Bulletin T90-TPCS-IM-2
Part # 1090002

PRODUCT SUPPORT
web: **t-rp.com/support**
see inside back cover for details
scan:

Parallel Compressor Systems Installation and Maintenance Manual

Air, Water and Remote Models

Hermetic, Semi-Hermetic and Scroll Compressors

WARNING: Only a qualified refrigeration mechanic who is familiar with refrigeration systems and components, including all controls, should perform the installation and start-up of the system.

PARALLELCOMPRESSOR SYSTEMS

CONTENTS

18/04/22

GENERAL SAFETY

IMPORTANT SAFETY NOTE

Only a qualified refrigeration mechanic who is familiar with refrigeration systems and components, including all controls, should perform the installation and start-up of the system. To avoid potential injury, use care when working around coil surfaces (if applicable) or sharp edges of metal cabinets. All piping and electrical wiring should be installed in accordance with all applicable codes, ordinances and local by-laws.

WARNING

Always **disconnect and lock off** the main power supply on any system that will be worked on to avoid accidental start up of the equipment.

INSPECTION

Inspect all equipment before unpacking for visible signs of damage or loss. Check shipping list against material received to ensure shipment is complete.

IMPORTANT: Remember, you, the consignee, must make any claim necessary against the transportation company. Shipping damage or missing parts, when discovered at the outset, will prevent later unnecessary and costly delays. **If damage or loss during transport is evident, make claim to carrier, as this will be their responsibility, not that of the manufacturer.**

Should carton be damaged, but damage to equipment is not obvious, a claim should be filed for “concealed damage” with the carrier.

IMPORTANT: Check the electrical ratings on the unit to make sure they correspond to those ordered and to electrical power available at the job site. Save all shipping papers, tags, and instruction sheets for reference by installer and owner.

NOTE: Accessories such as drier cores, run-in filters for oil separator, mounting pads etc. may be packaged in a separate carton. Be sure that you receive all items.

HANDLING, PLACEMENT AND INSTALLATION

IMPORTANT: When selecting a location for the condensing unit, consideration should be given to some of the following:

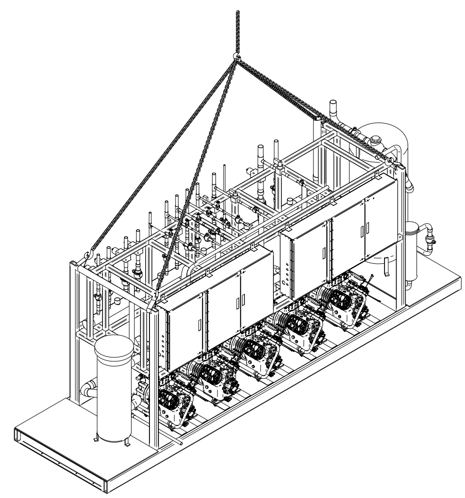
(a) Loading capacity of the floor or roof. Check building codes for weight distribution requirements.
(b) Distance to suitable electrical supply.
(c) Distance to the evaporator.
(d) Adequate air circulation and ventilation.
(e) Close proximity to water source and floor drains (water-cooled units)
(f) Accessibility for maintenance.
(g) Local building codes.
(h) Adjacent buildings relative to noise levels.
(i) Wishes of the end user / owner.

When all of the above points have been considered and a specific location chosen, it is advisable to obtain written approval of this location from the building and/or condensing unit owner. This may be a means of avoiding disagreement and expense at a later date.

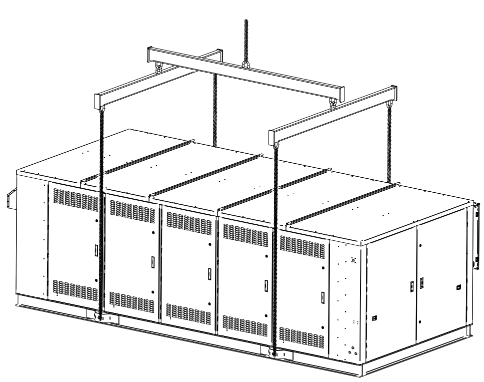
A fully qualified and properly equipped crew with the necessary tackle and rigging should be engaged to locate the condensing unit in position. When lifting the unit, spreader bars and chafing gear should be used to prevent damage.

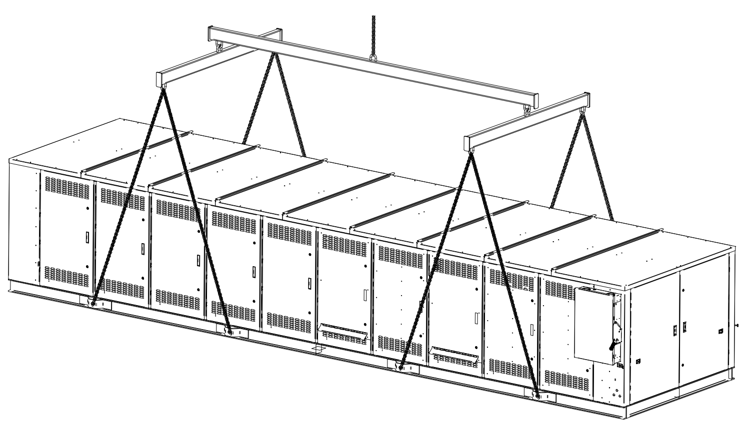
SPECIAL NOTE FOR LARGE PARALLEL RACK UNITS: Parallel rack units are large and heavy pieces of mechanical equipment and must be handled as such. A fully qualified and properly equipped crew with the necessary tackle and rigging should be engaged to locate the condensing unit into location. Spreader bars should be used to prevent damage to the sides of the unit. Do not sling directly around the base of unit. The unit should be placed on a base, which is level and even.

Indoor Racks, Trees and other indoor units aren't provided with lifting lugs. Strap lifting cables onto the top corners of the frame, and position the cables so the lifting forces are evenly distributed across the unit.



For outdoor Racks, welded structural-steel lifting lugs have been provided in strategic locations along the base frames to allow units to be lifted as level as possible. Attach lifting slings to the lifting lugs provided. Spreader bars must be used so that the lifting forces are applied vertically and damage to the cabinet doesn't occur. Spreader bars and lifting slings should be positioned so that the lifting forces are evenly and more vertically applied on the unit.

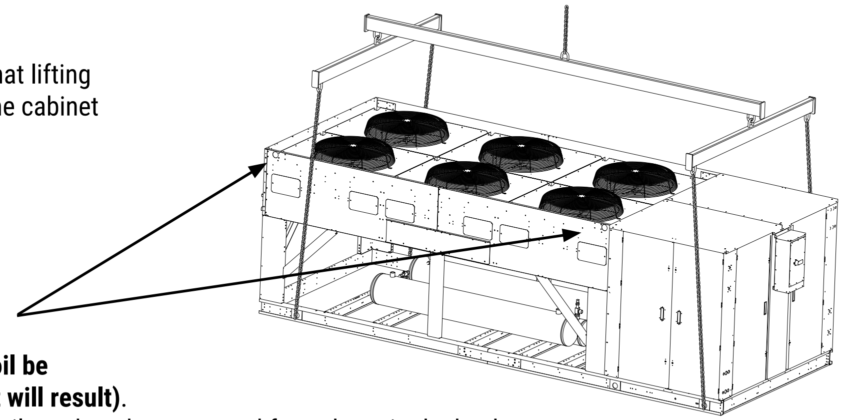




HANDLING, PLACEMENT AND INSTALLATION (cont'd)

For Link+ units, heavy gauge welded lifting lugs have been provided in strategic locations along the base frames to allow units to be lifted as level as possible. Use the lugs at the compressor end always, and find the lugs toward the opposite end that allow for the most level lift.

Spreader bars must be used when lifting so that lifting forces are applied vertically and damage to the cabinet and coil casing doesn't occur.



Warning: under no circumstances should the holes along the top edge of the condenser coil be used to lift an entire unit (Damage to the unit will result).
In the rare circumstance that the condenser coil needs to be separated from the unit, the backer plates can be removed from these holes and the coil section can be lifted off.
All heavy gauge side gussets must remain in place for any coil servicing removal.

VIBRATION ISOLATION

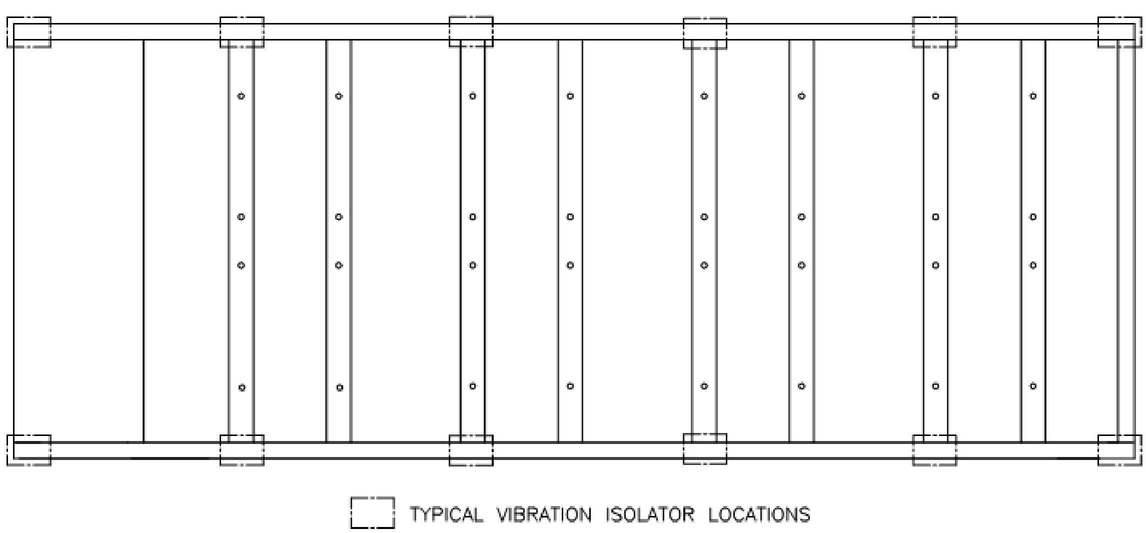
The unit should be placed on a base, which is level and even. Units should be lagged to sleepers or support base. Place unit where it will not be subject to damage by traffic or flooding.
On critical installations where noise is liable to be transmitted through the floor structure, vibration isolators should be installed. Isolators should be installed under mounting base and spaced out evenly to support the unit.

SPECIAL NOTE FOR LARGE PARALLEL RACK UNITS: Vibration isolation pads should be put under the rack. Refer to the sketch below for typical isolator locations.

DO NOT USE THE SHIPPING SKID (IF APPLICABLE) AS A PERMANENT BASE.

The unit should be positioned to allow adequate space for performing service work.

On units equipped with rigid mounted compressors, check the compressor mounting bolts to insure they have not vibrated loose during shipping.



VENTILATION REQUIREMENTS

INDOOR UNITS: If the unit is to be located in the machine room, adequate ventilation air must be provided to avoid an excessive temperature rise in the machine room. To allow for peak summer temperatures a maximum rise of 10°F is recommended.

In case of compressors with remote condensers, approx. 10% of the total heat rejected is given off by compressor and associated piping. The correct formula for calculating the ventilation requirement for indoor parallel compressor unit is:

$$CFM = \frac{10\% \text{ of THR (BTU/HR)}}{10\ (°F)}$$

The air intake should be positioned so that air passes over the units. All State, Local and National codes should be followed.

<u>This ventilation is only for the parallel compressor system. Additional ventilation must be taken in to account after considering other heat loads of the building.</u>

ELECTRICAL INFORMATION

WARNING

All wiring and connections to the unit must be made in accordance with national as well as local electrical codes and by-laws.

Electrical wiring should be sized in accordance with the minimum circuit ampacity (MCA) shown on the unit nameplate and applicable electrical codes. The unit power connections are approved for copper wire only.

Connect the field power supply through a properly sized branch circuit protection disconnect switch. The entering service fuse must not exceed the maximum overcurrent protection (MOP) value on the unit data plate.

Field connected control circuit wires are terminated directly at the control circuit terminal block in accordance with the appropriate wiring diagram.

Voltage at the unit terminals must not vary more than the allowable variation during start-up and while under full load. If the voltage is normal at the supply with the compressor not running and drops considerably when the switch is closed and the motor is trying to start, there is a high resistance due to undersized wires or faulty connections. Voltage drop between inoperative and full load must not exceed 3% of line voltage. In addition, the phase imbalance at the motor terminals should be within 2% on three phase units.

60 Hz Supply

Power	Allowable Variation
115-1-60	103-127 V
208/230-1-60	197-254 V
208/230-3-60	187-254 V
460-3-60	414-506 V
575-3-60	518-632 V

50 Hz Supply

Power	Allowable Variation
100-1-50	90-110 V
200/220-1-50	190-242 V
200/220-3-50	180-242 V
380/400-3-50	342-440 V

Refer to the wiring diagrams shipped with the unit for wiring arrangements.

WARNING

Any deviation or change to the electrical components or wiring as supplied on the original equipment, or noncompliance with the voltage and phase balance requirements without written authorization will void the warranty.

REFRIGERANT PIPING

WARNING

All local codes must be observed in the installation of refrigerant piping.

IMPORTANT PIPING NOTE

Appropriate line sizing practices must be used throughout the installation of the refrigeration system.
REFRIGERATION GRADE COPPER TUBING MUST BE USED FOR PIPING SYSTEMS.

Piping practice and line sizing charts as recommended by A.S.H.R.A.E. or other reputable refrigeration standards must be followed to ensure minimum pressure drop and correct oil return. An inert gas such as dry nitrogen should be passed through the piping during welding or brazing operations. This reduces or eliminates oxidation of the copper and formation of scale inside the piping. For specific piping requirements refer to your local distributor or sales representative.

Correct line sizing is most critical because of the several factors involved:

(a) Minimum pressure drop to ensure efficient compressor performance.
(b) Sufficient gas velocity to maintain proper oil return to the compressor under all load conditions.
(c) Elimination of conditions on multiple evaporators whereby oil may log in an idle evaporator.

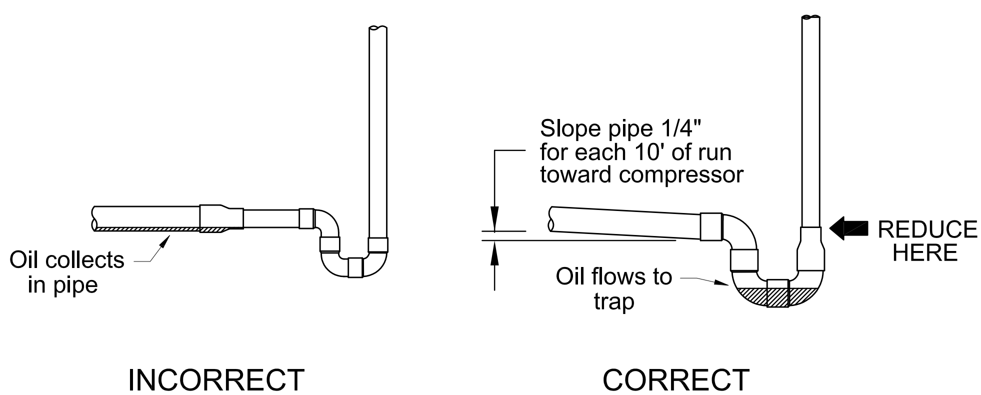
Suction Line: Suction lines should be sized on the basis of a maximum total pressure drop equivalent to a 2°F (*1.1°C*) change in saturated temperature. At 40°F (*4.4°C*) suction temperature, this is approximately 3 psig *(20.7 kPa)* for R-22. At -20°F *(-28.9°C)* suction temperature, this is approximately 1.3 psig *(9.0 kPa)* for R-404A.

At the temperatures encountered in the condenser, receiver and liquid line a certain amount of oil is always being circulated with the refrigerant through the system by the compressor. However, at the evaporator temperature, and with the refrigerant in a vapor state, the oil and refrigerant separate. This oil can only be returned to the compressor by gravity or by entrainment in the suction gas. Roof installations leave no alternative but by entrainment for oil return, so suction gas velocity and correct line sizing to maintain this velocity are imperative. Care must be taken not to oversize the suction line in the desire for maximum performance.

Gas velocity in vertical suction lines must not be less than 1,000 fpm *(5 m/s)* and preferably 1,250 to 1,500 fpm *(6 to 8 m/s)*.

Important: A suction trap must be installed at the base of all suction risers of four (4) feet or more in order to trap oil and allow entrainment in the suction gas.

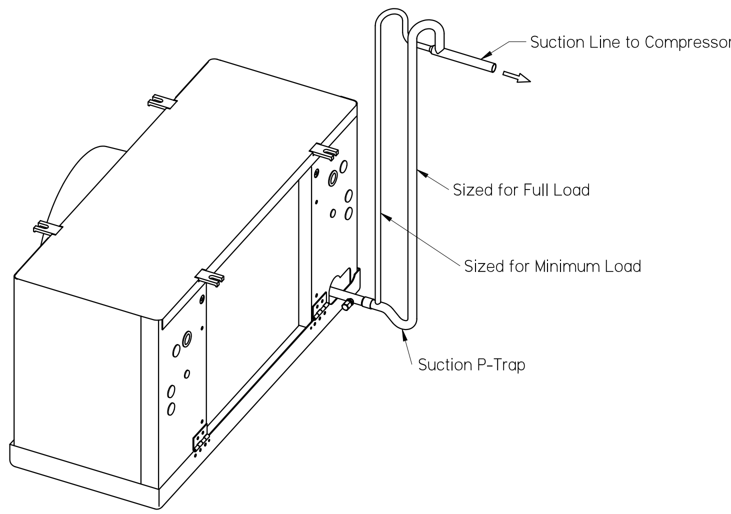
TYPICAL SUCTION P-TRAP



REFRIGERANT PIPING (cont'd)

IMPORTANT PIPING NOTE

If steps of capacity control are supplied on a compressor, provisions must be made for oil return by sizing suction risers to maintain adequate gas velocities at reduced refrigerant flow.



IMPORTANT: All suction lines outside of the refrigerated space must be insulated.

During the lower capacity running mode (compressor capacity control energized) oil will collect in the elbow or at U-bend below pipe "B". This will divert the gas and oil to flow up the smaller pipe "A" at a higher velocity.

Liquid Line: Horizontal liquid lines should be sized on a basis of a maximum pressure drop equivalent to a 2°F *(1.1°C)* drop in the sub-cooling temperature. If the lines must travel up vertically then adequate sub-cooling must be provided to overcome the vertical liquid head pressures. A head of two feet of liquid refrigerant is approximately equivalent to 1 psig *(6.9 kPa)*. Liquid line velocities should not exceed 300 fpm *(1.52 m/s)*. This will prevent possible liquid hammering when the solenoid valve closes

Pressure Loss of Liquid Refrigerant in Liquid Line Risers

Refrigerant	Liquid Line Rise in Feet									
	10'		15'		20'		25'		30'	
	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
R134a	4.9	2.0	7.4	2.9	9.8	4.1	12.3	5.2	14.7	6.3
R22	4.8	1.6	7.3	2.3	9.7	3.1	12.1	3.8	14.5	4.7
R404A R507	4.1	1.1	6.1	1.6	8.2	2.1	10.2	2.7	12.2	3.3
R407A R407C R448A R449A	4.3	1.4	6.5	2.1	8.7	2.8	10.8	3.5	12.8	4.1

Refrigerant	Liquid Line Rise in Feet							
	40'		50'		75'		100'	
	PSIG	°F	PSIG	°F	PSIG	°F	PSIG	°F
R134a	19.7	8.8	24.6	11.0	36.8	17.0	49.1	23.7
R22	19.4	6.2	24.2	8.0	36.3	12.1	48.4	16.5
R404A R507	16.3	14.1	20.4	5.6	30.6	8.3	40.8	11.8
R407A R407C R448A R449A	17.82	5.5	21.82	7	32.82	11	43.82	14

Based on 110°F liquid temperature at bottom of riser.

IMPORTANT: When brazing service valves or any components that may be damaged by heat, manufacturer's installation instructions must be followed. Wrapping components with a wet cloth will help to prevent damage from heat.

SYSTEM ACCESSORIES

Some of the important components of a parallel compressor system are as follows:

1. The **Coalescent Type Oil Separator** has an extremely fine and efficient filter. This filters particles down to 0.3 microns in size, which can easily pass through other filters and dryers in the system. Because of this nature, the initial filter has a tendency to get clogged quickly.
After an initial run of 24 to 48 hrs, the filter should be replaced with a new one.

2. An **Inlet Pressure Regulator and Outlet Pressure Regulator** are used for head pressure control under low ambient temperature conditions.

3. *(Optional)* **Oil Level Control** is used to regulate oil flow back to the compressor crankcase and maintain a minimum oil level. The oil level control is adjustable between ½ sight glass and ¼ sight glass. *Do not adjust beyond 10 turns down from the top stop or the control may be damaged*.
In addition, the **Oil Pressure Differential Valve** is installed on the oil feed line. The valve maintains the pressure of the oil to the compressor crankcase at 10-25 psi higher than crankcase pressure. Without the valve, the oil level control would overfeed the compressor. The valve setting is adjusted at the factory (20 psi).

4. *(Optional)* **OMB Electronic Oil Level Control** is used to regulate oil flow back to the compressor crankcase and maintain a minimum oil level. Offers alarm and status lights as well as safety lockout features.

5. *(Optional)* Each compressor may have a **Phase/Voltage Monitor** for protection against phase loss (single phasing), phase reversal (improper sequence), high voltage and low voltage (brownouts).

6. *(Optional)* A microprocessor **Refrigeration Controller** controls the refrigeration system including compressors and system evaporators. Separate output relay boards are mounted on each condenser (or at compressors) to control fan cycling and split circuiting. Refrigeration controller may require field programming to perform major functions as per available data. All the set points should be reviewed by customer and need to be reset as per actual requirements. An optional modem could be provided.

7. *(Optional)* A **Refrigerant Leak Detector** (sniffer type) is recommended. It may be mounted (or shipped separately) on the unit. This leak detector can detect leaks in the machine room area close to its sensor location. An IRLD (Infra Red Leak Detection System) is recommended for higher sensitivity of leak detection.

LEAK TESTING

IMPORTANT: All system piping, including the parallel compressor unit and accessories should be thoroughly tested for leaks prior to start up and charging. The system should be initially pressurized to a maximum of 150 psig *(1136 kPa)* with dry nitrogen to ensure that the system is free of major leaks. With the system free of major leaks, a more detailed leak check should be performed. It is recommended that an electronic leak detector be used when checking for leaks because of its greater sensitivity to small leaks. As a further check it is recommended that this pressure be held for a minimum of 12 hours and then rechecked. Follow the recommendations of the leak detector manufacturer for the procedure. The system must be leak free for satisfactory operation.

IMPORTANT ENVIRONMENTAL NOTE / WARNING

A proper refrigerant leak detector must be employed and monitored at all times in the machine room where the parallel compressor system is installed. An effective monitoring and quick response is necessary to avoid any prolonged leakage of refrigerant.
Manufacturer will not be responsible for any refrigerant loss and its environmental impact from the system.

IMPORTANT ENVIRONMENTAL NOTE

When conventional leak detection methods are employed using HCFC or CFC tracer gas, all of the tracer gas must be reclaimed and disposed of in a proper manner.

EVACUATION AND DEHYDRATION

CAUTION

Do not use the refrigeration compressor to evacuate the system. Never start the compressor or perform a megger insulation test while the system is in a vacuum.

When the system is completely free of refrigerant leaks, an evacuation of the entire system should be completed by using a “high vacuum” pump. This evacuation, if completed correctly, will ensure long life for the system as well as elimination of moisture and non-condensable gas problems. **Moisture problems causing compressor failure will void warranty. Follow the recommended procedure carefully.**

Use only a “high vacuum” pump capable of drawing a vacuum of 100 microns. Change the vacuum pump oil frequently. Gauges or vacuum measuring instruments should be suitable to measure conditions at any stage of the process in order to give the operator indications of progress. For specific recommendations, refer to the vacuum pump supplier for these instruments.

Copper jumper lines should be used to interconnect both high and low-pressure sides of the system. These lines should be at least 3/8” O.D. in order to handle the light density vapor at high vacuum obtained at completion of operation. Lines smaller than 3/8” O.D. will slow down the process considerably as well as make final system vacuum questionable. Double evacuation with a “sweeping” of dry nitrogen is recommended. First evacuation should be to at least 1,500 micron. When this point is reached, break the vacuum with refrigerant or dry nitrogen to melt any moisture, which may have frozen during the first vacuum stage.

Reclaim any tracer gas from the system and re-evacuate to a final vacuum of at least 500 microns. With this degree of evacuation, all moisture and non-condensables should be removed from the entire system.

LINE INSULATION

After the final system leak test is complete, it is important that all refrigerant lines exposed to high ambient conditions must be insulated to reduce the heat pick-up and prevent the formation of flash gas in the liquid lines. Suction lines should be insulated with 3/4 inch wall insulation, Armstrong "Armaflex" or equal. To prevent rupture due to condensate re-freezing, all **suction vibration** eliminators on low temperature systems **MUST BE COMPLETELY INSULATED**. Liquid lines exposed to high ambient temperatures should be insulated with 1/2 inch wall insulation or better. Any insulation that is to be located in an outdoor environment should be protected from UV exposure to prevent deterioration of the insulating value.

REFRIGERANT CHARGING

Condensing units must be charged only with the refrigerant for which they were designed. The type of refrigerant to be used is specified on the name plate of the unit. Installing a liquid line drier between the service gauge and the liquid service port when charging a unit will ensure the refrigerant supplied to the system is clean and dry. This is especially important when charging a low temperature system. Blend type refrigerants (400 series, i.e. R404A) **must not be vapor charged** unless the cylinder is completely emptied into the system.

Weigh the refrigerant drum before and after charging in order to keep an accurate record of the weight of refrigerant put into the system.

IMPORTANT REFRIGERANT CHARGING NOTE

Overcharging a system can result in poor system performance, personal injury and / or compressor damage. **DO NOT** charge strictly by the holding capacity of the receiver. **DO NOT** assume that bubbles in a sight glass, when located at the condensing unit, indicates the system is undercharged.

Note: *To estimate the total system requirement, refer to the manufacturer's evaporator and condensing unit specifications on typical operating charges and include the amount for the liquid lines. Allow an extra 10% to 15% safety factor.*

Break the vacuum by charging liquid refrigerant into the receiver side only.

If charging to the "bubble" method (observing liquid line sight glass), always use a sight glass located directly before the TXV (thermostatic expansion valve) for the final indicator.

On units that use an adjustable flooded condenser pressure-regulating valve, the controls should be re-adjusted to the following pressures:

185 psig *(1377 kPa)* for R-22
200 psig *(1480 kPa)* for R-404A

Refer to manufacturer's installation instructions for further details.

COMPRESSOR OILS

Check to see that the oil level is 1/8 to 1/3 up on the compressor sight glass on compressors so equipped before starting the compressor and after 15 to 20 minutes of operation.

CAUTION: Oil levels should not be allowed to go above the centre or 1/2 of the sight glass. Excessive oil levels in the compressor can result in excessive compressor noise, higher power consumption or internal compressor damage.

DO NOT re-use drained oil that has been exposed to the atmosphere.

DO NOT re-fill, at any one time more than a total of 110 % of the compressor's factory specified charge. Allow time for some of the oil to circulate into the system.

Refrigeration Oils - Copeland Semi-Hermetic Reciprocating Compressors

Lubricant Type		Traditional Refrigerants		Interims R-401A, R-401B, R402A, R-408A, R409A (MP-39, MP-66, HP-80, FX-10, FX-56)	HFC's R-134a, R-404A, R-507, R-407C, R-410A
		R-12	R-22, R-502		
POE's	Copeland Ultra 22CC	NOT ACCEPTABLE	A	A	P
	Mobil EAL ARTIC 22 CC		A	A	P
	ICI (Virginia KMP) Emkarate RL 32CF		A	A	P
	Thermal Zone 22CC		A	A	P
Mineral Oils	Witco Suniso 3GS	P	P	PM	NOT ACCEPTABLE
	Texaco Capella WF32	P	P	PM	
	Calumet RO15 (Witco)	P	P	PM	
	Witco LP-200*	P	P		
	Penreco* Sontex 200-LT Shritene	P	P		
A/B	Copeland Ultra 200	A	A	PM	NOT ACCEPTABLE
	Shreve Zerol 200 TD	A	A	PM	
	Soltex AB200A	A	A	PM	
	Thermal Zone 200	A	A	PM	
A/B M/O Mix	Shell 22-12	A	A	P	NOT ACCEPTABLE
	Witco R-195-0	A	A	P	

Legend P = Preferred Lubricant Choice A = Acceptable Alternative M = Mixture of Mineral Oil and AlkylBenzene (AB) with 50 % AB.

* BR, QR and Scroll A/C applications

COMPRESSOR OILS (cont'd)

Bitzer Semi-Hermetic Reciprocating Compressors: 2KC-05.2(Y) to 6F-50.2(Y)

Lubricant Type		(H)CFC R22 Interim Blends R-401A, R-401B, R-402A, R-408A, R-409A, (MP-39, MP-66, HP-80, FX-10, FX56)	HFC's R134a R404A R507 R407A R407C R448A R449A
Polyol Ester	ICI (Virgina KMP) Emkarate RL32S	A*	P
	Mobil EAL Arctic 32	A*	P
	Castrol Icematic SW32	A*	P
Mineral Oils	Suniso 3GS	A	Not Acceptable
	Suniso 4GS	A	
	Capella Oil WF32	A	
	Capella Oil WF68	A	
	Esso Zerice R68	A	
Alkyl Benzene	Zerol 150	P	Not Acceptable
	Zerol 300	P	
	Icematic 2284	P	
	Esso Zerice S46	P	
	Esso Zerice S68	P	
A/B M/O Mix	Shell Clavus SD 2212	P	Not Acceptable
	Esso Zerice R46	A	

Legend: P = Preferred A= Acceptable Alternative

- Compressor with "Y" designation are factory charged with polyolester oil
* NOTE: When operating (H)CFC with ester oils the quantity of refrigerant dissolved in the oil is more than doubled as compared with conventional lubricants. Special care should be taken. Refer to Bitzer Technical Bulletin KT-510-2, section 5 for additional information.

Refrigeration Oils--Carlyle Semi-Hermetic Reciprocating Compressors: 06D/E and 06CC

Lubricant Type		(H)CFC R-22	HFC's R-134a, R-404A, R-507, R-407C
Polyol Ester	Totaline P903-1001,1701	Not Approved	A
	Castrol E68		A
	ICI Emkerarate RL68H		A
	CPI CP-2916S		A
	CPI Solest 68		A
	BP Marine Enersyn MP-S68		A
Mineral/Alkyl Benzene	Witco Suniso 3GS	A	Not Approved
	Totaline P903-2001	A	
	Texaco Capella Oil WFI-32-150	A	
	IGI Cryol -150	A	
	Shrieve Zerol-150	A	

A = Approved
Some restrictions may apply.For further information consult Carlyle factory or Carlyle web site.

Due to the extreme hygroscopic (moisture absorbing) characteristics of Polyol Ester (POE) oils, systems MUST <u>NEVER</u> be left open to the atmosphere for any extended period of time. Simply pulling a deep vacuum on the system during the evacuation and dehydration procedure <u>WILL NOT</u> remove moisture that is absorbed into POE oils.

SYSTEM START-UP CHECK LIST

IMPORTANT START-UP NOTE

Only a qualified refrigeration mechanic who is familiar with compressor performance and the function and adjustment of all controls and components should start up the compressor. Finishing up work on the installations should be planned so that a qualified mechanic

Before any refrigeration system is started, the following items should be checked:

Before any refrigeration system is started, the following items should be checked:

(1) Check that the wiring diagrams, instructions, bulletins etc. are read and attached to the unit for future reference.
(2) Check that all electrical and refrigeration connections are tight.
(3) Check compressor crankcase oil level (if equipped with sight glass). It should be from 1/8 to 1/2 full in the sight glass.
(4) Ensure that compressor shipping spacers (spring mounted compressors) or hold down nut (solid mounted compressors are properly in place.
(5) Check that the compressor discharge and suction shut-off valves are open.
(6) Ensure that the high and low pressure controls (see table below), pressure regulating valves, oil pressure safety controls and any other safety controls are adjusted properly.
(7) Check all motors, fans and pump bearings in the condenser and evaporator. If they are the types that require oil or grease, make sure that this is attended to in accordance with the tag, which will be attached. Fan blades and pumps should be checked for correct rotation, tightness and alignment. Air should be drawn through the condenser (air cooled condensing unit models).
(8) Electric and hot gas evaporator fan motors should be temporarily wired for continuous operation until the room temperature has stabilized.
(9) Observe the system pressures during the charging and initial operation process. **DO NOT** add oil while the system is low on refrigerant charge unless the oil level is dangerously low.
(10) Continue to charge the system until it has enough charge for proper operation. **DO NOT OVERCHARGE THE SYSTEM.** Note that bubbles in the sight glass may not necessarily mean a shortage of refrigerant. It could be caused by a restriction.

After the system is started, pay attention to the following:

(1) **DO NOT** leave the system unattended until the system has reached its normal operating condition and the oil charge has properly adjusted itself to maintain the proper level in the sight glass.
(2) Compressor performance, and that of all of the moving components, should be watched carefully throughout the first operating cycle and then checked periodically during the first day of operation.

CAUTION

Extreme care must be used when starting compressors for the first time after the system has been charged. During this time liquid refrigerant may have migrated to the compressor crankcase, creating a condition that could cause the compressor damage due to slugging. Energizing a crankcase heater (if so equipped) 24 hours prior to start-up is recommended. If the compressor is not equipped with a crankcase heater, directing a 500 watt heat lamp or other safe heat source on the lower shell or crankcase of the compressor for approximately thirty minutes is recommended unless machine room is at above 65°F for at least 24 hrs prior to startup.

WARNING

Three phase scroll compressors must be checked for correct rotation. During the initial start up, observe the suction and discharge gauges to ensure the suction pressure drops and the discharge pressure rises.

SYSTEM START-UP CHECK LIST (cont'd)

Low Pressure Control Settings

Minimum Temperature °F *	R134a		R22		R404A R507		R407A R407C R448A R449A	
	Cut-in (PSIG)	Cut-out (PSIG)	Cut-in (PSIG)	Cut-out (PSIG)	Cut-in (PSIG)	Cut-out (PSIG)	Cut-in (PSIG)	Cut-out (PSIG)
50	35	5	70	20	85	30	65	20
40	25	5	55	20	70	30	50	20
30	17	5	40	20	50	30	35	20
20	12	0	30	10	40	20	25	5
10	7	0	20	0	30	10	15	0
0	5	0	15	0	20	5	10	0
-10	-	-	15	0	15	0	10	0
-20	-	-	10	0	10	0	7	0
-30	-	-	10	0	6	0	7	0

* The coldest Temperature of either the fixture or outdoor ambient.

High Pressure Control Settings

Refrigerant	Maximum Cut-out (PSIG)	
	Air-Cooled Units	Water Cooled Units
R134a	250	200
R22	350	315
R407A R407C R448A R449A	400	315

LOW TEMPERATURE ROOM PULL-DOWN

It can take up to two weeks to properly start-up and pull-down a large freezer. Large freezers should be pull-down to temperature in stages. Too fast a pull-down can cause structural problems in pre-fabricated rooms and will damage (crack) concrete floors. Reduce room temperature by 10 to 15°F *(5.6 to 8.4°C)* per day. Hold this temperature for 24 to 48 hours at 35°F *(1.7 °C)* and again at 25°F *(-3.9 °C)*. Monitor the amount of defrost water during this pull down stage.

Once the room is pulled down to temperature, expect frost on the compressor end bell and any exposed suction line. A lack of frost in these areas probably indicates too high of suction superheat.

Reduce defrost frequency to 30 minutes every 6 hours if possible. Adjust the defrost termination (and time clock) so that the coil and drain pan are **COMPLETELY** free of frost / ice at termination. Too short of a defrost cycle will allow residual ice to grow. Too long of a defrost will allow the coil(s) to steam at the end of the cycle. The steam will condense and freeze fans, fan guards and create frosting on the ceiling of the room. The evaporator fan delay must allow any condensate left on the coil surface to refreeze before the fans start.

CHECKING SUPERHEAT

IMPORTANT SYSTEM BALANCING NOTE

To obtain maximum system capacity and insure trouble free operation it is necessary to check both the compressor and evaporator superheat.

Compressor Superheat

Compressor suction superheat must be checked. To check the superheat at the compressor the following steps should be followed:

(1) Measure the suction pressure at the suction service valve of the compressor. Determine the saturated temperature corresponding to this pressure from a “Pressure- Temperature” chart.
(2) Measure the suction temperature of the suction line about 6 inches *(15 cm)* back from the compressor suction valve using an accurate thermometer.
(3) Subtract the saturated temperature (from step 1) from the actual suction line temperature (from step 2). This difference is the **actual superheat at the compressor.**

System capacity decreases as the suction superheat increases. For maximum system capacity, the suction superheat should be kept as low as is practical. The superheat at the compressor should range within 20 to 45 °F *(11.2 to 25.2 °C)* Superheat.

NOTE: Too low of a suction superheat can result in liquid being returned to the compressor. This can cause dilution of the oil and eventually cause failure of the bearings and rings through wash out as well as liquid slugging.

NOTE: Too high of a suction superheat will cause excessive discharge temperatures which cause a break down of the oil and will result in piston ring wear, piston and cylinder wall damage.

If adjustment to the suction superheat is required, it should be done either by adjusting the thermostatic expansion valve at the evaporator, the use of liquid to suction heat exchanger or suitable use of suction line insulation.

Evaporator Superheat

Once the refrigerated space is at its design temperature or close to design temperature, the evaporator superheat must be checked. To check the suction superheat at the evaporator the following steps should be followed:

(1) Measure the suction pressure in the suction line at the bulb location by either,
    (a) A gauge in the external equalizer line will indicate the pressure directly and accurately.
    (b) A gauge directly in the suction line near the evaporator or directly in the suction header will suffice.
(2) Measure the temperature of the suction line at the point where the thermostatic expansion valve bulb is clamped to the suction line.
(3) Convert the pressure obtained in step 1 above to a saturated evaporator temperature from a “Pressure-Temperature” chart.
(4) Subtract the saturated temperature (from step 1) from the actual suction line temperature (from step 2). This difference is the **actual superheat at the evaporator**.

The superheat at the evaporator should be a minimum of 6 to 10 °F *(3.4 to 5.6 °C)* for systems with a 10 °F *(5.6 °C)* design TD (temperature difference) to a maximum of 12 to 15 °F *(6.7 to 8.4 °C)* for systems with a higher operating TD.

Low temperature applications (freezers) should be set at superheats of 4 to 6 °F *(2.2 to 3.4 °C)*.

TD = Box temperature – evaporating temperature.

SYSTEM OPERATIONAL CHECK LIST

When the system has been running trouble free for an extended time (two weeks or more) and design conditions are satisfied, the following check list should be followed:

(1) Check that compressor **discharge and suction pressures** are operating within the allowable design limits for the compressor. If not, take the necessary corrective action.
(2) Check the liquid line sight glass and expansion valve operation. If there is an indication that the system is low on refrigerant, thoroughly **check the system for leaks before adding refrigerant.**
(3) Check the **level of the oil** in the compressor sight glass (if so equipped). Add oil as necessary.
(4) The thermostatic expansion valve must be checked for **proper superheat settings**. The sensing bulb must have positive contact with the suction line and should be insulated. Valves operating at a high superheat setting results in low refrigeration capacity. Low superheat settings can cause liquid slugging and compressor bearing washout. (Refer to the section on compressor and evaporator superheats)
(5) Check the **voltage and amperage** readings at the compressor terminals. Voltage reading must be within the recommended guidelines. Normal operating amperages can be much lower than the compressor nameplate values.
(6) To check the **high pressure control setting** it is necessary to build up the head pressure to the cut-out point of the control. This can be done by stopping the condenser fan(s) (air cooled condensing units) or pump and watching the pressure rise on a high pressure gauge to make sure the high pressure control is operating at the setting.
(7) Check the **low pressure settings** by throttling the compressor shut-off valve and allowing the compressor to pump down. This operation must be done with extreme caution to avoid too sudden a reduction in crankcase pressure, which will cause oil slugging and possible damage to the compressor valves. Close the valve a turn a a time while watching the compound gauge for change and allowing time for the crankcase pressure to equalize with the pressure control bellows pressure. The slower the pressure is reduced, the more accurate will be the check on the pressure control setting.
(8) Recheck all **safety and operating controls** for proper operation and adjust as necessary.
(9) Check **defrost controls for initiation and termination settings**, and the length of defrost period. Set the fail safe on the time clock at the length of defrost plus 25 %.
(10) If the system is equipped with winter head pressure controls (fan cycling or flooded valves), **check for operation**.
(11) Fill in the **Service Log** in the back of this Installation Manual.

SYSTEM TROUBLESHOOTING

The following System Troubleshooting Guide lists the most common types of malfunctions encountered with refrigeration systems. These simple troubleshooting techniques can save time and money minimizing unnecessary downtime and end-user dissatisfaction.

Contact the factory or your local sales representative for further information or assistance.

System Troubleshooting Guide	
Condensing Unit Problem	**Possible Causes**
Compressor will not run. Does not try to start.	1. Main power switch open. 2. Fuse blown or tripped circuit breaker. 3. Thermal overloads tripped. 4. Defective contactor or coil. 5. System shut down by safety devices. 6. Open thermostat or control. No cooling required. 7. Liquid line solenoid will not open. 8. Loose wiring.
Compressor hums, but will not start.	1. Improperly wired. 2. Low line voltage. 3. Loose wiring. 4. Defective start or run capacitor. 5. Defective start relay. 6. Motor windings damaged. 7. Internal compressor mechanical damage.
Compressor starts, but trips on overload protector.	1. Improperly wired. 2. Low line voltage. 3. Loose wiring. 4. Defective start or run capacitor. 5. Defective start relay. 6. Excessive suction or discharge pressure. 7. Tight bearings or mechanical damage in compressor. 8. Defective overload protector. 9. Motor windings damaged. 10. Overcharged system. 11. Shortage of refrigerant. 12. Suction or discharge pressure too high. 13. Inadequate ventilation. 14. Operating system beyond design conditions.
Compressor short cycles.	1. Low pressure control differential set too low. 2. Shortage of refrigerant. 3. Low airflow at evaporator(s). 4. Discharge pressure too high. 5. Compressor internal discharge valves leaking. 6. Incorrect unit selection (oversized).
Contact welded stuck	1. Short cycling.
Compressor noisy or vibrating.	1. Flood back of refrigerant. 2. Improper piping support on the suction or discharge lines. 3. Broken or worn internal compressor parts. 4. Incorrect oil level. 5. Scroll compressor rotating in reverse (three phase). 6. Improper mounting on unit base.

Continues on next page >>>

SYSTEM TROUBLESHOOTING (cont'd)

System Troubleshooting Guide Continued	
Condensing Unit Problem	**Possible Causes**
Discharge pressure too high.	1. Non-condensables in the system. 2. System overcharged with refrigerant. 3. Discharge service valve partially closed. 4. Condenser fan not running. 5. Dirty condenser coil.(air-cooled condensers) 6. Dirty tubes. .(water-cooled condensers) 7. Defective or improperly set water regulating valve. (water-cooled condensers) 8. Defective or improperly set flooded head pressure control.
Discharge pressure too low.	1. Low suction pressure. 2. Cold ambient air. 3. Suction service valve partially closed. 4. Shortage of refrigerant. 5. Defective or improperly set water regulating valve. (water-cooled condensers) 6. Defective or improperly set flooded head pressure control.
Suction pressure too high.	1. Excessive load. 2. Compressor internal valves broken. 3. Incorrect unit selection (undersized). 4. Improper TXV bulb charge.
Suction pressure too low.	1. Shortage of refrigerant. 2. Evaporator dirty or iced up. 3. Clogged liquid line filter drier. 4. Clogged suction line filter or compressor suction strainers. 5. Expansion valve malfunctioning. 6. Condensing temperature too low. 7. Improper TX valve selection. 8. Evaporator distributor feed problems.
Low or no oil pressure.	1. Low oil level. (trapped oil in evaporator or suction line) 2. Clogged suction oil strainer. 3. Excessive liquid refrigerant in the crankcase. 4. Worn oil pump. 5. Oil pump reversing gear sticking in the wrong position. 6. Worn bearings. 7. Loose fitting on oil line. 8. Pump housing gasket leaking.
Compressor loses oil.	1. Refrigerant leak. 2. Short cycling. 3. Excessive compressor ring blowby. 4. Refrigerant flood back. 5. Improper piping or traps. 6. Trapped oil in evaporator.
Compressor runs continuously	1. Excessive load. 2. Too low of a system thermostat setting or defective thermostat. 3. Shortage of refrigerant. 4. Leaking compressor internal valves. 5. Malfunctioning liquid line solenoid. 6. Incorrect unit selection (undersized).

Continues on next page >>>

SYSTEM TROUBLESHOOTING (cont'd)

System Troubleshooting Guide Continued	
Condensing Unit Problem	**Possible Causes**
Room temperature too high.	1. Defective room thermostat or improper differential / setting. 2. Malfunctioning liquid line solenoid valve. 3. Insufficient air across evaporator coil (iced up coil, product blocking evaporator, fan blade / motor problem). 4. Improper evaporator superheat (low refrigerant charge, plugged TXV strainer, poor TXV bulb contact, incorrect TXV setting). 5. Malfunctioning condensing unit.
Room temperature too low.	1. Defective room thermostat or improper differential / setting. 2. Malfunctioning liquid line solenoid valve.
Ice accumulating on ceiling.	1. Defrost on too long (improper setting / defective termination thermostat, improper setting / defective time clock). 2. Too many defrosts per day. 3. Fans not delayed after defrost (improper setting / defective fan delay thermostat).
Evaporator coil not clear of ice after defrost.	1. Defrost on too short (improper setting / defective termination thermostat, improper setting / defective time clock). 2. Electric heaters defective / miswired / low voltage. 3. Not enough defrosts per day. 4. Air defrost evaporator operating at too low of temperature (require electric defrost). 5. Defective / miswired interlock at compressor contactor. 6. Defective defrost contactor or coil.
Ice building up in drain pan.	1. Improper slope in pan. 2. Blocked drain line (unheated , not insulated). 3. Electric heater in drain pan defective / miswired / low voltage). 4. Not enough defrosts per day. 5. Lack of or improper P-trap in drain line.
Evaporator fans will not operate.	1. Main power switch open. 2. Fuse blown or tripped circuit breaker. 3. Defective contactor or coil. 4. Room temperature too high (fan delay thermostat open). 5. Fan delay thermostat improper setting / defective. 6. Defective fan motor (low voltage / tripped on thermal overload). 7. Defective time clock. 8. Normal mode during defrost cycle (electric defrost type evaporator).

IMPORTANT TROUBLESHOOTING NOTE

Before any components are changed on the refrigeration system, the cause of the failure must be identified. Further problems will exist unless the true cause or problem is identified and corrected.

CUSTOMER INSTRUCTIONS

Completely fill in System Start-Up Worksheets located at the back of this Installation and Maintenance Manual. This document should be left with the equipment for future reference.

Give the owner / end user instructions on normal operation of the system. Explain electrical characteristics, location of disconnect switches as well as other safety precautions. Advise on keeping equipment area clean and free of debris. If system has operational features, point these out to the operator.

MAINTENANCE PROGRAM

In order to ensure that the refrigeration system runs trouble free for many years, a follow-up maintenance program (consisting of a minimum of two inspections per year) should be set up. A qualified refrigeration service mechanic should carry out this semi-annual inspection. The main power supply must be disconnected and locked off to avoid accidental start up of the equipment.

(1) Check electrical components and tighten any loose connections.
(2) Check all wiring and electrical insulators.
(3) Check contactors to ensure proper operation and contact point for wear.
(4) Check that fan motors (if applicable) are operational, ensure fan blades are tight and all mounting bolts are tight.
(5) Check oil and refrigerant levels in the system.
(6) Ensure that the condenser surface (if applicable) is cleaned and free of dirt and debris.
(7) Check the operation of the control system. Make certain that all of the safety controls are operational and functioning properly.
(8) Check all refrigeration piping. Make sure that all mechanical joints and flare nuts are tight.

SERVICE PARTS AVAILABILITY

Genuine replacement service parts should be used whenever possible. Refer to the Service Parts List on the back cover of this Installation and Maintenance Manual or attached to the unit.

Parts may be obtained by contacting your local sales representative or authorized distributor.

NOTES

START-UP INFORMATION

Important: This start-up information should be completely filled in on each installation and remain with the unit as a permanent record for future reference.

PLEASE PRINT LEGIBLY

Name & address of installation ____
____
____

Name, address, phone & fax # of Installing contractor ____
____
____

Type of System (Cooler, Freezer, etc…) __________ **Design Box Temperature________°F**

Condensing Unit **System start-up date____________**

Unit model # _______________________________ Unit serial # ___________________

Compressor model # _________________________ Compressor serial #______________

Evaporator(s) QTY ______

Unit model # _________________________ Unit serial # _________________________

Unit model #_________________________ Unit serial #_________________________

Evaporator(s) unit electrical rating: Volts_________Phase_________Hz _________

Voltage at evaporator terminals: L1/L2__________ L2/L3 ___________ L1/L3_________

Amperage at evaporator: L1__________ L2___________ L3____________

Expansion valve - Manufacturer_________________________ Model # __________________

Evaporator drain line trapped outside of box____Yes _____No

System Conditions (Record just before desired box temperature is reached)

Refrigerant Type______Total Charge______System evacuation # of times_____Final micron _____

Ambient at start-up ______°F Operating box temperature______°F

Thermostat setting ______ °F Defrost settings ______ / day Minutes fail safe ______

Condensing unit electrical rating: Volts_________Phase_________Hz _________

Voltage at compressor terminals: L1/L2__________ L2/L3 ___________ L1/L3_________

Amperage at compressor: L1__________ L2 ___________ L3 __________

Compressor discharge pressure_________psig Compressor suction pressure_________psig

Discharge line temperature at compressor_____ °F Suction line temperature at compressor_____ °F

Superheat at compressor ___ °F

Suction line temperature at evaporator TX valve bulb_____ °F Superheat at evaporator______°F

Comments:____
____
____
____
____

PRODUCT SUPPORT RESOURCES

PRODUCT SUPPORT

web: **pcs.t-rp.com**
email: **racks@t-rp.com**
call: **1-844-893-3222 x525**

TROUBLESHOOTING

email: **troubleshooting@t-rp.com**
call: **1-844-893-3222 x529**

SERVICE PARTS

web: **t-rp.com/parts**
email: **parts@t-rp.com**
call: **1-844-893-3222 x525**

WARRANTY

web: **t-rp.com/warranty**
email: **warranty@t-rp.com**
call: **1-844-893-3222 x501**

ORDERS

email: **orders@t-rp.com**
call: **1-844-893-3222 x501**

SHIPPING

email: **shipping@t-rp.com**
call: **1-844-893-3222 x503**

"AS BUILT" SERVICE PARTS LIST

Service Parts List
Label
To Be Attached
HERE

Trenton Refrigeration
Brantford, ON • Longview, TX
1-800-463-9517   info@t-rp.com   www.t-rp.com