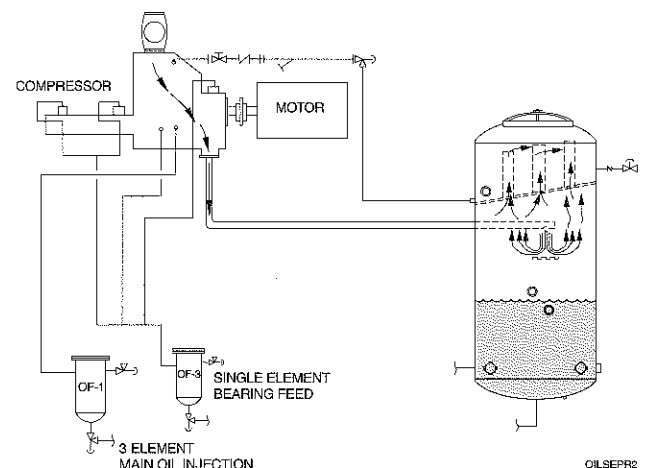
The sight glass located near the bottom of the coalescer section of the oil separator should remain empty during normal operation. If an oil level develops and remains in the sight glass, a problem in the oil return separation system or compressor operation has developed. Refer to Maintenance for information on how to correct the problem.

OIL SEPARATION SYSTEMS

HORIZONTAL, MODELS 60 - 856



VERTICAL, MODELS 496 - 856



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.

Compressor Loading: The compressor loads when MSV solenoid SV2 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.

Compressor Unloading: The compressor unloads when MSV solenoid SV1 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

Models 60 through 270: The volume ratio Vi is increased when MSS solenoid SV3 is energized and oil flows from the oil manifold through valve ports P and A to cylinder port SC-3 and enters the increase side of the cylinder. Simultaneously, oil contained in the decrease side of the cylinder flows out cylinder port SC-4 through valve ports B and T to compressor closed thread port.

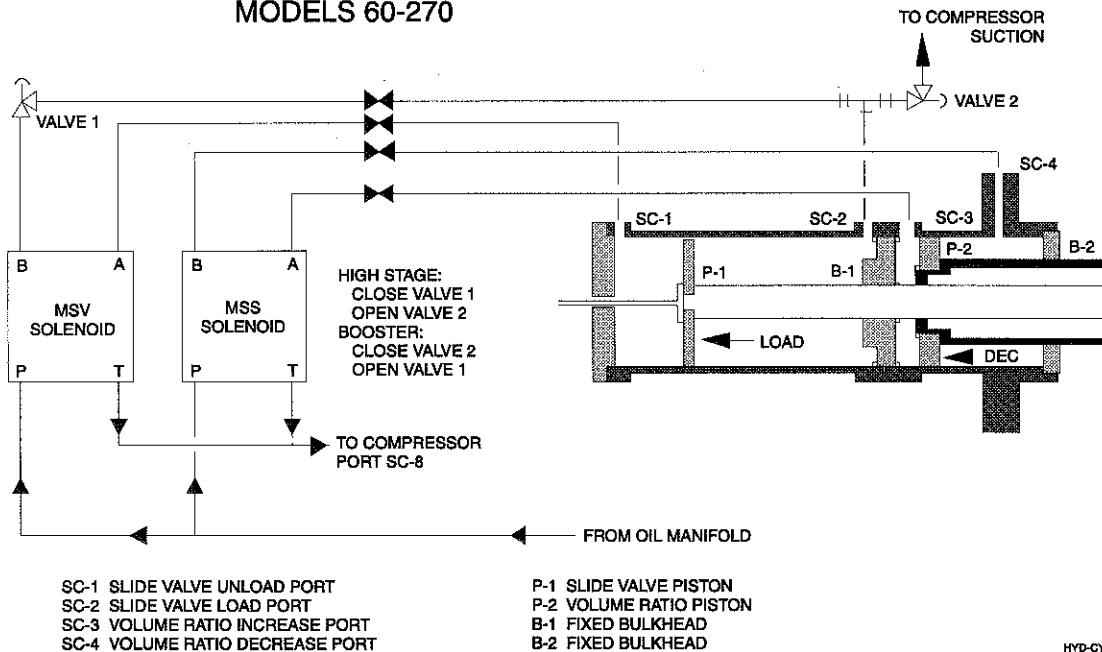
Models 316 through 480: The volume ratio Vi is increased when the MSS solenoid valve SV3 is energized and oil flows from oil manifold through valve ports P and A to compressor port SC-3, enters the increase side of the cylinder and overcomes the decrease spring tension.

Vi Decrease

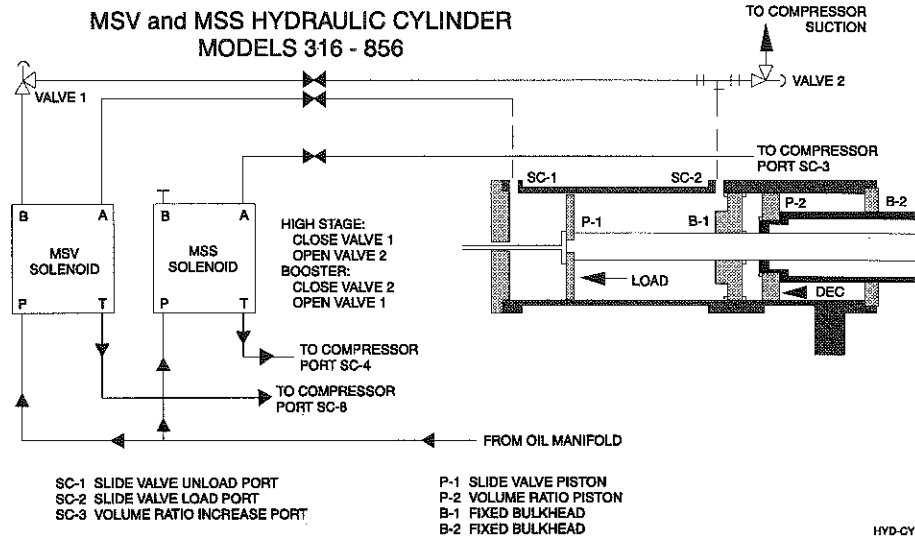
Models 60 through 270: The volume ratio Vi is decreased when MSS solenoid SV4 is energized and oil flows from the oil manifold through valve ports P and B to cylinder port SC-4 and enters the decrease side of the cylinder. Simultaneously, oil contained in the increase side of the cylinder flows out cylinder port SC-3 through valve ports A and T to compressor closed thread port.

Models 316 through 856: The volume ratio Vi is decreased when the MSS solenoid valve SV4 is energized and oil flows from the cylinder through compressor port SC-3, through valve ports A and T, to compressor Port SC-4.

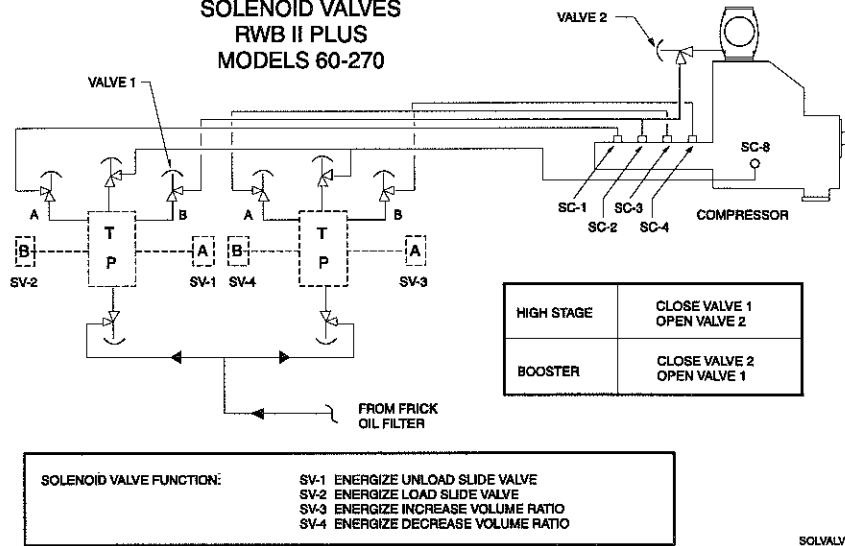
MSV and MSS HYDRAULIC CYLINDER
MODELS 60-270



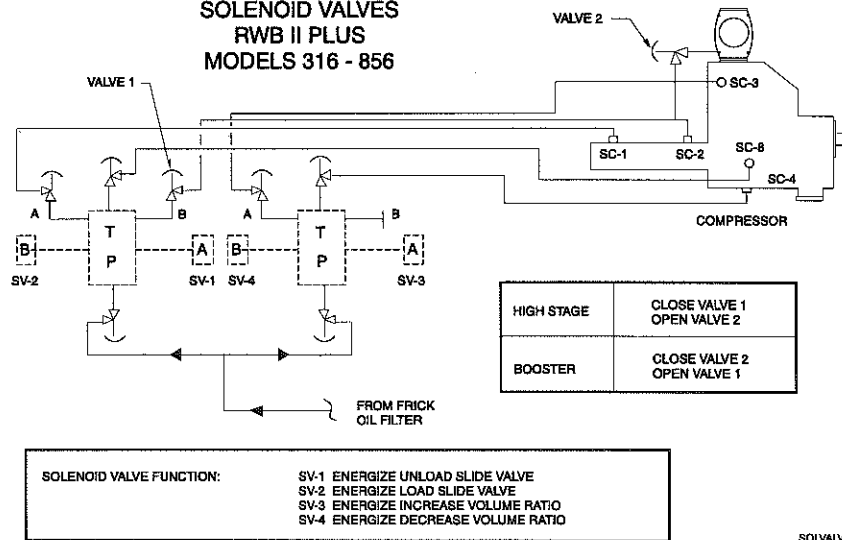
**MSV and MSS HYDRAULIC CYLINDER
MODELS 316 - 856**



**SOLENOID VALVES
RWB II PLUS
MODELS 60-270**



**SOLENOID VALVES
RWB II PLUS
MODELS 316 - 856**



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 and R-22:

Liquid Injection Oil Cooling	External* Oil Cooling
130 - 150°F	120 - 140°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 (V_i), 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 V_i , compressor port SL-1 supplies the liquid cooling. When the (V_i) rises ABOVE 3.5 V_i , 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

1. Close back-pressure bleed valve (V4).
2. Set pressure regulator valve (PDCV) for approximately 100 to 110 psig.
3. Open back-pressure bleed valve (V4) approximately one quarter turn.
4. Monitor the oil temperature of the compressor. If the oil temperature rises above 150°F, open back-pressure bleed valve (V4) a very small amount. This will reduce pressure on the equalizer and allow more refrigerant to flow to the compressor. If the oil temperature drops below 130°F, close back-pressure bleed valve (V4) a very small amount. This will increase pressure on the equalizer and allow less refrigerant to flow to the compressor, thus raising the oil temperature. The ideal condition is to maintain an oil temperature as stable as possible. By keeping the liquid injection system correctly tuned, extreme swings in the discharge temperature and the oil temperature can be avoided.



Back-pressure bleed valve (V4) must always be cracked open a small amount to prevent refrigerant from condensing in the tubing.

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 OM (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 down 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 at right.

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 auto-cycle 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.

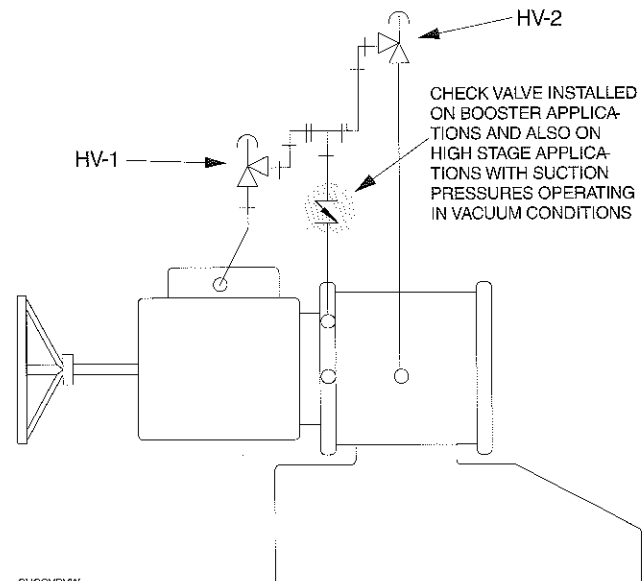
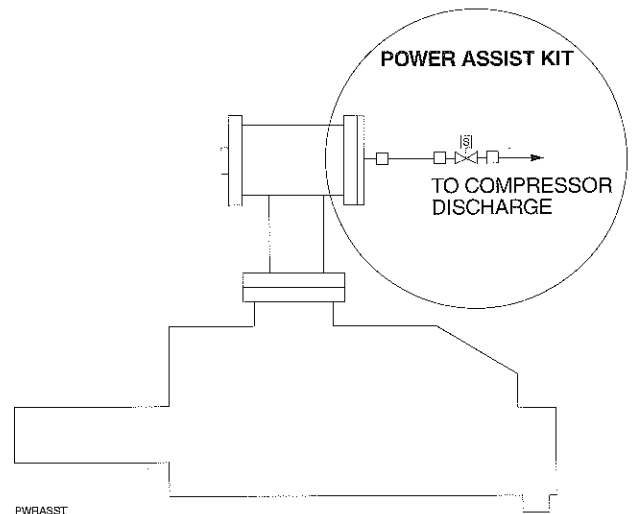
On systems located outdoors or in unheated buildings where the ambient temperature could drop below +40°F, insulating and/or heat tracing of the compressor lube oil systems is highly recommended.

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.





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 the IOM. 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
- Check compressor and driver shaft alignment
- Remove coupling center and **do not reinstall**
- 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 motor bearings (if applicable)
- 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)

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

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 driver rotation
4. Verify oil pump motor rotation
5. Verify the % of FLA on the micro display
6. Verify and finalize alignment
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 found in S90-010 OM (Quantum panel) or S70-200 OM (Plus panel)

Sign this form & fax to 717-762-2422 as confirmation of completion.

Signed: _____
Print Name: _____
Company: _____

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. For proper and safe operation the compressor must be run at the proper speed and discharge pressure. Exceeding design conditions creates a potential hazard.
2. Rotate and lubricate motor bearings according to manufacturer's recommendations PRIOR to start-up as required.
3. 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".
4. 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.

5. 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.

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 OM (*Quantum* panel) or S70-200 OM (Plus 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 assure 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 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.
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 60 through 856 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 60 – 856 with a prelube 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.

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

1. If a single oil filter is installed, push **STOP** key on micro-processor 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 element and 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 lock nut. Replace the gasket and reinstall the filter assembly into canister, securing with screws tightened to 7 ft-lb torque. Fill the canister with new Frick refrigeration oil. Replace the gasket and reinstall the canister cover. Torque cover bolts first to finger tight, then 65 ft-lb, then 130 ft-lb.
7. Close purge valve.
8. Open outlet service valve and leak test.
9. Filter is ready to place in service.

OIL FILTER/STRAINER - PRELUBE OIL PUMP

On compressor units with the prelube pump system the oil filter (F-3, **except F-2 on 496 – 856 units**) and strainer may be changed with the unit operating, 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 thermostatic valve.
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 thermostatic valve 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)

When changing the coalescer filter element(s) it is recommended that the oil be changed, cartridge(s) in oil filters F-1, F-2, and F-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

‡  **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.

 **CAUTION** Use of oils other than Frick Oil in Frick compressors must be approved in writing by Frick engineering or warranty claim may 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.**

 **CAUTION** 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. On models through 480, drain the oil filter(s) OF-1 and, if applicable, the oil coolers and filter OF-2. *On models 496 – 856, 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 described on page 41 under **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. Refer to the table on page 9 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.

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.

MOTOR BEARINGS

Follow the motor manufacturer's maintenance recommendations.

 **CAUTION** Make sure the motor bearings are properly lubricated before start-up as required by the motor manufacturer.

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, follow these recommendations:

1. Only use Frick refrigeration oil or high quality refrigeration oils approved by Frick Company for your application.
2. Participation in a regular, periodic oil analysis program may be helpful in the maintenance of 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.

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			■						■						■							■	
CHANGE FILTERS	■		■		■		■		■		■		■		■		■		■		■		■
CLEAN OIL STRAINERS	■		■		■		■		■		■		■		■		■		■		■		■
CLEAN LIQUID STRAINERS	■		■		■		■		■		■		■		■		■		■		■		■
CHANGE COALESCERS									■						■							■	
CHECK AND CLEAN SUCTION SCREEN	■	■	■		■		■		■		■		■		■		■		■		■		■
CHECK ALIGNMENT	■		■		■		■		■		■		■		■		■		■		■		■
CHECK COUPLING	■		■		■		■		■		■		■		■		■		■		■		■
CHECK TEMPERATURE AND PRESSURE CALIBRATION	■	■	■		■		■		■		■		■		■		■		■		■		■
OIL ANALYSIS		■		■		■		■		■		■		■		■		■		■		■	
VIBRATION ANALYSIS	■				■				■				■				■				■		
REPLACE SEAL ⁽¹⁾						a		b	c,a			a	b		c,a			b,a				c,a	
INSPECT COMPRESSOR ⁽²⁾						a		b	c,a			a	b		c,a			b,a				c,a	

1. See service manual S70-251 SM.
 2. Compressor inspection must be performed by Frick-authorized personnel.
- a. Gas processing or heat pump duty with higher than normal high stage operating pressures.
b. High stage duty.
c. Booster duty.

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.

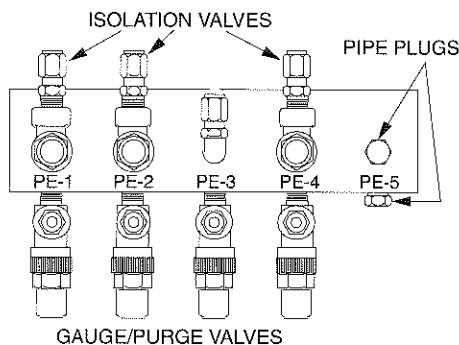
The third step is to identify the most likely cause and take action to correct the problem. If the symptoms are not relieved move to the next item on the list and repeat the procedure until you have identified the cause of the problem. Once the cause has been identified and confirmed make the necessary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

PRESSURE TRANSDUCERS - TESTING

Pressure transducers are located on a covered manifold directly behind the microprocessor console.

Test Procedure (1-15) Conversion Data Table, p.32

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.



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 the 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.
** RWB-II PLUS 496 – 856 High Stage 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 OM (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.



PRESSURE TRANSDUCER CONVERSION DATA								
Sensor Voltage	100 psi		200 psi		300 psi		500 psi	
	Range - PSIG*		Range - PSIG*		Range - PSIG*		Range - PSIG*	
	low	high	low	high	low	high	low	high
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
At 0 psig	1.388 V	1.788 V	1.094 V	1.494 V	1.046 V	1.346 V	0.968 V	1.268 V

* Below 0 PSIG measured in inches of mercury.

SV POSITION POTENTIOMETER REPLACEMENT AND ADJUSTMENT

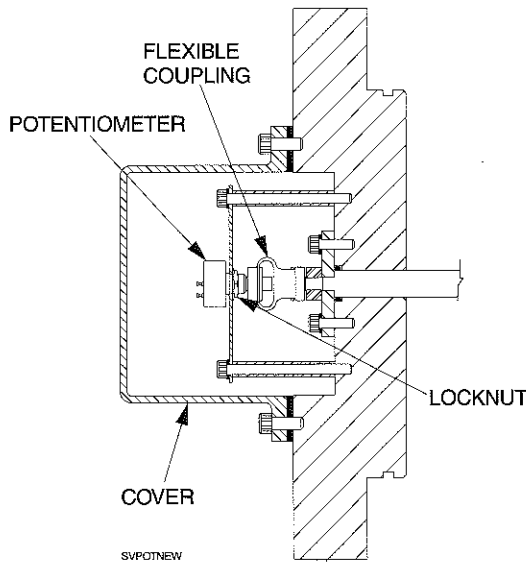
The Slide Valve Position potentiometer is located on the end of the compressor unloader cylinder.

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:

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. Re-tighten 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.**



FINE ADJUSTMENT must be made with the slide valve fully unloaded and the compressor running. The Operating display at this time should indicate a slide valve position of 0%. If the display is greater than 0%, adjust potentiometer POT #4 on the SBC until 0% is indicated. If 0% is not attainable, get as close as possible and then proceed to the next step. The adjustments of POT #4 and POT #3 are interactive and POT #3 may require adjustment to allow POT #4 to come into range.

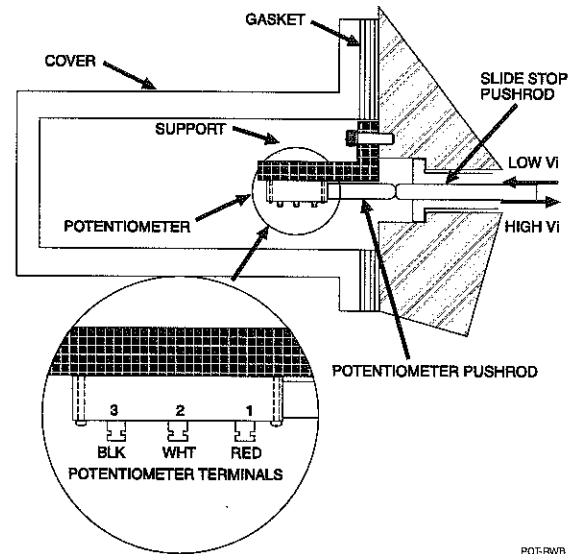
Completely load the slide valve. The display at this time should indicate 100%. If the display is less than 100%, adjust potentiometer POT #3 on the SBC until 100% is indicated.

Repeat this sequence until the slide valve indicates 0% fully unloaded and 100% fully loaded.

**VOLUMIZER® POTENTIOMETER
REPLACEMENT AND ADJUSTMENT**

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.



5. **ADJUSTMENT** must be made with the compressor running and the slide valve fully unloaded. With the slide stop at maximum (Vi) position, check that the potentiometer pushrod is in contact with the slide stop pushrod. If not, the bracket must be ground or trimmed until contact is made. Completely decrease the slide stop. The operating display at this time should indicate a (Vi) of 2.2. If greater than 2.2, adjust potentiometer POT #2 on the SBC until 2.2 is indicated. If 2.2 is not obtainable, get as close as possible and proceed to the next step. Adjustment of POT #2 and POT #1 are interactive and POT #1 may require adjustment to allow POT #2 to come into range. Now, completely increase the slide stop. The display at this time should indicate a (Vi) of ± 5.0 (4.2 for model 480). If less than 5.0 (4.2 for model 480), adjust potentiometer POT #1 on the SBC until 5.0 (4.2 for model 480) is indicated. Repeat this sequence until the slide stop indicates 2.2 when fully decreased and 5.0 (4.2 for model 480) when fully increased.

NOTE: The total travel on the VOLUMIZER® potentiometer is .394 inch.

**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 OM (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 Co.</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 Co. 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 Co. for assistance.</p> <p>Slipper seals worn out or damaged. Contact Frick Factor or Frick Co. 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 Company. 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
<p>SLIDE VALVE WILL NOT LOAD OR UNLOAD</p>	<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>
<p>SLIDE VALVE WILL LOAD BUT WILL NOT UNLOAD</p>	<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>
<p>SLIDE VALVE WILL UNLOAD BUT WILL NOT LOAD</p>	<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>
<p>SLIDE STOP WILL NOT FUNCTION EITHER DIRECTION</p>	<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 Co.</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

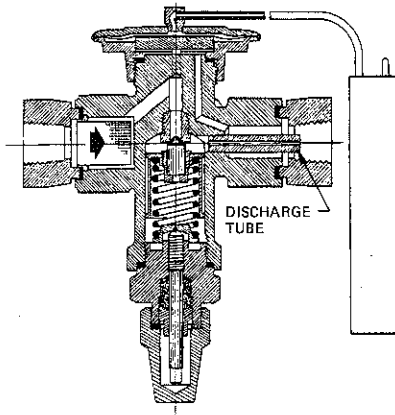
SYMPTOM	PROBABLE CAUSES and CORRECTIONS
HIGH OIL TEMPERATURE	<p>Insufficient liquid supply, check receiver level and pressure drop at injection solenoid.</p> <p>Equalizer pressure too high, lower (through 480 only).</p> <p>Suction superheat too high, correct system problem.</p> <p>Thermal valve power head lost charge, replace.</p> <p>Liquid strainer blocked, clean.</p> <p>Liquid solenoid coil failed, replace.</p> <p>Excessive load. Thermostatic valve undersized. Reduce load or install larger thermostatic valve.</p>
LOW OIL TEMPERATURE	<p>Equalizing pressure too low, raise (through 480 only).</p> <p>Suction superheat too low or liquid coming back on compressor, correct system problem.</p> <p>Low load conditions. Valve oversized, increase load or use smaller thermostatic valve.</p>
OIL TEMPERATURE FLUCTUATES	<p>System conditions rapidly fluctuate causing liquid injection system to over respond, stabilize system operation.</p>

THERMAL EXPANSION VALVES

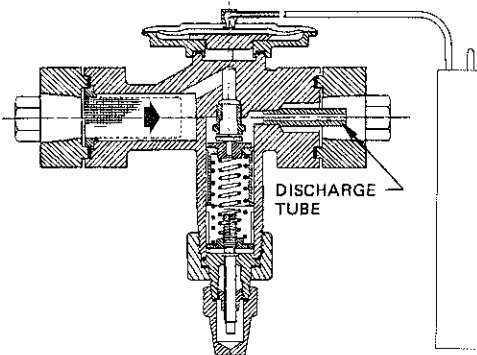
In situations where system load conditions increase or decrease over extended periods of time and the liquid injection thermal expansion valve is not adequate for the new conditions, an improvement in valve performance may be achieved by increasing or decreasing discharge tube size.

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. ONLY ADJUST 1/4" BLEED VALVE ON EQUALIZING LINE (not applicable on models 496 - 856).

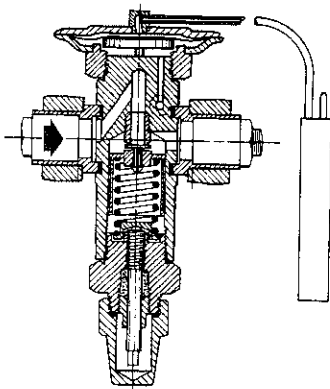
**TYPE D THERMAL EXPANSION VALVE (1-15 TONS)
R-717**



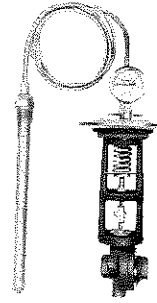
**TYPE A THERMAL EXPANSION VALVE (20-100 TONS)
R-717**



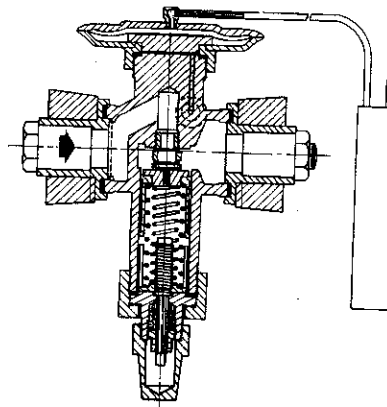
TYPE H THERMAL EXPANSION VALVE (2-1/2 TO 16 TONS) R-22



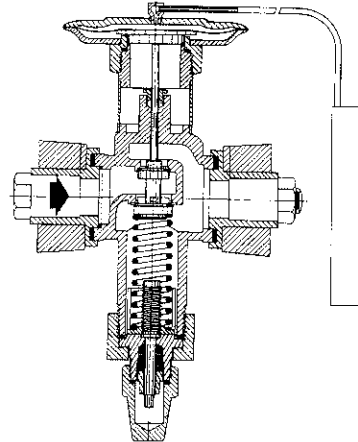
**JORDAN TEMPERATURE REGULATOR VALVE
(MODELS 496 - 856)**



**TYPE M THERMAL EXPANSION VALVE (12 TO 34 TONS)
R-22**



**TYPE V THERMAL EXPANSION VALVE (52 TO 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**

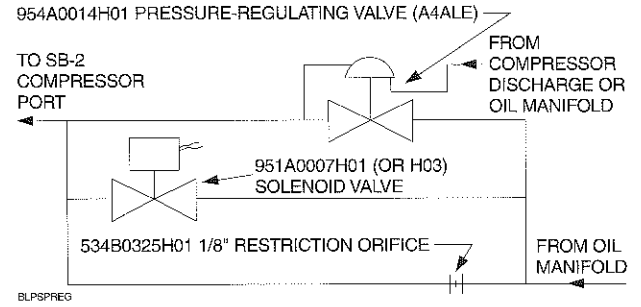
To increase or decrease the discharge temperature/oil temperature, adjust the knurled nut located on the actuator stem of the Jordan Temperature regulator valve. The temperature is allowed to increase as the nut is turned higher on the stem and decreases as the nut is turned lower. This valve is used on rotary screw compressor models 496 – 856.

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, on 496 – 856 compressors 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.

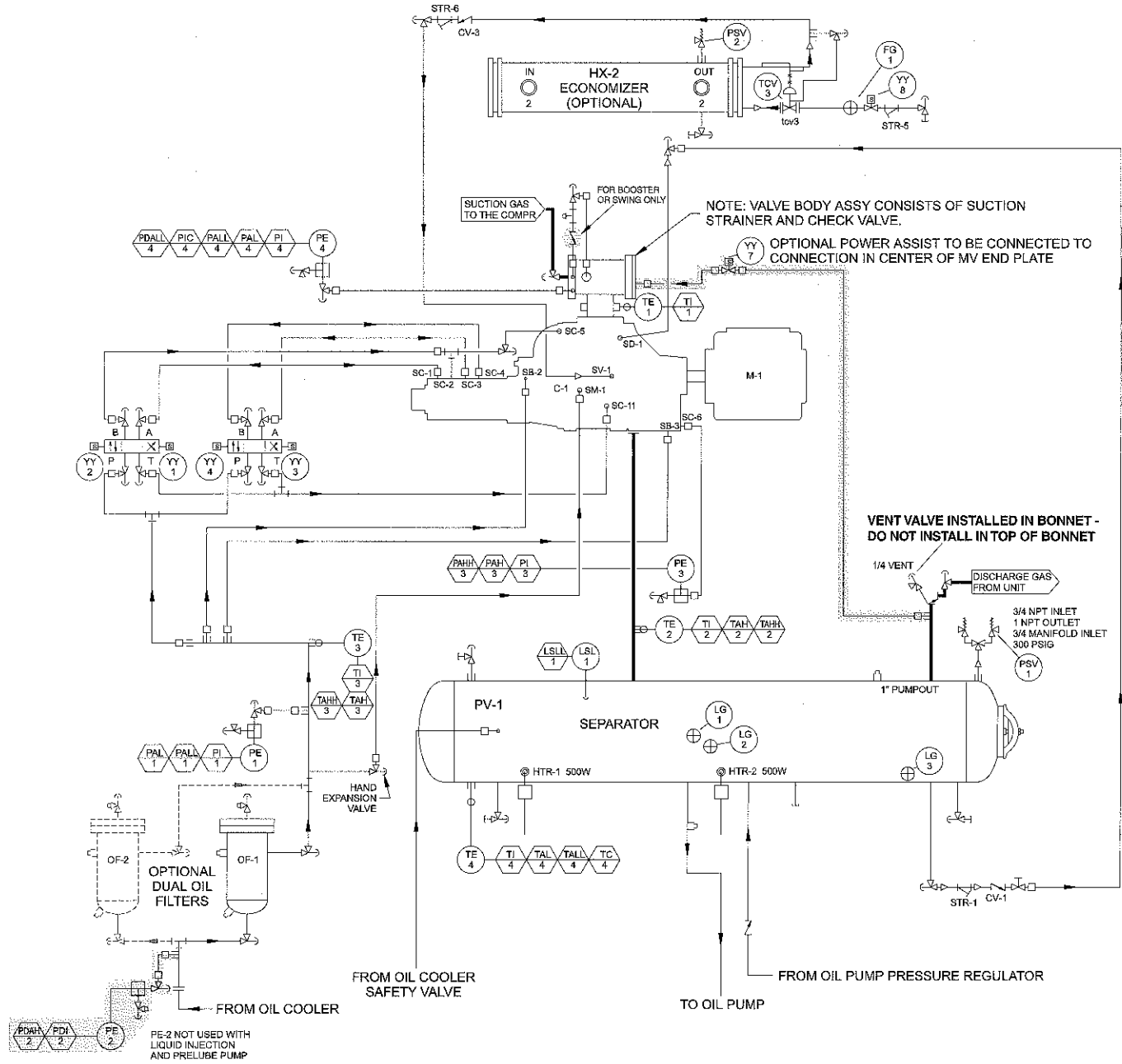
1. For units with *Quantum* Control Panels, refer to CONTROL SETUP - "OIL SETPOINTS DISPLAY" in S90-010 OM.
2. For units with *Microprocessor* Control Panels, install a pressure transducer to monitor the pressure of the oil supply to the balance piston. The correct pressure with the solenoid closed is 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 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.

3. For units with *Electromechanical* Control Panels, a safety shutdown on balance piston oil pressure may be omitted.

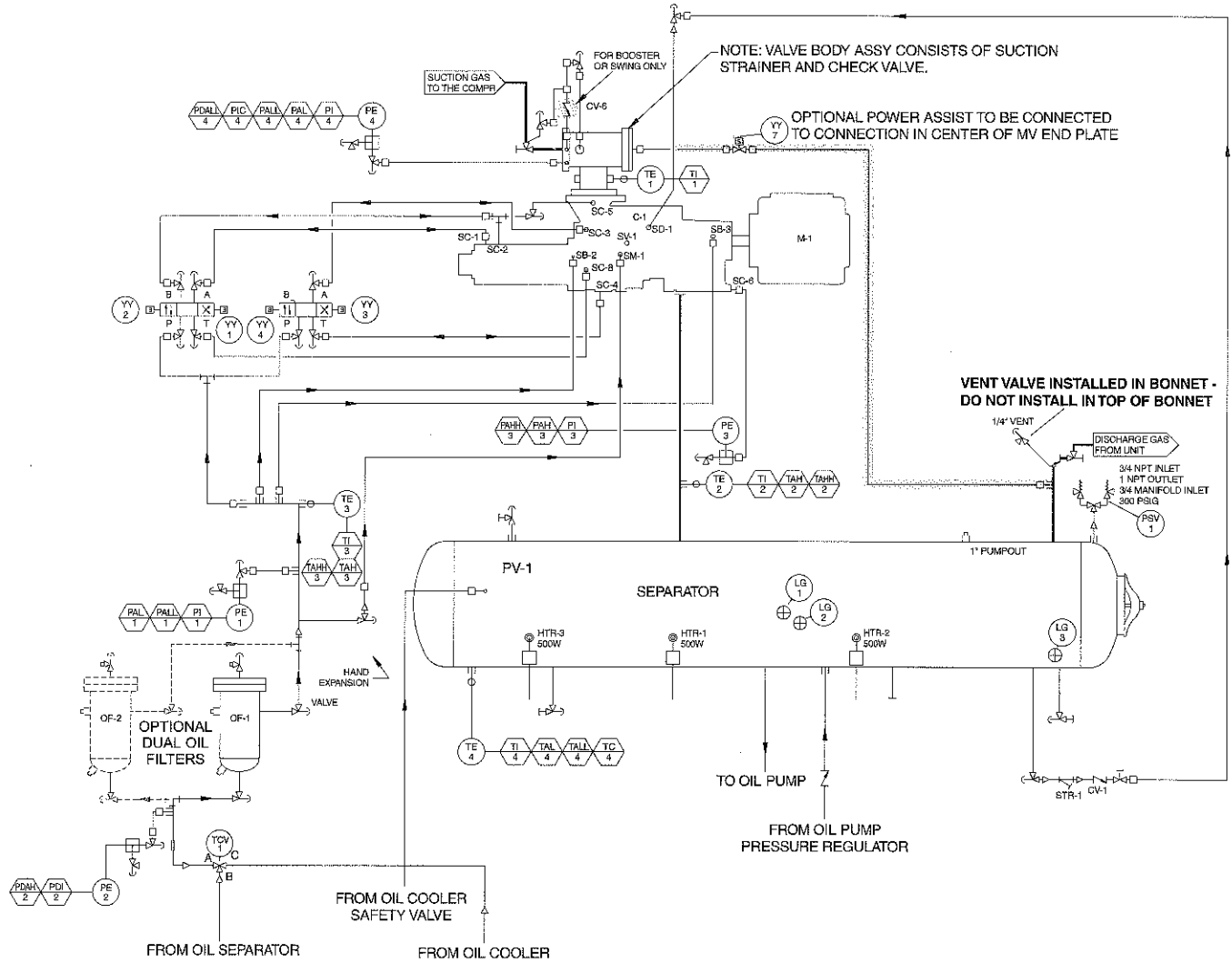
P & I DIAGRAM, 60 – 270



LEGEND (Covers P & I diagrams pages 40 – 43)

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

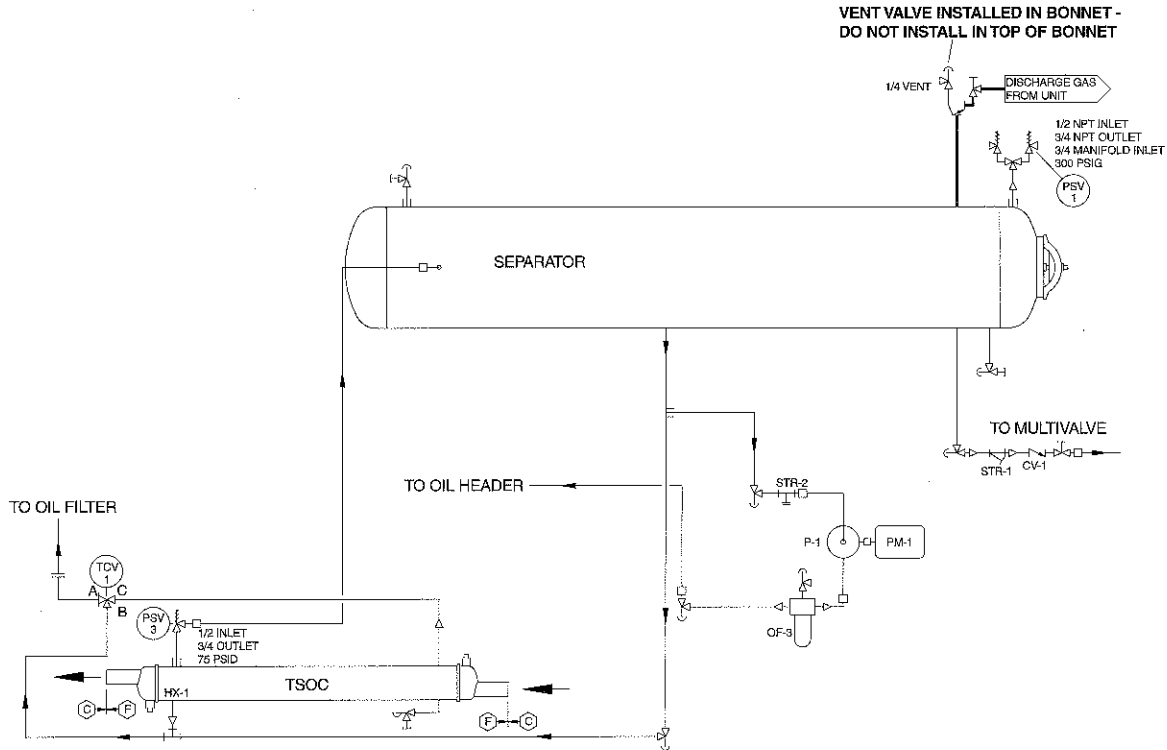
P & I DIAGRAM, 316 - 480



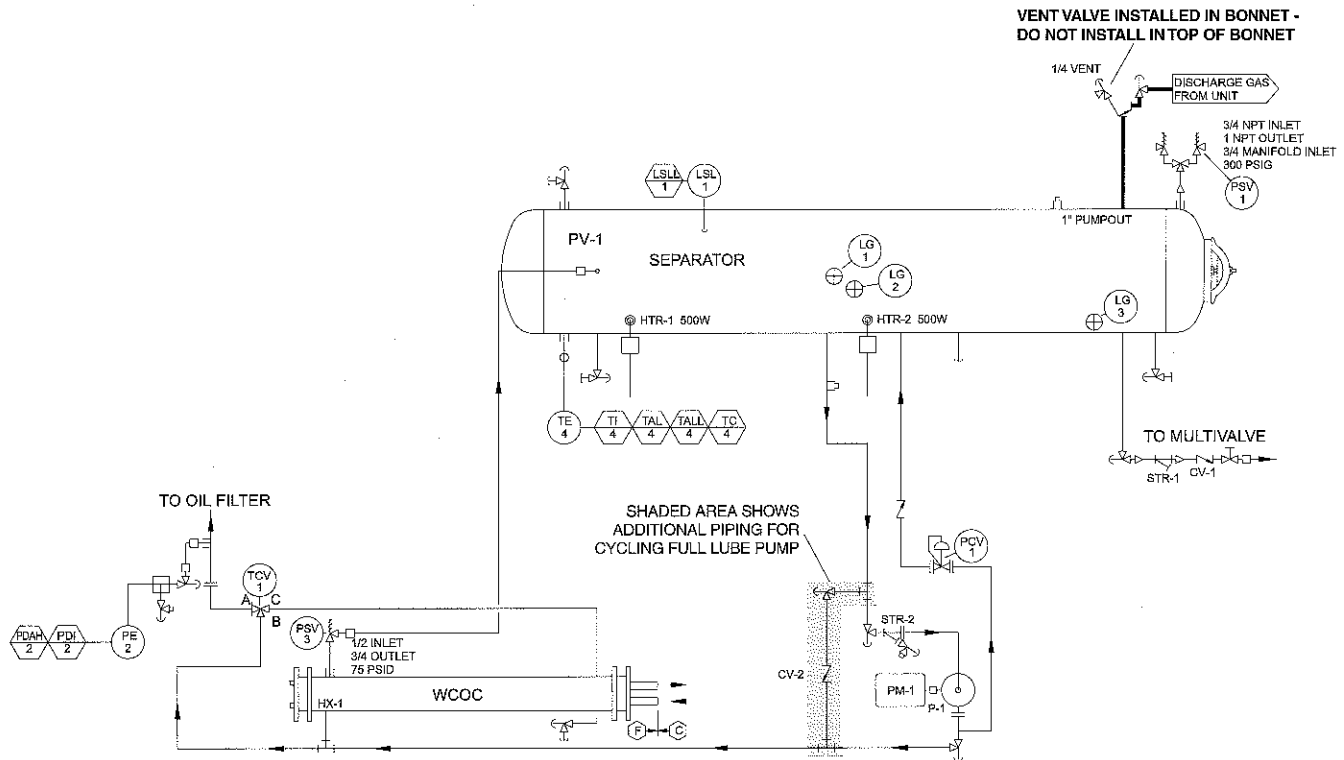
LEGEND (Covers P & I diagrams pages 40 – 43)

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

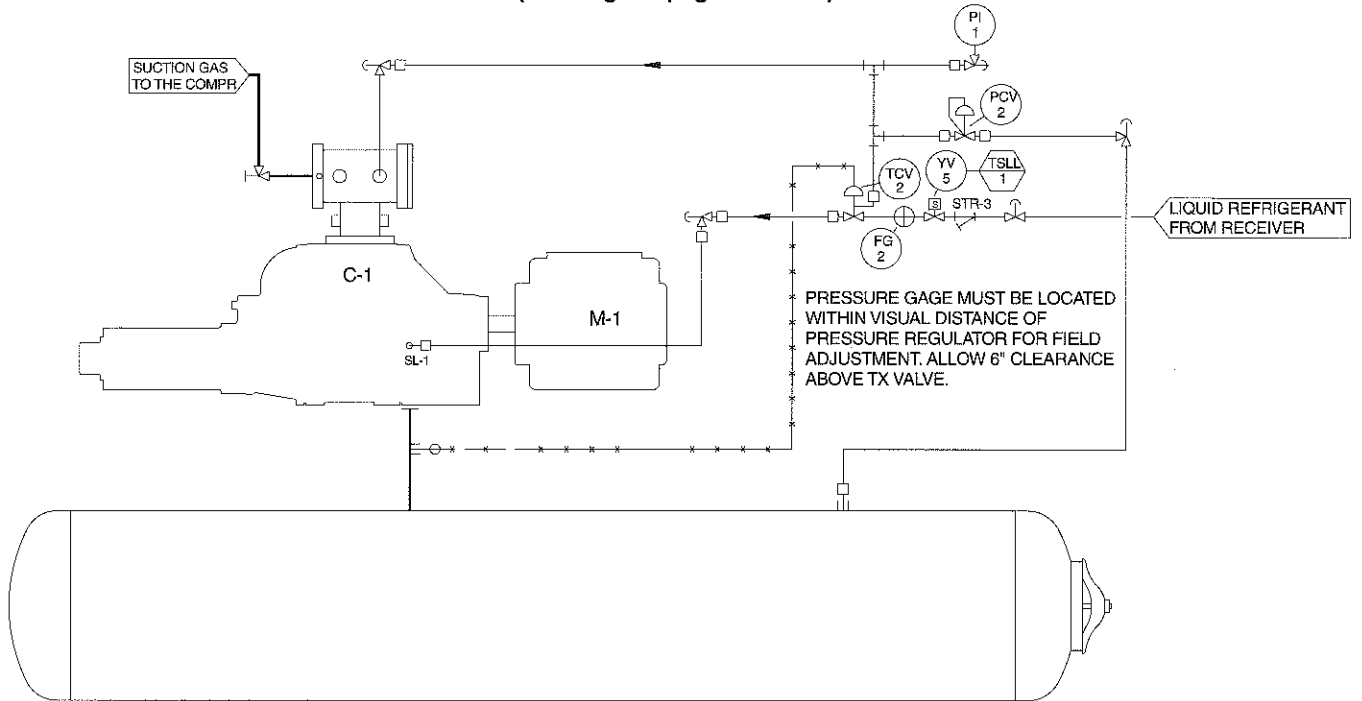
P & I DIAGRAM, WCOC w/PRELUBE OIL PUMP
(See Legend pages 40 & 41)



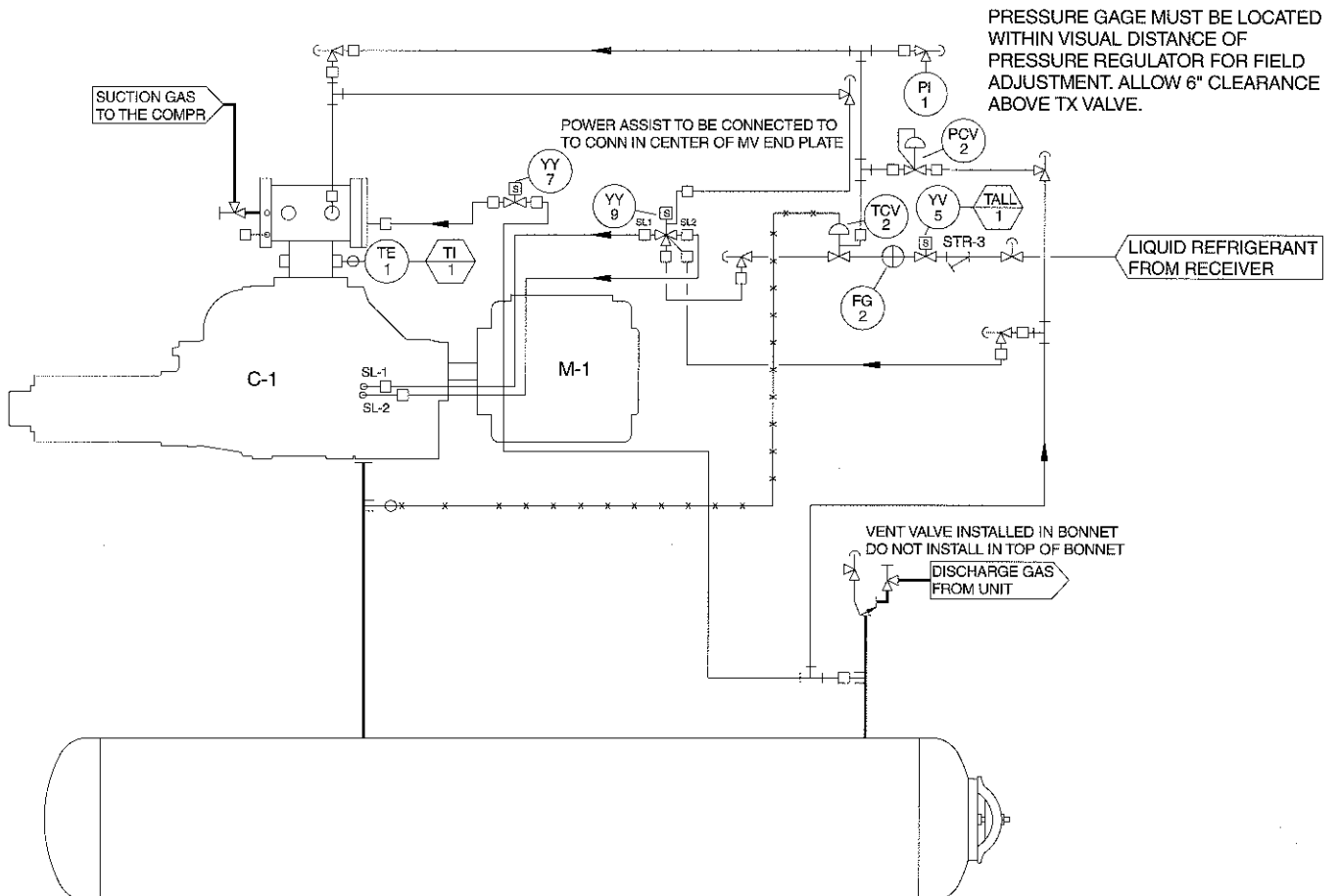
P & I DIAGRAM, TSOC w/FULL LUBE or FULL CYCLING OIL PUMP
(See Legend pages 40 & 41)



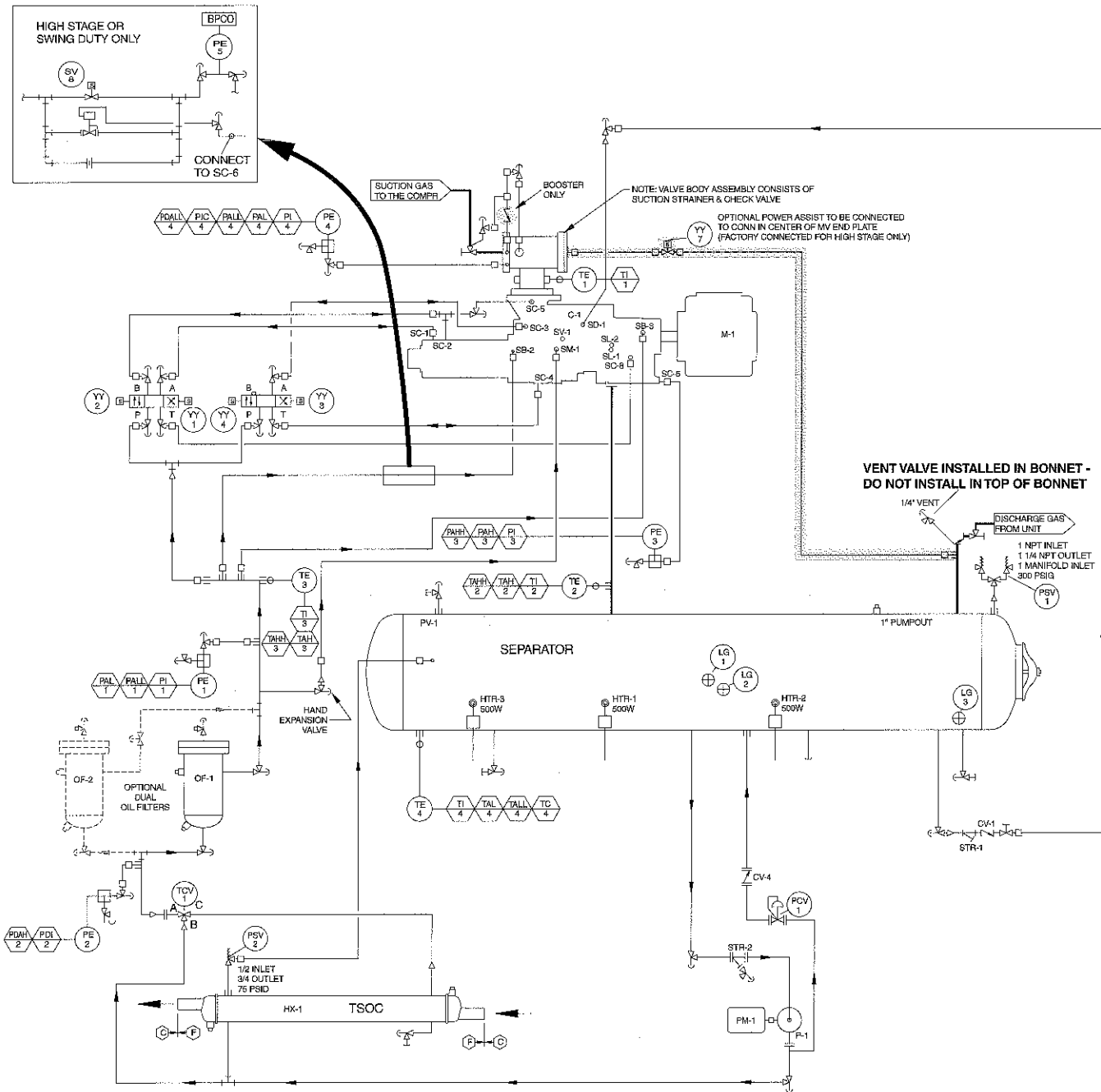
P & I DIAGRAM, LIQUID INJECTION – SINGLE PORT
(See Legend pages 40 & 41)



P & I DIAGRAM, LIQUID INJECTION – DUAL PORT
(See Legend pages 40 & 41)

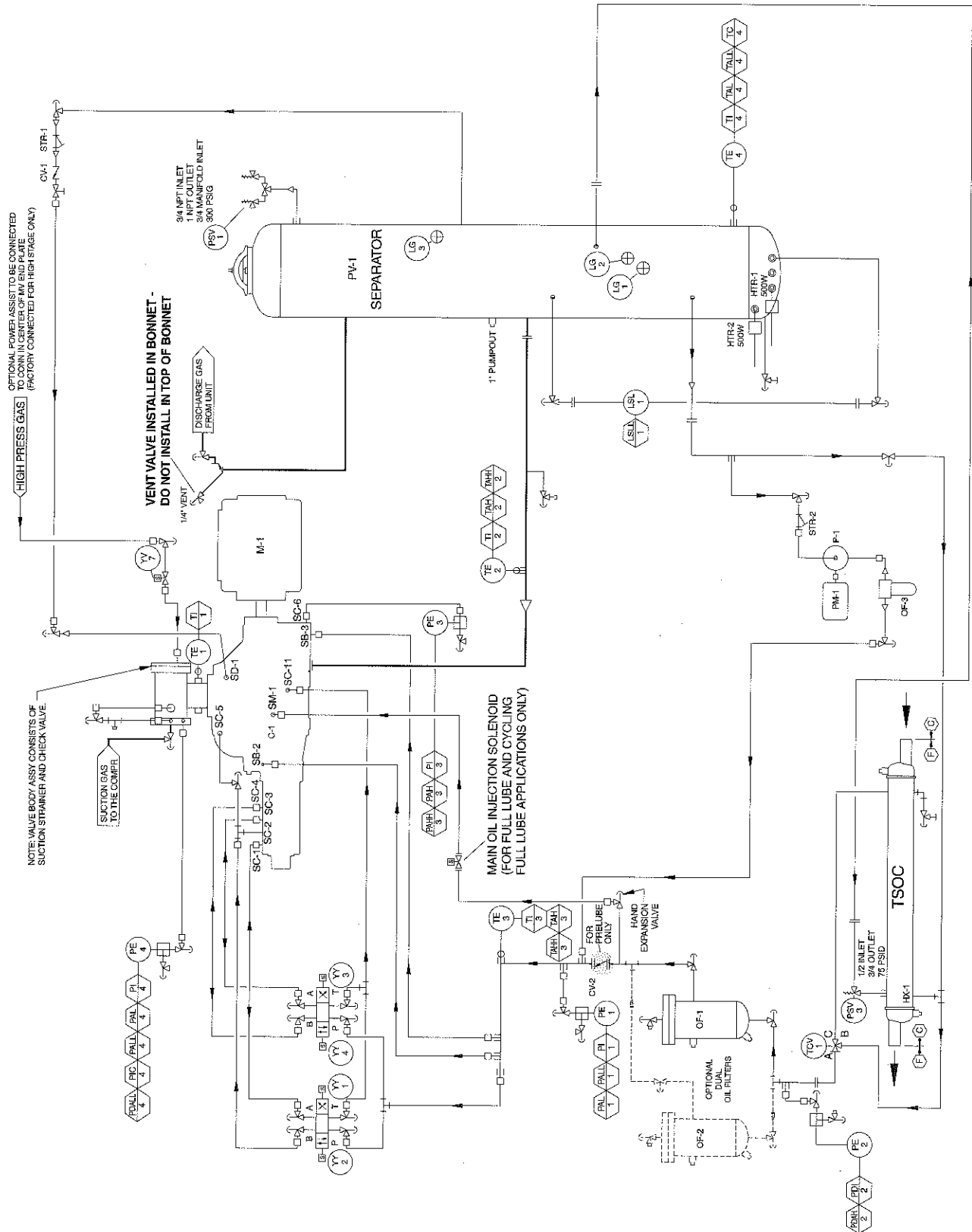


P & I DIAGRAM, 496 – 856, HORIZONTAL SEPARATOR



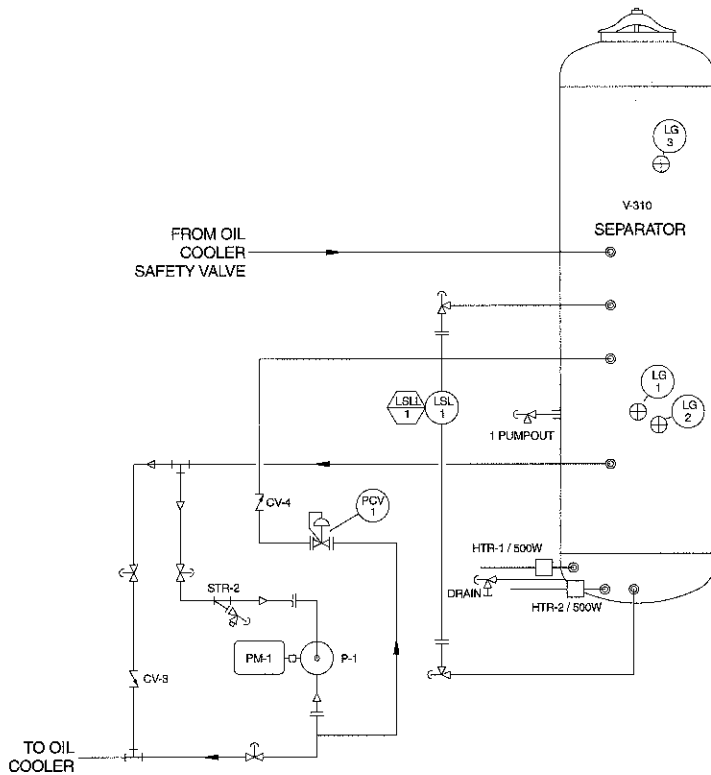
NOTE: See Legend on page 46.

P & I DIAGRAM, 496 – 856, VERTICAL SEPARATOR (w/prelube oil pump)

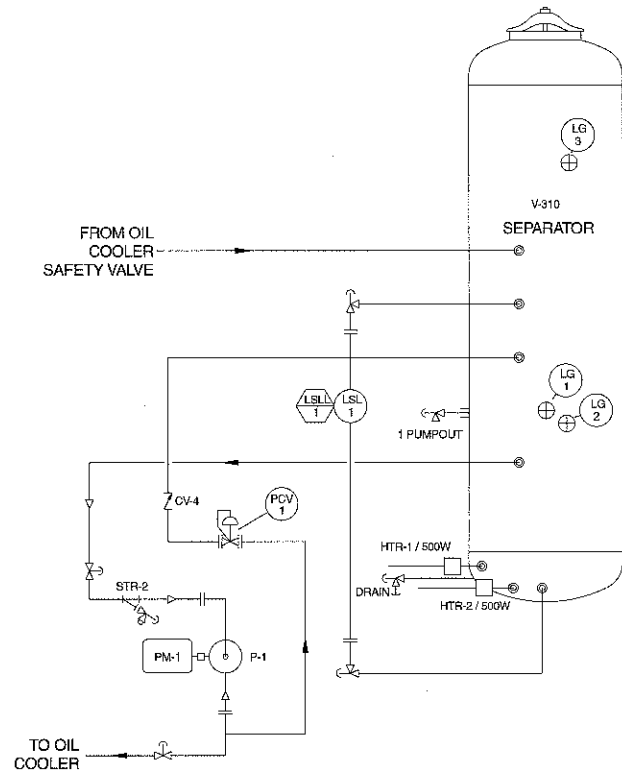


NOTE: See Legend on page 46.

P & I DIAGRAM, 496 – 856



CYCLING FULL LUBE OIL PUMP



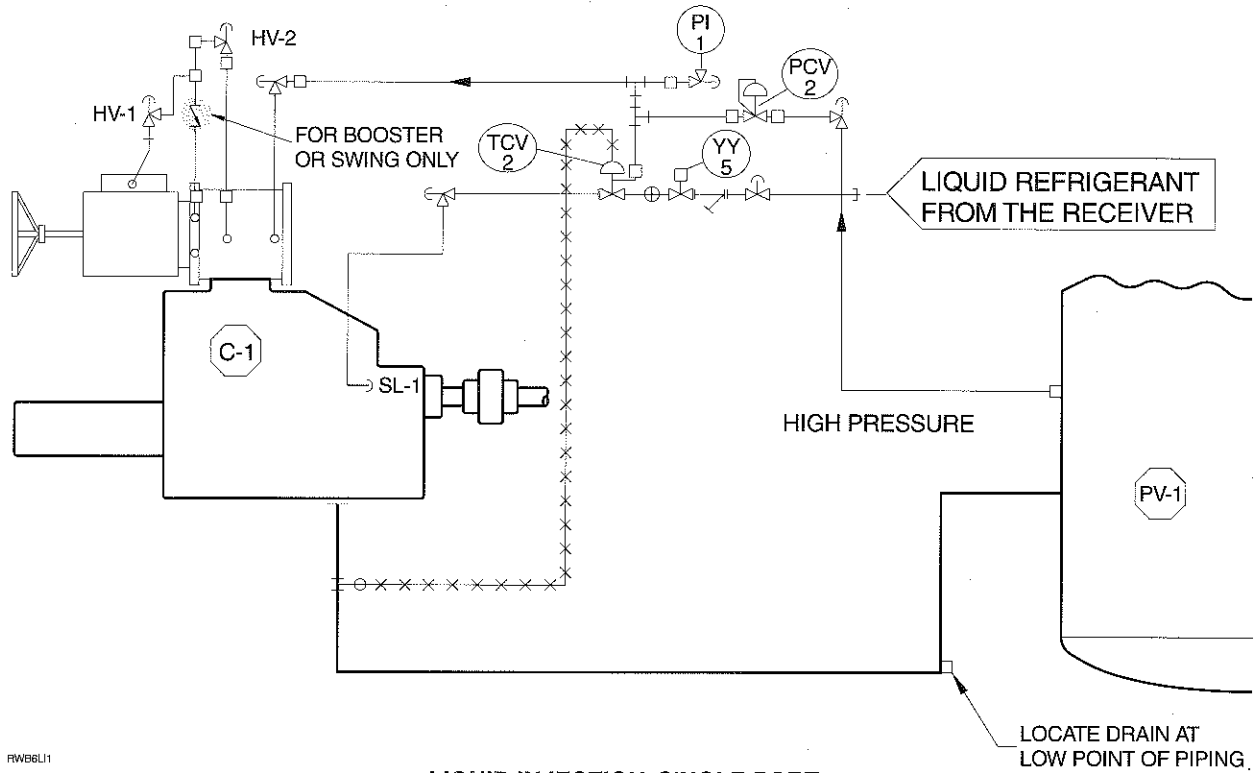
FULL LUBE OIL PUMP

LEGEND (Covers P & I diagrams pages 44 – 47)

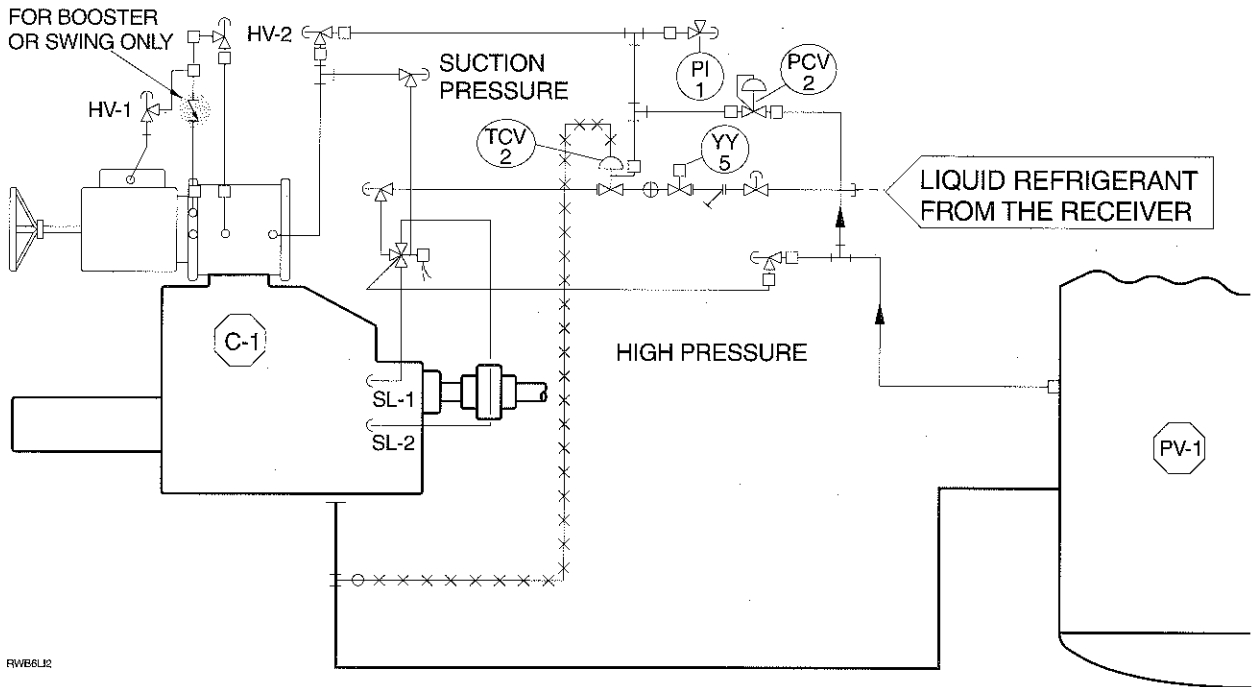
AS	AIR SUPPLY
BPCO	BALANCE PISTON CUTOUT
C	COMPRESSOR
CV	CHECK VALVE
DP	DISCHARGE PRESSURE
E	GAS ENGINE
F	FILTER OR FILTER DRIER
FG	FLOW GLASS
HV	HAND VALVE
HTR	HEATER
LG	LEVEL GLASS
LSL	LOW OIL LEVEL SWITCH
LSLL	SEPARATOR LOW OIL LEVEL SHUTDOWN
M	MOTOR
1MC	MOTOR CONTROL CENTER
2MC	MOTOR CONTROL CENTER
OP	OIL PRESSURE
P	PUMP
PAH	HIGH DISCHARGE PRESSURE ALARM
PAHH	HIGH DISCHARGE PRESSURE SHUTDOWN
PAL	LOW PRESSURE ALARM
PALL	LOW PRESSURE SHUTDOWN
PCV	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	ENRGIZE DECREASE VOLUME RATIO

P & I DIAGRAM, 496 – 856



LIQUID INJECTION, SINGLE PORT



LIQUID INJECTION, DUAL PORT

NOTE: See Legend on page 46.

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 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, 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. These 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 instrument engineers, but are usually not followed by general electricians.

There are a few basics, that if followed, will result in a trouble-free installation. The National Electric Code (NEC) is a guideline for safe wiring practices, but it does not 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.

WIRE SIZING

Size supply wires one size larger than required for amperage draw to reduce instantaneous voltage dips caused by large loads such as heaters and contactors and solenoids. These sudden dips in voltage can cause the processor, whether it be a microprocessor, 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 amp or #12 gauge wire for circuits of up to 20 amp. Therefore, when connecting the power feed circuit to an electronic industrial control, 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.

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" 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 and fuse 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 transformer to isolate the electronic control panel from other equipment in the plant that generate EMI. (Figure 1)**

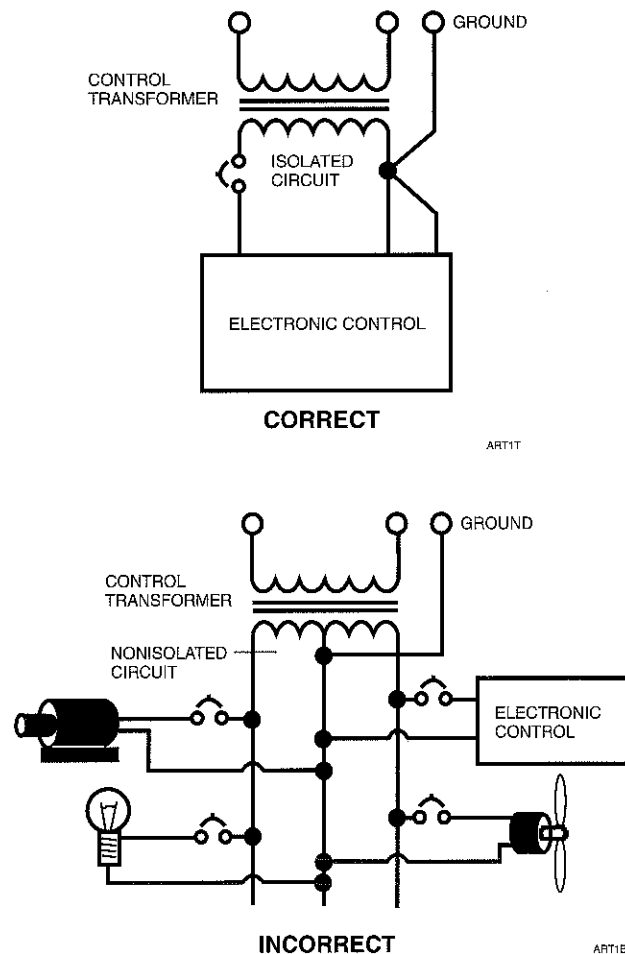


Figure 1

GROUNDING

Grounding is the most important factor for successful operation and is also 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 not acceptable for electronic control equipment. Conduit is made of steel and is a poor conductor relative to a copper wire. Electronic equipment reacts to very small currents and must have a good ground in order to operate properly; therefore, **copper grounds are required for proper operation.** Note: aluminum may be used for the large three-phase ground wire.

The ground wire must be sized the same size as the supply wires or one size smaller as a minimum. The three phase power brought into the plant must also have a ground wire, making a total of four wires. In many installations that are having electronic control problems, this essential wire is usually missing. A good ground circuit must be continuous from the plant source transformer to the electronic control panel for proper operation. (Figure 2) Driving a ground stake at the electronic control will cause additional problems since other equipment in the plant on the same circuits will ground themselves to the ground stake causing large ground flow at the electronic equipment.

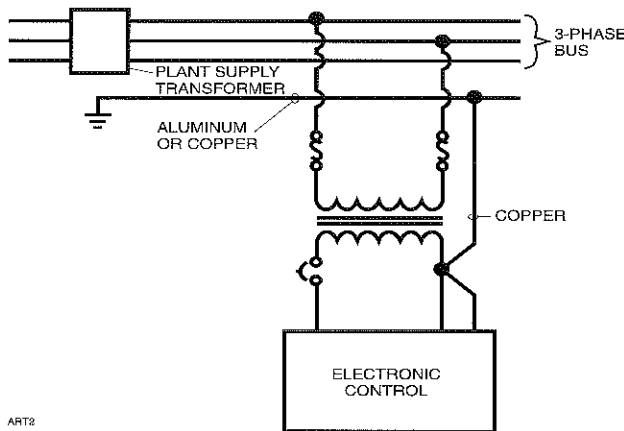


Figure 2

WIRING PRACTICES

Do not mix wires of different voltages in conduit. An example of this would be the installation of a screw compressor package. The motor voltage is 480 volts and the panel control 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 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 inducted into the 120 volt circuit causing functional problems with the electronic control. 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 in the same conduit with 120 volt wires.** (Figure 3)

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. An extreme example of this would be to run the 480 volts from a motor starter through the control panel to the motor.

When running conduit to an electronic control panel, take notice of 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 a 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. Drilling can cause metal chips to land in the electronics and create a short circuit. **If you must drill the panel, take the following precautions:** First cover the electronics with plastic and tape it to the board with masking or electrical tape. Second, 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 chips. Then clean all of the remaining chips from the panel before removing the protective plastic. It would be a good idea to call the manufacturer before drilling the panel to be sure you are entering the panel at the right place.

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 an "O" ring-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.

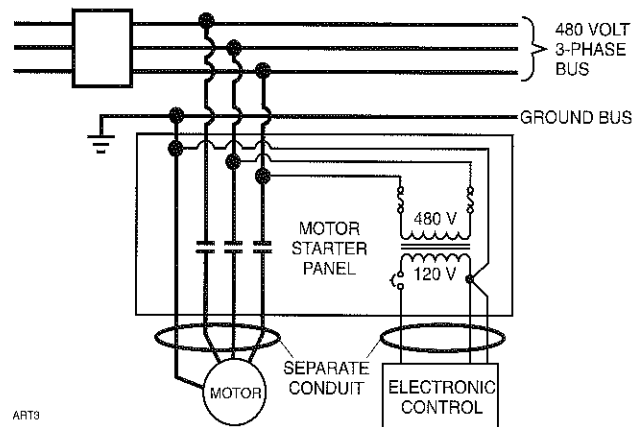


Figure 3

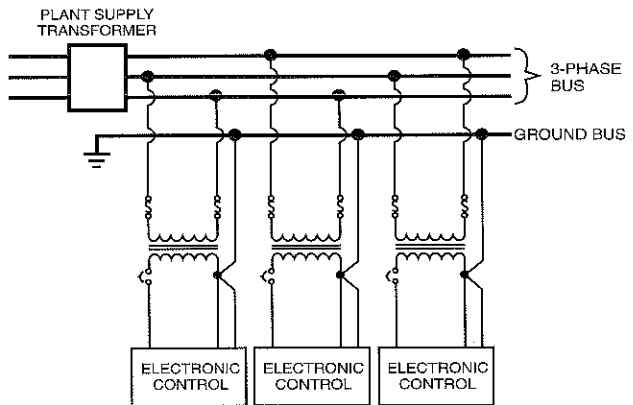
Never add relays, starters, timers, transformers, etc. inside an electronic control panel without first contacting the manufacturer. Contact arcing and EMI emitted from these devices can interfere with the electronics. Relays and timers are routinely added to electronic control panels by the manufacturer, 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.

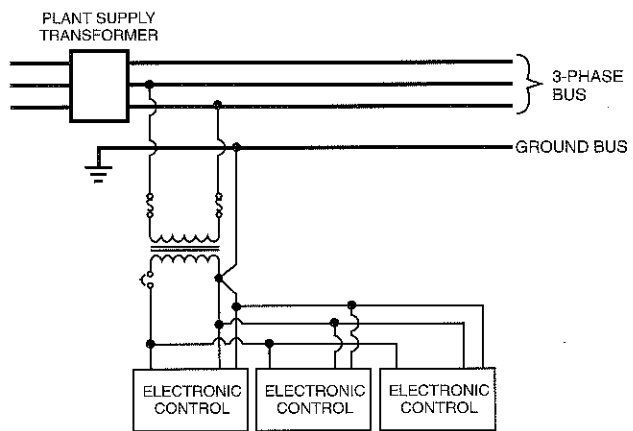
Never daisy-chain or parallel-connect power or ground wires to electronic control panels. Each electronic control panel must have its own supply wires back to the power source. Multiple electronic control panels on the same power wires create current surges in the supply wires which can cause controller malfunctions. Daisy-chaining ground wires allows ground loop currents to flow between electronic control panels which also causes malfunctions. (Figure 4)

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 have them send you the proper instructions. Every manufacturer of electronic equipment should have a knowledgeable staff, willing to answer your questions or fax additional information. Following correct wiring procedures will ensure proper installation of your electronic equipment.



ART4T

CORRECT



ART4B

INCORRECT

Figure 4

RECOMMENDED SPARE PARTS - CURRENT DESIGN

ITEM DESCRIPTION	QTY.	MODELS	ITEM NUMBER
Temperature Probe (TE-1—4)	1	ALL	640A0035H01
Transducer, Pressure, 0—200 PSIA (PE-4)	1	ALL	333Q001345
Transducer, Pressure, 0—500 PSIA (PE-1—3)	1	ALL	111Q0280887
Potentiometer, Slide Stop	1	ALL	111Q0041148
Kit, Potentiometer, Slide Valve	1	ALL	534D0523G02
Valve, Solenoid, Slide Stop/Slide Valve, 120-60, 110-50 (Low Force)	1	ALL	951A0056H39
Coil For 951A0056H39 Above	1	ALL	951A0056H40
Heater, Oil, 500W, 120V	1	ALL	913A0047H01
Heater, Oil, 500W, 240V	1	ALL	913A0047H03
Filter, Coalescing, Standard	A/R	60—399	531B0019H01
Filter, Coalescing, Convoluted	A/R	496—856	531B0065H01
Gasket, Manway For Coalescer	1	60—76	531A0105H03
Gasket, Manway For Coalescer	1	100—856	531A0105H04
Filter, Oil, 15 Micron	A/R	ALL	531A0028H01
Gasket, End Cover For 531A0028H01 Above	A/R	ALL	959A0082H01
Gasket, Clamping Plate For 531A0028H01 Above	A/R	ALL	959A0053H01
Shaft Seal Replacement Kit	1	60—76	534M0163G01
Shaft Seal Replacement Kit	1	100—134	534M0163G02
Shaft Seal Replacement Kit	1	177—270	534M0163G03
Shaft Seal Replacement Kit	1	316—399	534M0163G04
Shaft Seal Replacement Kit	1	496—856	534M0163G05
Element, In-Line Oil Filter, Prelube Pump (Spin-on Element)	1	60—222	535A0368H01
Element, In-Line Oil Filter, Prelube Pump (Spin-on Element)	1	270—676	535A0369H01

NOTE: This list is based on one unit. When stocking for more than one unit, the quantity should be adjusted to meet your individual requirements.



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