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INSTALLATION - OPERATION - MAINTENANCE

RXF

ROTARY SCREW COMPRESSOR UNITS

MODELS 12 – 101

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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SAFETY PRECAUTION DEFINITIONS

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

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

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

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

PREFACE

This manual has been prepared to acquaint the owner and service person with the **INSTALLATION, OPERATION and MAINTENANCE** procedures as recommended by Frick for **RXF** Rotary Screw Compressor Units.

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

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

CORRECT INSTALLATION
PROPER OPERATION
REGULAR, SYSTEMATIC PLANNED 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; oil return is controlled; and that high side condenser units control head pressures and temperatures are 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 to ensure 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 Publication E70-400 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.

Contact Frick, Sales Administration Department, in Waynesboro, PA to report damage or shortage claims.

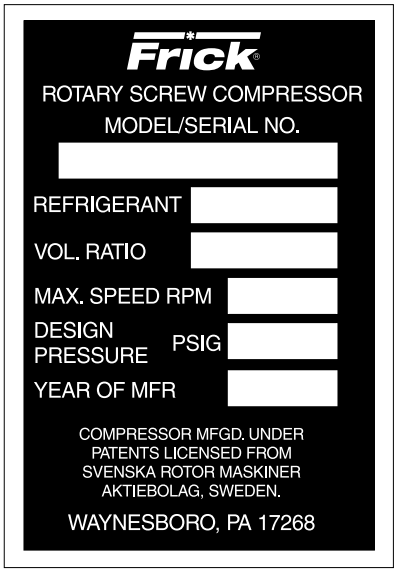
COMPRESSOR and UNIT IDENTIFICATION

Each compressor unit has 2 identification data plates.

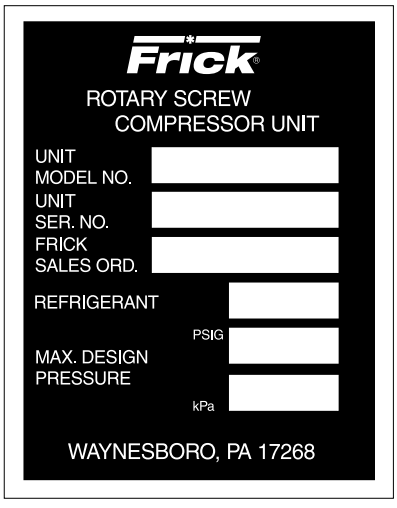
The compressor data plate containing compressor model and serial number is mounted on the compressor body.

The unit data plate containing unit model, serial number and Frick sales order number is mounted on the control panel.

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.



COMPRESSOR DATA PLATE



UNIT DATA PLATE

FOUNDATION

NOTE: Allow space for servicing both ends of the unit. A minimum of 24 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 shall 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 housekeeping pad to allow room for grouting. An expansion-type epoxy grout must be worked under all areas of the base with no voids and be allowed to settle with a slight outward slope so oil and water can run off of the base.

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

1. Use I-beams in the skid where the screw compressor will be attached to the system base. They shall run parallel to the package feet and support the feet for their full length.

2. The compressor unit feet shall be continuously welded to the system base at all points of contact, or bolted.

3. The compressor unit shall not be mounted on vibration isolators in order to hold down package vibration levels.

4. The customer's foundation for the system base shall 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 shall be supported in pipe hangers (preferably within 2 feet of vertical pipe run) so that the lines won't move if disconnected from the compressor. See table for Allowable Flange Loads.

ALLOWABLE FLANGE LOADS

NOZ. SIZE NPS (in.)	MOMENTS (ft-lbf)			LOAD (lbf)		
	AXI-	VERT.	LAT.	AXI-	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

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.

HANDLING and MOVING

The unit can be moved with a forklift or with rigging and a crane. Maximum unit weights are: RXF 12–19, 2288 lb; RXF 24–50, 3393 lb; RXF 58 and 68, 3495 lb; RXF 85 and 101, 3855 lb. The recommended method is to insert lengths of 2" pipe through the base tubing (see Figure 1 below).

⚠ CAUTION **Spreader bars should be used on both the length and width of the package to prevent bending oil lines and damage to the package. CAUTION must also be used in locating the lifting ring. 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.**

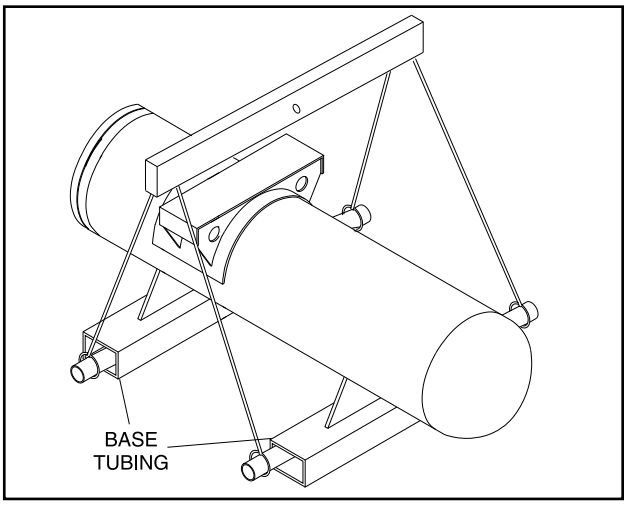


Figure 1

The unit can be moved with a forklift by forking through the base tubing. **NEVER MOVE THE UNIT BY PUSHING OR FORKING AGAINST THE SEPARATOR SHELL OR ITS MOUNTING SUPPORTS.**

COMPRESSOR/MOTOR COUPLINGS

RXF units are arranged for direct motor drive and include a flexible drive coupling to connect the compressor to the motor.

CH COUPLING

The T. B. Woods Elastomeric Type CH Coupling is used in most applications. This coupling consists of two drive hubs and a gear-type Hytrel or EDPM and neoprene 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. Because of the use of the motor/compressor adapter housing on the RXF, no field alignment is necessary.

⚠WARNING **It is mandatory that the coupling center be removed and the direction of motor rotation be confirmed *befo*re running the compressor. Proper rotation of the compressor shaft is clockwise looking at the end of the compressor shaft. Failure to follow this step could result in backward compressor rotation which can cause compressor failure or explosion of the suction housing.**

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.

4. 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.

5. 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.

6. 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.**

HOLDING CHARGE and STORAGE

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

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

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

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

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

COMPRESSOR OIL

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

⚠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. Normal operating level is between the top sight glass and bottom sight glass. Oil charge quantities are as follows:

RXF MODEL	BASIC CHARGE* (gal.)
12 – 19	10
24 – 50	11
58, 68	25
85, 101	36

*ADDITIONAL FOR OIL COOLER				
12 – 50 (Flat Plate)		58 – 101 (Plate & Shell)		
SIZE	GAL.	DIA.	PLATES	GAL.
5" x 20"	1/2	14"	66	2
10" X 20"	1	14"	116	3 1/2

CH COUPLING DATA TABLE

CH COUPLING SIZE	BETWEEN SHAFT SPACING MIN*		BETWEEN SHAFT SPACING MAX		COUPLING HUB SHAFT ENGAGEMENT MIN		COUPLING HUB SHAFT ENGAGEMENT MAX		COUPLING HUB FACE SPACING		CLAMP BOLT TORQUE DRY		CLAMP BOLT SIZE	KEYWAY SETSCREW TORQUE	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	ft-lb	Nm		ft-lb	Nm
6	2	50.8	2 3/4	69.9	1	25.4	1 15/16	49.2	7/8	22.2	15	20.3	1/4 - 20 UNC	13	17.6
7	2 5/16	58.7	3 7/16	87.3	1	25.4	2 3/16	55.6	1 1/16	27.0	30	40.7	5/16 - 24 UNF	13	17.6
8	2 9/16	65.1	4	101.6	1 1/16	27.0	2 1/2	63.5	1 1/8	28.6	55	74.6	3/8 - 24 UNF	13	17.6
9	3 1/16	77.8	4 5/8	117.5	1 7/16	36.5	3	76.2	1 7/16	36.5	55	74.6	3/8 - 24 UNF	13	17.6
10	3 9/16	90.5	5 1/4	133.4	1 11/16	42.9	3 1/2	88.9	1 11/16	42.9	130	176.3	1/2 - 20 UNF	13	17.6

Add oil by attaching the end of a suitable pressure-type hose to the oil charging valve, located towards the top of the oil separator in the middle of the vessel. 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 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.

The sight glass located near the bottom of the separator shell at the discharge end should remain empty when the unit is in operation. The presence of oil in this end of the vessel during operation indicates liquid carryover or malfunction of the oil return.

OIL HEATER

Standard units are equipped with 500 watt oil heaters, which provide sufficient heat to maintain the oil temperature for most indoor applications during shutdown cycles and to permit safe start-up. RXF 12–50 use one heater while models 58–101 use two. Should additional heating capacity be required because of an unusual environmental condition, contact Frick . The heater is energized only when the unit is not in operation.

⚠WARNING **Do not energize the heater when there is no oil in the unit, otherwise the heater will burn out. The oil heater will be energized whenever 120 volt control power is applied to the unit and the compressor is not running, unless the 16 amp circuit breaker in micro enclosure is turned off (or 15 amp fuse (1FU) in the Plus panel is removed).**

OIL FILTER(S)

⚠CAUTION **Use of filter elements other than Frick must be approved in writing by Frick engineering or warranty claim may be denied.**

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

THERMOSYPHON OIL COOLING

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 or plate-type vessel, cooling the oil. The vapor, at condensing pressure, is vented to the condenser inlet and reliquified. This method is the most cost effective of all currently applied cooling systems since no compressor capacity loss or compressor power penalties are 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 above the center of the oil cooler.

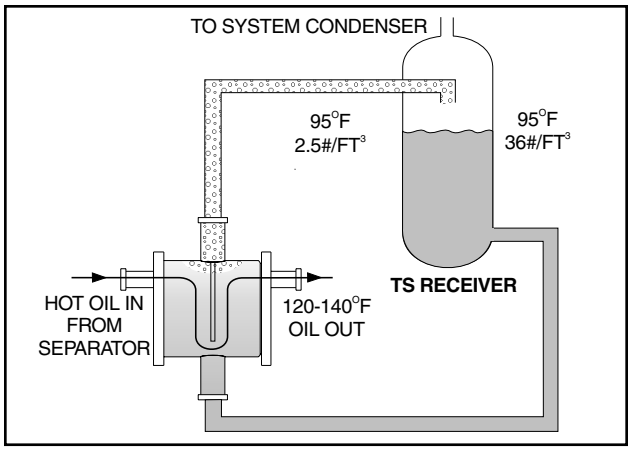


Figure 2

2. A shell and tube or plate-type oil cooler with a minimum 300 psi design working pressure on both the oil and refrigerant sides.

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

SYSTEM OPERATION: Liquid refrigerant fills the cooler tube side up to the Thermosyphon receiver liquid level.

Warm or 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 which 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.

INSTALLATION: The shell and tube or plate-type thermosyphon oil cooler with oil side piping and a thermostatically controlled mixing valve (optional) are factory mounted and piped.

The customer must supply and install all the 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 not be less than 8 feet above the center of the oil cooler.

3. A safety valve should be installed if refrigerant isolation valves are used for the oil cooler.

4. Frick recommends the installation of an angle valve in the piping before the thermosyphon oil cooler to balance the thermosyphon system. Frick also recommends the instal-

lation of sight glasses at the TSOC inlet and outlet to aid in troubleshooting.The factory-mounted plate-type thermosyphon oil cooler requires a refrigerant-side drain valve to be provided and installed by the customer.

FIELD WELDING INSTRUCTIONS: The following are requirements for welding to the socket weld fittings on FlatPlate brazed-plate heat exchangers:

1. Welding should be by the SMAW Process, E309 low-hydrogen welding electrode, 1/8" diameter or smaller.

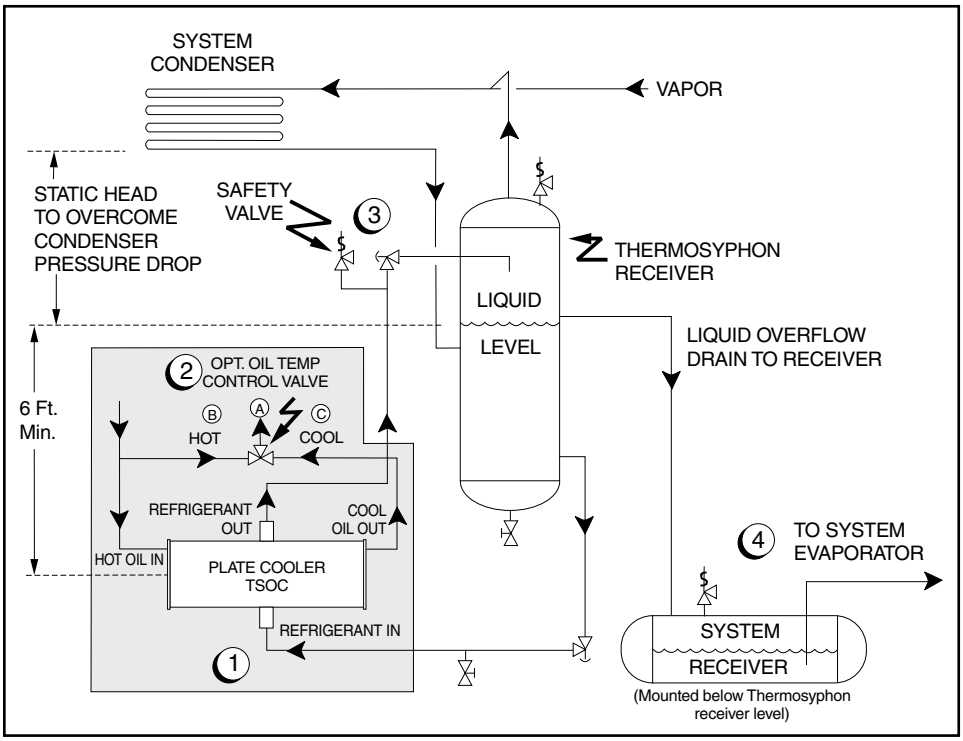
2. Welding should occur in two segments, from 6:00 to 12:00. The maximum intersegment temperature should be 350°F. Temperature should be verified with temperature indicating crayon or equivalent.

3. The fitting may be cooled with forced air to reduce the temperature of the fitting to 350°F or lower, prior to welding the second segment.

TSOC AND WCOC *OPTIONAL* OIL SIDE SAFETY RELIEF - Compressor units with flat plate oil coolers, 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 set to relieve at 75 psi delta P.

⚠ 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 will relieve into the separator vessel if the 75 psi delta P setpoint is exceeded.**



The component and piping arrangement shown in Figure 3 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.

Figure 3

1. Thermosyphon oil cooler is supplied with oil side piped to the compressor unit and stub ends supplied on the refrigerant side.
2. Three-way oil temperature control valve 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. System receiver must be mounted below thermosyphon receiver level in this arrangement.

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. 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 minimum 3/8" line connected into the solenoid valve provided. This gas is required by the expansion valve external port to control oil temperature.

High-stage compressor units may be supplied with single-port (low Vi) or dual-port (low Vi and high Vi), liquid injection oil cooling. Single port will be furnished for low compression ratio operation and dual port for high compression ratio operation. Booster compressor units use single-port, liquid injection oil cooling due to the typically lower compression ratios.

The control system on high-stage units with dual-port, liquid injection oil cooling switches the liquid refrigerant supply to the high port when the compressor is operating at higher compression ratios (3.5 Vi and above) for best efficiency.

The following table gives the condensing temperature(s) with the corresponding maximum evaporator temperature limit for liquid injection usage and the minimum evaporator temperature for a single-port application.

TABLE - EVAPORATOR TEMPERATURE with SINGLE-PORT LIQUID INJECTION

CONDENSING TEMP	MAXIMUM EVAP TEMP FOR LIQUID INJECTION USAGE		MINIMUM * EVAP TEMP FOR SINGLE PORT (LOW Vi)
	R-717	R-22	
75°F	+10°F	+5°F	-23°F
85°F	+25°F	+15°F	-17°F
95°F	+35°F	+25°F	-11°F
105°F	+40°F	+35°F	- 4°F

* Dual Injection Kit will be shipped by Frick below these temperatures.

REF	RXF MODEL	LIQ. LINE SIZE*		FLOW RATE (lb) 5 MIN	LIQUID VOLUME CU. FT.
		PIPE SCH 80	TUBING OD		
R-717 HIGH STAGE	12	1/2	–	10	.3
	15	1/2	–	12.5	.4
	19	1/2	–	15	.4
	24	1/2	–	20	.6
	30	1/2	–	25	.7
	39	1/2	–	30	.8
	50	3/4	–	40	1.1
	58	3/4	–	47	1.3
	68	3/4	–	55	1.6
	85	3/4	–	70	2.0
	101	3/4	–	80	2.3
R-22 HIGH STAGE	12	3/4	5/8	30	.4
	15	3/4	5/8	37.5	.5
	19	3/4	5/8	45	.6
	24	3/4	7/8	60	.8
	30	3/4	7/8	75	1.0
	39	3/4	7/8	95	1.3
	50	1	1-1/8	125	1.7
	58	1	1-1/8	145	1.9
	68	1	1-1/8	170	2.3
	85	1	1-1/8	210	2.8
	101	1	1-1/8	250	3.4
R-717 BOOSTER	12	1/2	–	2.0	.1
	15	1/2	–	2.5	.1
	19	1/2	–	3.5	.1
	24	1/2	–	4.5	.1
	30	1/2	–	5.5	.2
	39	1/2	–	6.5	.2
	50	1/2	–	8.5	.3
	58	1/2	–	10	.3
	68	1/2	–	12	.3
	85	1/2	–	15	.4
	101	1/2	–	18	.5
R-22 BOOSTER	12	3/4	5/8	6	.1
	15	3/4	5/8	7	.1
	19	3/4	5/8	9	.1
	24	3/4	5/8	12	.2
	30	3/4	5/8	14.5	.2
	39	3/4	5/8	18	.3
	50	3/4	5/8	24	.3
	58	3/4	5/8	28	.4
	68	3/4	5/8	33	.5
	85	3/4	5/8	41	.6
	101	3/4	5/8	50	.7

***** 100 ft. liquid line. For longer runs, increase line size accordingly.

Where low compression ratios (low condensing pressures) are anticipated, thermosyphon or water-cooled oil cooling should be used.

CAUTION **It is imperative that an uninterrupted 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. Failure to follow these requirements causes wire draw which can result in damage to the expansion valve. Two methods of accomplishing this are shown.**

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

DUAL DIP TUBE METHOD

The dual dip tube method uses two dip tubes in the receiver. The liquid injection tube is below the evaporator tube to assure continued oil cooling when the receiver level is low. See Figure 4.

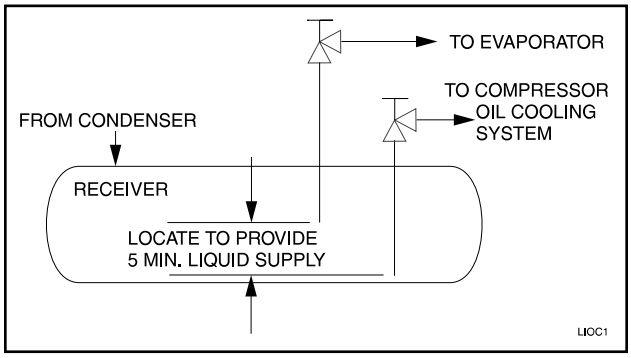


Figure 4

WATER-COOLED OIL COOLING

The flat plate or plate and shell-type water-cooled oil cooler is mounted on the unit complete with all oil piping. The customer must supply adequate water connections and install the two-way water regulating valve, if ordered. 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 into the chamber provided on the oil outlet connection. Determine the size of the water-cooled oil cooler supplied with the unit, then refer to the table for the water connection size and water flow range (GPM). The water supply must be sufficient to meet the required flow.

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

OIL COOLER DATA TABLE

TYPICAL COOLER		CONNECTION SIZE
RXF 12 – 50	5" x 20"	1½"
RXF 58 – 101	14" X 66 Plates	2"

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. **NOTE: The standard RXF microprocessor does not provide an output to turn the economizer solenoid on or off based on slide valve position.** If this control is required, specify the optional RXF Plus microprocessor. It provides an additional output to turn off the supply of flashing liquid when the capacity falls below approximately 45%-60% (85%-90% slide valve position). This is done to improve compressor operating efficiency. Please note however that shell and coil and DX economizers can be used at low compressor capacities in cases where efficiency is not as important as ensuring that the liquid supply is subcooled. In such cases, the economizer liquid solenoid can be left open whenever the compressor is running.

Due to the tendency of the port pressure to fall with decreasing compressor capacity, a back-pressure regulator valve (BPR) is generally required on a flash economizer system (Figure 7) 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 will be at suction pressure. 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 and a check valve between the economizer vessel and the economizer port on the compressor. The strainer prevents dirt from passing into the compressor and the check valve prevents oil from flowing from the compressor unit to the economizer vessel during shutdown.

CAUTION

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

For refrigeration plants employing multiple compressors on a common economizing vessel, regardless of economizer type, each compressor must have a back-pressure regulating valve in order to balance the economizer load, or gas flow, between compressors. The problem of balancing load becomes most important when one or more compressors run at partial load, exposing the economizer port to suction pressure. In the case of a flash vessel, there is no need for the redundancy of a back-pressure regulating valve on the vessel and each of the multiple compressors. Omit the BPR valve on the flash economizer vessel and use one on each compressor, as shown in Figure 8.

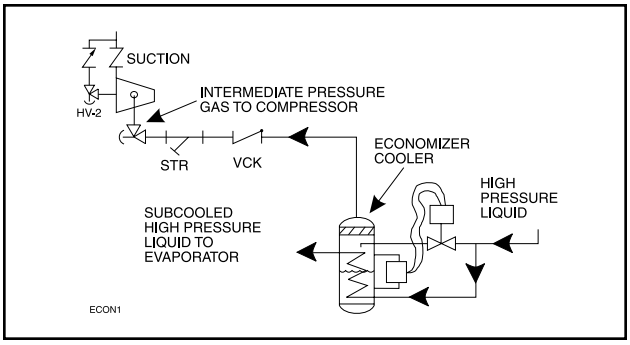


Figure 5 - Shell And Coil Economizer System

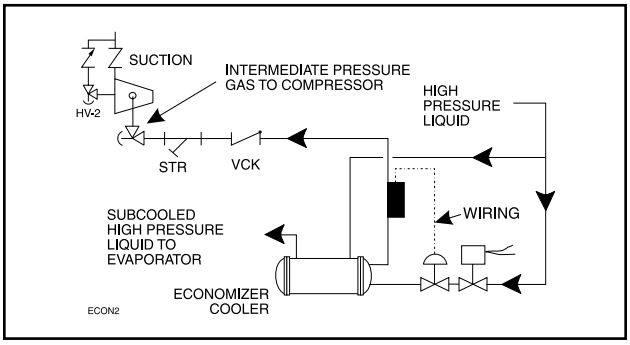


Figure 6 - direct expansion economizer system

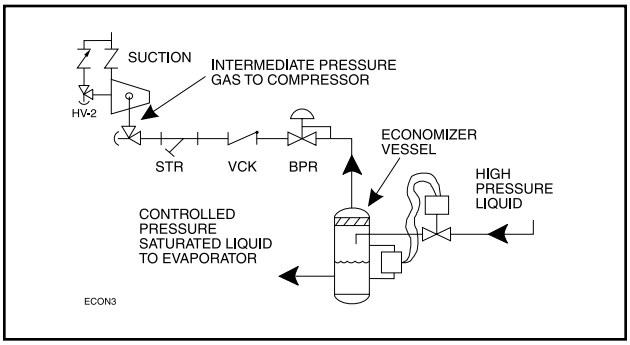


Figure 7- Flash Economizer System

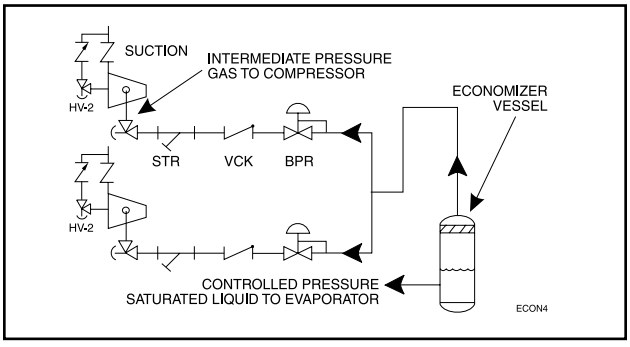


Figure 8 - Multiple Compressor Economizer System

ELECTRICAL

NOTE: Before beginning electrical installation, read the instructions in the section "Proper Installation of Electronic Equipment".

RXF units are supplied with a *QUANTUM* control system. Care must be taken that the controls are not exposed to physical damage during handling, storage, and installation. The microprocessor enclosure cover must be kept tightly closed to prevent moisture and foreign matter from entering.

CAUTION **All customer connections are made in the Quantum control panel(s) mounted on the unit. This is (these are) the ONLY electrical enclosure(s) and should be kept tightly closed whenever work is not being done inside. (NOTE: models 12 – 50 have two panels; models 58 – 101 have one panel).**

MOTOR STARTER PACKAGE

WARNING **SBC Board damage may occur without timer relay installed in control panel as shown in schematic below. All Frick motor starter packages have the timer relay as standard.**

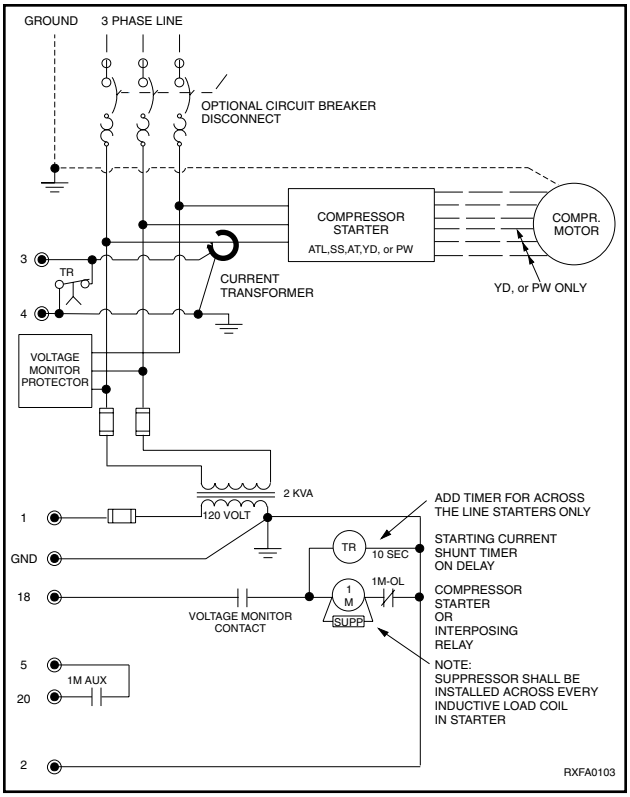


Figure 9

Motor starter and interlock wiring requirements are shown in the wiring diagram, Figure 9. All of the equipment shown is supplied by the installer unless a starter package is purchased separately from Frick . Starter packages should consist of:

1. The compressor motor starter of the specified horsepower 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 sufficient starting torque is available. Contact Frick if assistance is required.

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

3. A 2.0 KVA control power transformer (CPT) to supply 120 volt control power to the control system and separator oil heaters is included. If environmental conditions require more than 1000 watts of heat, an appropriately oversized control transformer will be required.

4. One normally open compressor motor starter auxiliary contact should be supplied and wired as shown on the starter package wiring diagram. In addition, the compressor starter coil and the CPT secondaries should be wired as shown on the starter package wiring diagram.

5. The compressor motor Current Transformer (CT) can be installed on any one phase of the compressor leads. **NOTE: the CT must see all the current on any one phase, therefore in wye-delta applications BOTH leads of any one phase must pass through the CT.**

CURRENT TRANSFORMER TABLE

	VOLTAGE				
HP	**200**	**230**	**380**	**460**	**575**
15	100	50	50	50	50
20	100	100	50	50	50
25	100	100	100	50	50
30	200	100	100	50	50
40	200	200	100	100	50
50	200	200	100	100	100
60	300	200	200	100	100
75	300	300	200	200	100
100	400	300	300	200	200
125	500	400	300	200	200
150	600	500	400	300	200
200	800	600	500	300	300
250	1000	800	600	400	300
300	1000	1000	800	500	400
350	–	1000	800	600	500
400	–	–	800	600	600

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

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

BATTERY BACKUP

The battery backup for the *QUANTUM* panel is used only for date and time retention during power interruption. All setpoints and other critical information are saved on EE-PROM chips.

NOTE: It is not necessary to disconnect the battery backup during extended downtime.

NOTE: The microprocessor will not operate without U24 and U35 EPROM chips installed. When U24 and U35 EPROM chips are not installed, the screen will display:

System Board Initialized

No boot device available,

Press enter to continue.

OPERATION and START-UP INSTRUCTIONS

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

Control Panel (See publication S90-010 O, M, & CS for *QUANTUM™* Panel, S70-400 OM for Mini panel, and S70-401 IOM for Plus panel); Compressor; Compressor Lubrication System; Compressor Oil Separation System; Compressor Hydraulic System; 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 RXF Rotary Screw Compressor Unit.

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

RXF COMPRESSOR

The Frick **RXF** rotary screw compressor utilizes mating asymmetrical profile helical rotors to provide a continuous flow of refrigerant vapor and is designed for high 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 angular contact ball bearings to carry axial loads are mounted at the discharge end of compressor.

3. Moveable slide valve to provide infinite step capacity control from 100% to 25% of full load capacity.

4. VOLUMIZER® II adjusts to the most efficient of three volume ratios (2.2, 3.5 or 5.0) depending upon system requirements.

5. Hydraulic cylinders to operate the volumizer slide stop and slide valve.

6. Compressor housing suitable for 350 PSI pressure.

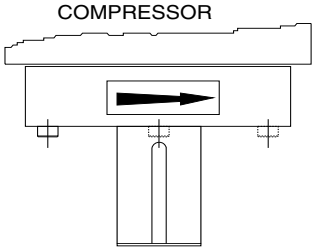
7. Most bearing and control oil is vented to closed threads in the compressor instead of suction port to avoid performance penalties from superheating suction gas.

8. The shaft seal is designed to maintain operating pressure on the seal well below discharge pressure for increased seal life.

9. Oil is injected into the rotors to maintain good volumetric and adiabatic efficiency, even at very high compression ratios.

⚠CAUTION

Compressor rotation is clockwise when facing the end of the compressor drive shaft. The compressor should never be operated in reverse rotation as bearing damage will result.



COMPRESSOR LUBRICATION SYSTEM

The **RXF** compressor is designed specifically for operation without an oil pump for high stage service. Boosters and some low-differential pressure applications will require the full-lube pump option.

The lubrication system on an **RXF** screw compressor unit performs several functions:

1. Lubricates the rotor contact area, allowing the male rotor to drive the female rotor on a cushioning film of oil.

2. Provides lubrication of the bearings and shaft seal.

3. Serves to remove the heat of compression from the gas, keeping discharge temperatures low and minimizing refrigerant or oil breakdown.

4. Fills gas leakage paths between or around the rotors with oil, thus greatly reducing gas leakage and maintaining good compressor performance even at high compression ratios.

5. Provides oil pressure for development of balance load on the balance pistons to reduce bearing loading and increase bearing life.

NO PUMP OIL SYSTEM

The RXF 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 high-stage operation an oil pump is not required.

COLD-START SYSTEM

The RXF package is equipped with a special "cold-start" discharge check valve on the gas outlet connection of the oil separator. This valve causes the oil separator to develop oil pressure rapidly on initial start in order to lubricate the compressor without requiring an oil pump, even in cold ambient temperatures with all pressures equalized. See Figure 10.

For high-stage packages, the cold-start valve is equipped with a large spring that creates 30 psi of pressure in the oil separator (above suction pressure), for lubrication of the compressor.

DO NOT ATTEMPT TO SERVICE THE COLD-START VALVE. PLEASE CONTACT THE FRICK SERVICE DEPARTMENT.

Once the compressor is running it will begin to force gas to the condenser at connection P2. As the condenser heats up it will begin to rise in pressure as the compressor suction pulls down in pressure. As soon as differential pressure is developed between the condenser and suction, these pressures act across a piston inside the cold-start valve to partially overcome the spring force. When the differential pressure reaches and exceeds 30 psi, the piston fully overcomes the spring force and powers the valve fully open for very low operating pressure drop.

For booster applications, the valve is equipped with a lighter spring which produces 15 psi oil pressure above suction pressure before it fully powers open.

The RXF package is also equipped with a suction check valve bypass. The oil separator will slowly bleed down to system suction pressure when the unit is stopped. This allows the compressor drive motor to have an easier start, and the discharge check valve will seat more tightly. See the "SUCTION CHECK VALVE BYPASS" section for operation.

NOTE: For alarm descriptions and shutdown or cutout parameters, see publication S90-010 O.

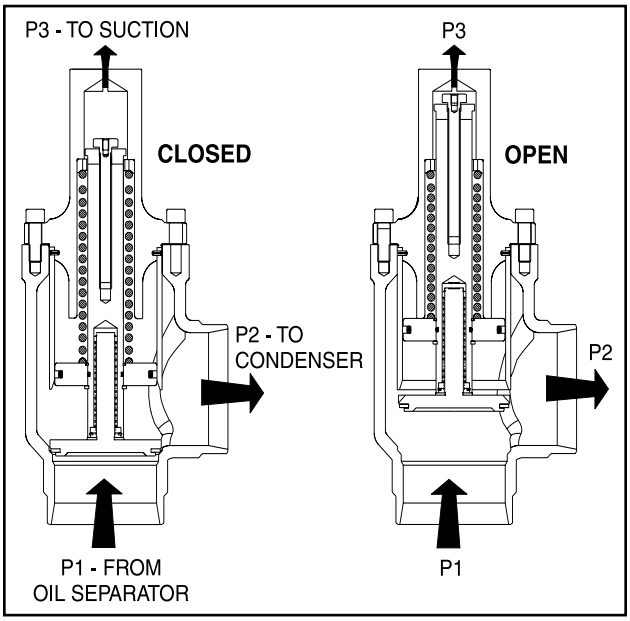


Figure 10

DEMAND PUMP OIL SYSTEM

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

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.

NOTE: For alarm descriptions and shutdown or cutout parameters, see publication S90-010 O.

COMPRESSOR OIL SEPARATION SYSTEM

The RXF 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. The coalescer filter element then coalesces 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 an angle valve (HV1). See Figure 11.

NOTE: Open angle valve (HV1) only enough to keep the coalescer end of the 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

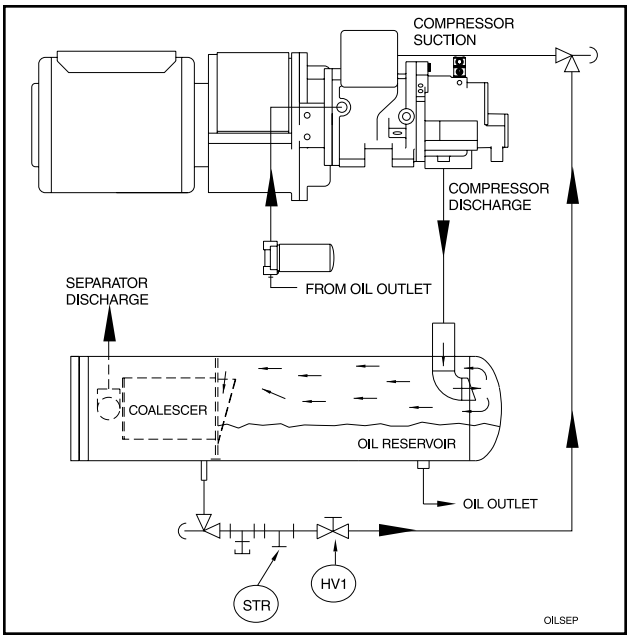


Figure 11

compressor operation has developed. Refer to Maintenance for information on how to correct the problem.

NOTE: The normal operating level is midway in the top sight glass located midway along the oil separator shell.

COMPRESSOR HYDRAULIC SYSTEM

The hydraulic system of the RXF compressor utilizes oil pressure from internally drilled passages in the compressor casing to selectively load and unload the compressor by applying this pressure to the actuating hydraulic piston of the movable slide valve (MSV). It also uses oil pressure to actuate a hydraulic piston that moves the movable slide stop, Volumizer® II. This allows adjustment of the compressor volume ratio, (Vi) while the compressor is running.

CAPACITY CONTROL

COMPRESSOR LOADING: The compressor loads when MSV solenoid coil YY2 is energized and oil flows from the solenoid valve through the needle valve (HV2) to compressor port 2, where it enters the load side of the slide valve piston. This equalizes the force on the slide valve piston and discharge pressure on the slide valve area loads the compressor. See Figure 12.

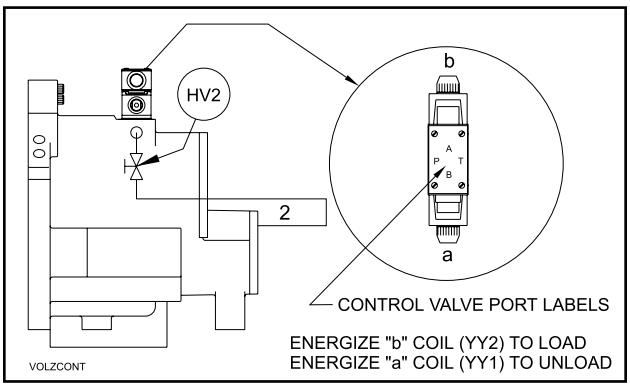


Figure 12

COMPRESSOR UNLOADING: The compressor unloads when MSV solenoid YY1 is energized and oil is allowed to flow from compressor port 2 thru the needle valve to the MSV solenoid. This allows discharge pressure on the slide valve piston to unload the slide valve as the piston moves outward.

ADJUSTMENT (Capacity Control): A needle valve (HV2) is provided to adjust slide valve travel time, preventing excessive slide valve "hunting". HV2 should be adjusted to restrict oil flow to the compressor port so that slide valve travel time from full load to full unload, or vice versa, is a minimum of 30 seconds.

NOTE: A change in operating conditions, such as winter to summer operation, may require readjustment of slide valve travel time.

VOLUMIZER® II Vi CONTROL

The RXF compressor is equipped with a special internal control that automatically adjusts the compressor volume ratio to the most efficient of three available steps, (2.2, 3.5, or 5.0 volume ratio). This gives the compressor the ability to operate at varying operating conditions while minimizing power consumption by avoiding over or undercompression.

Solenoid valves 3 and 4 control the Volumizer® II volume ratio control. Oil is internally ported to apply hydraulic pressure to two stepping pistons in order to move the moveable slide stop to the optimum position. The following chart shows the logic of solenoid operation to adjust the volume ratio.

Vi	YY3	YY4
2.2	Energized	Energized
3.5	Deenergized	Energized
5.0	Deenergized	Deenergized

Proper operation of the Volumizer® II control can be checked as follows.

1. Remove the potentiometer cover from the side of the compressor (see the Slide Valve Position Potentiometer Replacement and Adjustment section).

2. With the compressor running, adjust the volume ratio to manual 2.2 Vi.

3. Manually load the slide valve to 100%, until no further motion is observed on the pushrod that contacts the end of the potentiometer.

4. Manually increase the volume ratio to 3.5. The pushrod should move in by approximately .115 inches.

5. Further increase the volume ratio to manual 5.0. Again observe the pushrod. It should move into the compressor by approximately .062 inches.

6. If the above motions are observed, the Volumizer® II is operating normally. If motion is not observed, go to the troubleshooting section.

COMPRESSOR OIL COOLING SYSTEMS

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

Oil cooling systems maintain oil temperature within the following ranges for R-717 and R-22:

Liquid Injection Oil Cooling - 130 - 150°F
External* Oil Cooling - 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. See Figure 13.

Solenoid valve (YY7) is energized by the microprocessor when the oil temperature element (TE3), installed in the oil piping, exceeds the liquid injection cutout (LICO) setpoint. High pressure liquid refrigerant is then supplied to the temperature control valve (TCV1). The temperature control valve is equalized to a constant back pressure by the differential pressure control valve (PCV1) (see **LIQUID INJECTION ADJUSTMENT PROCEDURE**). 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.

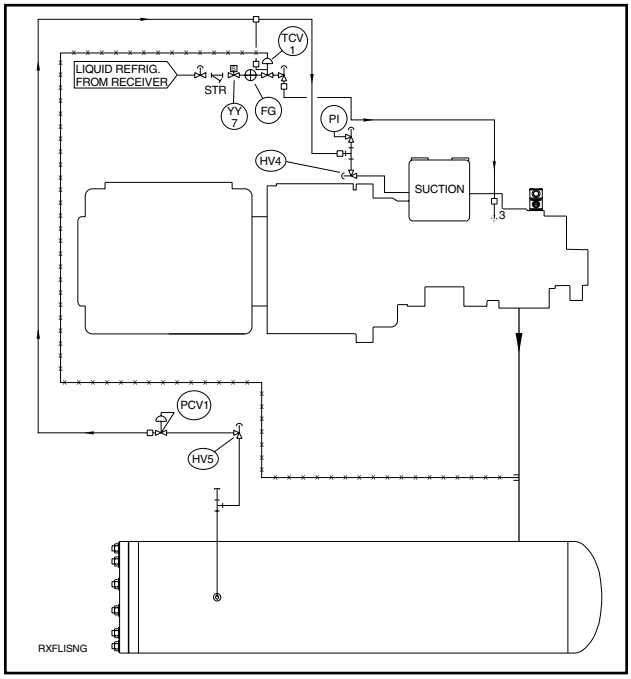


Figure 13

BOOSTER APPLICATION - Discharge gas from the high- stage compressor is required to assist the differential pressure control valve (PCV1) in providing the temperature control valve (TCV1) with a constant back pressure.

A solenoid valve YY6 is installed before the differential pressure control valve (PCV1) to prevent migration of high-pressure gas during shut down. see Figure 14.

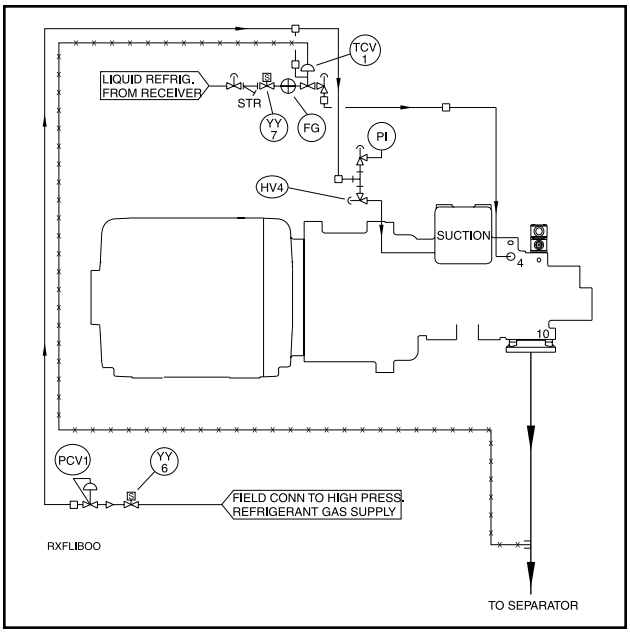


Figure 14

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 on the compressor. See Figure 15.

The dual-port system contains all the components of the single-port system with the addition of a double-acting solenoid valve (YY9) and operates as outlined.

Solenoid valve (YY7) is energized by the microprocessor when the temperature element (TE3) installed in the oil manifold exceeds the (LICO) setpoint. Liquid refrigerant is then passed through the temperature control valve (TCV1) to the double-acting solenoid valve (YY9). Depending on the compressor's operating volume ratio Vi, the microprocessor will select the flow of the liquid refrigerant to either compressor port 3 or port 4.

When the compressor operates at 3.5 or 2.2 Vi, compressor port 3 supplies the liquid cooling. At 5.0 Vi, port 4 supplies the liquid cooling.

The temperature control valve (TCV1) is equalized to a constant back pressure by the differential pressure control valve (PCV1).

Both the differential pressure control valve (PCV1) and the double-acting solenoid valve (YY9) 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 val ves.

LIQUID INJECTION ADJUSTMENT PROCEDURE

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

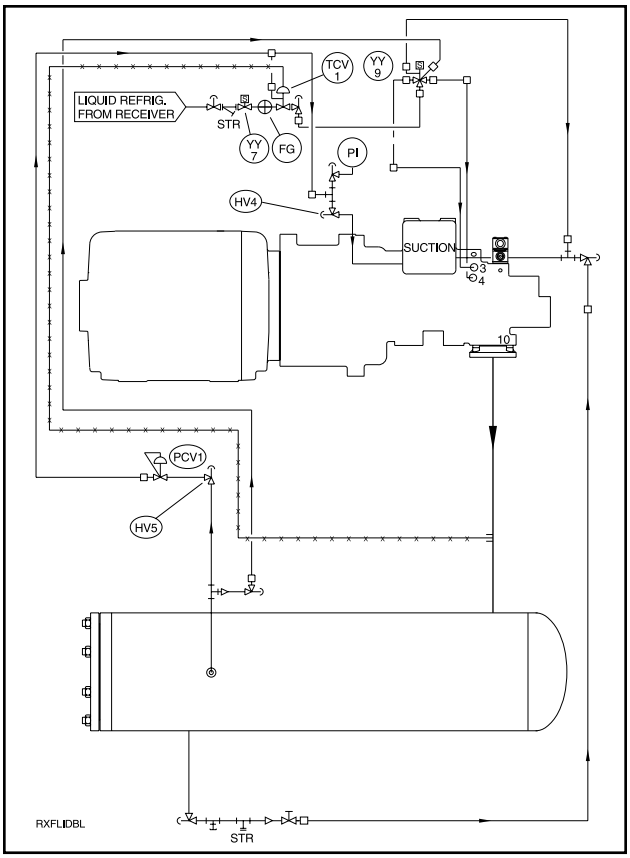


Figure 15

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

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

For low temperature oil – 125° to 135°F

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

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

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

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

For high temperature oil – 160° to 170°F

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

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

Next, adjust the pressure regulating valve to approximately 30 psig by turning the adjustment ring inside the top of the valve with a 5/16" Allen wrench . Turn the wrench clockwise to raise the oil temperature, and counter-clockwise to lower the oil temperature. After the adjustment has been made wait until the oil and discharge temperatures have had a chance to stabilize before readjusting. The end result should be between 160° and 170°F.

Liquid Injection Oil Cooling - Ammonia

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

If the unit is using Ammonia as a refrigerant and is for low temperature the Sporlan number on the power head should be Y764 or Y830. Set the oil temperature for135°F.

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

Liquid Injection Oil Cooling - Halocarbon

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

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

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

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

Set the oil temperature cutout for 180°F.

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

INITIAL START-UP PROCEDURE

Having performed the checkpoints on the prestart checklist, 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. On start-up the unit should be operated at as high a load possible for 3 hours. During the period, adjust liquid injection oil cooling if applicable. If unit has water-cooled oil cooling, adjust water control valve to cooler.

2. The compressor slide valve potentiometer should be calibrated.

3. Pull and clean suction strainer after 24 hours operation. If it is excessively dirty, repeat every 24 hours until system is clean. Otherwise, follow the Maintenance Schedule. See the Recommended Maintenance Program section.

SUCTION STRAINER CLEANING PROCEDURE

1. Open disconnect switch.

2. Isolate the package by closing all package valves to the system. Tag all closed valves.

⚠ CAUTION **Open any solenoid valves or other valves that may trap liquid between the isolation valves and other package valves to prevent injury or damage to components.**

3. With liquid injection, close the manual hand valve upstream of YY7 and manually open YY7 by turning in the manual opening stem (clockwise viewed from below valve).

⚠ CAUTION **Failure to do this will damage valve YY7.**

4. SLOWLY vent the separator to low-side system pressure using the suction check valve bypass. **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 transfer and recovery procedure, if necessary.**

5. Remove cover plate.

6. Remove strainer.

7. Clean strainer.

8. Reinstall the strainer in the proper direction (outboard end is marked) and replace the gasket.

⚠ CAUTION **If the strainer is installed backwards, it will be damaged.**

9. Pressurize and leak test. Evacuate unit to 29.88" Hg (1000 microns).

10. First, reset solenoid valves to automatic position then open all valves previously closed. Remove tags. Close disconnect switches for compressor. Start unit.

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. At start-up, the slide stop (volumizer) and the slide valve (capacity control) are in the **AUTO** mode.

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

1. Check **ADJUSTABLE** setpoints.

2. Follow normal start-up procedure.

MAINTENANCE

This section provides instructions for normal maintenance, a recommended maintenance program, troubleshooting and correction guides, typical wiring diagrams and typical P and I diagrams.

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, PUSH [STOP] KEY TO SHUT DOWN THE UNIT.**
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 finds it 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 probable 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 (six months) shutdown, use the following procedure:

1. Push **[STOP]** key to shut down unit.

2. Open disconnect switch for compressor motor starter.

3. Turn off power.

4. Isolate the package by closing all package valves to the system. Tag all closed valves.

CAUTION **Open any solenoid valves or other valves that may trap liquid between the isolation valves and other package valves to prevent injury or damage to components.**

5. With liquid injection, close the manual hand valve upstream of YY7 and manually open YY7 by turning “in” the manual opening stem (clockwise viewed from below valve).

6. Shut off the cooling water supply valve to the oil cooler. Drain water, if applicable. Attach **CLOSED** tags.

7. Protect oil cooler from ambient temperatures below freezing or remove water heads.

NOTE: The unit should be inspected monthly during shutdown. Check for leaks or abnormal pressure. Use the maintenance log to record readings to verify the pressure stability of the unit. To prevent the seals and bearing from drying out, run oil pump (if available) and manually rotate the compressor shaft. Consult motor manufacturer for motor recommendations.

TO START UP AFTER SEASONAL OR PROLONGED SHUTDOWN, USE THE FOLLOWING PROCEDURE :

1. Perform routine maintenance. Change oil and replace filters. Check strainers.

2. Any water necessary for the operation of the system that may have been drained or shut off should be restored or turned on. If oil cooler heads were removed, reinstall and remove tags.

3. Reset solenoid valves to automatic position, then open all valves previously closed. Remove tags.

4. Compressor unit is ready for prestart checks. Refer to **PRESTART CHECKLIST.**

COMPRESSOR/MOTOR SERVICING

Before removing the motor from an RXF unit, it is critical that proper support be provided for the compressor to prevent damage to the oil separator. Insert blocks or a jack

between the separator shell and compressor casting. Make sure the weight is held safely by the separator shell. Loosen the compressor discharge flange bolts to relax any flange and pipe stress, then carefully remove the motor. Similarly, before removing the compressor for servicing, the back end of the motor must be supported to prevent damage. Again, insert either blocks or a jack between the rear of the motor and the separator shell.

GENERAL INSTRUCTIONS FOR REPLACING COMPRESSOR UNIT COMPONENTS

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

1. Push **[STOP]** key to shut down the unit.

2. Open disconnect switches for compressor motor starter and oil pump motor starter (if applicable).

3. Isolate the package by closing all package valves to the system. Tag all closed valves.

⚠ CAUTION **Open any solenoid valves or other valves that may trap liquid between the isolation valves and other package valves to prevent injury or damage to components.**

4. SLOWLY vent separator to low-side system pressure using the suction check valve bypass. **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 transfer and recovery procedure, if necessary.**

5. Make replacement or repair.

6. Isolate the low pressure transducer, PE-4, to prevent damage during pressurization and leak test.

7. Pressurize unit and leak test.

8. Evacuate unit to 29.88" Hg (1000 microns).

9. Open all valves previously closed and reset solenoid valves to automatic position. Remove tags.

10. Close disconnect switches for compressor motor starter and oil pump motor starter, if applicable.

11. Unit is ready to put into operation.

OIL FILTER, SPIN-ON (RXF 12 – 50)

⚠ CAUTION **Use of oil filters other than Frick may cause warranty claim to be denied.**

To change the filter proceed as follows:

1. Push **[STOP]** key to shut down the unit. Open disconnect switches for the compressor.

2. Isolate the package by closing all package valves to the system. Tag all closed valves.

⚠ CAUTION **Open any solenoid valves or other valves that may trap liquid between the isolation valves and other package valves to prevent injury or damage to components.**

SLOWLY vent separator to low-side system pressure using the suction check valve bypass. **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 transfer and recovery procedure, if necessary.**

3. Remove spin-on oil filter element and discard.

4. Replace with new oil filter element. Make finger tight plus an additional half turn.

5. Isolate the low pressure transducer, PE-4, to prevent damage during pressurization and leak test.

6. Pressurize and leak test. Evacuate unit to 29.88" Hg (1000 microns).

7. Open the suction and discharge service valves, and the low pressure transducer. Close disconnect switches for the compressor. Start the unit.

OIL FILTER, SINGLE ELEMENT (58 – 101)

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

To change the filter cartridge proceed as follows:

1. If a single oil filter is installed, push **[STOP]** key to shutdown the unit. Open disconnect switches for the compressor and (if applicable) oil pump motor starters.

2. Close discharge service valve. **SLOWLY** vent the separator to low-side system pressure using the suction check valve bypass. Close suction valve and suction check valve bypass. **NOTE: Recover or transfer all refrigerant vapor, in accordance with local ordinances, before opening to atmosphere. The oil filter cartridge MUST be equalized to atmospheric pressure before opening.**

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

3. Close oil filter isolation valves. Open drain valve on oil filter head and drain the oil. Remove the canister cover. Discard the cartridge and gasket.

4. Flush the filter body with clean Frick refrigeration oil; wipe dry with a clean, lint-free cloth; and close drain valve.

5. Place a new cartridge in the filter canister. Replace the gasket and spring and reinstall the canister cover. Torque cover bolts in sequence to:
a. Finger tight
b. 17 ft-lb
c. 35 ft-lb

6. Isolate the low pressure transducer, PE-4, to prevent damage during pressurization and leak test.

7. Pressurize and leak test. Evacuate the unit to 29.88" hg (1000 microns).

8. Add 2 gallons of oil by attaching a suitable pressure-type hose to the oil-charging valve located on top of the separator. Use a pressure-type oil pump and recommended Frick oil.

9. Open the suction and discharge service valves, oil filter isolation valves, and the low pressure transducer. Readjust suction check valve bypass. Close disconnect switches for the compressor and (if applicable) the oil pump motor starters. Start the unit.

COALESCER OIL RETURN STRAINER

1. Push **[STOP]** key to shut down the unit. Open disconnect switches for the compressor.

2. Isolate the package by closing all package valves to the system. Tag all closed valves.

⚠ CAUTION **Open any solenoid valves or other valves that may trap liquid between the isolation valves and other package valves to prevent injury or damage to components.**

SLOWLY vent separator to low-side system pressure using the suction check valve bypass. **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 transfer and recovery procedure, if necessary.**

3. Close strainer isolation valves. Remove the large plug from the bottom of the strainer and remove the element from the strainer.

4. Wash the element in solvent and blow clean with air.

5. Replace the cleaned element and removed plug. Open strainer isolation valves.

6. Isolate the low pressure transducer, PE-4, to prevent damage during pressurization and leak test.

7. Pressurize and leak test. Evacuate unit to 29.88" Hg (1000 microns).

8. Open the suction and discharge service valves, and the low pressure transducer. Close disconnect switches for the compressor. Start the unit.

LIQUID INJECTION STRAINER

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

1. Push **[STOP]** key to shut down the unit, then open disconnect switches for the compressor.

2. Close the liquid supply service valve located before the 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 the service valve located between the compressor and the liquid injection thermal expansion 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 the strainer.

9. Open the service valve between the compressor and the liquid injection thermal expansion valve, purge entrained air, and check for leakage.

10. Screw out the manual solenoid valve stem.

11. Carefully open the liquid supply service valve.

12. Leak test.

13. Close disconnect switches for compressor starter.

14. Start the unit.

OIL PUMP STRAINER (Optional)

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

1. Push **[STOP]** key to shut down the unit, then open the disconnect switches for the compressor and (if applicable) the oil pump motor starters.

2. Close strainer service valves.

3. Open the drain valve located in the strainer cover and drain the oil into a container.

4. Remove the capscrews securing the strainer cover, strainer cover gasket, and element. Retain the gasket.

5. Wash the element in solvent and blow it clean with air.

6. Wipe the strainer body cavity clean with a lint-free clean cloth.

7. Replace the cleaned element and gasket, then reattach the cover using the retained capscrews.

8. Reinstall the drain plug and open the strainer service valves.

9. Check for leakage.

10. Close the disconnect switches for the compressor and (if applicable) the oil pump motor starters.

11. Start the unit.

SUCTION CHECK VALVE BYPASS

A 1/4" angle valve (HV3 on P & I diagram) is installed between the compressor and suction flange that can be used as a suction valve bypass. This feature has several uses including reducing starting torque, improving oil quality, and relieving the refrigerant to low side for servicing.

In most cases, the valve should be left open approximately 1 to 2 turns at all times. If the compressor back-spins or too much oil foaming is experienced while venting, partially close valve to slow speed of equalization. If system is on AUTO CYCLE and short cycling occurs, the valve must be closed. If compressor is piped to an economizer or sideload without a solenoid valve that closes when compressor is off, HV-3 must be closed.

To relieve refrigerant to low side, close separator discharge service valve. Slowly open bypass valve (if closed) and wait for pressure to equalize. Close bypass and suction service valves before evacuating the unit.

COALESCER FILTER ELEMENT

CAUTION **Use of coalescer filter elements other than Frick must be approved in writing by Frick engineering or warranty claim may be denied.**

When changing the coalescer filter element, it is recommended that the oil and oil filter be changed. Applicable strainer elements should be removed and cleaned.

1. Refer to **CHANGING OIL**, Steps 1 thru 8.

2. Remove coalescer head and gasket. Discard the gasket.

3. Remove and retain nut securing coalescer filter retainer.

4. Remove retainer, coalescer filter element(s), and two O-rings. Discard the filter element(s).

5. Install new coalescer filter element(s).

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

6. Replace coalescer filter retainer and nut. Tighten the nut to 21 ft/lb torque. **DO NOT OVERTIGHTEN NUT.** Install jam nut and tighten.

7. Install a new head gasket and replace the coalescer head.

8. Tighten the head bolts, first to finger tight, then 65 ft-lb, then 130 ft-lb. **NOTE: WHEN THE COMPRESSOR UNIT IS REPRESSURIZED, RETIGHTEN SINCE HEAD BOLTS WILL LOOSEN.**

9. Refer to **CHANGING OIL**, Steps 9 thru 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 may cause warranty claim to be denied.**

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

1. Push **[STOP]** key to shut down the unit.

2. Open disconnect switch for the compressor motor starter.

3. Close liquid injection service valves (if applicable).

4. Close discharge service valve. **SLOWLY** vent the separator to low-side system pressure using the suction check valve bypass. Close suction valve. **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 drain valve(s) located on the underside of the separator and drain the oil.

6. Drain oil filter, strainers, and oil cooler, if applicable.

7. Remove and install new oil filter element.

8. Remove, clean, and reinstall strainer elements in strainers.

9. Evacuate unit to 29.88" Hg (1000 microns).

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 oil level is midway in the top sight glass. **NOTE: Fill slowly because oil will fill up in the separator faster than it shows in the sight glass.** See Oil Charge section.

12. Open discharge and liquid injection service valves.

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 (see Maintenance Schedule):

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

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, at exactly the same percent 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. For additional information, request Frick publication E70-902 IB.

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 and air or other contaminants. In order to ensure the quality of the refrigeration oil in the compressor unit:

1. Only use Frick refrigeration oil or high quality refrigeration oils approved by Frick for your application.

2. Only use Frick filter elements. Substitutions must be approved in writing by Frick engineering or warranty claim may be denied.

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

MOTOR BEARINGS

⚠ CAUTION **Lubricate motor bearings properly before start-up. Maintain subsequent lubrication as recommended by the motor manufacturer. See Figure 16.**

OPERATING LOG

The use of an operating log, as shown 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.

LUBRICATION SCHEDULE / INSTRUCTIONS

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

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

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

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

THE FACTORY INSTALLED, RECOMMENDED LUBRICANT IS LISTED ON THE MOTOR DATA PLATE. THE FOLLOWING PRODUCTS ARE DEEMED SUITABLE LUBRICANTS UNDER NORMAL SERVICE CONDITIONS BUT MAY NOT BE CHEMICALLY COMPATIBLE OR INTERCHANGEABLE ONE TO THE OTHER OR CORRECT FOR ALL AMBIENT OR SERVICE CONDITIONS. FOLLOW ALL MANUFACTURER'S GUIDELINES WHEN INTRODUCING ALTERNATES - WHEN DOUBT EXISTS, PURGE THE BEARINGS AS DESCRIBED IN THE INSTRUCTION MANUAL.

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

Figure 16

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

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

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 unit's liquid injection will overfeed and oil temperature will drop. In solving the wrong problem a new problem was created.

The following list of abnormal system conditions can cause abnormal operation of the **RXF** 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 (carryover).

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 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

Test Procedure:

1. Shut compressor down and allow pressures to equalize.

2. Isolate suction transducer (PE-1) from 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-1) on connector (P2) (terminals WHT and BLK) on the SBC with a digital voltmeter.

4. The voltage reading should be between 1.48 VDC and 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. Barometric pressure can generally be ignored but in extreme cases may be compensated for by adding/subtracting 0.002 VDC for each 0.1 inch of barometric pressure (adjusted to sea level) above/below 0 PSIG. Therefore, if (PE-1) 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. Subtract 1 from the voltage.

6. Multiply by 25.

7. This result is the absolute suction pressure (PSIA). Subtract 14.7 to obtain PSIG which the Operating display will indicate.

8. Isolate the oil pressure transducer (PE-1) 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-1) on connector (P2) (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. (PE-1) and (PE-3) 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.

PRESSURE TRANSDUCER CONVERSION DATA								
Sensor Voltage	100 psi Range - PSIG*		200 psi Range - PSIG*		300 psi Range - PSIG*		500 psi 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.

11. Subtract 1.2 from the voltage.

12. Multiply by 75, the result will be PSIG.

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

14. Measure the voltage of (PE-3) on connector (P2) (terminals WHT and BLK) on the SBC.

15. Measure the voltage of (PE-1) on connector (P2) (terminals WHT and BLK) on the SBC.

16. Test 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" section before going to step 3.**

3. Use the chart to identify transducer terminals of the SBC.

TRANSDUCER	CONNECTION
Suction Pressure	PE-4
Discharge Pressure	PE-3
Oil Pressure	PE-1

4. Disconnect transducer leads by loosening the terminal screws for the transducer to be changed.

5. Tape a 3 foot length of pull wire to the leads of the transducer to be removed.

6. 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.**

7. Install new transducer and tape leads to the pull wire.

8. Pull new transducer leads into the microprocessor console and reconnect them to the terminal strip.

9. Reopen the transducer isolation valve or compressor package isolation valves.

10. Turn on control power.

SLIDE VALVE POSITION POTENTIOMETER REPLACEMENT AND ADJUSTMENT

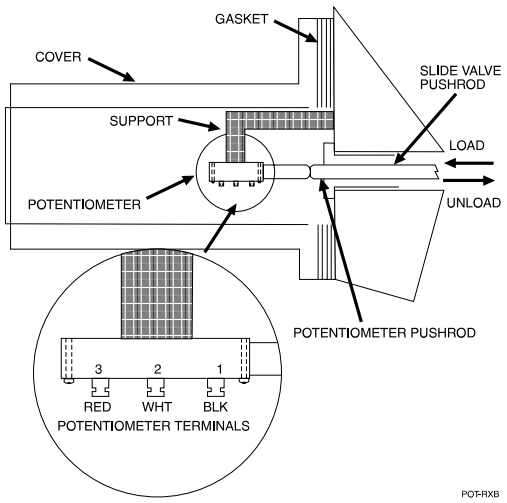


Figure 16
The slide valve potentiometer is located under a cover on the right side of the compressor (facing shaft) at the outlet end.

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.
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 #3 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 #3 and POT #2 are interactive and POT #2 may require adjustment to allow POT #3 to come into range.

Completely load the slide valve at 2.2 Vi. The display at this time should indicate 100%. If the display is less than 100%, adjust potentiometer POT #2 on the SBC until 100% is indicated.

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

TEMPERATURE and/or PRESSURE ADJUSTMENT

All temperature and pressure sensors are factory set. If calibration is required, refer to Analog Calibration for temperature or pressure in S90-010 O (*QUANTUM* panel) or Analog Offset Display in S70-400 OM (Mini panel), or S70-401 IOM (Plus panel).

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 insure 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 tubing, piping and wiring per the P & I and wiring diagrams.

TROUBLESHOOTING THE COMPRESSOR

SYMPTON	PROBABLE CAUSES and CORRECTIONS
EXCESSIVE NOISE and VIBRATION	Loose bolts on compressor mounting. Tighten bolts.
	No oil getting to compressor. Check oil level, oil filter and oil pressure.
	Bearing damage or excessive wear.
	Coupling loose on shaft. Tighten coupling. Replace if damaged.
	Volumizer not adjusted correctly. Readjust.
	Refrigerant flood-back. Correct system problem.

TROUBLESHOOTING THE OIL SEPARATOR

SYMPTON	PROBABLE CAUSES and CORRECTIONS
GRADUAL OIL LOSS WITH AN OIL LEVEL IN THE COALESCER SECTION SIGHT GLASS	Maintaining too high an oil level. Lower level.
	Refrigerant carryover or liquid injection overfeeding. Correct operation.
	Contaminated oil or damaged coalescer filter elements. Replace oil charge and coalescers.
	Coalescers may be loose. Tighten.
	Oil return valve closed. Open return valve.
	Return oil strainer blocked. Clean strainer.
RAPID LOSS WITH NO OIL LEVEL IN THE COALESCER SECTION SIGHT GLASS	Compressor unit suction check valve did not close on shutdown. Repair valve.
	Bypass open around suction check valve. Close bypass valve.
	Bypass valve opened too far. Tighten
	Coalescer filter elements not seated properly. Replace oil charge and coalescers.
	Oil viscosity too low. Verify correct oil, replace if incorrect.
	High system CFM. System operating out of design conditions (High suction and Low discharge pressures).
	Refrigerant flood-back. Correct system problem.
	Two or more compressors piped to a single economizer vapor port. Verify check valves are in working order.

TROUBLESHOOTING THE HYDRAULIC SYSTEM

SYMPTOM	PROBABLE CAUSES and CORRECTIONS
SLIDE VALVE WILL NOT LOAD OR UNLOAD	Solenoid coil burned out. Replace coil. HV2 needle valve closed. Open valve. Solenoid spool may be stuck or centering spring broken. Free spool or replace spring. 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. Solenoid valve piston hung in bore or bolt loose. Check piston or tighten bolt.
SLIDE VALVE WILL LOAD BUT WILL NOT UNLOAD	YY1 solenoid coil burned out. Replace coil. Check valve in solenoid valve piston bad. Replace or repair. Dirt inside solenoid valve preventing valve from operating both ways. Clean valve. Solenoid may be mechanically actuated by inserting a piece of 3/16" rod against armature pin and pushing spool to opposite end. Push YY1 valve to confirm unload capability. If valve works, problem is electrical. Slipper seals worn out or damaged. Replace. Check valve in slide valve piston sticking. Remove and clean check valve.
SLIDE VALVE WILL UNLOAD BUT WILL NOT LOAD	YY2 solenoid coil burned out. Replace coil. Dirt inside solenoid valve preventing valve from operating both ways. Clean valve. 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, the problem is electrical.
SLIDE STOP WILL NOT FUNCTION IN EITHER DIRECTION	Solenoid coil burned out. Replace coils. Solenoid valve sticking. Replace valve.
SLIDE VALVE and/or SLIDE STOP WILL NOT MOVE	Slipper seals worn out or damaged. Unloader spindle or slide valve jammed. Slide stop indicator rod jammed.

TROUBLESHOOTING THE LIQUID INJECTION OIL COOLING SYSTEM

SYMPTOM	PROBABLE CAUSES and CORRECTIONS
HIGH OIL TEMPERATURE	Insufficient liquid supply. Check receiver level. Check strainer. Equalizer pressure too high. Lower pressure. Suction superheat too high. Correct system problem. Thermal expansion valve power head lost charge. Replace. Liquid strainer blocked. Clean strainer. Operating conditions significantly different from design. Malfunctioning Vi Control Solenoids. See function check of the compressor "Volumizer II Vi Control" for further detail.
LOW OIL TEMPERATURE	Equalizing pressure too low. Raise pressure. Suction superheat too low or refrigerant flood back on compressor. Correct system problem. Operating conditions significantly different from design.
OIL TEMPERATURE FLUCTUATES	System conditions rapidly fluctuate causing liquid injection system to overrespond. Stabilize system operation.

THERMAL EXPANSION VALVES

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

NOTE: DO NOT ATTEMPT TO ADJUST SUPERHEAT ADJUSTMENT STEM ON BOTTOM OF VALVE IN AN EFFORT TO CHANGE THE VALVE'S PERFORMANCE. THIS ADJUSTMENT IS PRESET AT THE FACTORY. ONLY ADJUST 1/4" BLEED VALVE ON EQUALIZING LINE.

JORDAN TEMPERATURE REGULATOR VALVE

(For low differential pressure applications)

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.

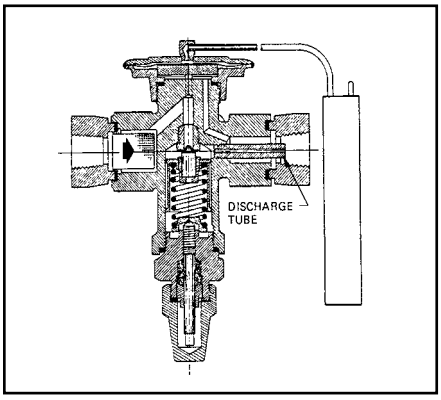


Figure 17 - TYPE D TX VALVE (1-15 TONS) R-717

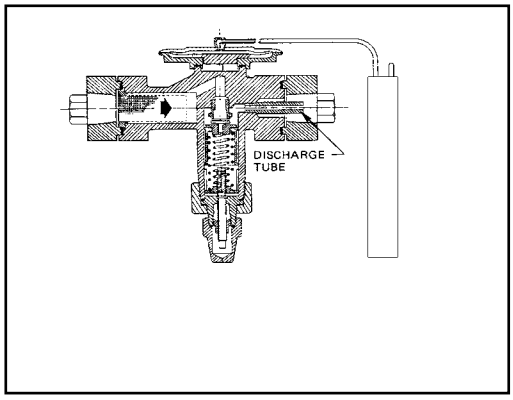


Figure 18 - TYPE A TX VALVE (20-100 TONS) R-717

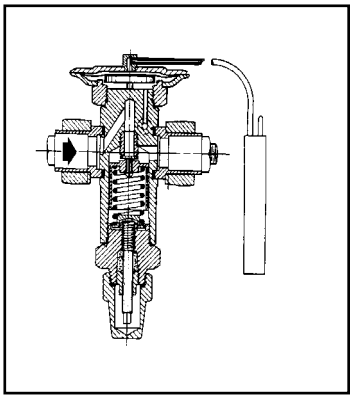


Figure 19 - TYPE H TX VALVE (2½ to 16 TONS) R-22

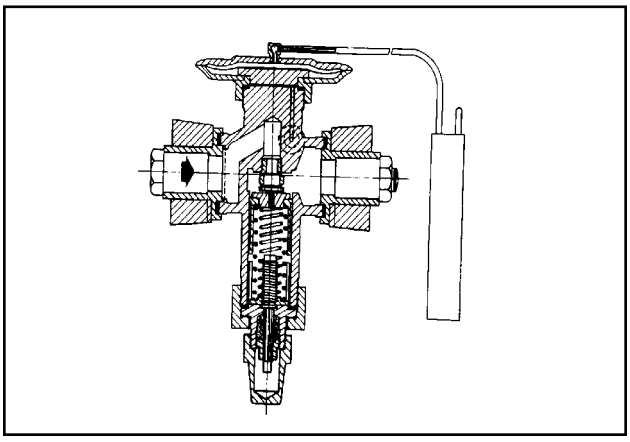


Figure 20 - TYPE M TX VALVE (12 TO 34 TONS) R-22

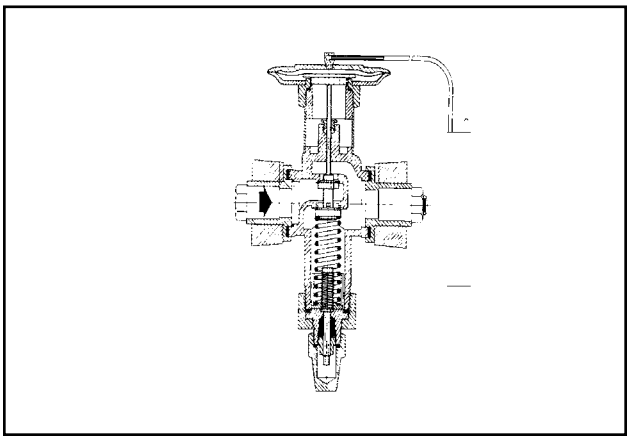


Figure 22 - TYPE V TX VALVE (52 TO 100 TONS) R-22

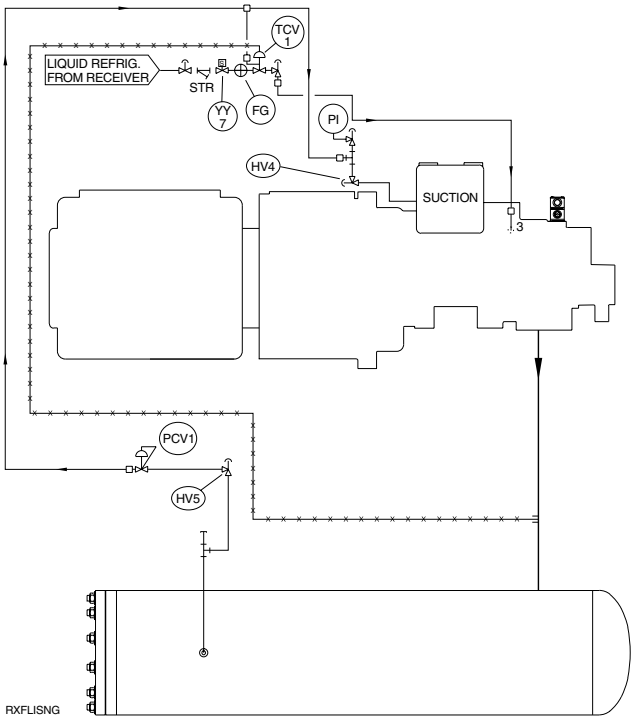
R-717 TX VALVE SIZES

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

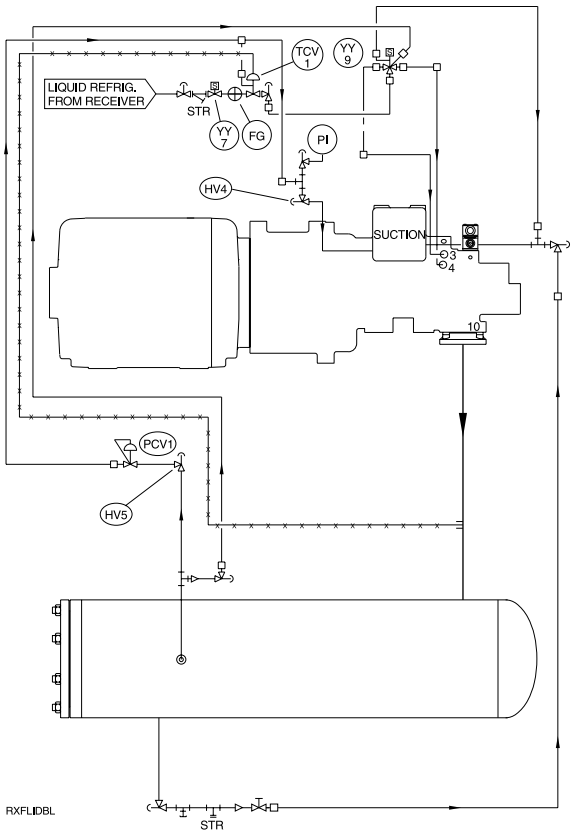
R-22 TX VALVE SIZES

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

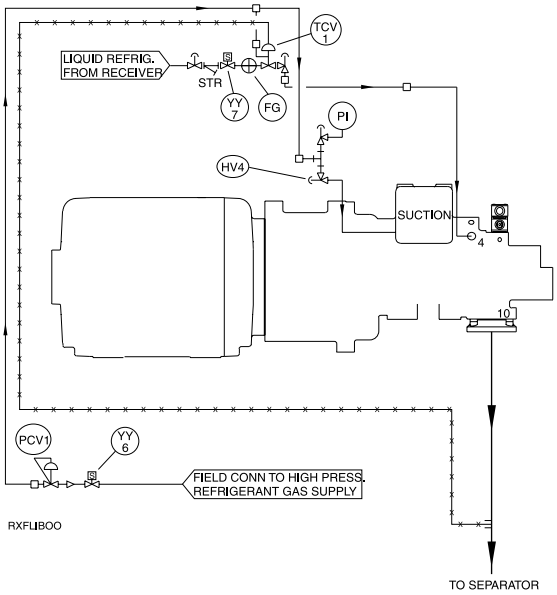
RXF COOLING OPTIONS (See P & I Diagrams)



SINGLE PORT LIQUID INJECTION



DUAL PORT LIQUID INJECTION



LIQUID INJECTION, BOOSTER APPLICATION

RXF COOLING OPTIONS (See P & I Diagrams)

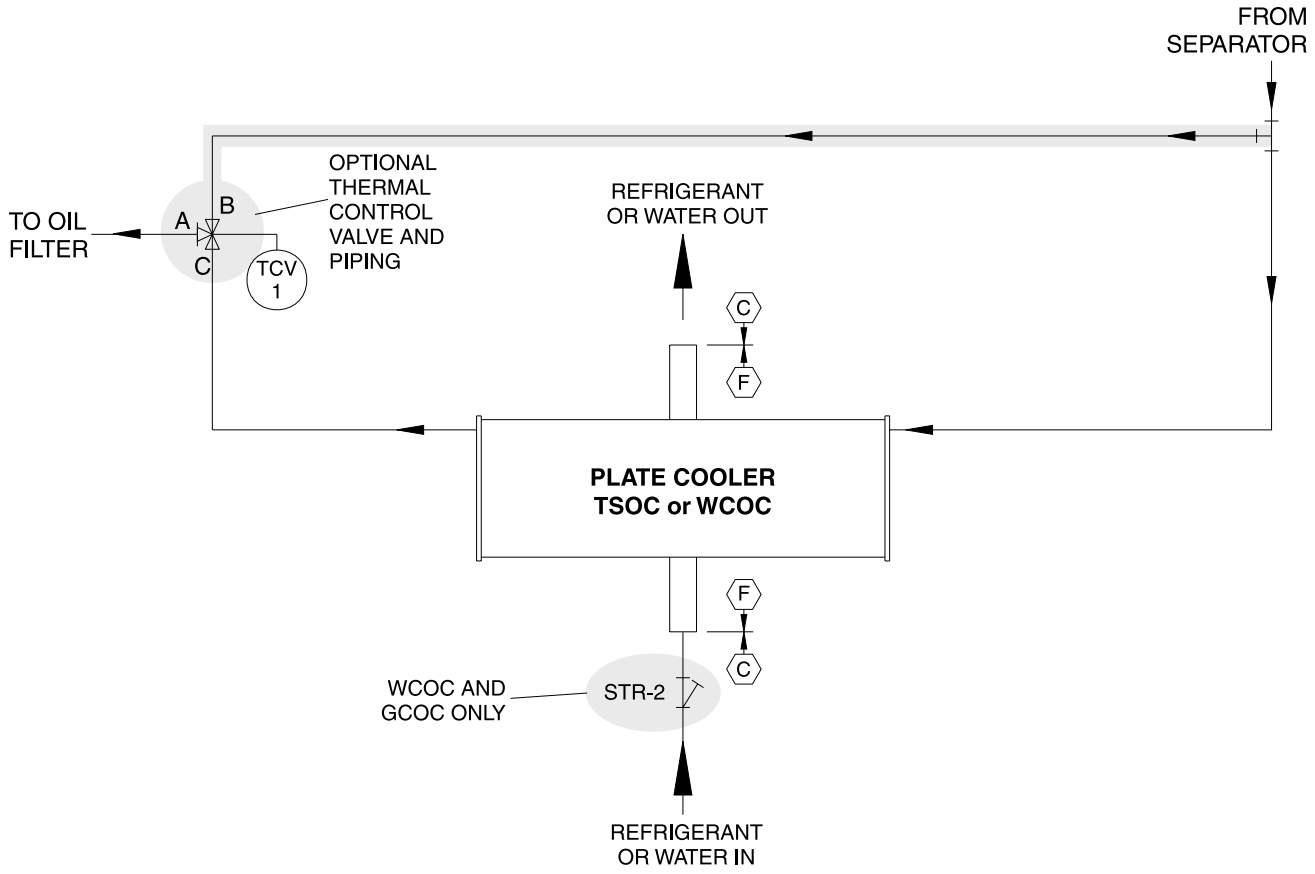
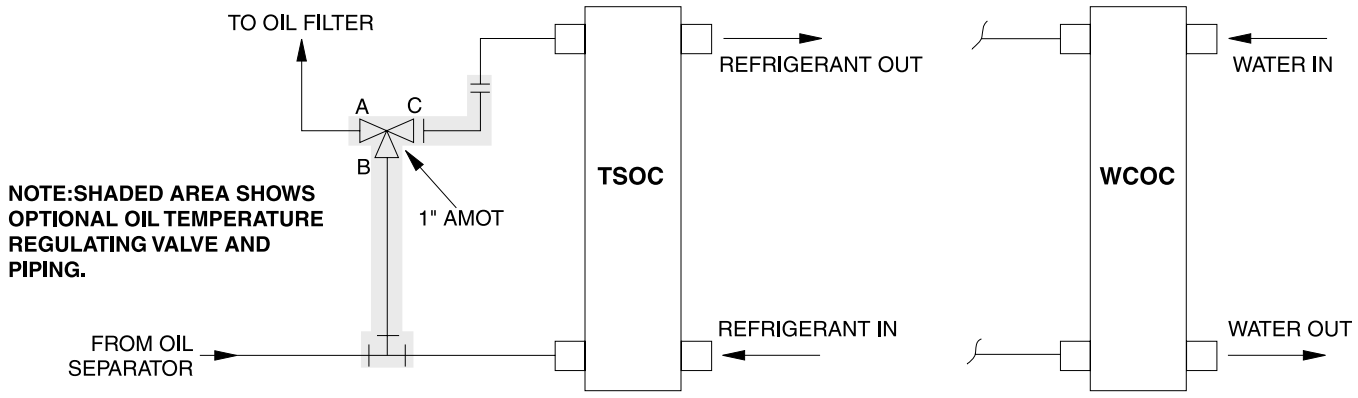
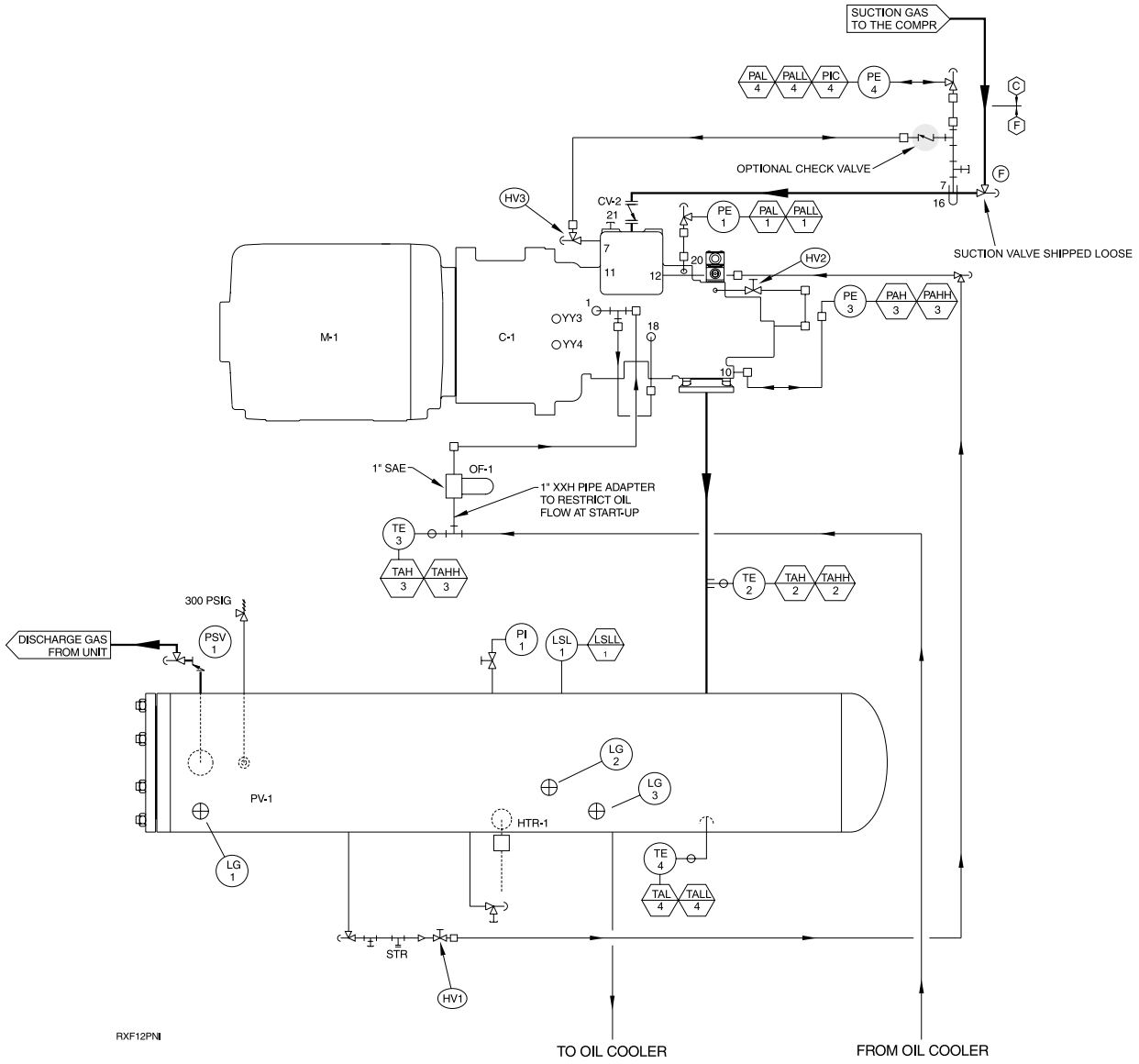


PLATE and SHELL THERMOSYPHON or WATER-COOLED OIL COOLER



FLAT PLATE OIL COOLER

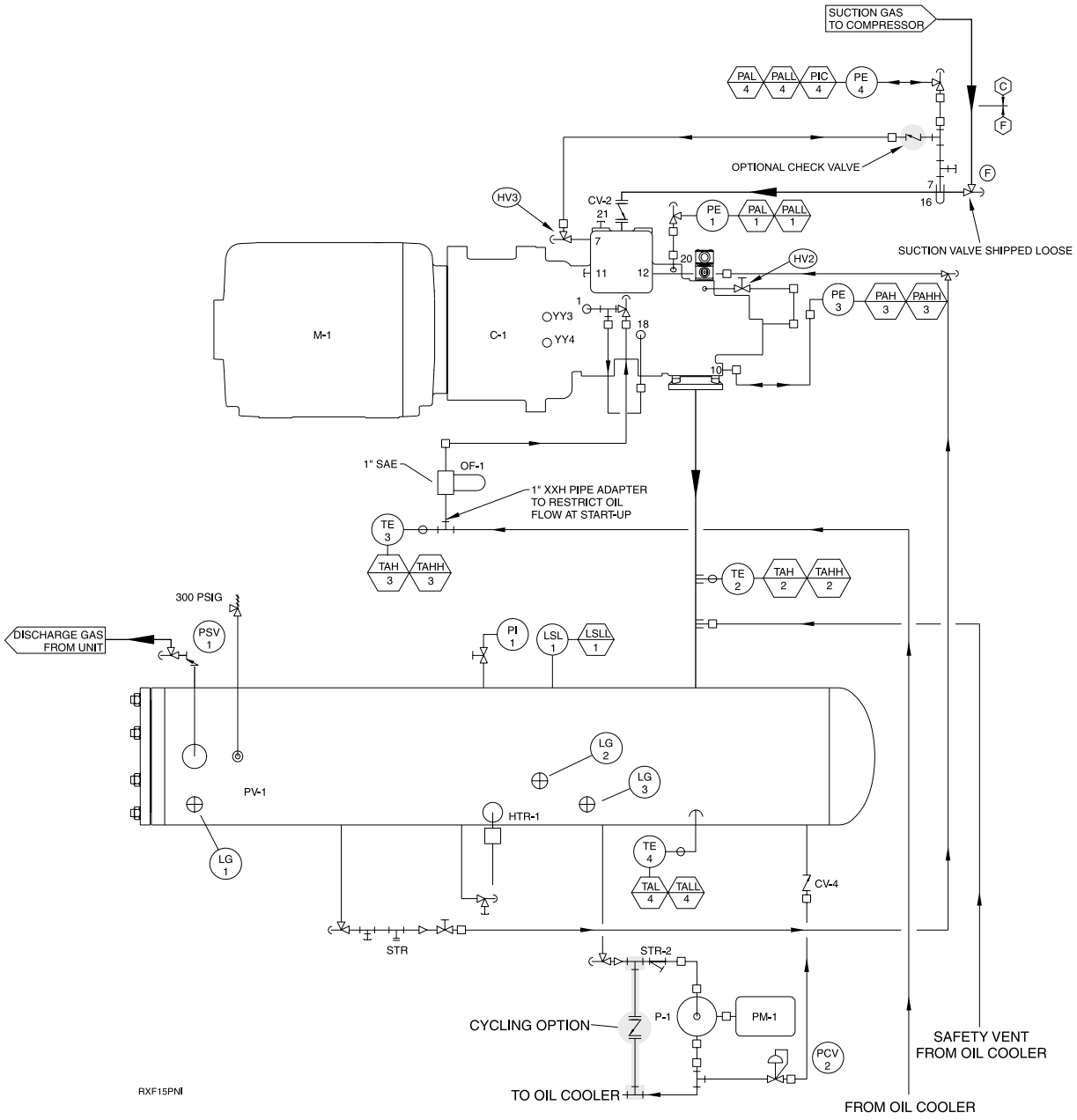
RXF MODELS 12, 15, & 19 without OIL PUMP (See OIL COOLING ADDITIONS)



LEGEND*					
AS	AIR SUPPLY	PAH	HIGH PRESSURE ALARM	TAHH	HIGH TEMP. SHUTDOWN
C	COMPRESSOR	PAHH	HIGH PRESSURE SHUTDOWN	TAL	LOW TEMPERATURE ALARM
CV	CHECK VALVE	PAL	LOW PRESSURE ALARM	TALL	LOW TEMPERATURE SHUTDOWN
DP	DISCHARGE PRESSURE	PALL	LOW PRESSURE SHUTDOWN	TCV	TEMPERATURE CONTROL VALVE
F	FILTER OR FILTER DRIER	PCV	PRESSURE CONTROL VALVE	TE	TEMPERATURE ELEMENT
FG	FLOW GLASS	PDSLL	LOW DIFFERENTIAL PRESS. SHUTDOWN	TI	TEMPERATURE INDICATOR
HTR	HEATER	PE	PRESSURE ELEMENT	TS	TEMPERATURE SWITCH
HV	HAND ACTUATED VALVE	PI	PRESSURE INDICATOR	TSH	TEMP. SWITCH HIGH ALARM
LG	SIGHT OR LEVEL GLASS	PIC/TIC	PRESS./TEMP. INDICATING CONTROLLER	TSLL	LIQUID INJECTION SHUTOFF
LSL	OIL LEVEL SWITCH LOW	PM	PUMP MOTOR	TW	THERMOWELL
LSLL	LOW OIL LEVEL SHUTDOWN	PS	AUTO CYCLE/PRESSURE SWITCH	VI	VI CONTROL
M	MOTOR	PSV	PRESSURE SAFETY VALVE	WS	WATER SUPPLY
1MC	MOTOR CONTROL CENTER	SP	SUCTION PRESSURE	YY	SOLENOID VALVE/EVENT VALVE
2MC	MOTOR CONTROL CENTER	STR	STRAINER		
OP	OIL PRESSURE	TAH	HIGH TEMPERATURE ALARM		
P	PUMP				

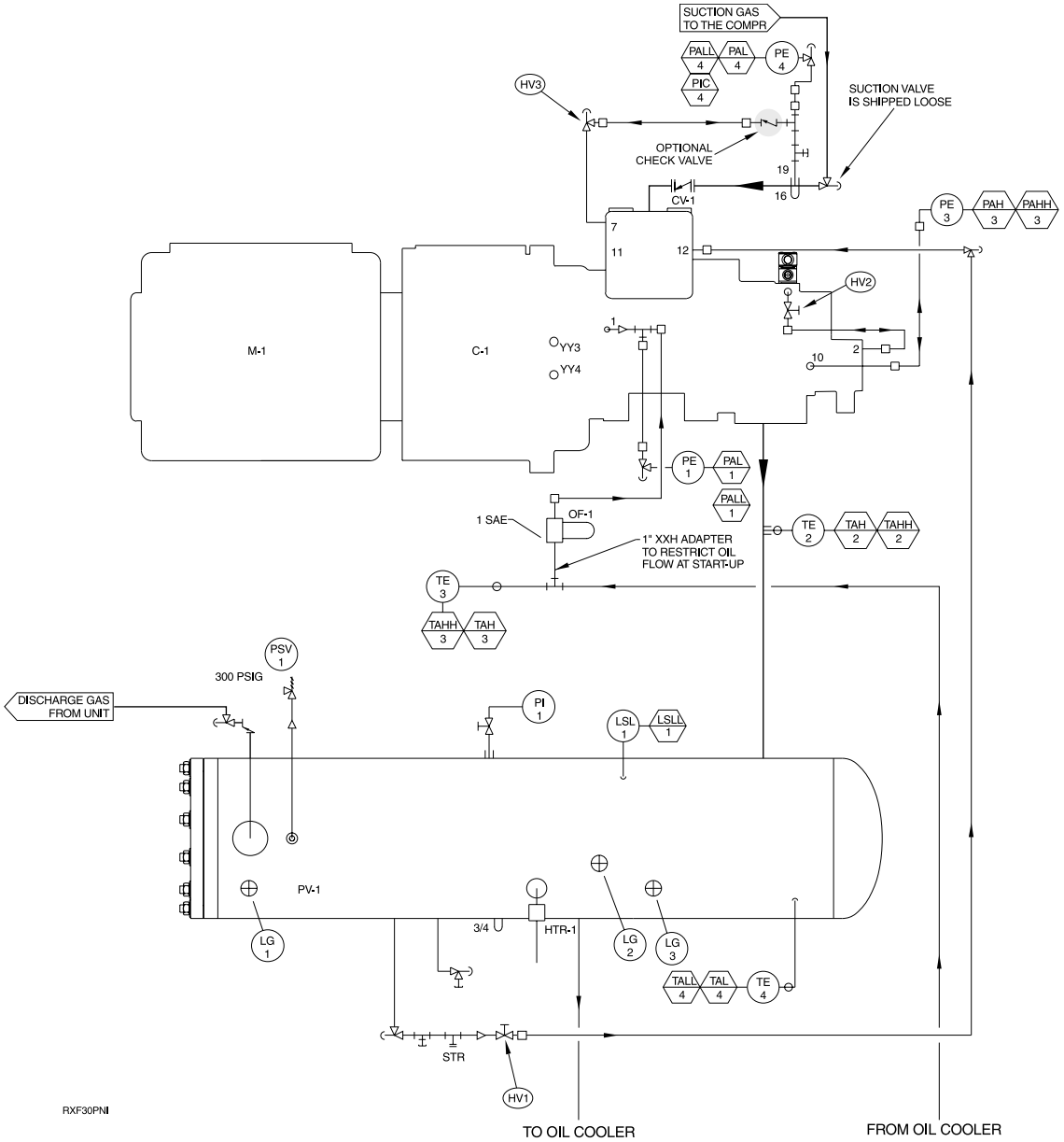
***** See additional Legend items on opposite page.

RXF MODELS 12, 15, & 19 with OIL PUMP (See OIL COOLING ADDITIONS)



LEGEND (Cont.)	
CONNECTIONS	
1 MAIN OIL SUPPLY	
3 LOW VI LIQUID INJECTION	
4 HIGH VI LIQUID INJECTION	
5 ECONOMIZER	
7 SUCTION PRESSURE	
8 CLOSED THREAD PRESSURE	
10 DISCHARGE PRESSURE	
11 LIQ. INJ. BLEED LINE	
12 COALESCER BLEED LINE	
16 THERMOWELL (SUCT. TEMP.)	
18 MAIN OIL INJECTION	
20 OIL PRESSURE	
21 EVACUATION PORT	
	NOTES:
	1. PRESSURE TRANSDUCERS INDICATE: PE-1 OIL PRESSURE PE-3 DISCHARGE PRESSURE PE-4 SUCTION PRESSURE
	2. TEMPRERATURE PROBES INDICATE: TE-1 SUCTION GAS TEMPERATURE TE-2 DISCHARGE GAS TEMPERATURE TE-3 LUBE OIL TEMPERATURE TE-4 SEPARATOR OIL TEMPERATURE
	3. TERMINATIONS "A" THROUGH "C" REFER TO CONNECTION POINTS FOR VARIOUS OPTIONS.

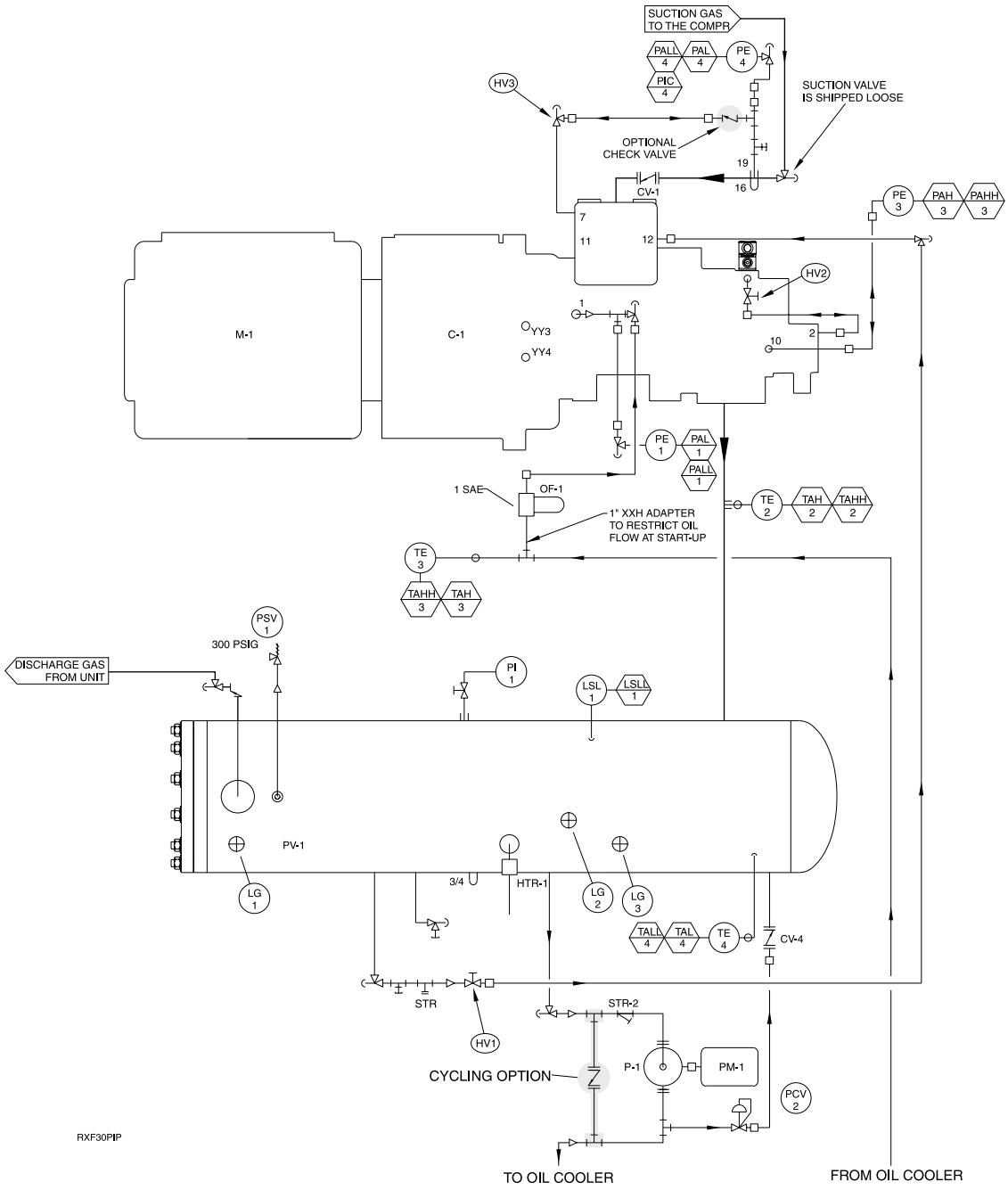
RXF MODELS 24, 30, 39, & 50 without OIL PUMP (See OIL COOLING ADDITIONS)



LEGEND*					
AS	AIR SUPPLY	PAH	HIGH PRESSURE ALARM	TAHH	HIGH TEMP. SHUTDOWN
C	COMPRESSOR	PAHH	HIGH PRESSURE SHUTDOWN	TAL	LOW TEMPERATURE ALARM
CV	CHECK VALVE	PAL	LOW PRESSURE ALARM	TALL	LOW TEMPERATURE SHUTDOWN
DP	DISCHARGE PRESSURE	PALL	LOW PRESSURE SHUTDOWN	TCV	TEMPERATURE CONTROL VALVE
F	FILTER OR FILTER DRIER	PCV	PRESSURE CONTROL VALVE	TE	TEMPERATURE ELEMENT
FG	FLOW GLASS	PDSLL	LOW DIFFERENTIAL PRESS. SHUTDOWN	TI	TEMPERATURE INDICATOR
HTR	HEATER	PE	PRESSURE ELEMENT	TS	TEMPERATURE SWITCH
HV	HAND ACTUATED VALVE	PI	PRESSURE INDICATOR	TSH	TEMP. SWITCH HIGH ALARM
LG	SIGHT OR LEVEL GLASS	PIC/TIC	PRESS./TEMP. INDICATING CONTROLLER	TSLL	LIQUID INJECTION SHUTOFF
LSL	OIL LEVEL SWITCH LOW	PM	PUMP MOTOR	TW	THERMOWELL
LSLL	LOW OIL LEVEL SHUTDOWN	PS	AUTO CYCLE/PRESSURE SWITCH	VI	VI CONTROL
M	MOTOR	PSV	PRESSURE SAFETY VALVE	WS	WATER SUPPLY
1MC	MOTOR CONTROL CENTER	SP	SUCTION PRESSURE	YY	SOLENOID VALVE/EVENT VALVE
2MC	MOTOR CONTROL CENTER	STR	STRAINER		
OP	OIL PRESSURE	TAH	HIGH TEMPERATURE ALARM		
P	PUMP				

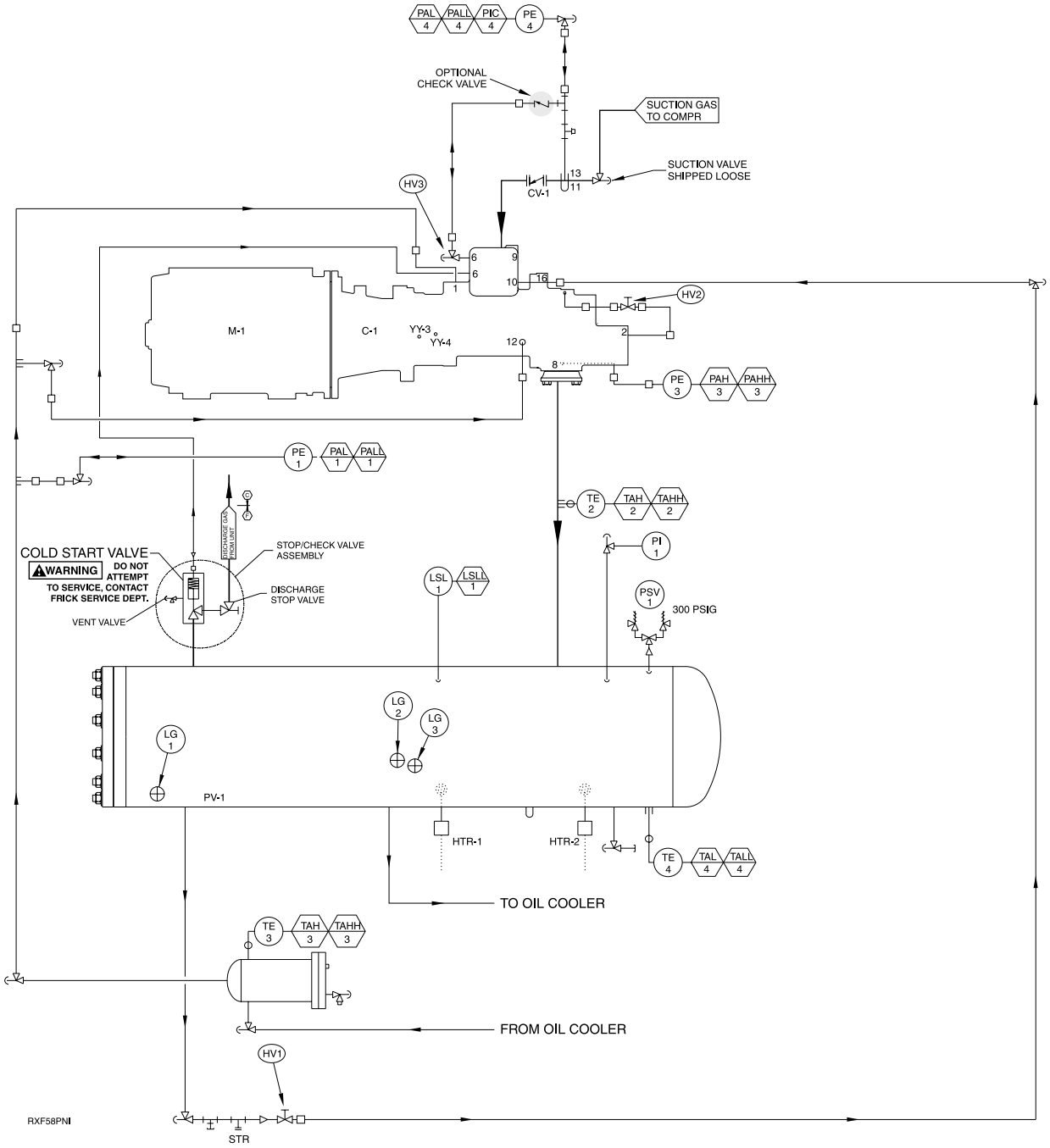
***** See additional Legend items on opposite page.

RXF MODELS 24, 30, 39, & 50 with OIL PUMP (See OIL COOLING ADDITIONS)



LEGEND (Cont.)					
CONNECTIONS		15	VENT - UNLOADING	**NOTES:**	
1	MAIN OIL SUPPLY	16	THERMOWELL	1. PRESSURE TRANSDUCERS INDICATE:	
2	SLIDE VALVE PISTON	18	SOLENOID FEED	PE-1	OIL PRESSURE
3	LOW VI LIQUID INJECTION	19	SUCTION PRESSURE	PE-3	DISCHARGE PRESSURE
4	HIGH VI LIQUID INJECTION	20	SEAL WEEPAGE	PE-4	SUCTION PRESSURE
5	ECONOMIZER			2. TEMPRERATURE PROBES INDICATE:	
6	OIL DRAIN			TE-1	SUCTION GAS TEMPERATURE
7	SUCTION PRESSURE			TE-2	DISCHARGE GAS TEMPERATURE
8	CLOSED THREAD			TE-3	LUBE OIL TEMPERATURE
10	DISCHARGE PRESSURE			TE-4	SEPARATOR OIL TEMPERATURE
11	LIQ. INJ. BLEED LINE			3. TERMINATIONS "A" THROUGH "C" REFER TO CONNECTION POINTS FOR VARIOUS OPTIONS.	
12	COALESCER BLEED LINE				

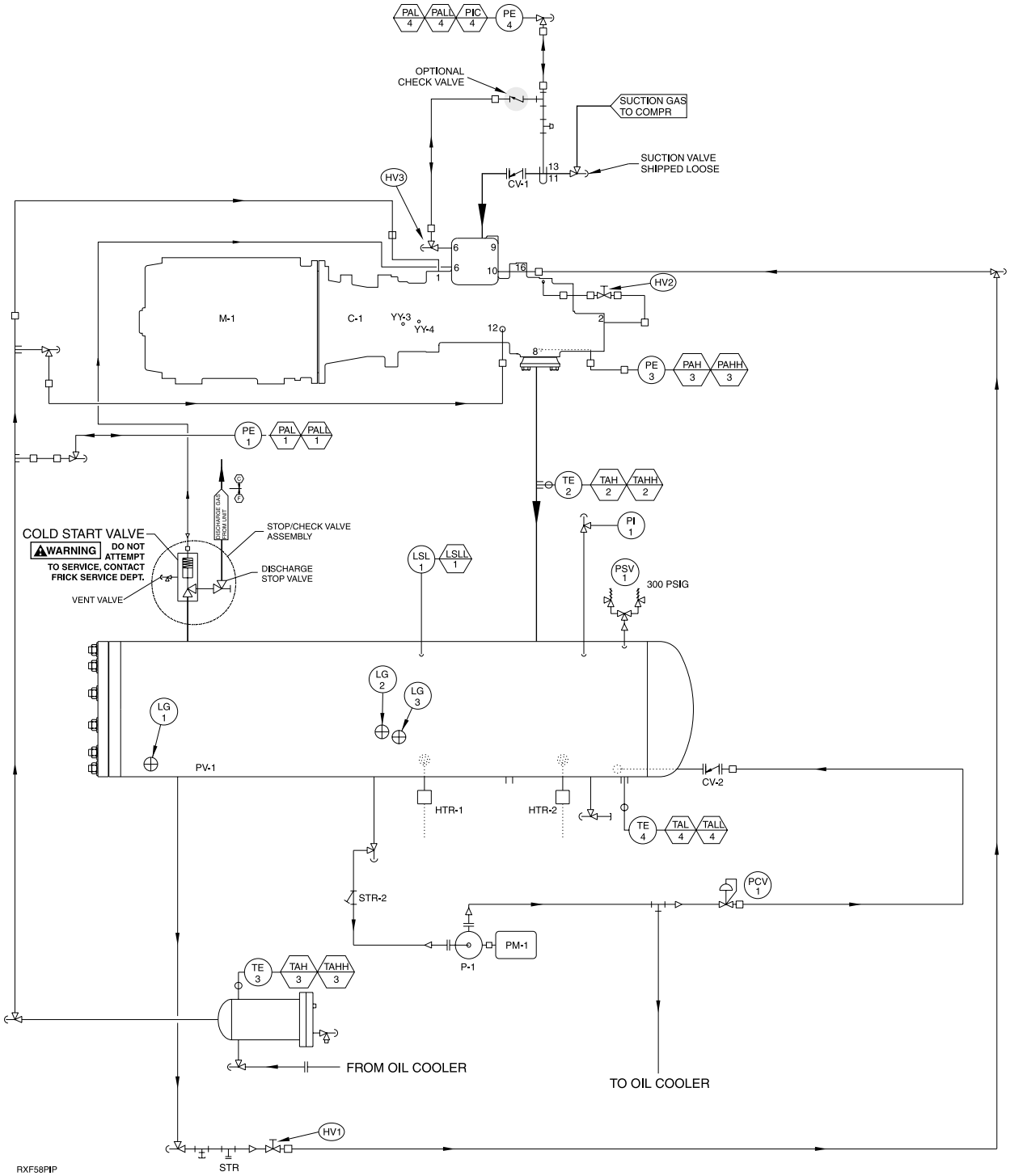
RXF MODELS 58, 68, 85, & 101 without OIL PUMP (See OIL COOLING ADDITIONS)



LEGEND*					
AS	AIR SUPPLY	PAH	HIGH PRESSURE ALARM	TAHH	HIGH TEMP. SHUTDOWN
C	COMPRESSOR	PAHH	HIGH PRESSURE SHUTDOWN	TAL	LOW TEMPERATURE ALARM
CV	CHECK VALVE	PAL	LOW PRESSURE ALARM	TALL	LOW TEMPERATURE SHUTDOWN
DP	DISCHARGE PRESSURE	PALL	LOW PRESSURE SHUTDOWN	TCV	TEMPERATURE CONTROL VALVE
F	FILTER OR FILTER DRIER	PCV	PRESSURE CONTROL VALVE	TE	TEMPERATURE ELEMENT
FG	FLOW GLASS	PDSLL	LOW DIFFERENTIAL PRESS. SHUTDOWN	TI	TEMPERATURE INDICATOR
HTR	HEATER	PE	PRESSURE ELEMENT	TS	TEMPERATURE SWITCH
HV	HAND ACTUATED VALVE	PI	PRESSURE INDICATOR	TSH	TEMP. SWITCH HIGH ALARM
LG	SIGHT OR LEVEL GLASS	PIC/TIC	PRESS./TEMP. INDICATING CONTROLLER	TSLL	LIQUID INJECTION SHUTOFF
LSL	OIL LEVEL SWITCH LOW	PM	PUMP MOTOR	TW	THERMOWELL
LSLL	LOW OIL LEVEL SHUTDOWN	PS	AUTO CYCLE/PRESSURE SWITCH	VI	VI CONTROL
M	MOTOR	PSV	PRESSURE SAFETY VALVE	WS	WATER SUPPLY
1MC	MOTOR CONTROL CENTER	SP	SUCTION PRESSURE	YY	SOLENOID VALVE/EVENT VALVE
2MC	MOTOR CONTROL CENTER	STR	STRAINER		
OP	OIL PRESSURE	TAH	HIGH TEMPERATURE ALARM		
P	PUMP				

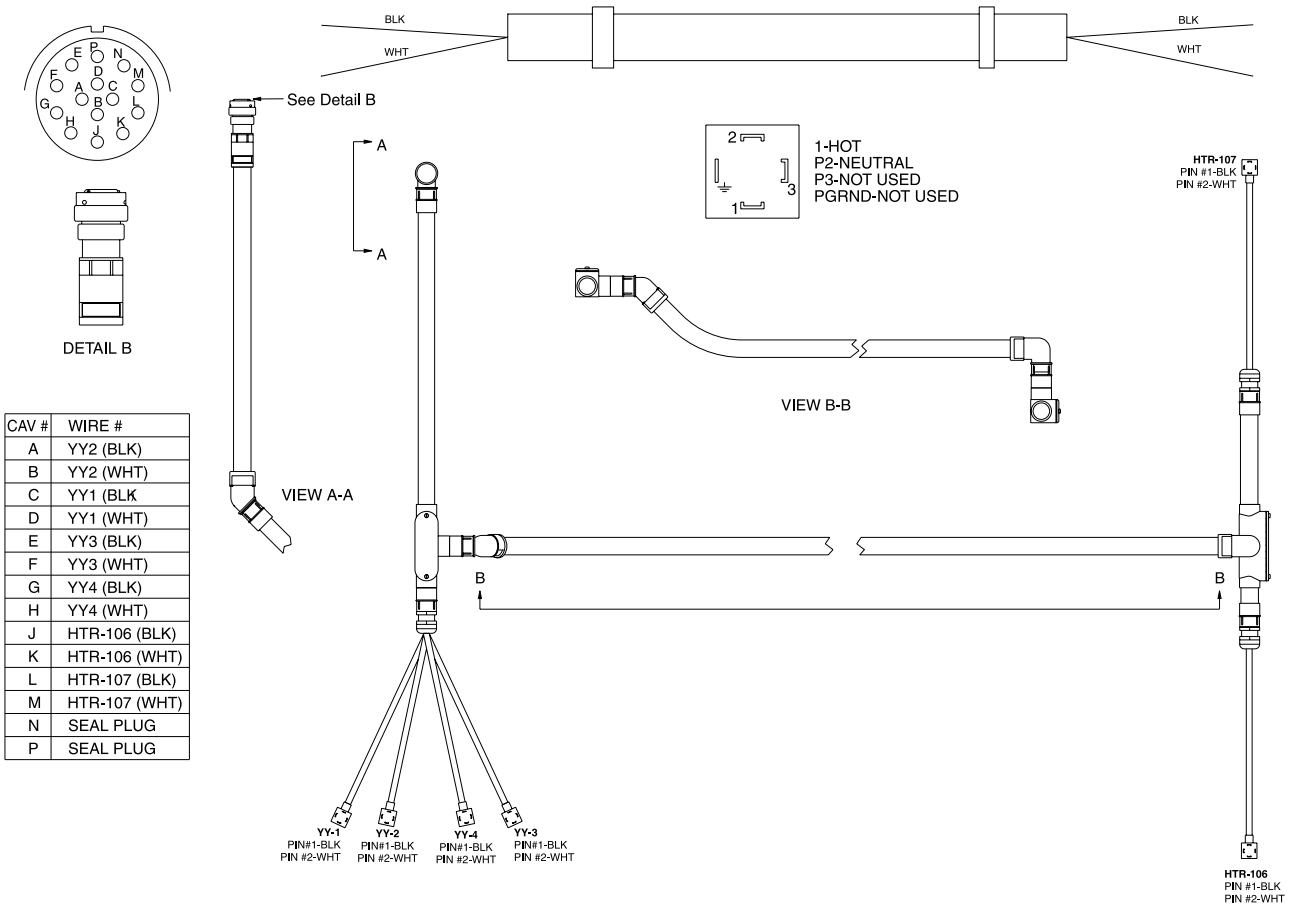
***** See additional Legend items on opposite page.

RXF MODELS 58, 68, 85, & 101 with OIL PUMP (See OIL COOLING ADDITIONS)



LEGEND (Cont.)		
CONNECTIONS		**NOTES:**
1 MAIN OIL SUPPLY	12 MAIN OIL INJECTION	1. PRESSURE TRANSDUCERS INDICATE:
2 SLIDE VALVE PISTON	13 SUCTION PRESSURE	PE-1 OIL PRESSURE
3 LOW VI LIQUID INJECTION	14 SEAL WEEPAGE	PE-3 DISCHARGE PRESSURE
4 HIGH VI LIQUID INJECTION	15 ELECTRICAL CONNECTION	PE-4 SUCTION PRESSURE
5 ECONOMIZER	16 OIL PRESSURE	2. TEMPRERATURE PROBES INDICATE:
6 SUCTION PRESSURE		TE-1 SUCTION GAS TEMPERATURE
7 CLOSED THREAD		TE-2 DISCHARGE GAS TEMPERATURE
8 DISCHARGE PRESSURE		TE-3 LUBE OIL TEMPERATURE
9 LIQ. INJ. BLEED LINE		TE-4 SEPARATOR OIL TEMPERATURE
10 COALESCER BLEED LINE		3. TERMINATIONS "A" THROUGH "C" REFER TO CONNECTION POINTS FOR VARIOUS OPTIONS.
11 THERMOWELL (SUCT. TEMP.)		

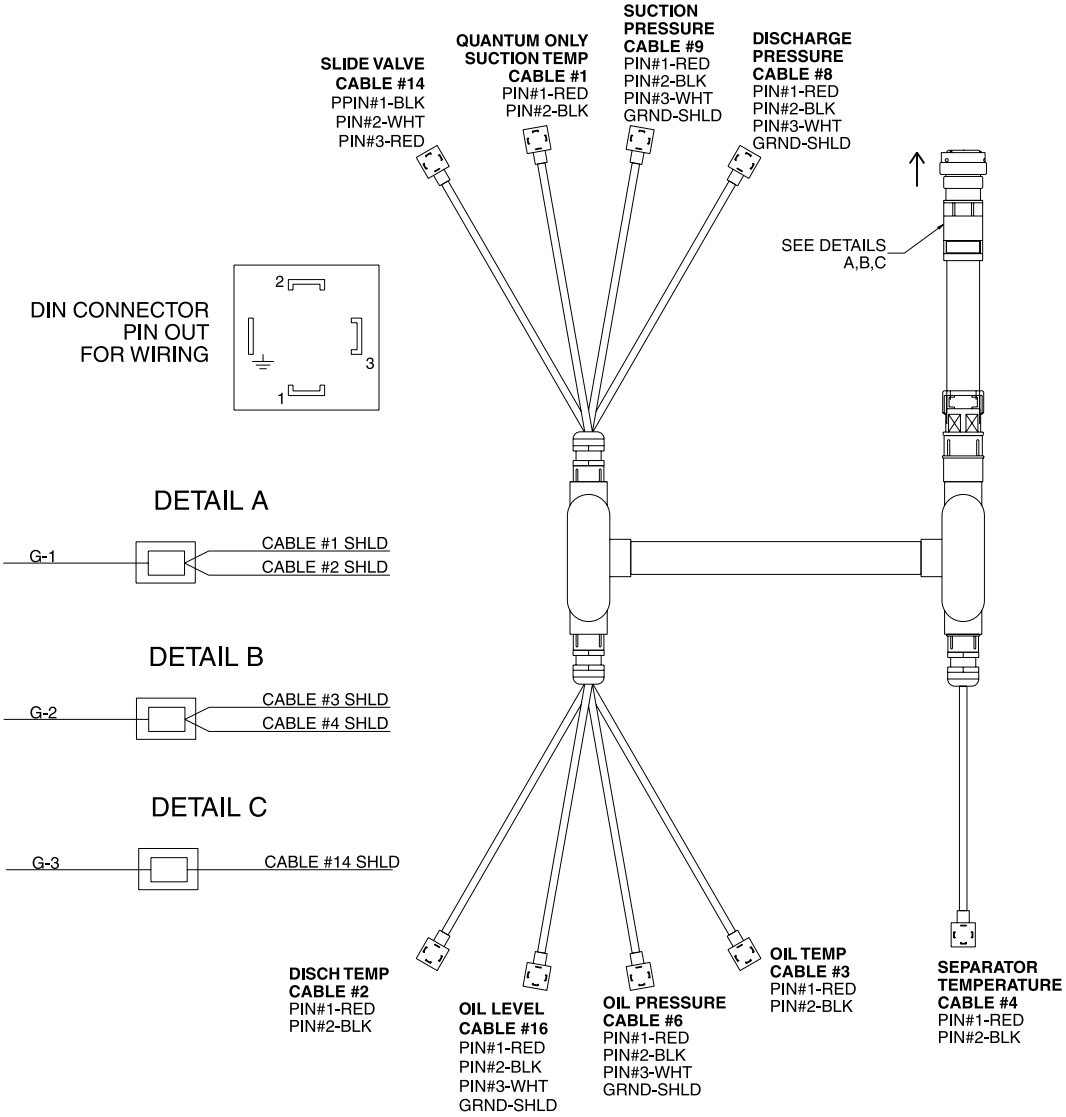
WIRING HARNESS - AC to Heaters and Valves (External)

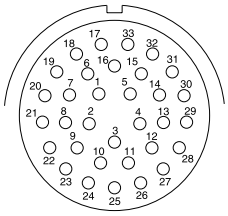


CAV #	WIRE #
A	YY2 (BLK)
B	YY2 (WHT)
C	YY1 (BLK
D	YY1 (WHT)
E	YY3 (BLK)
F	YY3 (WHT)
G	YY4 (BLK)
H	YY4 (WHT)
J	HTR-106 (BLK)
K	HTR-106 (WHT)
L	HTR-107 (BLK)
M	HTR-107 (WHT)
N	SEAL PLUG
P	SEAL PLUG

WIRING HARNESS - Internal for Analog Devices

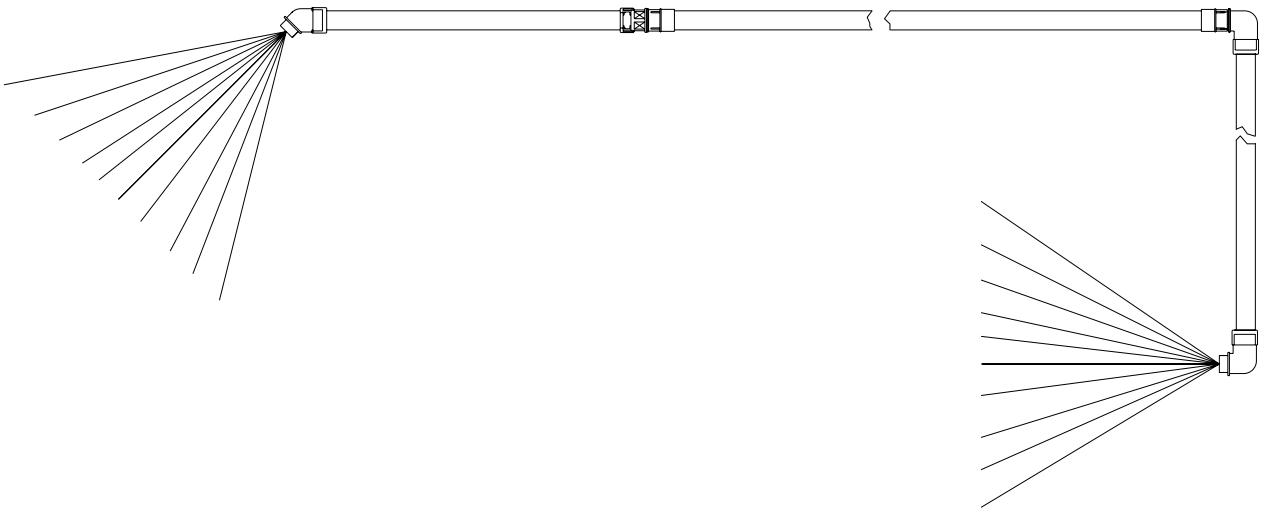
WIRING HARNESS - External for Analog Devices





CAV #	WIRE #
1	CABLE 1-RED
2	CABLE 1-BLK
3	G-1
4	CABLE 2-RED
5	CABLE 2-BLK
6	CABLE 3-RED
7	CABLE 3-BLK
8	G-2
9	CABLE 4-RED
10	CABLE 4-BLK
11	CABLE 6-RED
12	CABLE 6-WHT
13	CABLE 6-BLK
14	SEAL PLUG
15	SEAL PLUG
16	SEAL PLUG
17	CABLE 8-RED
18	CABLE 8-WHT
19	CABLE 8-BLK
20	CABLE 9-RED
21	CABLE 9-WHT
22	CABLE 9-BLK
23	CABLE 14-RED
24	CABLE 14-WHT
25	CABLE 14-BLK
26	G-3
27	SEAL PLUG
28	SEAL PLUG
29	SEAL PLUG
30	CABLE 16-RED
31	CABLE 16-BLK
32	CABLE 16-WHT
33	SEAL PLUG

WIRING HARNESS - AC Conduit - Quantum to DBS Panel



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 23)**

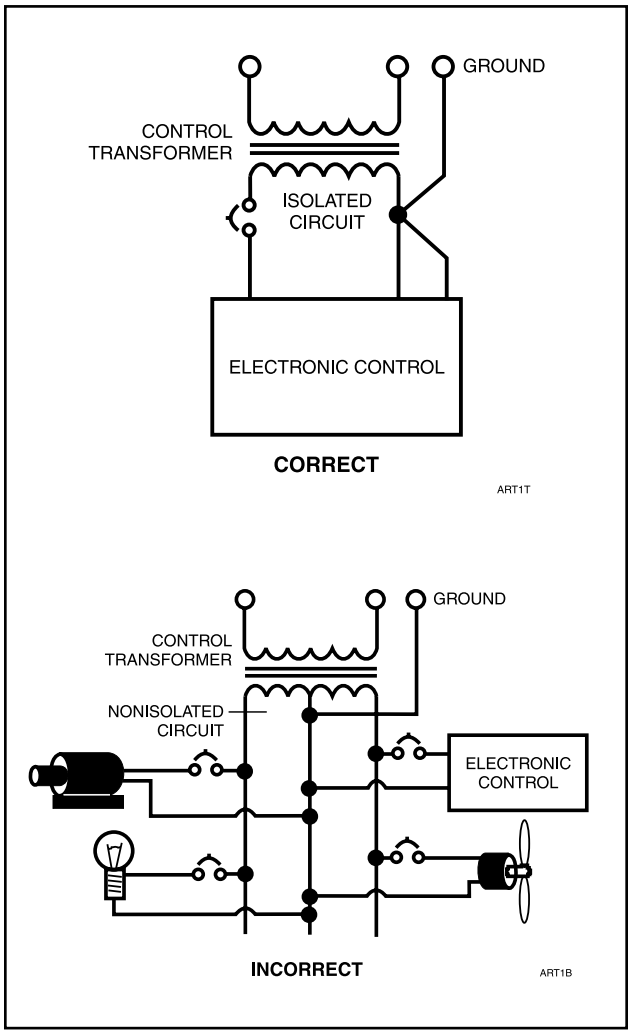


Figure 23

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. See Figure 24. 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.

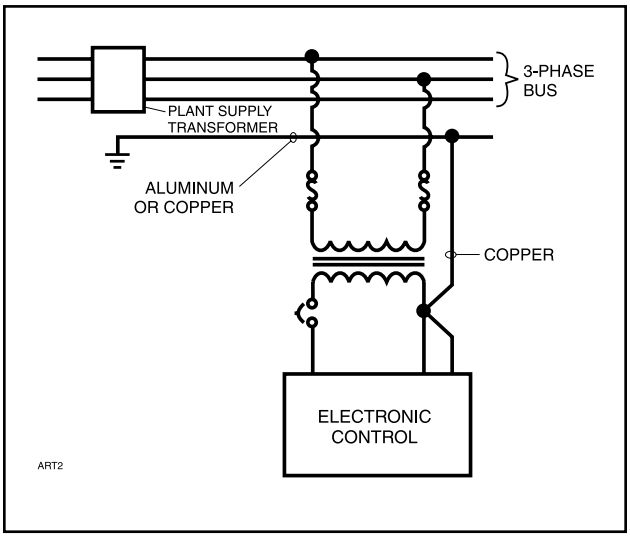


Figure 24

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 25)**

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.

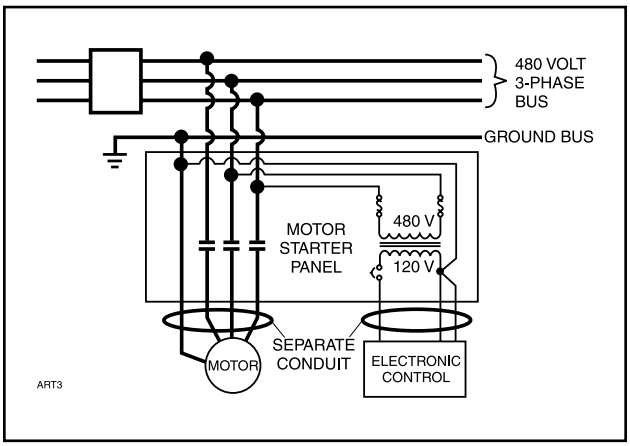


Figure 25

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. See Figure 26.

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.

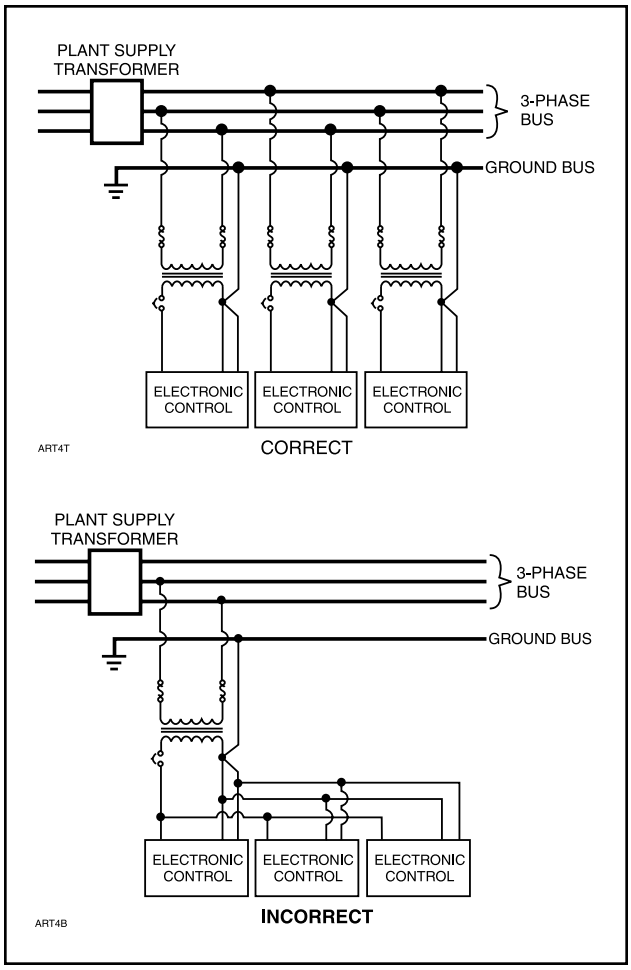


Figure 26

Frick®

SCREW COMPRESSOR
Operating Log Sheet

Frick Order No. _____
Compr. Ser. No. _____
Unit Location _____

Date											
Time											
Hour Meter Reading											
Equipment Room Temp./Outdoor Temp.		/	/	/	/	/	/	/	/	/	/
Compressor	Suction Pressure										
	Suction Temperature										
	Suction Superheat										
	Discharge Pressure										
	Corresponding Temperature										
	Actual Discharge Temperature										
	Oil Pressure										
	Oil Temperature										
	Oil Filter Press. Drop - DP										
	Slide Valve Position %										
	Volume Ratio (V.I.)										
	FLA %										
	Seal Leakage (drops/min)										
Capacity Control Setpoint											
Oil Sep.	Separator Temperature										
	Oil Level (example ◒ ●)	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○	○ ○
	Oil Added (gallons)										
Evap. Brine	Inlet Temperature										
	Outlet Temperature										
	Pressure Drop - DP										
	Flow Rate - GPM										
Condenser Air	Air On Temperature										
	Air Off Temperature										
Condenser Water	Inlet Temperature										
	Outlet Temperature										
	Pressure Drop - DP										
	Flow Rate - GPM										
Leaving Liquid Refrigerant Temperature											
Rcvr/Econ	Level										
	Pressure										
Remarks:											

NOTE: Temperature and Pressure Units in °F and PSIG respectively, unless otherwise indicated.

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 on page 44 (Quantum for Models 12 to 50), in S90-010 M (Quantum panel for Models 58 - 101), S70-401 IOM (Plus panel or S70-400 OM (Mini panel)

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

Signed: _____
Print Name: _____
Company: _____

START-UP REPORT

Sold To: _____ Contact Name: _____ Date: _____
End User: _____ Contact Name: _____ Phone: _____
End User Address: _____ Fax No: _____
City, State, Zip: _____ Start-up Rep. _____

Unit General Information

Unit Model # _____ Customer Package Identification # _____
Compressor Serial # _____ Separator National Board # _____
Unit Serial # _____ Oil Cooler National Board # _____

Refrigerant ☐ R-717 ☐ R-22 ☐ R-290 ☐ Other _____
Lube Oil Type ☐ 2A ☐ 3 ☐ 4 ☐ 9 ☐ Other _____ Design Operating Conditions
Lube System ☐ None ☐ Prelube ☐ Cycling ☐ Full ☐ Demand _____ °Suct./ _____ °Disch.
Oil Cooling ☐ TSOC ☐ WCOC ☐ S-LIOC ☐ D-LIOC ☐ GCOC
Oil Filters ☐ Single ☐ Dual Micro Log I.D. _____

Micro Information

Micro Type ☐ Quantum ☐ Plus ☐ Standard ☐ Electromechanical U3, U4, U5 Program _____
SBC / CPU Serial # _____ Rev. ___ U24/U35 Program ID/OS Ver # _____ and Date _____
U36 Bios Ver # _____ and Date _____ U42 Keyboard Ver # _____ and Date _____
Digital I/O Board #1 Serial # _____ Rev. _____ U8 Digital I/O Ver # _____ and Date _____
Digital I/O Board #2 Serial # _____ Rev. _____ U8 Digital I/O Ver # _____ and Date _____
Analog Board #1 Serial # _____ Rev. _____ U13 Analog Ver # _____ and Date _____
Analog Board #2 Serial # _____ Rev. _____ U13 Analog Ver # _____ and Date _____

Compressor Motor Information

Manufacturer _____ Frame Size _____ H.P. _____ RPM _____
Serial # _____ Service Factor _____ Voltage _____ Hz _____ FLA _____
Design _____ Code _____ Bearing Type ☐ Antifriction ☐ Sleeve

Compressor Motor Starter Information

Manufacturer _____ Serial # _____
Starter Type ☐ WDCT ☐ ATL ☐ Auto-Trans ☐ Solid State ☐ Digital DBS ☐ Standalone DBS
CT Location Checked ☐ CT Phase _____ CT Ratio _____ Transition Time _____ DBS Ver. # _____

Oil Pump Information

Pump Manufacturer _____ Model # _____ Serial # _____
Motor Manufacturer _____ H.P. _____ RPM _____ Serial # _____
Service Factor _____ Voltage _____ Hz _____ FLA _____ Design _____ Code _____ Starter Size _____

Special Options

☐ DX Economizer ☐ Frick Supplied Starter ☐ PC Control System ☐ Other

Prestart Checks

☐ Position of all valves ☐ All wiring connections ☐ Motor rotation ☐ Oil pump motor rotation
☐ All micro settings ☐ Cold alignment ☐ Proper oil charge ☐ Installation, Foundation

Factory Setup Options (Quantum™)

☐ No Pump ☐ Prelube ☐ Cycling ☐ Full Time ☐ Dual ☐ Oil Filter Transducer ☐ Yes ☐ No
Refrigerant _____ K-Factor for User Defined Refrigerant _____ Slide Valve Travel _____

Dual Dischaarge Control ☐ Enabled ☐ Disabled Liquid Injection Cooling ☐ Enabled ☐ Disabled
Main Oil Injection Control ☐ Enabled ☐ Disabled Balance Piston Setup ☐ Enabled ☐ Disabled
Oil Log Setup ☐ Enabled ☐ Disabled Enable Aux 1 & 2 ☐ None ☐ 1 ☐ 2 ☐ Both

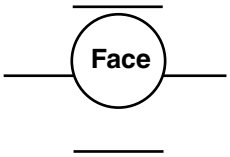
Adjustable Safety Setpoints

High Discharge Pressure Stop Load _____ Force Unload _____ Alarm _____ Delay_____ Shutdown_____ Delay_____
High Discharge Temp. Stop Load _____ Force Unload _____ Alarm _____ Delay_____ Shutdown_____ Delay_____
Motor Amps_____ Volts_____ Service Factor _____ Horsepower _____ CT Factor _____ Recycle Delay_____
Low Motor Amps Shutdown_____ Delay _____ Force Unload Inhibit Delay _____
High Motor Amps Stop Load _____ Force Unload _____ Alarm _____ Delay_____ Shutdown_____ Delay_____
High Oil Temperature Alarm _____ Delay _____ Shutdown _____ Delay _____
Low Oil Temperature Alarm _____ Delay _____ Shutdown _____ Delay _____ High Level Shutdown Delay _____
Low Separator Oil Temp. Alarm _____ Delay _____ Shutdown _____ Delay _____

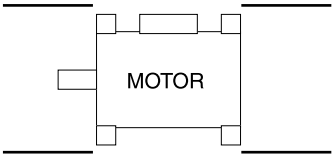
Drive Train Alignment

Ambient Temperature at Time of Alignment _____ Oil Separator Temperature at Time of Alignment _____
Motor Coupling Type _____ Size _____ Distance Between Coupling Hub Faces _____
Soft Foot Check ☐ OK as Found ☐ Shimming Required Amount of Shims used to Correct _____
Indicator Readings in ☐ in./1000 ☐ mm Indicator Clamped to ☐ Motor ☐ Compressor
Indicator Readings Facing ☐ Compressor ☐ Motor Magnetic Center Checked ☐ Marked ☐ N/A
Compressor Coupling Hub Runout _____ Motor Coupling Hub Runout _____

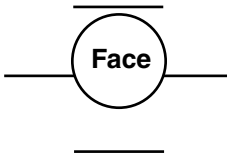
Initial Cold Alignment



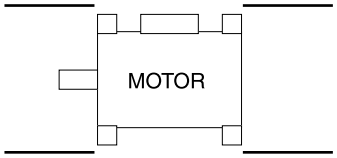
Thickness of Shims Added



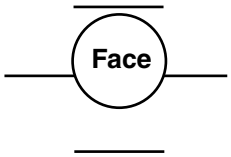
Initial Hot Alignment



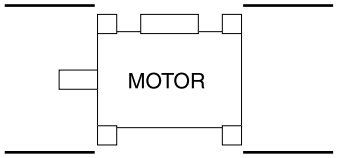
Thickness of Shims Added



Final Hot Alignment



Thickness of Shims Added



Operating Log Sheet

Date							
Time							
Hour Meter Reading							
Equip. Room Temp.							
Suction Pressure							
Suction Temperature							
Suction Superheat							
Discharge Pressure							
Discharge Temperature							
Corresponding Temperature							
Oil Pressure							
Oil Temperature							
Oil Filter Pressure Drop							
Separator Temperature							
Slide Valve Position							
Volume Ratio (VI)							
Motor Amps / FLA %							
Capacity Control Setpoint							
Oil Level							
Oil Added							
Seal Leakage (Drops/Min.)							

VIBRATION DATA SHEET

Date: _____
End User: _____
Address: _____

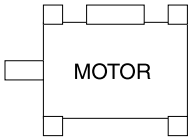
Sales Order Number:_____
Installing Contractor: _____
Service Technician: _____

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

Final Hot Alignment

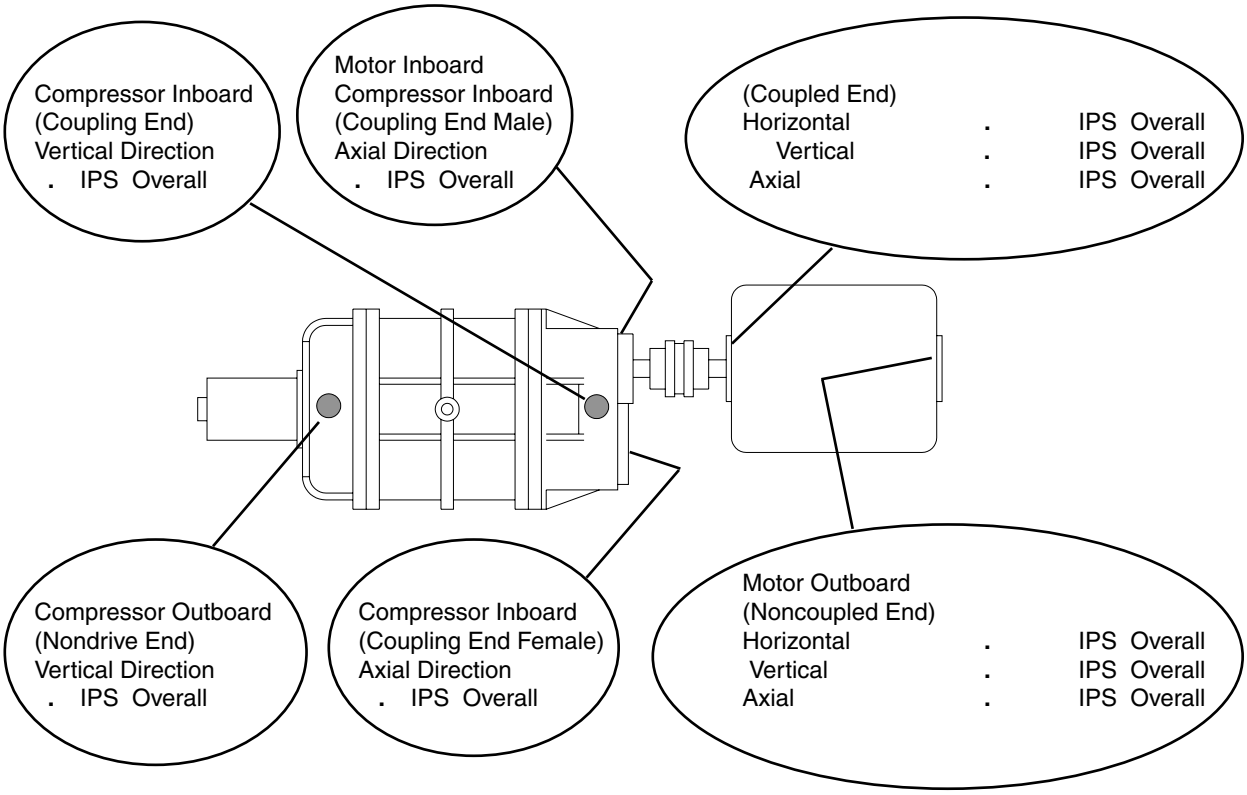
Total Thickness of Shims Added

Soft Foot **Soft Foot**



Soft Foot **Soft Foot**

SUCTION	DISCHARGE	OIL	SEPARATOR	Slide Valve Position %
Press #	Press #	Press #	Temp °F	V.I. Ratio
Temp °F	Temp °F	Temp °F		F.L.A. %



RECOMMENDED SPARE PARTS - CURRENT DESIGN

DESCRIPTION	QTY.	MODEL	ITEM NUMBER
QUANTUM CONTROL:			
Assembly, VGA Display, Phillips* (Display only 649C1078H01)	1	ALL	640C0052G01
Assembly, VGA Display, Sharp (Display only 333Q0001581)	1	ALL	640C0021G01
Inverter (part of 640C0052G01 Assembly above)	1	ALL	333Q0001582
Power Supply	1	ALL	640C0022G01
Cable CCFT Backlight Inverter and Display	1	ALL	649D4824H01
Keypad, Overlay	1	ALL	640D0060H01
Circuit Board, Main (Arcom, Quantum™ IV)	1	ALL	649C1091G01
Board, Analog	1	ALL	640C0026G01
Board, Digital	1	ALL	640C0024G01
Module, Output, 280V (For 115/230V)	2	ALL	111Q0281061
Module, Input, 90-140V (For 115V)	1	ALL	333Q0000116
Fuse, 5 Amp, 250V, Digital Board	4	ALL	333Q0001326
Relay, 3PDT, 115V	1	ALL	333Q0000206
Relay, 2PDT, 24VDC	1	ALL	333Q0001095
Fuse, 2 Amp, 24 VDC, Quantum™ Panel	1	ALL	333Q0001672
UNIT:			
Sensor, Temperature Probe	1	12—50	640A0035H01
Sensor, Temperature Probe	1	58—101	913A0101H11
Transducer, Pressure, 0—200 PSIA (with Quantum™)	1	ALL	913A0110H01
Transducer, Pressure, 0—500 PSIA (with Quantum™)	1	ALL	913A0110H02
Potentiometer Service Kit	1	ALL	111Q0045464
Valve, Solenoid, Vickers 120/60 & 110/50	1	12—50	951A0056H39
Valve, Solenoid, Vickers 120/60 & 110/50	1	58—101	951A0092H01
Coil For 951A0056H39 Above	2	12—50	951A0056H40
Coil For 951A0092H01 Above	1	58—101	951A0092H04
Heater, Oil, 500W, 120V	1	ALL	913A0092G01
Switch, Liquid Level w/2 " Reducing Bushing (See Fig. 5)	1	ALL	536A1419H01
Switch, Liquid Level w/1 " Reducing Bushing (See Fig. 5)	1	12—50	913A0086H01
Filter, Coalescing	1	12—19	531B0065H06
Filter, Coalescing	1	24—50	531B0065H03
Filter, Coalescing	1	58—68	531B0065H01
Filter, Coalescing	2	58—101	531B0065H01
Gasket, Separator Access Cover	1	12—19	959A0090H02
Gasket, Separator Access Cover	1	24—50	959A0090H03
Gasket, Separator Manway	1	58 & 68	531A0105H03
Gasket, Separator Manway	1	85 & 101	531A0105H04
Cartridge, Oil Filter, SuperFilter™ (Required for 1-2-3 Warranty)	1	12—50	535A0354H01
Element, Filter, Oil, SuperFilter™ (Required for 1-2-3 Warranty)	1	58—101	531A0224H01
Gasket, for 531A0224H01 above	1	58—101	959A0082H02
Kit, Shaft Seal, XJF 95	1	12—19	111Q0043229
Kit, Shaft Seal, XJF 120	1	24—50	111Q0043231
Kit, Shaft Seal, XJF 151	1	58—101	534M0602G02

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

For help in identifying valves, see Shutoff Valve Identification Guide S160-800 SPL.

* Phillips Display cannot be used on Quantum™ I & II boards due to voltage differences. Use Sharp Display.

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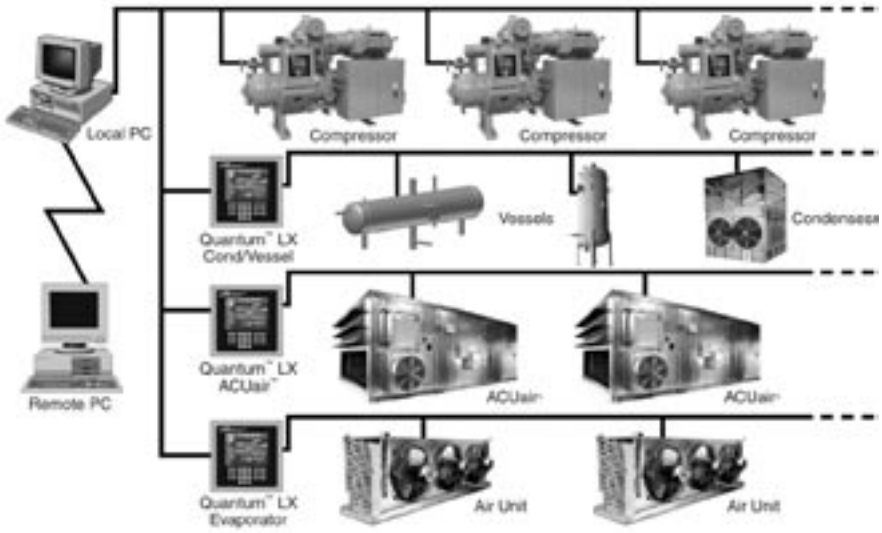

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