TX Series
Central Chillers
Installation, Operation and Maintenance Manual

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Form 3-350.6

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Foreword

The intent of this manual is to serve as a guide for placing your central chiller in service and operating and maintaining it properly. Improper installation can lead to poor equipment performance or severe equipment damage. Failure to follow the installation instructions may result in damage that will not be covered by your warranty. It is extremely important that a qualified refrigeration installation contractor perform all installation line sizing and piping. Please supply these instructions to your authorized refrigeration contractor. This manual is supplemented as required to accommodate any special items that may have been provided for a specific application. The written information contained in this manual, as well as various drawings, are intended to be general in nature. The drawings included in this manual are typical only and may not represent the actual unit purchased. Actual drawings are included with the equipment and should be referred to for troubleshooting and servicing of the unit. Additional copies of drawings are available upon request. We strive to maintain an accurate record of all equipment during the course of its useful life. While every effort is made to standardize the design features of these chillers, the various options may make it necessary to rearrange some of the components; therefore, some of the general drawings in this manual may differ from your specific unit.

Specific references to current applicable codes, ordinances, and other local laws pertaining to the use and operation of this equipment are avoided due to their ever-changing nature. There is no substitute for common sense and good operating practices when placing any mechanical equipment into operation. We encourage all personnel to familiarize themselves with this manual's contents. Failure to do so may unnecessarily prolong equipment down time.

The chilling equipment uses chemical refrigerants for heat transfer purposes. This chemical is sealed and tested in a pressurized system containing ASME coded vessels; however, refrigerant gas can be released if there is a system failure. Refrigerant gas can cause toxic fumes if it is exposed to fire. These units must be placed in a well-ventilated area, especially if open flames are present.

Failure to follow these instructions could result in a hazardous condition. The standard refrigerant used in these units is a hydrochloro-fluorocarbon (HCFC) trade named R-22. The EPA has enacted laws regarding the handling of refrigerants and eventual phase-out of HCFC refrigerants. HCFC refrigerant production will continue until January 1, 2010 for new equipment and until January 1, 2020 for service purposes. Customers are advised to immediately implement a refrigerant management program including a survey of all equipment to document the type and quantity of refrigerant in each machine. All refrigeration service technicians must be licensed and certified by an EPA approved organization. It is recommended that good piping practices are followed and that the information in this manual is adhered to. We cannot be held responsible for liabilities created by substandard piping methods and installation practices external to the chiller.

We trust your equipment will have a long and useful life. If you should have any questions, please contact our Customer Service Department specifying the serial number and model number of the unit as indicated on the nameplate.

Installation

Receiving Inspection

Each chiller is skid mounted and plastic wrapped prior to shipment. If the chiller has a remote air-cooled condenser, the condenser will ship skid mounted and will contain a holding charge of Nitrogen. Before accepting delivery, check the overall equipment condition for any visible damage. If damage is evident, it should be properly documented on the delivery receipt. Shipping damage is the responsibility of the carrier. In order to expedite payment for damages, it is important that proper procedures are followed and records kept. Photographs of damaged equipment are excellent documentation for your records.

Once the packing is removed, the unit should be inspected for hidden damage. Refrigerant lines can be susceptible to damage in transit. Check for broken lines, oil leaks, damaged controls, or any other major component torn loose from its mounting point.

Any sign of damage should be recorded and a claim filed immediately with the shipping company. Our Customer Service Department will provide assistance in preparation and filing of your claims, including arranging for an estimate and quotation on repairs; however, filing the claim is the responsibility of the receiving party.

Rigging, Handling, and Locating Equipment

The units have a structural steel frame. Proper rigging methods must be followed to prevent damage to components. Avoid impact loading caused by sudden jerking when lifting or lowering the chiller. Use pads where abrasive surface contact is anticipated. The frame supporting the unit can be used for positioning the unit with a crane or a forklift. Please refer to the drawings provided with the chiller for chiller rigging details. If the chiller was ordered with a remote air cooled condenser please refer to the Remote Condenser Installation Guidelines manual for further instructions on locating and rigging remote condenser. This separate document has been prepared to assist refrigeration contractors with the installation and piping design for our remote condensers.

As standard, these chillers are designed for indoor use. Unless this unit was specifically ordered with construction for outdoor duty, it should not be installed or even stored in an outdoor location.

Serviceability was a primary concern when designing your central chiller. Do not compromise this feature by locating the chiller in an inaccessible area. Please refer to the drawings provided with the chiller for required clearance around the chiller. If it is necessary to store the chiller in an unheated area when not in use, be sure that all water is drained or that an adequate amount of antifreeze is added to prevent freeze-up of the unit.

Electrical Power

All wiring must comply with local codes and the National Electric Code. Minimum circuit ampacities and other unit electrical data are on the unit nameplate and are shown in Table 1 and Table 2.

A specific electrical schematic is shipped with the unit. Measure each leg of the main power supply voltage at the main power source. Voltage must be within the voltage utilization range given in Table 1. If the measured voltage on any leg is not within the specified range, notify the supplier and correct before operating the unit. Voltage imbalance must not exceed two percent. Excessive voltage imbalance between the phases of a three-phase system can cause motors to overheat and eventually fail. Voltage imbalance is determined using the following calculations:

%Imbalance = (Vavg – Vx) x 100 / Vavg

Vavg = (V1 + V2 + V3) / 3

Vx = phase with greatest difference from Vavg

For example, if the three measured voltages are 442, 460, and 454 volts, the average would be:

(442 + 460 + 454) / 3 = 452

The percentage of imbalance is then:

(452 – 442) x 100 / 452 = 2.2 %

This exceeds the maximum allowable of 2%.

A terminal block is provided for main power connection to the main power source. The main power source should be connected to the terminal block through an appropriate disconnect switch. A separate lug for grounding the unit is also provided in the main control panel. Electrical phase sequence must be checked at installation and prior to start-up. Operation of the compressor with incorrect electrical phase sequencing will result in mechanical damage to the compressors. The phasing must be checked with a phase sequence meter prior to applying power. The proper sequence should read “ABC” on the meter. If the meter reads “CBA”, open the main power disconnect and switch two line leads on the line power terminal blocks (or the unit mounted disconnect). All components requiring electric power are wired in-phase at the factory. Do not interchange any load leads that are from the unit contactors or the motor terminals.

WARNING: It is imperative that L1-L2-L3 are connected in the A-B-C phase sequence to prevent equipment damage due to reverse rotation.

CAUTION: The unit requires the main power to remain connected during off-hours to energize the compressor's crankcase heater. Disconnect main power only when servicing the chiller. The crankcase heater should remain on when the compressor is off to ensure liquid refrigerant does not accumulate in the compressor crankcase.

WARNING: The control panel and safeties are wired such that connecting the appropriate power source to the main terminal block energizes the entire electric circuitry of the chiller. A control transformer has been factory wired to step down the incoming power to the 115-volt control power. Electric power at the main disconnect should be shut off before opening access panels for repair or maintenance. The unit must be properly grounded in compliance with local and national codes.

Table 1 - Electrical Data (Single-Circuit Units)

Model	Voltage	Compressor						Unit MCA	Maximum Fuse or HACR	Recommended Time Delay or RDE
		Qty	Nominal Tons	Overload Setting	Current Transformer # of Wraps	RLA	LRA			
TXW40 & TXR40	208/3/60	1	40	15*	2	157	880	196	250	225
	230/3/60	1	40	156	n/a	136	760	170	225	200
	460/3/60	1	40	81	n/a	70	380	88	125	100
	575/3/60	1	40	62	n/a	54	304	68	90	80
TXW50 & TXR50	208/3/60	1	50	20*	2	209	990	261	350	300
	230/3/60	1	50	18*	2	181	820	226	300	250
	460/3/60	1	50	106	n/a	92	410	115	150	125
	575/3/60	1	50	84	n/a	73	328	91	125	100
TXW60 & TXR60	208/3/60	1	60	25*	2	252	1190	315	400	350
	230/3/60	1	60	21*	2	219	1044	274	350	300
	460/3/60	1	60	125	n/a	109	522	136	175	150
	575/3/60	1	60	102	n/a	89	420	111	150	125
TXW70 & TXR70	208/3/60	1	70	16*	1	301	1456	376	500	450
	230/3/60	1	70	16*	1	301	1704	376	500	450
	460/3/60	1	70	170	n/a	136	633	170	225	200
	575/3/60	1	70	130	n/a	104	512	130	175	150
TXW85 & TXR85	208/3/60	1	85	19*	1	350	1762	438	600	500
	230/3/60	1	85	19*	1	350	2062	438	600	500
	460/3/60	1	85	16*	2	156	766	195	250	225
	575/3/60	1	85	151	n/a	121	611	151	200	175
TXW105 & TXR105	208/3/60	1	100	22*	1	407	2061	509	700	600
	230/3/60	1	100	22*	1	407	2411	509	700	600
	460/3/60	1	100	19*	2	183	896	229	300	275
	575/3/60	1	100	16*	2	154	725	193	250	225

*uses a current transformer with a 23:1 current ratio so the overload setting is the trip point divided by 23.

(1) Overload setting based upon 125% of RLA.
(2) RLA (Rated Load Amps) based on MMTC (Maximum Must Trip Current)/1.29 for 40, 50 and 60 ton compressors and MMTC/1.40 for 70, 85 and 100 tons compressors.
(3) LRA (Locked Rotor Amps) based on full winding starts.
(4) MCA (Minimum Circuit Ampacity) based on 125% of compressor RLA per NEC 440-33.
(5) Maximum Fuse or HACR type circuit breaker based on 225% of the compressor RLA per NEC 440-22.
(6) Recommended time delay or dual element (RDE) fuse size based on 150% of the compressor RLA.

Voltage Utilization range:

Rated Voltage	Utilization range
230	208-254
460	414-506
575	516-633

Table 2 - Electrical Data (Dual Circuit Units)

Model	Voltage	Compressors						Unit MCA	Maximum Fuse or HACR	Recommended Time Delay or RDE
		Qty	Nominal Tons Each	Overload Setting Each	Current Transformer # of Wraps	RLA Each	LRA Each			
TXW80 & TXR80	208/3/60	2	40	15*	2	157	880	353	500	400
	230/3/60	2	40	156	n/a	136	760	306	400	350
	460/3/60	2	40	81	n/a	70	380	158	225	175
	575/3/60	2	40	62	n/a	54	304	122	175	125
TXW100 & TXR100	208/3/60	2	50	20*	2	209	990	470	600	550
	230/3/60	2	50	18*	2	181	820	407	550	450
	460/3/60	2	50	106	n/a	92	410	207	250	225
	575/3/60	2	50	84	n/a	73	328	164	225	175
TXW120 & TXR120	208/3/60	2	60	25*	2	252	1190	567	800	600
	230/3/60	2	60	21*	2	219	1044	493	700	550
	460/3/60	2	60	125	n/a	109	522	245	350	275
	575/3/60	2	60	102	n/a	89	420	200	250	225
TXW140 & TXR140	208/3/60	2	70	16*	1	301	1456	677	900	700
	230/3/60	2	70	16*	1	301	1704	677	900	700
	460/3/60	2	70	170	n/a	136	633	306	400	350
	575/3/60	2	70	130	n/a	104	512	234	300	250
TXW170 & TXR170	208/3/60	2	85	19*	1	350	1762	788	1000	900
	230/3/60	2	85	19*	1	350	2062	788	1000	900
	460/3/60	2	85	16*	2	156	766	351	500	400
	575/3/60	2	85	151	n/a	121	611	272	350	300
TXW200 & TXR200	208/3/60	2	100	22*	1	407	2061	916	1200	1000
	230/3/60	2	100	22*	1	407	2411	916	1200	1000
	460/3/60	2	100	19*	2	183	896	412	550	450
	575/3/60	2	100	16*	2	154	725	347	500	400

*uses a current transformer with a 23:1 current ratio so the overload setting is the trip point divided by 23.

(1) Overload setting based upon 125% of RLA.

(2) RLA (Rated Load Amps) based on MMTC (Maximum Must Trip Current)/1.29 for 40, 50 and 60 ton compressors and MMTC/1.40 for 70, 85 and 100 tons compressors.

(3) LRA (Locked Rotor Amps) based on full winding starts.

(4) MCA (Minimum Circuit Ampacity) based on 125% of largest compressor RLA plus 100% of second compressor RLA per NEC 440-33.

(5) Maximum Fuse or HACR type circuit breaker based on 225% of the largest compressor RLA plus 100% of the second compressor RLA per NEC 440-22.

(6) Recommended time delay or dual element (RDE) fuse size based on 150% of the largest compressor RLA plus 100 percent of the second compressor RLA.

Voltage Utilization range:

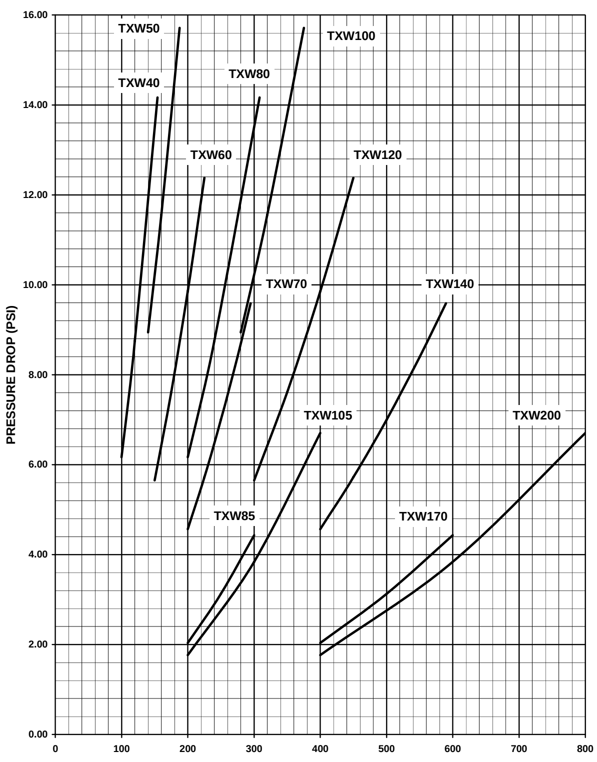
Rated Voltage	Utilization range
230	208-254
460	414-506
575	516-633

Condenser Water Line

(TXW Models Only) The performance of a condenser is dependent on maintaining the proper flow and temperature of water through the heat exchanger. Insufficient water flow or high condenser water supply temperature will result in the reduction of cooling capacity of the chiller. Extreme conditions will eventually result in the chiller shutting down due to high refrigerant pressure. Performance can also be affected if the condenser is allowed to plug up from contaminants in the condenser water stream. In order to reduce maintenance costs and chiller downtime, a water treatment program is highly recommended for the condenser cooling water. If any condenser does become plugged, contact our Customer Service Department for assistance in the proper procedure for cleaning out the condenser.

The standard cooling capacity is based upon 85°F (29°C) condenser cooling water supply. Under normal operating conditions there will be a 10°F (6°C) rise through the condenser resulting in 95°F (35°C) exiting water temperature from the condenser. To ensure proper water flow through the condenser, the condenser water pump should be able to handle the minimum pressure drop given in Figure 1.

Figure 1 – TXW Series Condenser Water Pressure Drop



The pressure drop given in Figure 1 is the minimum pressure drop required in order that the condenser water regulating valve operates below a 60° open position. Above 60° open position, the valve flow characteristics are non-linear and can result in erratic control. To prevent damage to the condenser or regulating valve, the condenser water pressure should not exceed 150 PSIG (1035 kPa). The condenser water regulating valve controls the condenser water flow in order to maintain the pressure setpoint. The chiller loading, condenser water inlet temperature, and pressure setpoint determine the actual flow. Table 3 shows minimum condenser water flow requirements for the different size chillers at different supply temperatures. The minimum flows are determined using the recommended head pressure setting for a given supply temperature. The supply temperature range is from 70°F (24°C) to 90°F (32°C). Supply temperatures beyond this range are not recommended and may lead to improper chiller operation.

Table 3 - Condenser Water Flow Requirements

Model	GPM (L/min) @ 70°F (21°C)	GPM (L/min) @ 75°F (24°C)	GPM (L/min) @ 80°F (27°C)	GPM (L/min) @ 85°F (29°C)	GPM (L/min) @ 90°F (32°C)
TXW40	103 (390)	109 (411)	124 (468)	133 (502)	154 (583)
TXW50	140 (528)	146 (553)	167 (632)	178 (672)	188 (710)
TXW60	153 (578)	159 (600)	180 (682)	190 (718)	224 (846)
TXW70	197 (746)	209 (790)	233 (882)	256 (957)	295 (1115)
TXW80	206 (780)	217 (821)	247 (935)	265 (1003)	308 (1166)
TXW85	204 (771)	210 (795)	236 (894)	259 (981)	288 (1089)
TXW100	279 (1056)	292 (1105)	334 (1264)	355 (1344)	375 (1420)
TXW105	260 (983)	268 (1013)	301 (1140)	324 (1227)	370 (1399)
TXW120	305 (1155)	317 (1200)	360 (1363)	379 (1435)	447 (1692)
TXW140	394 (1492)	417 (1579)	466 (1764)	511 (1934)	589 (2230)
TXW170	407 (1541)	420 (1590)	472 (1787)	518 (1961)	575 (2177)
TXW200	519 (1965)	535 (2025)	602 (2279)	648 (2453)	739 (2797)
Head Pressure Setting PSI (kPa)*	180 (1241)	190 (1310)	200 (1379)	210 (1448)	220 (1517)

*Recommended head pressure setting in order to minimize energy usage while maintaining proper chiller operation.

Interconnecting Refrigerant Piping

(TXR Models Only) The chiller unit is shipped with a full charge of oil, excluding the additional charge for field piping, and a refrigerant holding charge. The chiller is designed for use only with the air-cooled condenser provided with the unit. Please refer to our Remote Condenser Installation Guidelines manual for detailed piping design and sizing.

Chilled Water Line

All chilled water piping should be adequately insulated to prevent condensation. If water is allowed to condense on the piping, the state change of the water from gas to liquid will result in a substantial heat load that becomes an additional burden for the chiller.

Standard central chillers have been designed to provide 50°F (10°C) coolant to the process. Under normal operating conditions there will be a 10°F (6°C) rise through the process resulting in 60°F (16°C) return coolant temperature to the chiller.

The importance of properly sized piping between the chiller and process cannot be overemphasized. See the ASHRAE Handbook or other suitable design guide for proper pipe sizing. In general, run full size piping out to the process and then reduce the pipe size to match the connections on the process equipment. One of the most common causes of unsatisfactory chiller performance is poorly designed piping. Avoid unnecessarily long lengths of hoses or quick disconnect fittings that offer high resistance to water flow. When manifolds are required for water distribution, they should be installed as close to the use point as possible. Provide flow-balancing valves at each machine to assure adequate water distribution in the entire system. Reference Figure 2 and Table 4 to determine proper pump size based on flow and pressure requirements.

Figure 2 - Chilled Water Pressure Drop

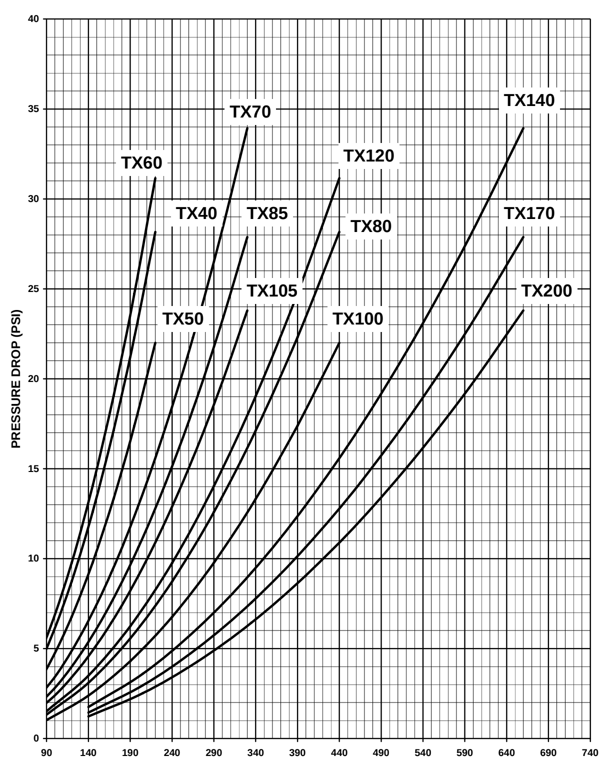


Table 4 - Chilled Water Flow Requirements

Model	Nominal Flow* GPM (L/min)	Minimum Flow GPM (L/min)	Maximum Flow GPM (L/min)
TXW40	98 (371)	45 (170)	220 (833)
TXR40	87 (329)	45 (170)	220 (833)
TXW50	126 (477)	45 (170)	220 (833)
TXR50	111 (420)	45 (170)	220 (833)
TXW60	152 (575)	45 (170)	220 (833)
TXR60	132 (500)	45 (170)	220 (833)
TXW70	189 (715)	70 (265)	330 (1249)
TXR70	169 (640)	70 (265)	330 (1249)
TXW80	196 (742)	90 (341)	440 (1666)
TXR80	174 (659)	90 (341)	440 (1666)
TXW85	207 (784)	70 (265)	330 (1249)
TXR85	186 (704)	70 (265)	330 (1249)
TXW100	251 (950)	90 (341)	440 (1666)
TXR100	221 (837)	90 (341)	440 (1666)
TXW105	246 (931)	70 (265)	330 (1249)
TXR105	226 (856)	70 (265)	330 (1249)
TXW120	304 (1151)	90 (341)	440 (1666)
TXR120	264 (999)	90 (341)	440 (1666)
TXW140	378 (1431)	140 (530)	660 (2498)
TXR140	337 (1276)	140 (530)	660 (2498)
TXW170	413 (1563)	140 (530)	660 (2498)
TXR170	371 (1404)	140 (530)	660 (2498)
TXW200	492 (1862)	140 (530)	660 (2498)
TXR200	451 (1707)	140 (530)	660 (2498)

* Nominal flow required to meet capacity at standard conditions of 60°F (15°C) EWT and 50°F(10°C) LWT.

Operating Principles

Coolant Circuit

The coolant pump circulates coolant through the evaporator. In the evaporator, heat is transferred from the coolant to the refrigerant. Varying the amount of heat transferred in the evaporator determines the loading of the compressor, which maintains the temperature set point of the coolant delivered to the process.

After leaving the evaporator, the coolant passes by Freezestat sensing probe, flow switch and the "Process Supply" thermocouple. The Freezestat sensing probe and flow switch are safety controls that are connected to the PLC controller. The thermocouple senses the temperature of the coolant being delivered to process and communicates this temperature to the PLC controller.

Refrigerant Circuit

The heat transferred in the evaporator from the coolant to the refrigerant changes the state of the refrigerant from a liquid to a gas. This refrigerant gas then moves from the evaporator to the compressor.

The compressor is the heart of the refrigeration circuit. Cool, low-pressure gas enters the compressor and hot, high-pressure gas exits the compressor. Since the compressor are not 100% efficient, some extra heat is added to the refrigerant as it is being compressed.

The hot, high-pressure gas that exits the compressor, passes through the oil separator, and is delivered to the condenser. In water-cooled condenser units (TXW Models), the heat is transferred from the refrigerant flow around the tubes to the water that is flowing through the tubes. In air-cooled condenser units (TXR Models), the heat is transferred from the refrigerant in the finned tubes to the air that is flowing across the finned tubes. As the heat is transferred, the refrigerant changes from a gas to a liquid. The condenser has been sized to remove the heat from the process load and the heat that was added by the compressor.

After leaving the condenser, the liquid refrigerant passes through the filter dryer and sight glass. The filter dryer filters out any particles and/or moisture from the refrigerant. The sight glass is used to monitor the stream of liquid refrigerant. The liquid refrigerant then passes through the thermal expansion valve (TXV) which meter the flow into the evaporator where the process begins again.

Oil Circuit

The compressor uses oil to control the discharge temperature, lubricate the compressor bearings and seal the rotors. The oil is entrained in the refrigerant gas when it leaves the compressor. The discharge gas enters the oil separator tangentially, which causes the refrigerant to swirl in the tube separating the oil to the outside, where it collects on the walls of the separator and flows to the bottom. The discharge gas exits out the top of the oil separator. The oil separator serves as the oil sump for the compressor. After the oil leaves the separator, it passes through the oil cooler, through a manual shutoff valve and back into the compressor. Cooling of the oil is important for the life of the bearings and also to help control the thermal expansion of the rotors. The maximum allowable oil temperature entering the compressor is 170°F (76.7°C). When the maximum entering oil temperature is exceeded, bearing life is reduced and rotor-to-housing interference resulting in compressor damage can occur. Metering liquid refrigerant into the oil cooler via a temperature responsive valve controls the oil temperature. The temperature responsive valve is factory set and cannot be adjusted. The Oil Temperature switch located on the oil line before the compressor monitors the oil temperature. The Oil Temperature switch is set to open at 170°F (76.7°C). A pressure differential switch also monitors oil pressure. The oil differential pressure switch senses an obstruction of oil flow to the compressor. Low oil differential pressure occurs if the manual shutoff valve is closed, the oil filter (internal on TX40-60,80, 100 & 120, external on TX70, 85, 105, 140-200) is plugged, or the oil valve (internal shut-off valve on TX40-60,80, 100 & 120, external solenoid valve on TX TX70, 85, 105, 140-200) does not open.

Components

Compressor

The TX series chillers use semi-hermetic, direct-drive helical rotary type screw compressors. Each compressor has two rotors, “male” and “female”, which provide compression. The male rotor is attached to, and driven by, the motor. The male rotor, in turn, drives the female rotor. Separately housed bearing sets are provided at each end of both rotors. The helical rotary compressor is a positive displacement device. The refrigerant from the evaporator is drawn into the suction opening, across the motor, and into the intake of the compressor rotor section. The gas is then compressed and discharged directly into the discharge line.

Compressor load capacity is dictated by the positions of the unloader valves. They divert refrigerant gas from the rotors to the compressor suction, thus unloading the compressor. This varies the compressor capacity to match the load and reduces the kW draw of the compressor motor.

Water Cooled Condenser

(TXW Models Only) The shell and tube condenser is constructed with a steel shell, removable cast iron end bells, and a bundle of copper tubes. The condenser water passes through the copper tubes, while the refrigerant flows around the tubes on the shell side.

Air Cooled Remote Condenser

(TXR Models Only) The remote air cooled condenser is constructed with a copper tube and aluminum fin coil with multiple fans. The refrigerant passes through the copper tubes, while the air passes over the fins.

Evaporator

The evaporator is constructed of stainless steel plates and copper brazing. The refrigerant passes between every other set of plates, while the coolant flows on the other side of the plates in the opposite direction.

Oil Cooler

An external oil cooler is used to maintain the temperature of the oil circulated back to the compressor. The oil cooler is designed to maintain the oil temperature to 10°F (5.5°C) above the design saturated condensing temperature. Maintaining this temperature helps the performance of the compressor. The oil cooler is stainless steel plate, copper brazed heat exchanger that transfers the heat from the oil to the refrigerant. The refrigerant is metered into the oil cooler via a temperature responsive valve.

Oil Separator

The oil separator removes the oil from the refrigerant at the discharge of the compressor and serves as the oil sump for the compressor. The discharge gas enters the oil separator tangentially, which causes the refrigerant to swirl in the tube separating the oil to the outside, where it collects on the walls of the separator and flows to the bottom. The discharge gas exits out the top of the oil separator. The oil separator reduces the oil circulation rate to less than 0.5% by weight.

Thermostatic Expansion Valve

The Thermal Expansion Valve (TXV) separates the refrigerant high pressure/temperature on the condenser side from the refrigerant low pressure/temperature on the evaporator side. The TXV meters the amount of refrigerant into the evaporator in the precise quantity in order to maintain superheat.

The difference between the saturated evaporative temperature and the suction line temperature at the TXV sensor bulb location is called superheat. The superheat is factory set for 10°F to 12°F (5°C to 6°C) and should never exceed 15°F (8°C) or go below 4°F (2°C). Only a trained refrigeration service technician should adjust this valve.

Temperature Responsive Valve

Oil cooling is attained by the use of a temperature responsive valve at the refrigerant inlet of the oil cooler. The valve meters a precise amount of liquid refrigerant to the oil cooler in order to control the oil temperature entering the compressor. The temperature setting of the valve cannot be adjusted and is typically set to control the oil temperature to 10°F (5.5°C) above the design saturated condensing temperature. The setting may be different if the chiller was designed for a special application.

Liquid Line Solenoid Valve

The liquid line solenoid valve is located upstream of the sight glass. The valve is normally closed and opens when the circuit is enabled and cooling is required. The valve is opened five seconds prior to starting the compressor to allow the low pressure switch to close in the event a circuit has been pumped down for service. The solenoid valve closes when the compressor stops. This is to prevent migration of liquid refrigerant back to the compressor during shutdown.

Because of the compressor's tolerance of liquid, pump down prior to shutdown is not used. The use of pump down control leads to potential situations where the compressor is subjected to operating in a vacuum. Operating in a vacuum causes high discharge temperatures that cause thermal expansion of the rotor, which can interfere with the housing and cause compressor damage.

Refrigerant Sight Glass

The refrigerant sight glass is located in the liquid line immediately ahead of the expansion valve. They allow the operator or service technician to observe the flow of liquid refrigerant in the circuit. Prolonged periods of foaming in the sight glass may indicate a low refrigerant condition or a restriction in the liquid line.

Note: Occasional bubbling in a sight glass may occur at a time when load conditions are changing and the thermostatic expansion valve is adjusting to the new conditions. This momentary occurrence is a result of normal chiller operation.

The sight glass can also be used to check if there is moisture in the refrigeration circuit. If there is moisture in the circuit, the green dot in the center of the sight glass will turn yellow. If this occurs, the chiller should be serviced immediately.

Refrigerant Filter/Dryer

The filter/dryer is located in the liquid line between the condenser and the refrigerant sight glass. It is designed to remove any moisture and/or foreign matter that may have gotten into the refrigerant stream. Moisture and foreign matter can cause serious damage to the components of a refrigeration system. For this reason, it is important that the chiller be equipped with a clean filter drier. Replace the filter drier core if any of the following conditions occur.

- The refrigeration system is opened to the atmosphere for repairs or maintenance.
- Moisture is indicated in the sight glass (the green dot has changed to yellow).
- An excessive pressure drop develops across the filter drier. This is indicated by a significant temperature difference between the filter inlet and outlet.

Discharge Pressure Sensor

The discharge pressure sensor or transducer is used for monitoring the discharge pressure. On the TXW models, this input is used to control the electronic condenser water regulating valve. The discharge pressure or compressor head pressure is displayed on the PLC screen. The pressure sensor will also detect a low limit condition and will shut down the compressor if the pressure is below 100 PSIG (690 kPa) for more than 20 seconds. This minimum pressure is essential for oil circulation.

Suction Pressure Sensor

(TXR Models Only) The suction pressure sensor or transducer is used to monitor the suction pressure. The normal operating pressure differential between the suction and discharge pressure is between 50 PSI (345 kPa) and 300 PSI (2068 kPa), The minimum and maximum pressure differential alarms will be activated if the pressure differential is outside these limits for more than 20 seconds.

Condenser Water Regulating Valve

(TXW Models Only) An electronic condenser water regulating valve is provided as standard on all TXW models. The valve is a modulating type butterfly valve located in the condenser water piping at the outlet of the condenser. The valve actuator is controlled by the PLC using a high-side refrigerant pressure signal from a pressure transducer. The valve regulates the flow of water through the condenser in order to maintain the pressure set point. The pressure set point is set at the factory to maintain 210 PSIG (1448 kPa) based on the design inlet temperature of 85°F (29°C). The valve only passes as much water as is required to maintain the refrigerant pressure, so less water will be required if the water temperature is lower than the design 85°F (29°C). The setting should be adjusted if inlet temperatures are different than the design 85°F (29°C). See Controller Operation and Tables 1 and 2 for changing the pressure set point for different inlet temperatures.

The valve can be manually opened or closed by sliding and holding the gear release on the side of the actuator. The valve should not be manually opened or closed while the circuit is enabled. If the valve is manually opened, it must be manually closed prior to enabling the circuit if automatic control is desired.

The valve will automatically close when the circuit is disabled or the compressor shuts down due to an alarm condition. When the circuit is enabled, the valve automatically opens to a predetermined position before starting the compressor.

High Refrigerant Pressure Switch

The High Refrigerant Pressure switch is designed to limit the compressor discharge pressure so that it stays within the design parameters of the compressor. The switch is located on the discharge service valve and are set to open at 300 PSIG (2068 kPa) for TXW units and 375 PSIG (2586 kPa) for TXR models. Each switch has a manual reset.

Should the switch open when a fault condition occurs, pressing the reset button on the back of the switch and pressing the Alarm Reset on the control panel will reset the alarm. The setting on the switch is not adjustable.

Low Refrigerant Pressure Switch

The Low Refrigerant Pressure switch is designed to provide loss of charge protection for both slow and rapid loss of charge. Loss of charge results in low refrigerant velocities, which results in oil logging in the system. Oil logging in the system will result in loss of lubrication and eventually, compressor failure. The switch is located on the compressor suction and are typically set to open at 25 PSIG (172 kPa) and close at 55 PSIG (379 kPa). Pressing the Alarm Reset button on the control panel can reset the switch. The setting on the switch is not adjustable.

Low Compressor Pressure Switch

The Low Compressor Pressure switch is designed to prevent operating the compressor in a vacuum. The switch is are located on the compressor suction and are typically set to open at 10 PSIG (69 kPa) and close at 40 PSIG (276 kPa). Pressing the Alarm Reset button on the control panel can reset the switch. The setting on the switch is not adjustable.

Warning: The Low Compressor Pressure switch should not be bypassed at any time, either during start-up, service, low ambient starts, or charging of the unit. Bypassing the switch could subject the compressor to operate in a vacuum that results in rotor thermal expansion and compressor damage.

High Discharge Temperature Switch

Each compressor is protected with a discharge temperature switch that shuts down the compressor when the discharge temperature exceeds 220°F (104.4°C). The switch is located on the discharge line at the compressor.

High Oil Temperature Switch

Each compressor has a high oil temperature switch that shuts down the compressor when the oil temperature entering the compressor exceeds 170°F (76.7°C). The switch is mounted on the oil line entering the compressor downstream of the manual shutoff valve.

Oil Differential Pressure Switch

Each compressor has a pressure differential switch that senses an obstruction of oil flow to the compressor. The high pressure port of the switch is attached to the oil supply line upstream of the manual shutoff valve. The low pressure port is attached to the compressor, downstream of the oil filter (internal on TX40-60,80, 100 & 120, external on TX70, 85, 105, 140-200) and oil valve (internal shut-off valve on TX40-60,80, 100 & 120, external solenoid valve on TX TX70, 85, 105, 140-200). If the shutoff valve is closed, the internal oil filter is plugged, or the internal oil shutoff valve does not open, the pressure differential switch will open, indicating a loss of oil flow. The switch will open on a rise to 40 PSIG (276 kPa) with a twenty second time delay.

Freezestat

The Freezestat control is a thermostat that senses the coolant temperature separately from the PLC controller. This safety is designed to limit the temperature of the coolant leaving the evaporator and prevent any possible freeze-up situations. This control should be set 10°F (5°C) below the minimum coolant supply temperature and there should be a sufficient glycol concentration for 5°F (2.8°C) below the Freezestat setting. See Table 6 for recommended glycol solutions.

Note: It is critical that the Freezestat is set properly and that there is sufficient glycol in the system to correspond with the Freezestat setting. Freeze-ups can cause extensive damage to several components in the chiller, and the warranty does not cover repairs required due to a freeze-up.

Coolant Flow Switch

This switch is located in the piping directly after the evaporator outlet. It is designed to shut the unit down if there is insufficient coolant flow through the evaporator. The switch is adjustable; however, no adjustments should be made without prior approval from the factory. If the chiller shuts down due to low coolant flow, it can be restarted on the control panel. This switch is delayed for five seconds after the enable button is pressed so that the pump can develop flow and make the switch.

Operator Interface

The chiller uses a color touch screen interface that is designed to use clear language text menus. Menu access and adjustment is accomplished by touching the screens.

Alarm Banner Summary

The following list summarizes the alarm conditions displayed on the alarm banner when a fault occurs. The specific circuit number to which the fault occurs is listed after the alarm condition if it applies to both circuits. Refer to the Troubleshooting section when determining the cause and remedy of the fault.

No Flow

There is not adequate flow in order to close the flow switch.

Freezestat

The temperature at the outlet of the evaporator is lower than the freezestat setting.

High Refrigerant Pressure

The discharge pressure is higher than the switch setting. The switch setting is typically 300 PSIG (2,068 kPa) for TXW models and 375 PSIG (2586 kPa) for TXR models. The switch has a manual reset.

Low Refrigerant Pressure

The compressor suction pressure is lower than the switch setting. The switch typically cuts out at 25 PSIG (172 kPa) and cuts in at 55 PSIG (379 kPa). On TXR units this alarm is ignored for 3 minutes after start-up to prevent unwanted alarm trips during low ambient start-up.

Maximum Pressure Differential

This function is only present on TXR units. The differential between the discharge and suction pressures is more than 300 PSI (2064 kPa) for more than 20 seconds.

Minimum Pressure Differential

This function is only present on TXR units. The differential between the discharge and suction pressures is less than 50 PSI (344 kPa). This alarm is ignored for 3 minutes after start-up to prevent unwanted alarm trips during low ambient start-up.

Compressor Fault

The compressor external overload or the internal winding thermostat tripped.

P1 Process Pump Fault

The P1 process pump overload tripped.

SB Standby Pump Fault
The standby pump overload tripped.

P2 Recirculation Pump Fault
The P2 recirculation pump overload tripped.

Low Reservoir Water Level
The low level switch in the reservoir is open.

Process Low Water Pressure
The process pump pressure switch is open. The setting of the switch is adjustable.

Recirc. Low Water Pressure
The recirculation pump pressure switch is open. The setting of the switch is adjustable.

PLC Battery Low
The PLC battery is low and needs replacing.

Thermocouple Fault
The thermocouple is bad or open.
Channel #0 - Process Return
Channel #1 - Process Supply
Channel #2 - Condenser Water In (TXW models)
Channel #3 - Condenser Water Out (TXW models)

High Supply Water Temperature
The supply water is greater than the alarm set point. The high temperature alarm set point is factory set at 100°F (37.8°C).

Low Discharge Pressure
(TXW Models Only) The discharge pressure is below 100 PSIG (690 kPa) for more than twenty seconds. A minimum of 100 PSI oil pressure is required for proper oil delivery to the compressor.

Open Pressure Transducer
The discharge pressure transducer has failed or the wiring is open.

High Differential Oil Pressure
The oil differential switch is open due to a differential greater than 40 PSIG (276 kPa) for more than twenty seconds.

High Oil Temperature
The oil temperature entering the compressor has exceeded 170°F (76.7°C).

High Discharge Temperature
The discharge temperature leaving the compressor has exceeded 220°F (104.4°C).

Low Compressor Pressure
The compressor suction pressure is lower than the switch setting. The switch typically cuts out at 10 PSIG (69 kPa) and cuts in at 40 PSIG (276 kPa).

Power Phase Fault
The incoming power is incorrectly phased. The phasing must be checked with a phase sequence meter prior to applying power. See Start-Up procedures earlier in this manual.

WARNING: It is imperative that L1-L2-L3 be connected in the A-B-C phase sequence to prevent equipment damage due to reverse rotation.

Circuit Off Warning. Freeze Risk
One of the circuits has been disabled without closing the process water off on that circuit. If this is done, the warmer water from the circuit that is off will mix with the cooler water from the circuit that is on. In order to maintain process supply temperature, the evaporator temperature will decrease on the circuit that is running, potentially causing an evaporator freeze-up.

Warning! Need Glycol – See Manual
The process supply set point is set to 45°F (7.2°C) or below, requiring glycol for freeze protection. See Table 6 for recommended glycol solutions at different temperatures.

Control Sequence

The TX40-60, 80, 100 and 120 models use a combination of incremental and variable capacity control. The compressors are equipped with a slide valve that provides variable capacity control from 60-100%. The slide valve provides infinite capacity control by diverting refrigerant gas from the rotors to the compressor suction. The amount of gas diverted depends on the valve position. The slide valve position is controlled by the male loader and unloader solenoid valves. When the male loader is energized and the male unloader is de-energized, the compressor loads. When the male loader is de-energized and the male unloader is energized, the compressor unloads. These valves are pulsed in short time increments to balance compressor capacity with the chiller load. This is accomplished by using a PID control algorithm with the supply temperature as the process variable. Below 60% capacity, the compressors are incrementally stepped using the female unloader solenoid valve and compressor cycling. The female unloader is a two-position valve at the discharge end of the female rotor. This unloads the compressor an additional 30% by relieving refrigerant gas to the suction when de-energized. The compressors have a minimum start to start recycle time of ten minutes. For example, if the compressor has run for ten minutes and cycles down on normal temperature control, then it may restart immediately. If the compressor has run for six minutes, then it will be off for a minimum of four minutes before a restart may occur.

The TX70, 85, 105, 140-200 models are equipped with a slide valve that provides variable capacity control from 25-100%. The slide valve provides infinite capacity control by diverting refrigerant gas from the rotors to the compressor suction. The amount of gas diverted depends on the valve position. The slide valve position is controlled by the male loader and unloader solenoid valves. When the male loader is energized and the male unloader is de-energized, the compressor loads. When the male loader is de-energized and the male unloader is energized, the compressor unloads. These valves are pulsed in short time increments to balance compressor capacity with the chiller load. This is accomplished by using a PID control algorithm with the supply temperature as the process variable. Below 25% capacity, the compressors are cycled on and off. The compressors have a minimum start to start recycle time of ten minutes. For example, if the compressor has run for ten minutes and cycles down on normal temperature control, then it may restart immediately. If the compressor has run for six minutes, then it will be off for a minimum of four minutes before a restart may occur.

Start-Up Sequence

If the circuit is enabled, the safeties are met, the recycle timer has expired, the condenser water regulating valve has opened, and the system requires cooling, the liquid line solenoid will energize and the compressor will start. The compressors will run unloaded for approximately two minutes. They will remain on until the shutdown sequence is activated due to low demand or a safety is engaged.

Shutdown Sequence

The unit will run through a shutdown sequence if demand decreases and cooling is no longer required. During this sequence, the compressors will run unloaded for approximately two minutes and then shutdown. When the compressor(s) stop, the liquid line solenoid valve(s) will close, and the condenser water regulating valve(s) will close. The TX series does not require a pump down sequence due the nature of its design. The system is now ready to begin the next start-up sequence. If a safety is engaged on a particular circuit, that circuit will be stopped immediately.

(see following page for chiller loading sequences)

Table 5 – TX40, 50 & 60 Loading Sequence

Stage	Circuit 1				Chiller Percent Capacity
	Male Loader	Male Unloader	Female Unloader	Percent Capacity	
0	Compressor Off			0%	0%
1	Off	On	Off	30%	15%
2	Off	On	Off	30%	30%
3	Off	On	On	60%	45%
4	Off	On	On	60%	60%
5	Variable Pulse	Variable Pulse	On	60-100%	60-100%

Table 6 – TX80, 100 & 120 Loading Sequence

Stage	Circuit 1				Circuit 2				Chiller Percent Capacity
	Male Loader	Male Unloader	Female Unloader	Percent Capacity	Male Loader	Male Unloader	Female Unloader	Percent Capacity	
0	Compressor Off			0%	Compressor Off			0%	0%
1	Off	On	Off	30%	Compressor Off			0%	15%
2	Off	On	Off	30%	Off	On	Off	30%	30%
3	Off	On	On	60%	Off	On	Off	30%	45%
4	Off	On	On	60%	Off	On	On	60%	60%
5	Variable Pulse	Variable Pulse	On	60-100%	Variable Pulse	Variable Pulse	On	60-100%	60-100%

Table 7 – TX70, 85 & 105 Loading Sequence

STAGE	Circuit 1			Percent Chiller Capacity
	Male Loader	Male Unloader	Percent Capacity	
0	Compressor Off		0%	0%
1	Off	On	25%	13%
2	Off	On	25%	25%
3	Variable Pulse	Variable Pulse	25-100%	25-100%

Table 8 – TX140, 170 & 200 Loading Sequence

STAGE	Circuit 1			Circuit 2			Percent Chiller Capacity
	Male Loader	Male Unloader	Percent Capacity	Male Loader	Male Unloader	Percent Capacity	
0	Compressor Off		0%	Compressor Off		0%	0%
1	Off	On	25%	Compressor Off		0%	13%
2	Off	On	25%	Off	On	25%	25%
3	Variable Pulse	Variable Pulse	25-100%	Variable Pulse	Variable Pulse	25-100%	25-100%

Start-Up

The chiller is fully tested prior to shipping. Readings of voltage, amperage, compressor suction and discharge pressures, water inlet and outlet temperatures, water flow rates, etc., are recorded to make sure that all system components are performing up to their specifications. Every unit is factory set to deliver chilled water in accordance with the standard operating specifications for that particular chiller. Due to variables involved with different applications and different installations, minor adjustments may be required during the initial start-up to ensure proper operation.

The following start-up procedure should only be performed by a qualified experienced refrigeration technician and must be followed in sequence. If trouble is encountered in putting a chiller in operation, the fault can usually be traced to one of the control or safety devices. This outline can be used as a checklist for the initial start-up and for subsequent start-ups if the chiller is taken out of service for a prolonged period of time.

1. Assure the main power source is connected properly, that it matches the voltage shown on the nameplate of the unit, and that it is within the voltage utilization range given in Tables 1 and 2. Electrical phase sequence must be checked at installation and prior to start-up. Operation of the compressor with incorrect electrical phase sequencing will result in mechanical damage to the compressors. The phasing must be checked with a phase sequence meter prior to applying power. The proper sequence should read "ABC" on the meter. If the meter reads "CBA", open the main power disconnect and switch two line leads on the line power terminal blocks (or the unit mounted disconnect). All components requiring electric power are wired in-phase at the factory. Do not interchange any load leads that are from the unit contactors or the motor terminals. Once proper power connection and grounding have been confirmed, turn the main power on.

WARNING: It is imperative that L1-L2-L3 be connected in the A-B-C phase sequence to prevent equipment damage due to reverse rotation.

Note: The main power must be on for 24 hours prior to starting the compressor to allow the crankcase heater to sufficiently vaporize any liquid refrigerant that may be present in the compressor.

2. Check to make sure that all process chilled water piping connections are secure. Fill the chilled water reservoir with the proper water or water/glycol solution. Use a glycol with a corrosion inhibitor only. See Table 9 for recommended glycol solutions.

3. (TXW Models Only) Check the condenser water lines to make sure all connections are secure. Make sure sufficient condenser water flow and pressure are available, the condenser water supply is turned on, and all shut-off valves are opened. The electronic water regulating valves are shipped in the closed position and will open automatically when the circuit is enabled.

Table 9 - Recommended Glycol Solutions

Chilled Water Temperature	Percent Glycol By Volume
50°F (10°C)	Not required
45°F (7.2°C)	5 %
40°F (4.4°C)	10 %
35°F (1.7°C)	15 %
30°F (-1.1°C)	20 %
25°F (-3.9°C)	25 %
20°F (-6.7°C)	30 %
15°F (-9.4°C)	35 %
10°F (-12.2°C)	35 %
5°F (-15°C)	40 %
0°F (-17.8°C)	40 %

4. (TXR Models Only) Check the refrigerant lines to make sure all connections are secure and that the system is fully and correctly charged.

5. Verify that all refrigerant valves are open.

CAUTION: Do not operate the unit with the compressor, oil line, or liquid line service valves "CLOSED". Failure to have these "OPEN" may cause serious compressor damage.

6. Make sure the Freezestat is set appropriately for the operating conditions of the chiller. The Freezestat is located inside the main electrical control panel. It should be set at 10°F (5°C) below the minimum chilled water temperature setting that the chiller will be operated at. Be sure the coolant solution has sufficient freeze protection (glycol) to handle at least 5°F (2.8°C) below the Freezestat setting. All chillers are shipped from the factory with the Freezestat set at 40°F (4°C). This is done to protect against a possible freeze-up if no glycol has been added to the coolant. Once the proper glycol solution has been added, the Freezestat can be adjusted to the appropriate setting.

Note: Our warranty does not cover the evaporator from freezing. It is vital that the Freezestat is set properly.

7. Turn on the control power by pulling the E-Stop button to "On". The panel displays should now be illuminated.

8. Due to extreme temperatures during shipment the High Refrigerant Pressure switch may have tripped. If this is the case, reset the High

Refrigerant Pressure by depressing the manual reset button located on the switch.

9. Establish flow through the evaporator(s).

Note: The compressors will not start as long as the flow switch is open. A positive flow must be established through the evaporator(s) before the compressor(s) can operate.

Set process water flow through the evaporator(s) as indicated in Table 4. If a flow meter is not available, run the chiller fully loaded and balance the flow until a 10°F (6°C) rise is established. A significant increase in flow beyond the recommended rate may damage the evaporators and create excessive pressure drops that influence the overall efficiency of the system.

10. Activate compressor(s). No compressor will not start until its cycle time has expired, its electronic condenser water regulating valve (CWRV's) is open (TXW Models only), its liquid line solenoid valve is open, and its safeties are met. The time to complete this is displayed on the screen. Once the compressor starts, it will operate fully unloaded for two minutes. If the demand requires additional loading after the two minutes has expired, the compressor will load accordingly. This sequence is to improve the compressor's liquid refrigerant handling capability during start-up.

WARNING: During normal operation, all circuits must be enabled. Failure to heed this warning may lead to evaporator freeze-up. If a circuit needs to be shut down, the water to that circuit's evaporator must be shut off.

WARNING: Under no circumstance should the High Refrigerant Pressure or the Low Compressor Pressure switch be deactivated. Failure to heed this warning can cause serious compressor damage, severe personal injury or death.

11. Control of the chiller temperature is based on supply water temperature. Unless otherwise specified, it is factory set to deliver coolant at 50°F (10°C). Adjust to the desired operating temperature. Resetting the temperature will change the operating conditions of the chiller. Any lower readjustment of the controller must be done only after providing adequate antifreeze protection to the coolant as shown in Recommended Glycol Solution Table 9.

12. Operate the system for approximately 30 minutes. Check the liquid line sight glasses. The refrigerant flow past the sight glasses should be clear. Bubbles in the refrigerant indicate either low refrigerant charge or excessive pressure drop in the liquid line. A shortage of refrigerant is indicated if operating pressures are low and subcooling is low. Normal subcooling ranges from 10°F (5.5°C) to 20°F (11°C). If subcooling is not within this range, check the superheat and adjust if required. The superheat should be approximately 10°F (5.5°C). Since the unit is factory charged, adding or removing refrigerant charge should not be necessary. If the refrigerant pressure, sight glass, superheat, and subcooling readings indicate a refrigerant shortage, gas-charge refrigerant into each circuit, as required. With the unit running, add refrigerant vapor by connecting the charging line to the suction service valve and slowly charging through the backseat port until operating conditions become normal.

CAUTION: A clear sight glass alone does not mean that the system is properly charged. Also check system superheat, subcooling, and unit operating pressures. If both suction and discharge pressures are low but subcooling is normal, a problem other than refrigerant shortage exists. Do not add refrigerant, as this may result in overcharging the circuit.

Preventive Maintenance

Once your chiller has been placed into service, the following maintenance procedures should be adhered to as closely as possible. The importance of a properly established preventive maintenance program cannot be overemphasized. Taking the time to follow these simple procedures will result in substantially reduced downtime, reduced repair costs, and an extended useful lifetime for the chiller. Any monetary costs of implementing these procedures will usually more than pay for itself.

To make this as simple as possible, a checklist should be prepared which lists the recommended service operations and the times at which they are to be performed. At the end of this manual, you will find a checklist that can be used for this purpose. Please notice that there are locations for voltage readings, amperages, etc. so that they can be monitored over time. With this information, maintenance personnel may be able to correct a potential problem before it causes any downtime. For best results, these readings should be taken with a full heat load from process, preferably with similar operating conditions each time. The following is a list of suggested periodic maintenance.

Once a Week

1. Check to make sure that the To Process temperature is maintained reasonably close to the Set Point temperature. If the temperature stays more than 5°F (3°C) away from the set point, there may be a problem with the chiller. If

this is the case, refer to the Troubleshooting Chart or contact our Customer Service Department.

2. Check the chiller and/or process pump discharge pressures. Investigate further if the pressure starts to stray away from the normal operating pressure.

3. Check the suction and discharge refrigerant pressure at the compressor.

4. Check each refrigerant sight glass for air bubbles or moisture indication. Bubbles in the refrigerant indicate either low refrigerant charge or excessive pressure drop in the liquid line. If the sight glass indicates that there is a refrigeration problem, have the unit serviced as soon as possible.

Once a Month

Repeat items 1 through 4 listed above and continue with the following.

5. Shut off the power disconnect. Check the condition of electrical connections at all contactors, starters and controls. Check for loose or frayed wires.

6. Check the incoming voltage to make sure it is within 10% of the design voltage for the chiller.

7. Check the amp draws to each leg of the compressor(s) to confirm that it is drawing the proper current.

8. Check the system superheat and subcooling. Normal superheat is approximately 10°F (5.5°C) and should not exceed 15°F (8°C). Normal subcooling ranges from 10°F (5.5°C) to 20°F (11°C).

Once a Year

Repeat items 1 through 8 listed above and continue with the following.

9. (TXW Models) Check the condition of the condenser water for algae and scale. If contamination is discovered, rod out the tubes and back flush condensers before reconnecting pipes.

10. (TXR Models) Check the condition of the air coils of the remote condensers for dirt and debris. If the coils are dirty or clogged, use a compressed air source to blow the contaminants out of the air coil.

11. Check the oil level. See “Checking Oil Separator Level” in the maintenance section of this manual.

12. Have a qualified laboratory perform a compressor oil analysis to determine system moisture content and acid level.

Maintenance

Installing and Replacing Processor Battery

The variable settings of the chiller are backed up by a replaceable lithium battery. The lithium battery provides backup for approximately 2 years. A PLC BATTERY LOW Alarm on the Operator interface and a red BATTERY LOW LED will alert you when the battery voltage has fallen below a threshold level. Once the BATTERY LOW LED goes on, do not remove processor power or your variable settings will revert back to the factory settings. An EEPROM Module backs up the processor program. Replace the battery as soon as possible. You can replace the battery while the processor is powered and the chiller is running. For battery installation or replacement do as follows.

1. Open the door of the processor.

2. If installing a battery in a new processor (battery never installed before), remove the jumper from the battery connector socket. Store the jumper in a safe place for possible future use without the battery.

3. If replacing an old battery, unplug the existing battery connector and remove from the retainer clips.

4. Insert a new or replacement battery in the holder. Make sure the retainer clips hold it in.

5. Plug the battery connector into the socket.

6. Close the processor door.

Replacing a Fuse on the Power Supply

To replace a fuse on the power supply do the following:

1. Remove power from the power supply.

2. Open the door of the power supply and use a fuse puller to remove the fuse.

3. Install a replacement fuse.

WARNING: Use only replacement fuses of the type and rating specified for the unit. Improper fuse selection can result in equipment damage. The exposed pin on the 3-pin jumper is electrically live. Contact with the pin may cause injury to personnel.

Cleaning the Operator Interface

Use of abrasive cleaners or solvents may damage the window. Do not scrub or use brushes. To clean the display window:

1. Disconnect power from the terminal at the power source.

2. Using a clean sponge or a soft cloth, clean the display with a mild soap or detergent. If paint or grease splash is present, remove before drying by rubbing lightly with isopropyl alcohol. Afterward, provide a final wash using a mild soap or detergent solution. Rinse with clean water.

3. Dry the display with a chamois or moist cellulose sponge to avoid water spots.

Checking Oil Separator Level

Follow the steps listed below for checking oil separator level.

Caution: Do not check the oil level with the machine operating. Severe oil loss will occur. When checking oil level, wear protective clothing and eyewear since the oil will spray when discharged.

1. Turn off the unit.

2. Attach refrigerant grade hoses and sight glass to the oil separator charging valve and the back seat port on the compressor discharge service valve as shown in Figures 7 and 8.

Figure 3 - Oil Separator Level (TX40-60, 80, 100 & 120)

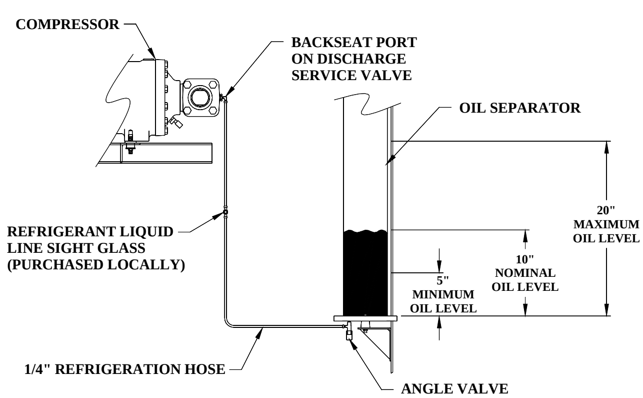
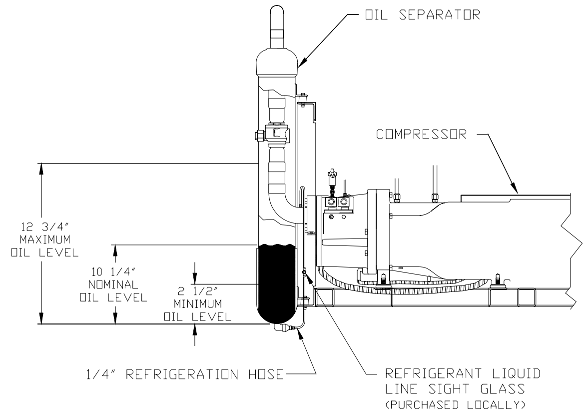


Figure 4 – Oil Separator Level (TX70, 85, 140-200)



3. Crack open the service valve and open the oil separator charging valve.

4. Wait 10 minutes for the oil to settle, then move the sight glass up and down until the level can be seen.

5. After the oil level has been determined, backseat the discharge service valve on the TX80-120 or closed the service valve on the TX140-200 and close the oil separator charging valve. Remove the sight glass and hoses.

6. If oil level is low, contact our Customer Service Department for assistance.

Warranty Information

The manufacturer warrants its equipment to be free from defects in material and workmanship when used under recommended operating conditions.

The manufacturer’s obligation is limited to repair (i.e. rewind a motor) or replacement (not adjustment or maintenance), F.O.B. the factory of any parts supplied by the manufacturer within 12 months and labor for 12 months from the date of shipment to the original purchaser. Labor warranty is for the continental U.S.A., Canada, and Puerto Rico only. Refrigerant and any labor associated with its evacuation or replacement is not covered by this warranty for remote condenser systems.

This warranty does not cover the cost of labor during overtime hours (after normal working hours or during weekends and holidays). Any cost differential for overtime labor will be the responsibility of the customer. The manufacturer is not responsible for any sales, use, excise or other applicable taxes associated with the replacement of parts under this warranty. This warranty will be voided when, in the manufacturer’s opinion, the equipment and/or system has been subject to misuse, negligence or operation in excess of recommended limits, including freezing, or has been altered, and/or repaired without express factory authorization. If equipment is installed in hostile environments, unless such conditions were specified at the time of purchase; or the serial number has been removed or defaced this warranty shall not apply. This warranty is not transferable.

Under no circumstances shall the manufacturer be liable for loss of prospective or speculative profits, or special, indirect, incidental or consequential damages.

All warranty service must be authorized by the manufacturer prior to work being performed and have a manufacturer purchase order issued. All defective parts become the property of the manufacturer and must be returned as advised by the manufacturer.

The manufacturer neither assumes, nor authorizes any person to assume for it, any liability not expressed in this warranty. There is an implied warranty of merchantability and of fitness for particular purpose; all other implied warranties, and any liability not based upon contract are hereby disclaimed and excluded by this warranty. This warranty is part of the standard conditions and terms of sale of the manufacturer.

PLC Troubleshooting

Once the status of the LED's are matched to the appropriate table, simply move across the table identifying error description and probable causes. Follow the recommended action steps for each probable cause until the error is corrected. If recommended actions do not correct the error, contact our Customer Service Department.

Before working on a Processor modular system, always remove the power supply input power at the main power disconnect switch. The power LED on the power supply indicates that DC power is being supplied to the chassis. The LED could be off when incoming power is present.

Table 10 - Processor Status LED's

LED	When it is	Indicates that
RUN	On (steadily)	The processor is in the Run mode
	Off	The processor is in a mode other than Run
CPU FAULT	Flashing (at power up)	The processor has not been configured
	Flashing (during operation)	The processor detects a major error either in the processor, expansion chassis or memory
	On (steadily)	A fatal error is present (no communication)
	Off	There are no errors
FORCED O/I	Flashing	One or more input or output addresses have been forced to an On or Off state but the forces have not been enabled
	On (steadily)	The forces have been enabled
	Off	No forces are present or enabled
BATTERY LOW	On (steadily)	The battery voltage has fallen below a threshold level or the battery and the battery jumper are missing
	Off	The battery is functional or the battery jumper is present
COMM	On (steadily)	The processor is receiving data
	Off	The processor is not receiving data

General Troubleshooting

Problem	Possible Cause	Remedy
Compressor will not start	Three-phase power monitor tripped	Check correct phasing of incoming power
	Compressor overload	Check supply voltage, amperage of each leg, contactor and wiring, overload set point
	Compressor contactor	Replace if faulty
	PLC output card	Replace if faulty
	Compressor failure	Contact Customer Service Department for assistance
Low refrigerant pressure	Low refrigerant charge	Contact refrigeration service technician
	Refrigerant leak	Contact refrigeration service technician
	Compressor suction service valve partially or fully closed	Open valve all the way
	Low refrigerant pressure sensor	Replace if faulty
	PLC input card	Replace if faulty
High refrigerant pressure	Plugged condenser	Clean condenser
	Insufficient condenser water flow (TXW models only)	Make sure chiller is installed in accordance with recommendations in this manual
	High condenser water temperature (TXW models only)	Maximum temperature is 95°F (35°C)
	Condenser water regulating valve (TXW models only)	Replace if faulty
	Compressor discharge service valve is fully or partially closed	Open valve all the way
	Refrigerant circuit overcharged	Contact refrigeration service technician
	High refrigerant pressure sensor	Replace if faulty
	PLC input card	Replace if faulty
Freezestat	Low flow through evaporator	Adjust flow to proper level
	Freezestat control	Check for proper setting and replace if faulty
	Thermistor	Replace if faulty
	PLC input card	Replace if faulty
Insufficient cooling (temperature continues to rise above set point)	Process load too high	Check to make sure chiller is properly sized for process load
	Coolant flow through evaporator is outside of normal operating range	Adjust flow to proper level
	Insufficient condenser cooling	See High refrigerant pressure
	Refrigeration circuit problem	Contact refrigeration service technician
	Thermocouple	Replace if faulty
	PLC input card	Replace if faulty
Erratic temperature control	Low coolant flow through evaporators	Adjust flow to proper level
	Overloading of chiller capacity	Check to make sure chiller is properly sized for process load
	Thermocouple	Replace if faulty
	PLC input card	Replace if faulty
High differential oil pressure	Oil line service valve is fully or partially closed	Open valve all the way
	Oil filter plugged	Contact Customer Service Department for assistance
	Low oil level	Contact Customer Service Department for assistance
	PLC input card	Replace if faulty

Problem	Possible Cause	Remedy
High oil temperature	Temperature responsive valve	Contact refrigeration service technician
	Oil temperature sensor	Replace if faulty
	Low oil level	Contact Customer Service Department for assistance
	PLC input card	Replace if faulty
High discharge temperature	Temperature responsive valve	Contact refrigeration service technician
	Discharge temperature sensor	Replace if faulty
	Low oil level	Contact Customer Service Department for assistance
	PLC input card	Replace if faulty
No LEDs are illuminated on PLC	Control power not available at power supply	Check for power at power supply, check control transformer
Display not updating information	Loss of communication	Check communication cables for correct port connections. Check that selector switch is in run mode.
	PLC fault	Cycle E-stop switch
Temperature values unsteady or out of range	Loose thermocouple wire connections	Tighten terminal screw
Thermocouple fault indicated on operator display	Open circuit in thermocouple wiring or bad thermocouple	Replace thermocouple
"No active nodes found on network" (No communication with SLC or PLC controller)	Communications (COMM) fault	Check status of COMM LED and refer to LED Indicators section and verify cable connections
	Baud rate not set properly	Verify that terminal and controller are set at same baud rate
	Controller is not in run mode	Place controller in run mode
	Terminal node and maximum node numbers are not correctly set	Verify node number settings
	Controller fault	Call the Customer Service Department for assistance
Screen objects do not function	PLC fault	Cycle control power
Application file name appears as ******* on Terminal Information screen	Application is invalid or may contain an error	Download application again or download new application
Area on touch screen appears dark	One of the tubes in the backlight has burnt out	Replace backlight tube
Screen objects are not visible	Correct power is not applied	Verify power connections
	Touch screen interface is in Screen Saver mode	Contact Customer Service Department for assistance
	Backlight lamp is not on	Contact Customer Service Department for assistance
	Backlight lamp is burnt out	Replace backlight

Preventive Maintenance Checklist

Maintenance Activity	Week Number											
	1	2	3	4	5	6	7	8	9	10	11	12
Date												
Temperature Control												
Pump Discharge Pressure												
Refrigerant Suction Pressure #1												
Refrigerant Suction Pressure #2												
Refrigerant Discharge Pressure #1												
Refrigerant Discharge Pressure #2												
Refrigerant Sight Glass #1												
Refrigerant Sight Glass #2												
Electrical Connections												
Incoming Voltage												
Compressor L1 Amps #1												
Compressor L2 Amps #1												
Compressor L3 Amps #1												
Compressor L1 Amps #2												
Compressor L2 Amps #2												
Compressor L3 Amps #2												
Refrigerant Superheat #1												
Refrigerant Superheat #2												
Refrigerant Subcooling #1												
Refrigerant Subcooling #2												
*Clean Condenser #1												
*Clean Condenser #2												
*Oil Level Check #1												
*Oil Level Check #2												
*Oil Analysis #1												
*Oil Analysis #2												

* Once a year

Drawings

We have prepared a custom set of drawings for your unit and placed them inside the control panel prior to shipment. Please refer to these drawings when troubleshooting, servicing and installing the unit. If you cannot find these drawings or wish to have additional copies sent, please contact our Customer Service Department and reference the serial number of your unit.

Notes

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