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THERMAL CARE

Installation, Operation and Maintenance Manual

TS Series

Scroll Central Chillers
20 to 100 Tons

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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. Consult the unit serial tag for information about the refrigerant type and charge amount. 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 chiller and 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 the 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. 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 of the drawings included with the unit. 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.

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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.

Condenser Water Line

(TSW 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 provide at least 20PSI.

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 set point. The chiller loading, condenser water inlet temperature, and pressure set point determine the actual flow. Table 1 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 (21°C) to 90°F (32°C). Supply temperatures beyond this range are not recommended and may lead to improper chiller operation.

Table 1 - Condenser Water Flow Requirements

Model	GPM (L/min) @ 70°F (21°C)	GPM (L/min) @ 75°F (24°C)	GPM (L/min) @ 85°F (29°C)	GPM (L/min) @ 90°F (32°C)
TSW20A	49 (186)	51 (194)	63 (239)	70 (265)
TSW30A	75 (283)	78 (294)	96 (363)	107 (403)
TSW40A	98 (372)	102 (386)	126 (477)	140 (529)
TSW50A	122 (470)	126 (488)	156 (602)	173 (668)
TSW60A	147 (558)	153 (579)	189 (715)	210 (794)
TSW80A	192 (736)	199 (764)	246 (943)	273 (1047)
TSW100A	234 (886)	243 (920)	300 (1136)	333 (1261)
Head Pressure Setting PSI (kPa)*	180 (1241)	190 (1310)	210 (1448)	220 (1517)

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

Interconnecting Refrigerant Piping

(TSR Models Only) The chiller unit is shipped with a nitrogen holding charge and has a full charge of oil, excluding the additional charge for field piping. Proper evacuation is required prior to charging with refrigerant. 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.

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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 a 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 Circuits

The heat transferred in the evaporators 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 evaporators to the compressors.

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

The hot, high-pressure gas exits the compressors and is delivered to the condensers. In water-cooled condenser units (TSW 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 (TSR 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 condensers have been sized to remove the heat from the process load and the heat that was added by the compressor.

After leaving the condensers, the liquid refrigerant passes through the filter dryers and sight glasses. The filter dryer filters out any particles and/or moisture from the refrigerant. The sight glasses are used to monitor the stream of liquid refrigerant. The liquid refrigerant then passes through the thermal expansion valves that meter the flow into the evaporators where the process begins again.

Compressors

The chiller is equipped with hermetic scroll compressors. Both the compressors and the motors are encased together and solidly mounted in the compressor housing. The compressors are unidirectional and will only pump refrigerant when properly phased. The cool refrigerant suction gas cools the motor windings, and there is an internal thermal overload to protect the windings from overheating. The compressors are lubricated with oil that travels throughout the system with the refrigerant.

Water Cooled Condensers

(TSW Models Only) The shell and tube condensers are constructed of steel shells, 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 sides.

Air Cooled Remote Condenser

(TSR 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.

Evaporators

The evaporators are 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.

Thermostatic Expansion Valves

The thermal expansion valves separate the refrigerant high pressure/temperature on the condenser sides from the refrigerant low pressure/temperature on the evaporator sides. The thermal expansion valves meter the amount of refrigerant into the evaporators in the precise quantity in order to maintain superheat.

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The difference between the saturated evaporative temperatures and the suction line temperatures at the thermal expansive sensor bulb locations 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 these valves.

Liquid Line Solenoid Valves

The liquid line solenoid valves are located upstream of the sight glasses. The valves are normally closed and open when the circuit is enabled and cooling is required. The valves are opened five seconds prior to starting the compressor(s) in the circuit to allow the low pressure switches to close in the event a circuit has been pumped down for service. The solenoid valves close when the compressor(s) stops. This is to prevent migration of liquid refrigerant back to the compressor (s) during shutdown.

Refrigerant Sight Glasses

The refrigerant sight glasses are located in the liquid lines immediately ahead of the thermal expansion valves. They allow the operator or service technician to observe the flow of liquid refrigerant in the refrigerant circuit. Prolonged periods of foaming in the sight glasses 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 glasses 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/Dryers

The refrigerant filter/dryers are located in the liquid lines between the condensers and the refrigerant sight glasses. They are 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 Sensors

The discharge pressure sensors or transducers are used for monitoring the discharge pressures. The pressure sensors will also detect a low limit conditions and will shut down the compressor(s) if the pressure is below 100 PSIG (690 kPa) for more than 20 seconds. This minimum pressure is essential for oil circulation.

Suction Pressure Sensors

(TSR Models Only) The suction pressure sensors or transducers are used to monitor the suction pressures. The normal operating pressure differentials between the suction and discharge pressures are 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 Valves

(TSW Models Only) Mechanical condenser water regulating valves are provided as standard on all TSW models. The valves regulate the flow of water through the condensers 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 valves 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 settings should be adjusted if inlet temperatures are different than the design 85°F (29°C).

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High Refrigerant Pressure Switches

The high refrigerant pressure switches are designed to limit the compressor discharge pressures so they stay within the design parameters of the compressors. The switch is located on the discharge service valve and is 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 switches open when a fault condition occurs, pressing the reset button on the back of the switches and pressing the Alarm Reset on the control panel will reset the alarm. The setting on the switches is not adjustable.

Low Refrigerant Pressure Switches

The low refrigerant pressure switches are 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 switches are located on the compressor suctions 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 switches. The setting on the switch is not adjustable.

Freezestats

The freezestat controls are thermostats that sense the coolant temperatures separately from the PLC controller. These safeties are designed to limit the temperatures of the coolant leaving the evaporators and prevent any possible freeze-up situations. These controls 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 2 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 manifold outlet. It is designed to shut the unit down if there is insufficient coolant flow through the evaporators. 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 TS Series of central chillers standard controller is an OCS (Operator Control Station) PLC with integrated HMI (Human Machine Interface). The interface is designed using clear text English language menus.

Menu access and adjustment is accomplished by:

1. Pressing one of the 10 menu selector keys.
2. Scrolling to the desired menu item.
3. Use the enter key to select the menu item.
4. For menu items that can be changed the keypad or arrow keys can be used for adjustment.

There are six messages that make up the default display. They will appear in turn with each message being displayed for about three seconds before the next one appears. Pressing the ESC button once (or several times depending on what display is up) will access the display. Once the buttons remain unused for about 30 minutes, the controller will again display the rotating displays. The rotating screens will be overridden when a fault occurs or when the operator selects another screen.

Set Up Menu (Key Pad #1)

Pressing this key will bring up the set up menu. This menu is password protected to ensure desired parameters and not inadvertently changed. The factory default password is ‘9999’. Once this has been entered the menu is fully accessible.

Temperature Set Point – the set point of the chiller leaving water temperature.

Set Temp Deviation – the set point of the deviation from set point that will cause a temperature deviation alarm condition.

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Set High Temp Alarm – the set point of the high temperature alarm that will cause a high temperature alarm condition.

Select Single Flow – used for most applications where the process flow is 2.4 GPM per ton of chiller capacity. This is the standard setting.

Select Double Flow – used for applications with 4.8 GPM per ton of chiller capacity. This is only used in special applications. Do not change this setting without verifying the application.

Select Auto Lead – used to set which circuit will be the lead circuit. As standard this setting is in the auto lead selection however, if desired, a manual setting can be entered to have either circuit one or circuit two be the lead circuit. The advantages of automatic lead lag are the operating times are equally split between the circuits. It is recommended to leave the lead lag in the automatic mode at all times.

Enter New Password – allows changing of the password.

Temperature Scale Select – selects °F or °C temperature scale.

Pumps Menu (Key Pad #2)

Pressing this key will bring up the pumps menu. This menu is only functional if the chiller has been ordered with an optional pump tank and pumps.

Process P1 Pump – allows for enabling or disabling pump. This menu item will also allow access to the running hour meter display for this pump.

Standby PSB Pump - allows for enabling or disabling pump. This menu item will also allow access to the running hour meter display for this pump.
Recirc P2 Pump - allows for enabling or disabling pump. This menu item will also allow access to the running hour meter display for this pump.

CKT #1 Menu (Key Pad #3)

Pressing this key will bring up the circuit 1 menu. This menu allows for monitoring and control of refrigerant circuit number 1.

CKT1 Enable/Disable – allows the circuit to be enabled or disabled.

Circuit 1 Status (two compressor units only) - allows viewing of the circuit status for: off, running, ready, no demand, sequence delay, and fault status displays. In addition there is a recycle and run time timers for each of the status displays.

Circuit 1A Status (four compressor units only) - allows viewing of the circuit status for: off, running, ready, no demand, sequence delay, and fault status displays. In addition there is a recycle and run time timers for each of the status displays.

Circuit 1B Status (four compressor units only) - allows viewing of the circuit status for: off, running, ready, no demand, sequence delay, and fault status displays. In addition there is a recycle and run time timers for each of the status displays.

Compressor Hours – shows the actual total hours of operation for each compressor in the circuit. In two compressor chillers there will be only one compressor hour display. In four compressor units there will be two compressor hour displays, one for compressor A and one for compressor B.

Start Menu (Key Pad #4)

Pressing this key will start the unit and will bring up the start-up screens. The screens will display the various start-up processes. If the unit does not have the optional pump and tank the screen sequence will be: system started or system already started, enabling chiller circuits or lead circuit not enabled, and start-up complete. If the unit does have the optional pump and tank the screen sequence will be: system started or system already started, starting recir pump or recirc pump not enabled, enabling chiller circuits or lead circuit not enabled, starting process pump or process pump not enabled, and start-up complete.

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Alarm Acknowledge (Key Pad #5)

Pressing this key will acknowledge the alarm condition being display. Each alarm must be acknowledged before it can be cleared. Each alarm must be individually acknowledged and reset. All alarms must be acknowledged to silence the alarm horn. It is possible to acknowledge all faults without resetting any of them.

Alarm History Menu (Key Pad #6)

Pressing this key will display the alarm history for the last 25 faults that may have occurred. Once full, the fault history will delete the oldest fault in order to make room for a new fault.

Each alarm will have a time stamp indicating the date and time of the alarm fault. The following are alarm faults that are kept in the alarm history: no faults, circuit 1 compressor low pressure, circuit 2 compressor low pressure, circuit 1 low flow, circuit 2 low flow, chiller tank low (only on units with the optional pump and tank), circuit 1 freezestat, circuit 2 freezestat, return water sensor fault, circuit 1 high refrigerant pressure, circuit 2 high refrigerant pressure, supply water sensor fault, circuit 1 low refrigerant pressure, circuit 2 low refrigerant pressure, control power off, compressor fault (general fault indicating at least one compressor fault), pump fault (general fault indicating at least one pump fault).

Service Menu (Key Pad #7)

Pressing this key will display the direct dial Customer Service Depart phone numbers. The phone numbers will remain displayed for 30 seconds after which time the display will return to the default message display.

CKT #2 Menu (Key Pad #8)

Pressing this key will bring up the circuit 2 menu. This menu allows for monitoring and control of refrigerant circuit number 2.

CKT1 Enable/Disable – allows the circuit to be enabled or disabled.

Circuit 2 Status (two compressor units only) - allows viewing of the circuit status for: off, running, ready, no demand, sequence delay, and fault status displays. In addition there is a recycle and run time timers for each of the status displays.

Circuit 2A Status (four compressor units only) - allows viewing of the circuit status for: off, running, ready, no demand, sequence delay, and fault status displays. In addition there is a recycle and run time timers for each of the status displays.

Circuit 2B Status (four compressor units only) - allows viewing of the circuit status for: off, running, ready, no demand, sequence delay, and fault status displays. In addition there is a recycle and run time timers for each of the status displays.

Compressor Hours – shows the actual total hours of operation for each compressor in the circuit. In two compressor chillers there will be only one compressor hour display. In four compressor units there will be two compressor hour displays, one for compressor A and one for compressor B.

Stop Menu (Key Pad #9)

Pressing this key will stop the unit and will bring up the shutdown screens. The screens will display the various shutdown processes. If the unit does not have the optional pump and tank the screen sequence will be: system shutdown requested or system already stopped, stopping chiller, and shutdown complete. If the unit does have the optional pump and tank the screen sequence will be: system shutdown requested or system already stopped, stopping process pump, stopping chiller, stopping recirc pump, and shutdown complete.

Alarm Reset (Key Pad #4)

Pressing this key will cause the system to reset the current displayed alarm to clear if it has been acknowledged. If pressing this key does not clear the alarm check to make sure the Alarm Acknowledge key was pressed to acknowledge the alarm. The alarm cannot be reset until after it has been acknowledged.

Warning Messages

The below warning messages will pop up and disappear on demand as the system conditions necessitate their need. System warning messages are meant to inform the operator and typically do not need to be acknowledged or reset with the keys used for handling faults.

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Freeze Risk! – Enable Circuit 1
Freeze Risk! – Enable Circuit 2
Can't Enable Pump – Two Pumps On Max
High Temperature Deviation Warning
Low Temperature Deviation Warning
Glycol Usage Warning See Manual

Fault Messages

All the fault messages for the system are listed below. The fault messages will appear in response to a fault condition detected by the controller. Several faults may activate at once. Different active faults can be viewed by pressing the left and right arrow keys. Each alarm must be individually acknowledged and reset. All alarm must be acknowledged to silence the alarm horn. It is possible to acknowledge all faults without resetting any of them. If a fault condition still exists after reset, it will re-trigger, and must be acknowledged and reset again.

Circuit 1 Alarm – Low Flow
Circuit 1 Alarm – Freezestat
Circuit 1 Alarm – High Refrigerant Pressure
Circuit 1 Alarm – Compressor Low Pressure
Circuit 2 Alarm – Low Flow
Circuit 2 Alarm – Freezestat
Circuit 2 Alarm – High Refrigerant Pressure
Circuit 2 Alarm – Compressor Low Pressure
System Alarm – Compressor Fault
System Alarm – Pump Fault
System Alarm – Chiller Tank Low Level
System Alarm – Supply Temperature High
System Alarm – Process Return Sensor Fault
System Alarm – Process Supply Sensor Fault
System Alarm – E-Stop Pressed

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 and that it matches the voltage shown on the nameplate of the unit. 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 are connected in the A-B-C phase sequence to prevent equipment damage due to reverse rotation.

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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 2 for recommended glycol solutions.

3. (TSW 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 2 - 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 %

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4. (TSR Models Only) Check the refrigerant lines to make sure all connections are secure and that a proper evacuation of the chiller, the field piping, and the remote condenser has occurred.

5. (TSR Models Only) Charge the chiller with refrigerant. Please refer to the TSR Series Chiller Remote Air-Cooled Condenser Installation Guidelines Manual to determine the required refrigerant charge.

6. (TSR Models Only) Check the remote condenser main power and control wiring to ensure all connections are secure.

7. 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.

8. 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.

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

10. 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.

11. 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). 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.

12. Activate Compressors. A compressor can only be started if its cycle time has expired, 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.

13. 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 2.

14. 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.

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

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.

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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.

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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 (TSW Models only)	Make sure chiller is installed in accordance with recommendations in this manual
	High condenser water temperature (TSW Models only)	Maximum temperature is 95°F (35°C)
	Condenser water regulating valve (TSW 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

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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 #1 L1 Amps												
Compressor #1 L2 Amps												
Compressor #1 L3 Amps												
Compressor #2 L1 Amps												
Compressor #2 L2 Amps												
Compressor #2 L3 Amps												
Compressor #3 L1 Amps												
Compressor #3 L2 Amps												
Compressor #3 L3 Amps												
Compressor #4 L1 Amps												
Compressor #4 L2 Amps												
Compressor #4 L3 Amps												
Refrigerant Circuit #1 Superheat												
Refrigerant Circuit #2 Superheat												
Refrigerant Circuit #1 Subcooling												
Refrigerant Circuit #2 Subcooling												
*Oil Level Check #1												
*Oil Level Check #2												
*Oil Analysis #1												
*Oil Analysis #2												

* Once a year

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