23XL
Hermetic Screw Liquid Chillers with HCFC-22 and HFC-134a, 50/60 Hertz
PIC II Controls

Start-Up, Operation and Maintenance Instructions

SAFETY CONSIDERATIONS

Screw liquid chillers are designed to provide safe and reliable service when operated within design specifications. When operating this equipment, use good judgment and safety precautions to avoid damage to equipment and property or injury to personnel.

Be sure you understand and follow the procedures and safety precautions contained in the chiller instructions, as well as those listed in this guide.

⚠ WARNING

DO NOT VENT refrigerant relief valves within a building. Outlet from rupture disc or relief valve must be vented outdoors in accordance with the latest edition of ANSI/ASHRAE 15 (American National Standards Institute, American Society of Heating, Refrigeration, and Air Conditioning Engineers), latest edition. The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation.

PROVIDE adequate ventilation in accordance with ANSI/ ASHRAE 15, especially for enclosed and low overhead spaces. Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Misuse can be fatal. Vapor is heavier than air and reduces the amount of oxygen available for breathing. Product causes eye and skin irritation. Decomposition products are hazardous.

DO NOT USE OXYGEN to purge lines or to pressurize a chiller for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.

NEVER EXCEED specified test pressures. VERIFY the allowable test pressure by checking the instruction literature and the design pressures on the equipment nameplate.

DO NOT USE air for leak testing. Use only refrigerant or dry nitrogen.

DO NOT VALVE OFF any safety device.

BE SURE that all pressure relief devices are properly installed and functioning before operating any chiller.

⚠ WARNING

DO NOT WELD OR FLAMECUT any refrigerant line or vessel until all refrigerant (*liquid and vapor*) has been removed from chiller. Traces of vapor should be displaced with dry air or nitrogen and the work area should be well ventilated. *Refrigerant in contact with an open flame produces toxic gases*.

DO NOT USE eyebolts or eyebolt holes to rig chiller sections or the entire assembly.

DO NOT work on high-voltage equipment unless you are a qualified electrician.

DO NOT WORK ON electrical components, including control centers, switches, starters, or oil heater (if applicable) until you are sure ALL POWER IS OFF and no residual voltage can leak from capacitors or solid-state components.

LOCK OPEN AND TAG electrical circuits during servicing. IF WORK IS INTERRUPTED, confirm that all circuits are deenergized before resuming work.

DO NOT syphon refrigerant.

AVOID SPILLING liquid refrigerant on skin or getting it into the eyes. USE SAFETY GOGGLES. Wash any spills from the skin with soap and water. If liquid refrigerant enters the eyes, IMMEDIATELY FLUSH EYES with water and consult a physician.

NEVER APPLY an open flame or live steam to a refrigerant cylinder. Dangerous over pressure can result. When it is necessary to heat refrigerant, use only warm (110 F [43 C]) water.

DO NOT REUSE disposable (nonreturnable) cylinders or attempt to refill them. It is DANGEROUS AND ILLEGAL. When cylinder is emptied, evacuate remaining gas pressure, loosen the collar, and unscrew and discard the valve stem. DO NOT INCINERATE.

CHECK THE REFRIGERANT TYPE before adding refrigerant to the chiller. The introduction of the wrong refrigerant can cause damage or malfunction to this chiller.

Operation of this equipment with refrigerants other than those cited herein should comply with ANSI/ASHRAE 15 (latest edition). Contact Carrier for further information on use of this chiller with other refrigerants.

DO NOT ATTEMPT TO REMOVE fittings, covers, etc., while chiller is under pressure or while chiller is running. Be sure pressure is at 0 psig (0 kPa) before breaking any refrigerant connection.

CAREFULLY INSPECT all relief devices, rupture discs, and other relief devices AT LEAST ONCE A YEAR. If chiller operates in a corrosive atmosphere, inspect the devices at more frequent intervals.

DO NOT ATTEMPT TO REPAIR OR RECONDITION any relief device when corrosion or build-up of foreign material (rust, dirt, scale, etc.) is found within the valve body or mechanism. Replace the device.

DO NOT install relief devices in series or backwards.

USE CARE when working near or in line with a compressed spring. Sudden release of the spring can cause it and objects in its path to act as projectiles.

⚠ CAUTION

DO NOT STEP on refrigerant lines. Broken lines can whip about and release refrigerant, causing personal injury.

DO NOT climb over a chiller. Use platform, catwalk, or staging. Follow safe practices when using ladders.

USE MECHANICAL EQUIPMENT (crane, hoist, etc.) to lift or move inspection covers or other heavy components. Even if components are light, use mechanical equipment when there is a risk of slipping or losing your balance.

BE AWARE that certain automatic start arrangements CAN ENGAGE THE STARTER, TOWER FAN, OR PUMPS. Open the disconnect *ahead* of the starter, tower fan, or pumps. Shut off the chiller or pump before servicing equipment.

USE only repair or replacement parts that meet the code requirements of the original equipment.

DO NOT VENT OR DRAIN waterboxes containing industrial brines, liquid, gases, or semisolids without the permission of your process control group.

DO NOT LOOSEN waterbox cover bolts until the waterbox has been completely drained.

DOUBLE-CHECK that coupling nut wrenches, dial indicators, or other items have been removed before rotating any shafts.

DO NOT LOOSEN a packing gland nut before checking that the nut has a positive thread engagement.

PERIODICALLY INSPECT all valves, fittings, and piping for corrosion, rust, leaks, or damage.

PROVIDE A DRAIN connection in the vent line near each pressure relief device to prevent a build-up of condensate or rain water.

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INTRODUCTION

Prior to initial start-up of the 23XL chiller, those involved in the start-up, operation, and maintenance should be thoroughly familiar with these instructions and other necessary job data. This book is outlined to familiarize those involved in the start-up, operation and maintenance of the unit with the control system before performing start-up procedures. Procedures in this manual are arranged in the sequence required for proper chiller start-up and operation.

⚠ WARNING

This unit uses a microprocessor control system. Do not short or jumper between terminations on circuit boards or modules. Control or board failure may result.

Be aware of electrostatic discharge (static electricity) when handling or making contact with circuit boards or module connections. Always touch a chassis (grounded) part to dissipate body electrostatic charge before working inside control center.

Use extreme care when handling tools near circuit boards and when connecting or disconnecting terminal plugs. Circuit boards can be damaged easily. Always hold boards by the edges, and avoid touching components and connections.

This equipment uses, and can radiate, radio frequency energy. If not installed and used in accordance with the instruction manual, it may interfere with radio communications. This equipment has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his own expense, will be required to take whatever measures may be required to correct the interference.

Always store and transport replacement or defective boards in an anti-static shipping bag.

ABBREVIATIONS AND EXPLANATIONS

Frequently used abbreviations in this manual include:

CCM	— Chiller Control Module
CCN	— Carrier Comfort Network
CVC	— Chiller Visual Controller
CCW	— Counterclockwise
CW	— Clockwise
ECDW	— Entering Condenser Water
ECW	— Entering Chilled Water
EMS	— Energy Management System
HGBP	— Hot Gas Bypass
I/O	— Input/Output
ISM	— Integrated Starter Module
LCD	— Liquid Crystal Display
LCDW	— Leaving Condenser Water
LCW	— Leaving Chilled Water
LED	— Light-Emitting Diode
OLTA	— Overload Trip Amps
PIC II	— Product Integrated Control II
RLA	— Rated Load Amps
SCR	— Silicon Controlled Rectifier
SI	— International System of Units

Words printed in all capital letters or in italics may be viewed on the Chiller Visual Controller (CVC) (e.g., LOCAL, CCN, ALARM, etc.).

Words printed in both all capital letters and italics can also be viewed on the CVC and are parameters (e.g., CONTROL MODE, COMPRESSOR START RELAY, ICE BUILD OPTION, etc.) with associated values (e.g., modes, temperatures, percentages, pressures, on, off, etc.).

Words printed in all capital letters and in a box represent softkeys on the CVC control panel (e.g., $\boxed{\text{ENTER}}$, $\boxed{\text{EXIT}}$, $\boxed{\text{INCREASE}}$, $\boxed{\text{QUIT}}$, etc.).

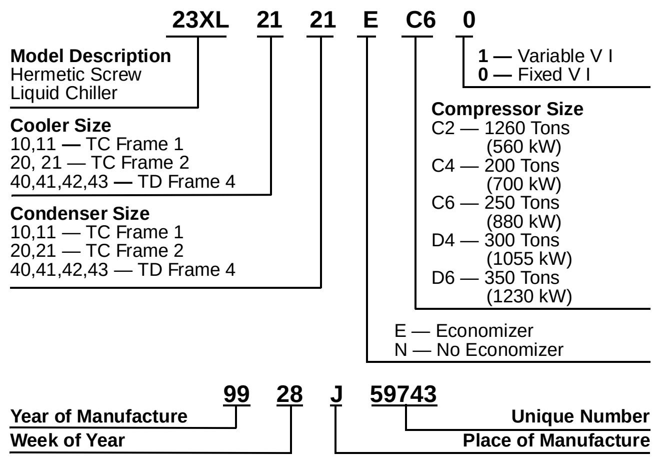
Factory-installed additional components are referred to as options in this manual; factory-supplied but field-installed additional components are referred to as accessories.

The chiller software part number of the 23XL unit is located on the back of the CVC.

23XL CHILLER FAMILIARIZATION (Fig. 1, 2A, and 2B)

Chiller Identification Nameplate — The chiller identification nameplate is located on the right side of the chiller control panel center.

System Components — The components include cooler and condenser, heat exchangers in separate vessels, motor-compressor, lubrication system, control panel, and optional motor starter. All connections from pressure vessels have external threads to enable each component to be pressure tested with a threaded pipe cap during factory assembly.



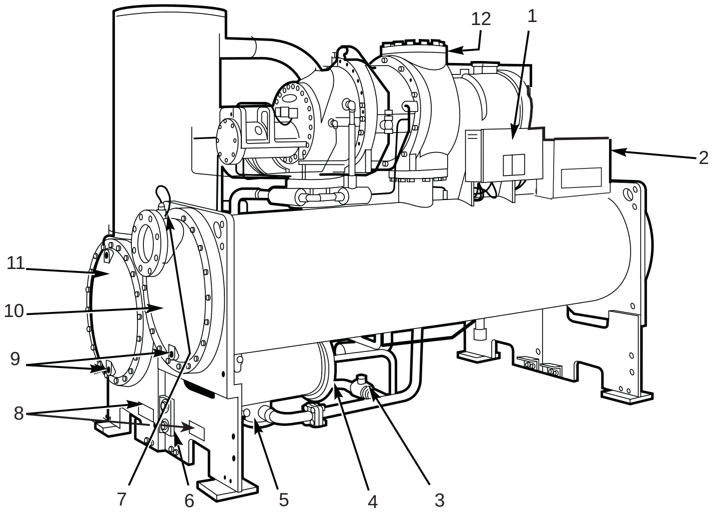
LEGEND

VI — Volumetric Index

SERIAL NUMBER BREAKDOWN

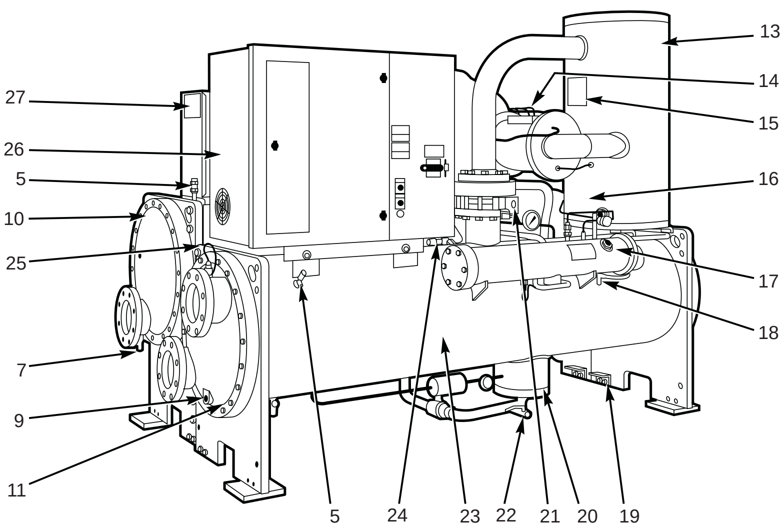
Fig. 1 — 23XL Identification

FRONT VIEW



1 — Power Panel
2 — Chiller Visual Controller (CVC)
3 — Cooler Refrigerant Isolation Valve
4 — ASME Nameplate, Economizer (Hidden)
5 — Service Valve
6 — Take-Apart Rabbet Fit Connector (Lower)
7 — Cooler Temperature Sensor
8 — ASME Nameplate, Condenser/Cooler
9 — Typical Waterbox Drain Port
10 — Cooler Supply/Return End Waterbox Cover
11 — Condenser Supply/Return End Waterbox Cover
12 — Compressor Nameplate (Hidden)

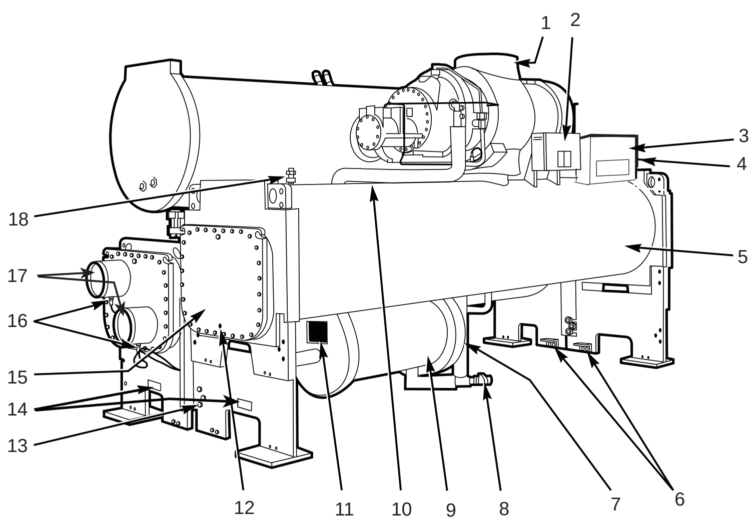
REAR VIEW



13 — Oil Separator
14 — ASME Nameplate, Muffler (Hidden)
15 — ASME Nameplate, Oil Separator
16 — Cooler Relief Valves (Hidden)
17 — Oil Sump Filter Assembly
18 — Oil Charging Valve
19 — Vessel Separation Feet
20 — Float Chamber
21 — Condenser Isolation Valve (Option or Accessory)
22 — Refrigerant Charging Valve
23 — Condenser
24 — Condenser Relief Valves (Hidden)
25 — Take-Apart Rabbet Fit Connector (Upper)
26 — Unit Mounted Starter (Option)
27 — Machine Identification Nameplate

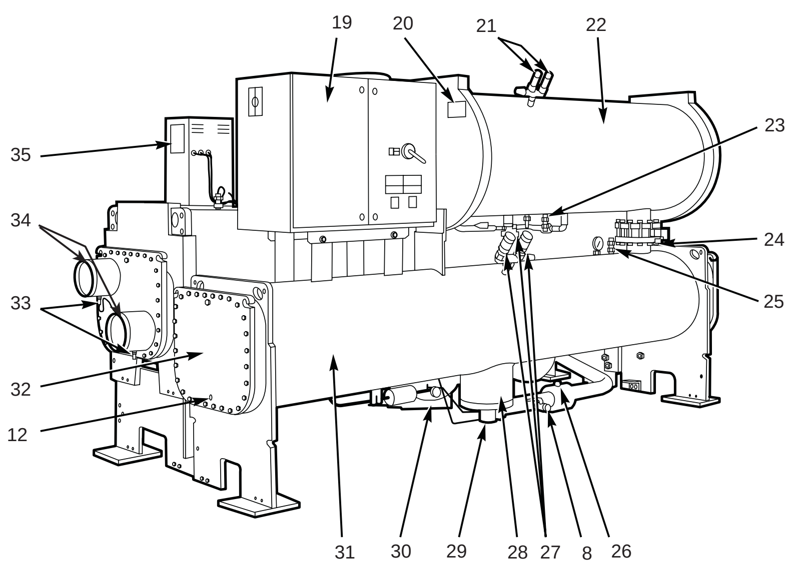
Fig. 2A — Typical 23XL Installation (TC Frame 1 and 2 Chillers)

FRONT VIEW



1 — Compressor Nameplate (Hidden)
2 — Power Panel
3 — Chiller Visual Controller (CVC)
4 — ASME Nameplate, Cooler
5 — Cooler
6 — Vessel Separation Feet
7 — Economizer Float Valve Access Cover (Hidden)
8 — Refrigerant Charging Valve
9 — Economizer
10 — Oil Filter Assembly (Hidden)
11 — ASME Nameplate, Economizer
12 — Typical Waterbox Drain Port
13 — Take-Apart Rabbet Fit Connector
14 — ASME Nameplate, Condenser/Cooler
15 — Cooler Supply/Return End Waterbox Cover
16 — Condenser Temperature Sensors
17 — Condenser Water Pressure Sensors
18 — Cooler Relief Valve

REAR VIEW



19 — Unit Mounted Starter (option)
20 — ASME Nameplate, Oil Separator
21 — Oil Separator Relief Valves
22 — Oil Separator
23 — Oil Charging Valve
24 — Condenser Isolation Valve (Option or Accessory)
25 — Service Valve
26 — Cooler Refrigerant Isolation Valve
27 — Condenser Relief Valves and Oil Filter
28 — Float Chamber
29 — Poppet Valve Assembly
30 — Motor Cooling Isolation Valve
31 — Condenser
32 — Condenser Supply/Return End Waterbox Cover
33 — Cooler Temperature Sensors
34 — Cooler Water Pressure Sensors
35 — Machine Identification Nameplate

Fig. 2B — Typical 23XL Installation (TD Frame 4 Chiller)

Cooler — This vessel (also known as the evaporator) is located underneath the compressor. The cooler is maintained at low temperature/pressure so that evaporating refrigerant can remove heat from water/brine flowing through its internal tubes.

Condenser — The condenser operates at a higher temperature/pressure than the cooler and has water flowing through its internal tubes to remove heat from the refrigerant.

Motor-Compressor — The motor-compressor maintains system temperature/pressure differences and moves the heat carrying refrigerant from the cooler to the condenser.

Muffler-Oil Separator — The muffler provides acoustical attenuation.

Refrigerant/oil separation is accomplished by the oil separator. Discharge gas enters near the midsection and leaves near the top, while the separated oil drains out through the bottom and flows through a horizontal oil sump/filter assembly (TC frame 1 and 2 chillers).

TC frame 1 and 2 chillers have an oil separator and a muffler assembly. On TD frame 4 chiller, the muffler is located inside the oil separator.

Control Panel — The control panel is the user interface for controlling the chiller and regulating the chiller's capacity to maintain the proper chilled water temperature. The control panel:

- registers cooler, condenser, and lubricating system pressures
- shows chiller operating condition and alarm shutdown conditions
- records the total chiller operating hours, starts, and the number of hours the chiller has been currently running
- sequences chiller start, stop, and recycle under microprocessor control
- provides access to other Carrier Comfort Network devices

Factory-Mounted Starter (Optional Accessory) — The starter allows for the proper starting and disconnecting of electrical energy for the compressor-motor, oil heater (TC frame 1 and 2 chillers), and control panel.

Storage Vessel (Optional) — Two sizes of storage vessels are available. The vessels have double relief valves, a magnetically coupled dial-type refrigerant level gage, a 1-in. FPT drain valve, and a $^1/_2$-in. male flare vapor connection for the pumpout unit. A 30-in.-0-400 psi (–101-0-2750 kPa) gage is also supplied with each unit.

NOTE: If a storage vessel is not used at the jobsite, factory-installed optional isolation valves may be used to isolate the chiller charge in either the cooler or condenser. An optional pumpout compressor system is used to transfer refrigerant from vessel to vessel.

REFRIGERATION CYCLE

The compressor continuously draws refrigerant vapor from the cooler. As the compressor suction reduces the pressure in the cooler, the remaining refrigerant boils at a fairly low temperature (typically 38 to 42 F [3 to 6 C]). The energy required for boiling is obtained from the water flowing through the cooler tubes. With heat energy removed, the water becomes cold enough for use in an air-conditioning circuit or process liquid cooling.

After taking heat from the water, the refrigerant vapor is compressed. Compression adds still more energy, and the refrigerant is quite warm (typically 130 to 160 F [54 to 71 C]) when it is discharged from compressor into condenser.

Relatively cool (typically 65 to 85 F [18 to 29 C]) water flowing into the condenser tubes removes heat from the refrigerant and the vapor condenses to liquid.

The liquid refrigerant passes through orifices into the FLASC (Flash Subcooler) chamber (Fig. 3 and 4). Since the FLASC chamber is at a lower pressure, part of the liquid refrigerant flashes to vapor, thereby cooling the remaining liquid. The FLASC vapor is recondensed on the tubes which are cooled by entering condenser water. The liquid then passes through a float valve assembly which forms a liquid seal to keep FLASC chamber vapor from entering the cooler.

An optional economizer can be installed between the condenser and cooler. In this case, the float valve meters the refrigerant liquid into the economizer. Pressure in this chamber is intermediate between condenser and cooler pressures. At this lower pressure, some of the liquid refrigerant flashes to gas, cooling the remaining liquid. The flash gas, having absorbed heat, is returned directly to the compressor at a point after suction cutoff (Fig. 5). Here it is mixed with gas from the suction cut-off point to produce an increase in the mass flow of refrigerant transported and compressed without either an increase in suction volume or a change in suction temperature. Rather than providing the same capacity with less power, the compressor provides substantially increased capacity with only a slight increase in power requirements.

The cooled liquid refrigerant in the economizer is metered through a linear float valve into the cooler. Because pressure in the cooler is lower than economizer pressure, some of the liquid flashes and cools the remainder to evaporator (cooler) temperature. The cycle is now complete.

MOTOR COOLING CYCLE

The motor is cooled by liquid refrigerant taken from the bottom of the condenser vessel. The flow of refrigerant is maintained by the pressure differential that exists due to compressor operation. The refrigerant flows through an isolation valve, in-line filter/drier, and a sight glass/moisture indicator (dry-eye), into the motor through the motor spray nozzle. See Fig. 3 and 4.

The motor spray nozzle is orificed to control refrigerant flow through the gaps in the rotor and axial vent holes. The refrigerant collects in the bottom of the motor casing and then drains into the cooler through the motor cooling drain line.

The motor is protected by a temperature sensor imbedded in the stator windings. Motor temperatures above the MOTOR WINDING TEMPERATURE OVERRIDE THRESHOLD (see Capacity Override section, page 38) will override the chilled water temperature capacity control to hold. If the motor temperature rises 10 F (5.5 C) above this threshold, the slide valve will unload. If the motor temperature rises above the safety limit, the compressor will shut down.

LUBRICATION CYCLE

Summary — The 23XL does **not** require an oil pump. Oil flow is driven by differential pressure between condenser and evaporator. This system pressure difference holds the potential to push the oil through the oil separator and filter into the compressor rotors, bearings, and slide valve. The cycle is referred to as a "high side" oil system. See Fig. 3, 4, and 5.

Details — The oil system:

- lubricates the roller bearings which support the male and female rotors, and the ball bearings of the 23XL compressor.
- positions the slide valve for capacity control. The slide valve is connected to a piston via a rod. The position of the piston, which rides in a cylinder, is determined by energizing one of two solenoids which function to

supply and equalize oil pressure to and around the piston. This allows the slide valve to unload and load.

- seals the gap between the male and female rotors. The oil hydrodynamically seals this space to allow the refrigerant vapor to be compressed. A specific flow rate of oil is injected into the compressor rotor housing at the point where the compression process is initiated.
- cools the compressed refrigerant vapor. The oil that is injected into the compressor for sealing also acts as a heat sink by absorbing a portion of the heat from compression. Thus, constant and cool compressor discharge gas temperature, relative to an oil-less screw compressor, is maintained.

Oil is charged into the system through a hand valve located on the bottom of the oil sump (TC frame 1 and 2 chillers) or separator (TD frame 4 chillers). Sight glasses on the oil sump (TC frame 1 and 2 chillers) and/or oil separator (TD frame 4 chillers) permit oil level observation. When the compressor is shut down, an oil level should be visible in the oil sump (TC frame 1 and 2 chillers) or the lower oil separator sight glass (TD frame 4 chillers). During operation, the oil level should rise and be visible in the oil separator sight glass (TC frame 1 and 2 chillers) or the upper oil separator sight glass (TD frame 4 chillers). Approximately 4.2 gal. (15.9 L) of an oil and refrigerant mixture accumulates in the sump of TC frame 1 and 2 chillers. Approximately 10 gal (38 L) of oil accumulates in the separator and 2 gal. (7.6 L) accumulates on the cooler of TD frame 4 chillers.

Oil is driven from the oil separator through an oil filter to remove foreign particles. The oil filter has a replaceable cartridge. The filter housing is capable of being valved off to permit removal of the filter (see Maintenance sections, pages 72-76, for details). The oil then travels through a shutdown solenoid and past a pressure transducer to three separate inlets on the compressor. The oil pressure measured by the transducer is used to determine the oil pressure differential and pressure drop across the oil filter. The oil pressure differential is equal to the difference between the oil pressure transducer reading and the evaporator pressure transducer reading. It is read directly from the Chiller Visual Controller (CVC) default screen.

Part of the oil flow to the compressor is directed to the slide valve and is used for capacity control positioning. The remaining oil flow is divided between the rotors and bearings. A specific quantity is sent to the rotors and injected at the start of compression to seal the clearances between the rotors. Another portion is sent to the bearings and used for lubrication.

Oil leaves the compressor mixed with the compressed discharge refrigerant vapor. The mixture then enters the oil separator, where oil is removed from the refrigerant and collected at the bottom to complete the cycle.

TC FRAME 1 AND 2 CHILLERS — The oil and refrigerant vapor mixture enters the oil separator through a nearly tangential nozzle, giving a rotational flow pattern. Oil is thrown to the sides of the oil separator and runs down the walls to a chamber in the bottom where it drains to the sump. A baffle separates this chamber from the vortex flow to prevent re-entrainment. Gas flows up through a vortex funnel to a removable coalescing element where the rest of the oil collects. This oil runs down the element surface to a scavenge line which is piped to the first closed lobe port.

TD FRAME 4 CHILLERS — The oil and refrigerant vapor mixture is directed against the rear wall of the oil separator as it enters the side of the oil separator. This action causes the bulk of the oil to drop from the refrigerant and collect at the bottom of the oil separator. A mesh screen is provided near the oil separator outlet to remove any additional oil which may still be entrained in the refrigerant vapor.

The oil sump (TC frame 1 and 2 chillers) contains a combined level switch and temperature sensor, 500-watt oil heater (TC frame 1 and 2 chillers), and oil filter. Oil temperature is measured and displayed on the CVC default screen. During shutdown, oil temperature is maintained by the Product Integrated Control II (PIC) II). See Oil Sump Temperature Control section on page 39.

NOTE: TD frame 4 chillers do not have an oil heater.

Operating oil pressure must be at least 20 psi (138 kPa) for HCFC-22 [7 psi (48.3 kPa) for HFC-134a] and is dependent upon system pressure differential (lift). The oil pressure transducer is located downstream of the filter, so the value displayed on the CVC will be slightly less than the lift value. Under normal full load conditions, oil pressure is approximately 120 psi (827 kPa) [76 psi (517 kPa)]. If sufficient system differential pressure is not established or maintained, oil pressure will not be established (or will be lost) and chiller shutdown will result.

The compressor provides a pressure differential, but the system pressure differential is constrained by the temperatures of the chilled and tower water circuits. Cold tower water, rapid tower water temperature swings, and high return chilled water temperature are among the factors which could contribute to frequent **low oil pressure** alarms. To help ensure that suitable oil pressure is established at start-up, sufficient tower water control should exist. Increasing the chiller ramp loading rate will allow faster compressor load up. This will quickly establish the refrigerant and, therefore, oil pressure differential.

Conversely, rapid loading of the compressor could cause any refrigerant in the oil to flash due to the sudden drop in suction pressure. During initial start-up, the 23XL PIC II control follows a ramped oil pressure requirement algorithm for the first 160 seconds. Therefore, the PIC II control follows and internal oil pressure ramp loading schedule during initial start-up. See The Troubleshooting Guide section on page 76 for further information.

If the start-up oil pressure falls below the values specified in Table 1, the PIC II control will shut down the chiller.

Table 1 — Oil Pressure Ramp-Up Rate

TIME (SEC)	MINIMUM START-UP OIL PRESSURE REQUIREMENT			
	HCFC-22		HFC-134a	
	psi	kPa	psi	kPa
40	1.4	9.7	1.4	9.7
80	4	27.6	4	27.6
120	7	48.3	7	48.3

Oil Reclaim System — The oil reclaim system operates to return oil from the cooler back to the compressor.

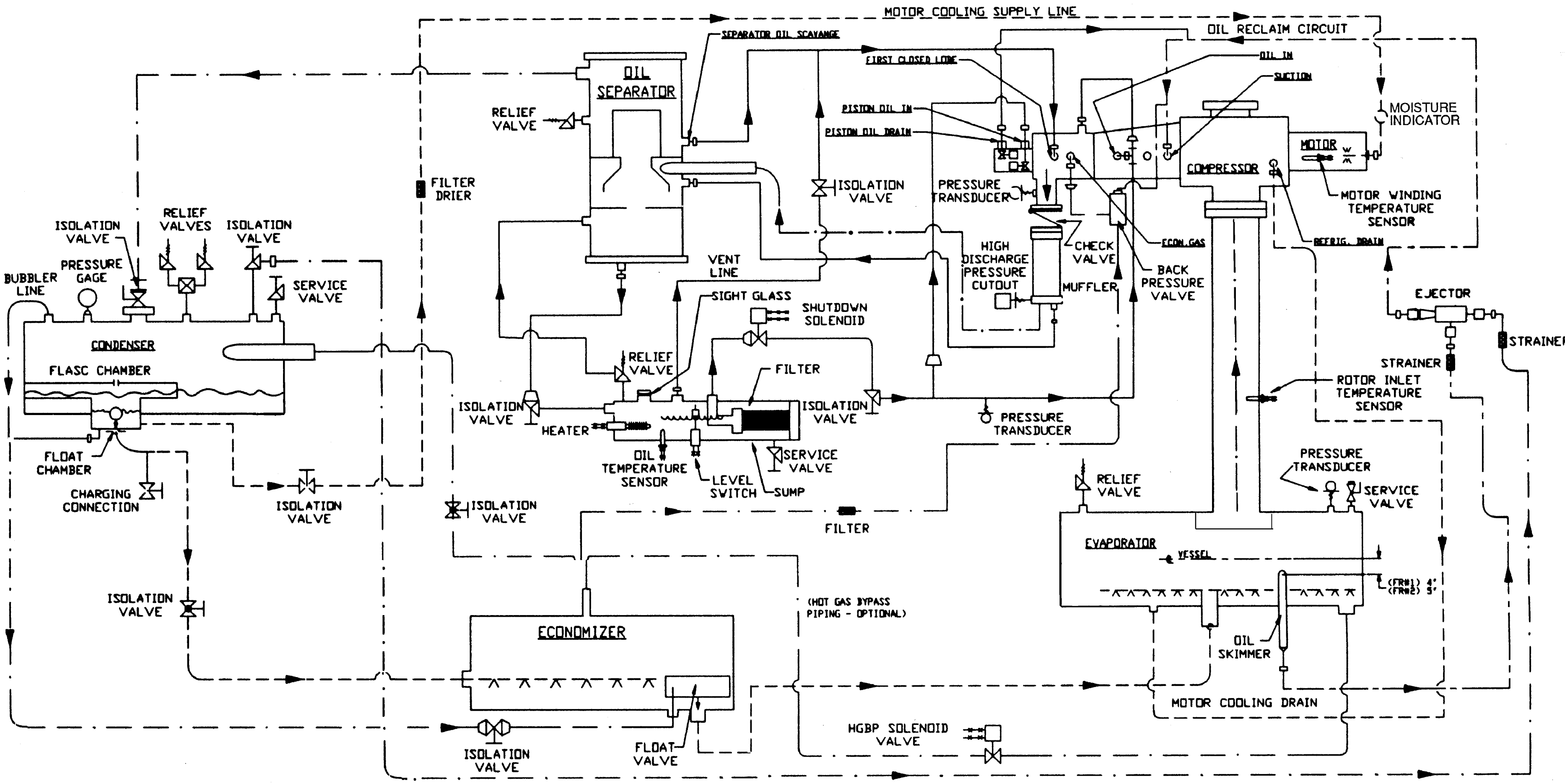
TC FRAME 1 AND 2 CHILLERS — The oil reclaim system returns oil to the compressor using discharge gas pressure to power an ejector. The oil and refrigerant mixture is vacuumed from the top of the cooler liquid refrigerant level and discharged into the compressor suction port.

TD FRAME 4 CHILLERS — TD frame 4 chillers do not require an external oil reclaim system.

Oil Loss Prevention — The suction pan is located on top of the cooler, where oil collects during low-load operation. The cooler is designed so that when oil drains into the cooler from the compressor during low loads, it will be re-entrained with the suction gas flow.

In addition, the PIC II Controls minimize oil loss to the cooler once the rotor inlet temperature sensor detects hot oil draining down the suction pipe.

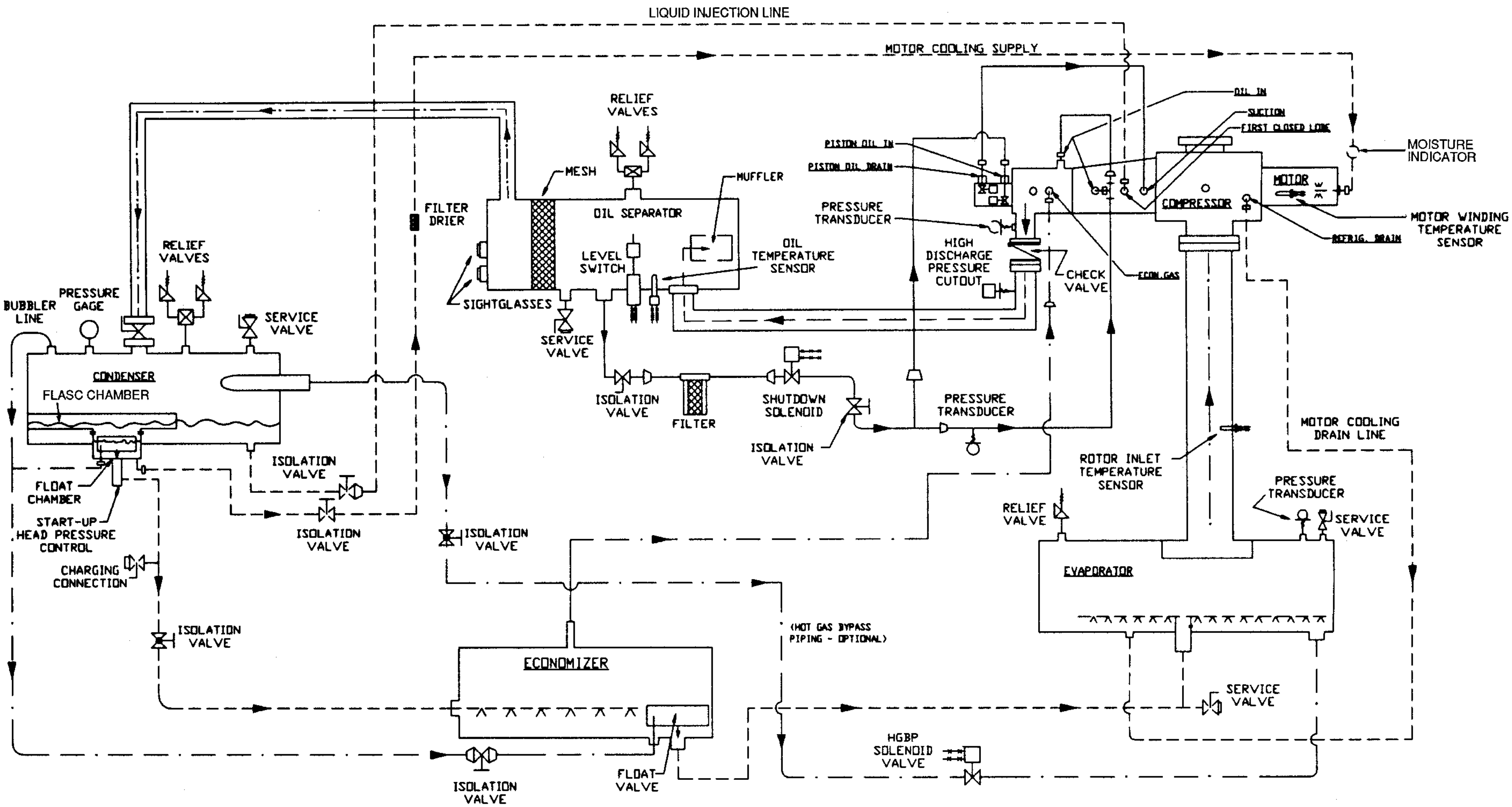
If the rotor inlet temperature increases 4 F (2.2 C) in TC (frame 1 and 2) chillers or TD (frame 4) chillers above the leaving chilled water temperature, the slide valve is proportionately moved in the load direction to increase suction gas velocity. The chiller will continue to load until the rotor inlet temperature is equal to LCWT+1° F or the chiller recycles.



LEGEND

HGBP —	Hot Gas Bypass
– – – –	Refrigerant Liquid Flow
–·–·–	Refrigerant Vapor Flow
–·–·–	Oil and Refrigerant Liquid Flow
–·–·–	Oil and Refrigerant Vapor Flow
———	Oil Flow

Fig. 3 — Refrigerant Oil Flow Schematic (TC Frame 1 and 2 Chillers)



LEGEND

HGBP — Hot Gas Bypass
Refrigerant Liquid Flow
Refrigerant Vapor Flow
Oil and Refrigerant Vapor Flow
Oil Flow

Fig. 4 — Refrigerant Oil Flow Schematic (TD Frame 4 Chillers)

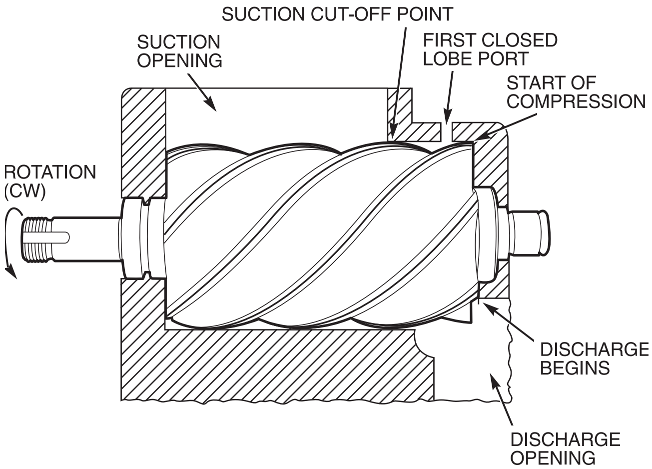


Fig. 5 — Screw Compressor Principle

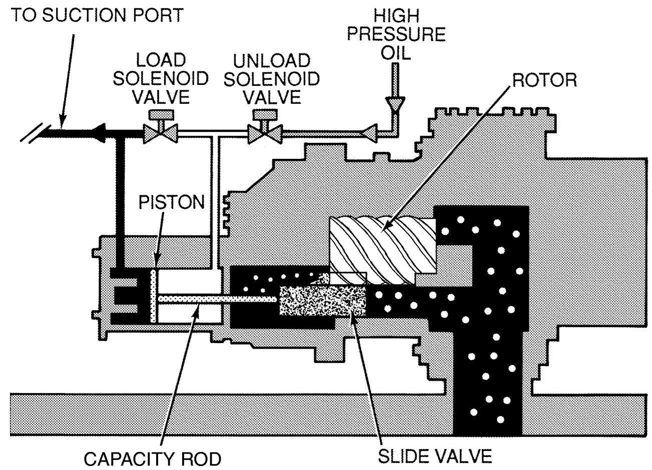


Fig. 6 — Slide Valve Position at Unload

Slide Valve Principle — Oil flow to the slide piston is controlled by two solenoid valves. Each solenoid is operated by load and unload signals from the PIC II control.

To unload the compressor, the unload solenoid valve is energized and the load solenoid valve is deenergized. This conducts high pressure oil to the cylinder, retracting the capacity rod, and modulating the slide valve toward the open position. See Fig. 6. The slide valve opening vents compressed gas back to the suction port on the compressor, retarding the start of the compression process.

To load the compressor, the unload solenoid valve is deenergized and the load solenoid valve is energized. This bleeds oil from the cylinder to the suction pressure area within the compressor housing. Forces resulting from the discharge-to-suction pressure differential are then allowed to push the slide valve toward the closed (fully loaded) position. See Fig. 7. When the slide valve is closed, the compressor pumps the maximum gas flow.

Extension and retraction of the piston/capacity rod position the slide valve along the bottom of the rotors. The valve position controls the gas flow rate delivered by the compressor.

STARTING EQUIPMENT

The 23XL requires a motor starter to operate the centrifugal hermetic compressor motor and various auxiliary equipment. The starter is the main field wiring interface for the contractor.

See Carrier Specification Z-415 for specific starter requirements. All starters must meet these specifications in order to properly start and satisfy mechanical safety requirements. Starters may be supplied as separate, free-standing units or may be mounted directly on the chiller (unit mounted) for low-voltage units only.

Multiple separate circuit breakers are inside the starter. Circuit breaker CB1 is the compressor motor circuit breaker. The disconnect switch on the starter front cover is connected to this breaker. Circuit breaker CB1 supplies power to the compressor motor.

⚠ WARNING

The main circuit breaker (CB1) on the front of the starter disconnects the main motor current only. Power is still energized for the other circuits. Two more circuit breakers inside the starter must be turned off to disconnect power to the PIC II controls, and TC frame 1 and 2 chillers oil heater.

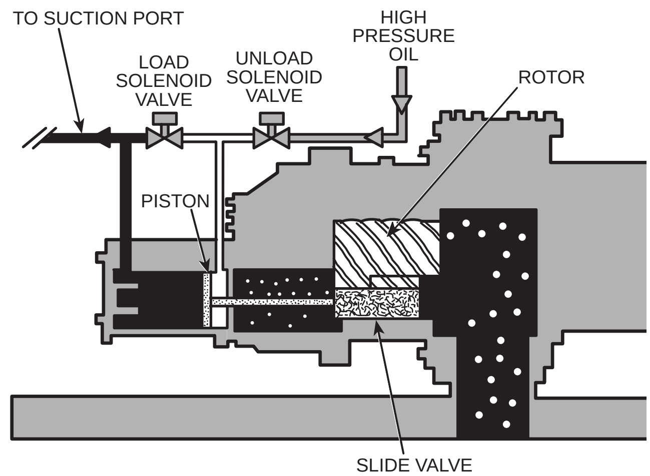


Fig. 7 — Slide Valve Position at Full Load

Circuit breaker CB2 supplies power to the control panel, TC frame 1 and 2 chillers, oil heater, and portions of the starter controls.

An optional circuit breaker is available when required for a pumpout unit.

⚠ CAUTION

Pumpout compressor voltage must be the same as the compressor motor voltage.

All starters must include a Carrier control module called the Integrated Starter Module (ISM), excluding the Benshaw solid-state starters. This module controls and monitors all aspects of the starter. See the Controls section on page 14 for additional ISM information. All starter replacement parts are supplied by the starter manufacturer excluding the ISM (contact Carrier's Replacement Component Division [RCD]).

Unit-Mounted Solid-State Starter (Optional) —

The 23XL chiller may be equipped with a solid-state, reduced-voltage starter (Fig. 8 and 9). This starter's primary function is to provide on-off control of the compressor motor. This type of starter reduces the peak starting torque, reduces the motor inrush current, and decreases mechanical shock. This capability is summed up by the phrase "soft starting." The solid-state starter is available as a 23XL option (factory supplied and installed). The solid-state starters manufacturer name is located inside the starter access door.

A solid-state, reduced-voltage starter operates by reducing the starting voltage. The starting torque of a motor at full voltage is typically 125% to 175% of the running torque. When the voltage and the current are reduced at start-up, the starting torque is reduced as well. The object is to reduce the starting voltage to just the voltage necessary to develop the torque required to get the motor moving. The voltage is reduced by silicon controlled rectifiers (SCRs). The voltage and current are then ramped up in a desired period of time. Once full voltage is reached, a bypass contactor is energized to bypass the SCRs.

⚠ WARNING

When voltage is supplied to the solid-state circuitry, the heat sinks in the starter as well as the wires leading to the motor and the motor terminal are at line voltage. Do not touch the heat sinks, power wiring, or motor terminals while voltage is present or serious injury will result.

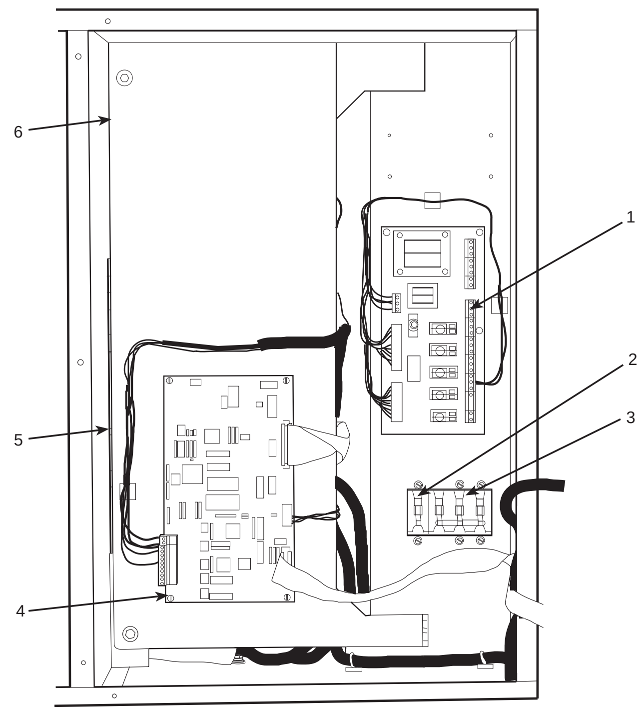
There is a display on the front of the Benshaw, Inc., solid-state starters that is useful for troubleshooting and starter checkout. The display indicates:

- voltage to the SCRs
- power indication
- proper phasing for rotation
- start circuit energized
- run state
- software configuration

The starter is further explained in the Check Starter and Troubleshooting Guide sections, pages 59 and 76.

Unit-Mounted Wye-Delta Starter (Optional) —

The 23XL chiller may be equipped with a wye-delta starter mounted on the unit. This starter is intended for use with low-voltage motors (under 600 v). It reduces the starting current inrush by connecting each phase of the motor windings into a wye configuration. This occurs during the starting period when the motor is accelerating up to speed. Once the motor is up to speed, the starter automatically connects the phase windings into a delta configuration. Starter control, monitoring, and motor protection is provided by Carrier's Integrated Starter Module (ISM).



LEGEND

1 — REDISTART™ Micro Input/Output Card
2 — Circuit Breaker 2 (CB2): Machine Control and Heater Power
3 — Circuit Breaker 3 (CB3): Pumpout Unit
4 — REDISTART Micro Central Processing Unit Card (CPU)
5 — Restart Micro Power Card (hidden, not depicted)
6 — Restart Micro Bypass Card (hidden, not depicted)

Fig. 8 — Solid-State Starter Box, Internal View

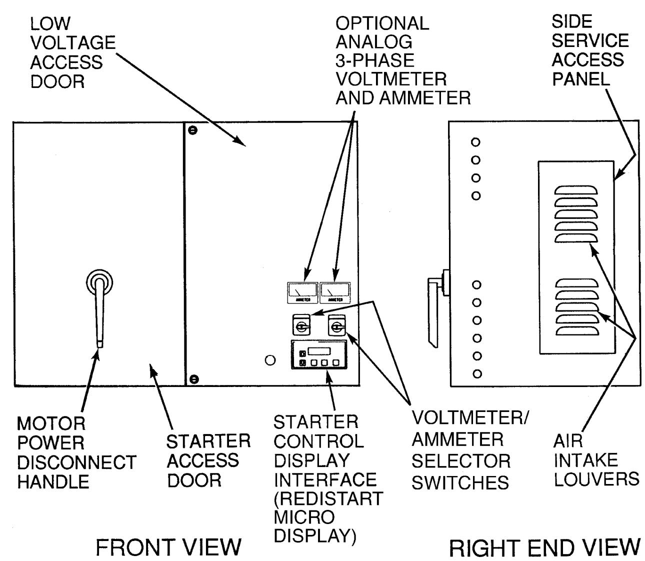


Fig. 9 — Typical Starter External View (Solid-State Starter Shown)

CONTROLS

Definitions

ANALOG SIGNAL — *An analog signal* varies in proportion to the monitored source. It quantifies values between operating limits. (Example: A temperature sensor is an analog device because its resistance changes in proportion to the temperature, generating many values.)

DISCRETE SIGNAL — *A discrete signal* is a 2-position representation of the value of a monitored source. (Example: A switch produces a discrete signal indicating whether a value is above or below a set point or boundary by generating an on/off, high/low, or open/closed signal.)

General Controls Overview — The 23XL hermetic screw liquid chiller contains a microprocessor-based control center that monitors and controls all operations of the chiller. The microprocessor control system matches the cooling capacity of the chiller to the cooling load while providing state-of-the-art chiller protection. The system controls cooling capacity within the set point plus the deadband by sensing the leaving chilled water or brine temperature and regulating the slide valve via a mechanically linked, hydraulically actuated piston. Movement of the slide valve alters the point during rotor travel at which compression begins and reduces the effective length of the compression cavities. This permits internal gas recirculation and reduces suction volume. Thus, smooth, stepless capacity regulation is provided in the load direction. Moving of the slide valve increases capacity. Moving of the slide valve in the unload direction decreases capacity. See Fig. 10. Chiller protection is provided by the processor, which monitors the digital and analog inputs and executes capacity overrides or safety shutdowns, if required.

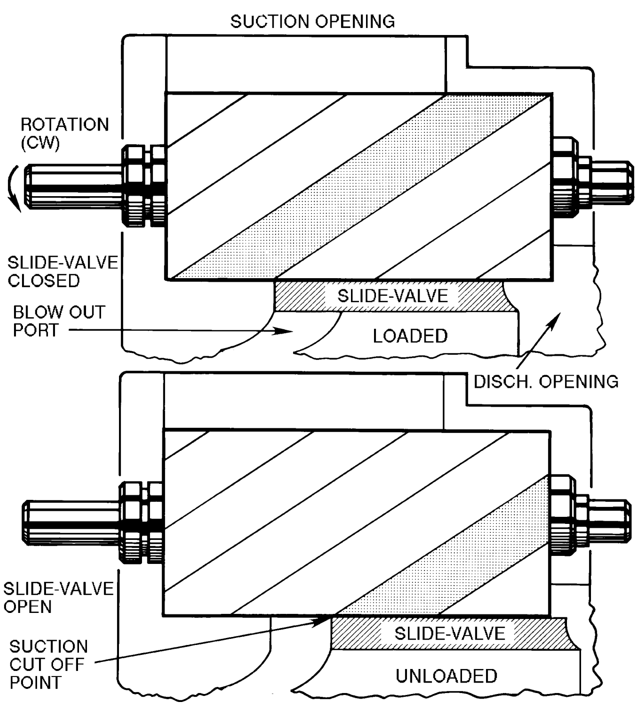


Fig. 10 — Slide-Valve Capacity Control

PIC II System Components — The chiller control system is called PIC II (Product Integrated Control II). See Table 2. The PIC II controls the operation of the chiller by monitoring all operating conditions. The PIC II can diagnose a problem and let the operator know what the problem is and what to check. It promptly positions the slide valve to maintain leaving chilled water temperature. It can interface with auxiliary equipment such as pumps and cooling tower fans to turn them on when required. It continually checks all safeties to prevent any unsafe operating condition. It also regulates the oil heater while the compressor is off and regulates the hot gas bypass valve, if installed. The PIC II controls provide critical protection for the compressor motor and controls the motor starter.

The PIC II can interface with the Carrier Comfort Network (CCN) if desired. It can communicate with other PIC I or PIC II equipped chillers and other CCN devices.

The PIC II consists of 3 modules housed inside 3 major components. The component names and corresponding control voltages are listed below (also see Table 2 and Fig. 11-16):

- control panel
  all extra low-voltage wiring (24 v or less)
- power panel
  230 or 115 v control voltage (per job requirement)
- starter cabinet
  chiller power wiring (per job requirement)

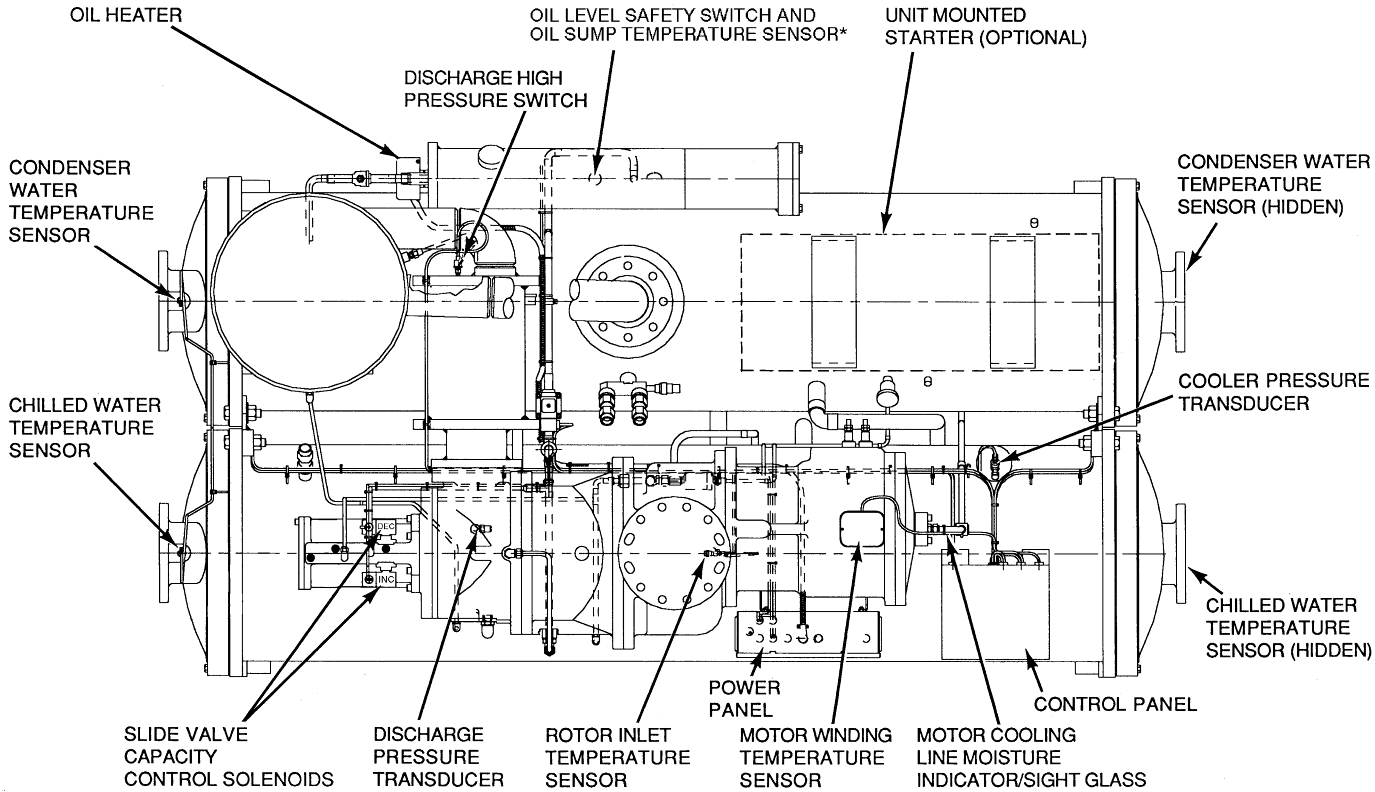
Table 2 — Major PIC II Components and Panel Locations*

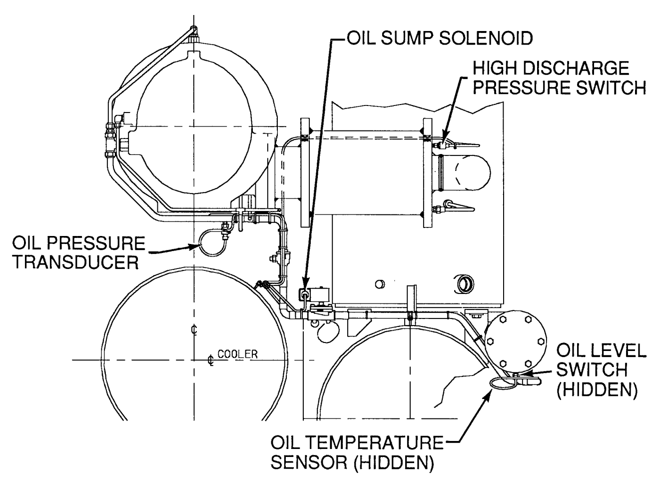
PIC II COMPONENT	PANEL LOCATION
Chiller Visual Controller (CVC) and Display	Control Panel
Integrated Starter Module (ISM)	Starter Cabinet
Chiller Control Module (CCM)	Control Panel
Oil Heater Contactor (1C)	Power Panel
Hot Gas Bypass Relay (3C) (Optional)	Power Panel
Control Transformers (T1, T2)	Power Panel
Temperature Sensors	See Fig. 11 and 12.
Pressure Transducers	See Fig. 11 and 12.

*See Fig. 8 and Fig. 11-16.

CHILLER VISUAL CONTROLLER (CVC) — The CVC is the “brain” of the PIC II. This module contains all the primary software needed to control the chiller. The CVC is mounted to the control panel (Fig. 15) and is the input center for all local chiller set points, schedules, configurable functions, and options. The CVC has a stop button, an alarm light, four buttons for logic inputs, and a backlight display. The backlight will automatically turn off after 15 minutes of non-use. The functions of the four buttons or “softkeys” are menu driven and are shown on the display directly above the softkeys. The CVC is mounted in the Control Panel.

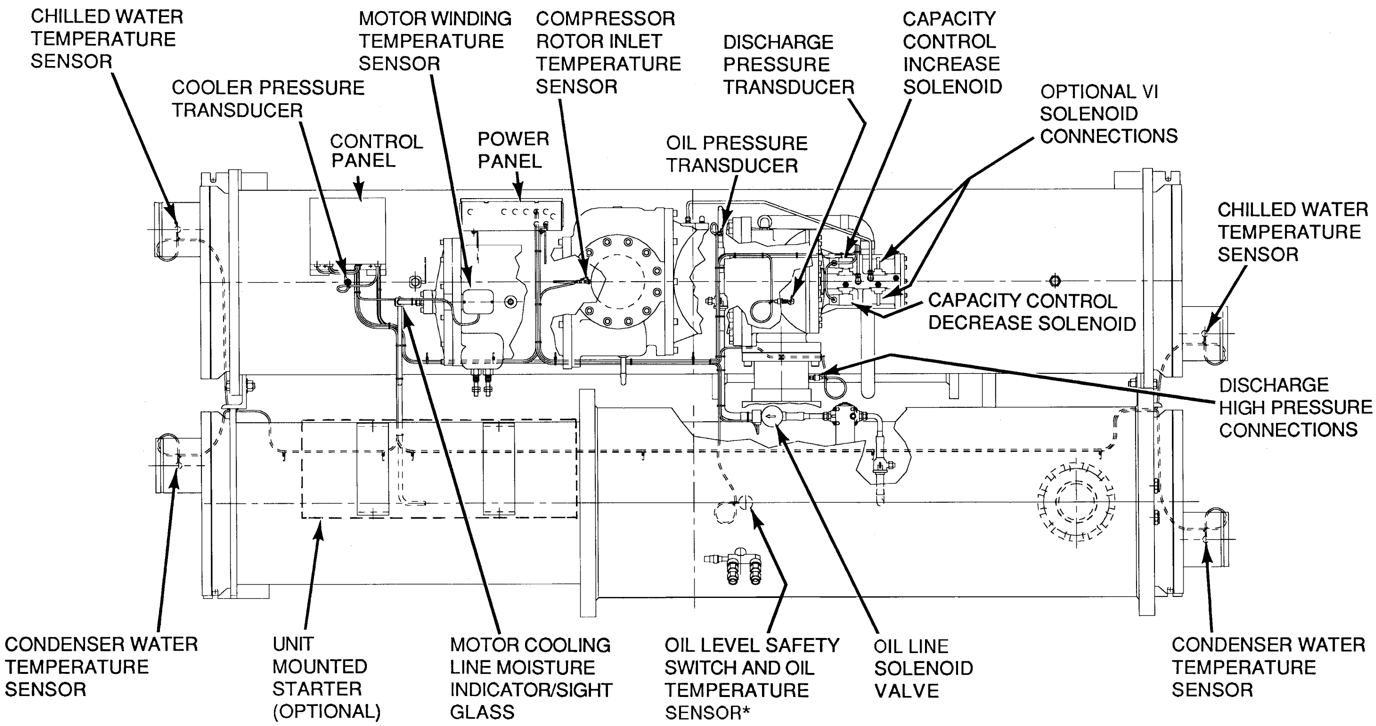
The angle of the control panel can be adjusted for optimum viewing. Remove the 2 bolts connecting the control panel to the brackets attached to the cooler. Place them in one of the holes to pivot the control panel forward to backward to change the viewing angle. See Fig. 15. To change the contrast of the display, access the adjustment on the back of the CVC. See Fig. 15.

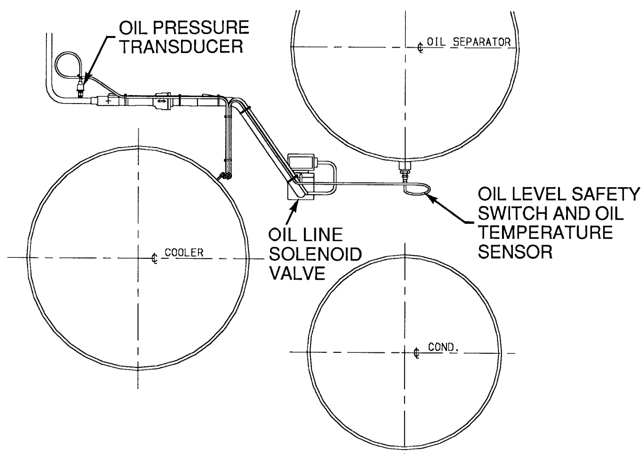




*Some 23XL chillers will have both an oil temperature sensor and an oil level safety switch (two separate components).

Fig. 11 — 23XL Control and Sensor Locations (TC Frame 1 and 2 Chillers)





*Some 23XL chillers will have both an oil temperature sensor and an oil level safety switch (two separate components).

Fig. 12 — 23XL Control and Sensor Locations (TD Frame 4 Chillers)

INTEGRATED STARTER MODULE (ISM) — This module is located in the starter cabinet. This module initiates commands from the CVC for starter functions such as starting and stopping the compressor, condenser, chilled water pumps, tower fan, spare alarm contacts, 4 to 20 mA Head Pressure Reference output, and the shunt trip. The ISM monitors starter inputs such as line voltage, motor current, ground fault, remote start contact, spare safety, condenser high pressure, starter 1M, and run contacts. The ISM contains logic capable of safety shutdown. It shuts down the chiller if communications with the CVC are lost.

CHILLER CONTROL MODULE (CCM) — This module is located in the control panel. The CCM provides the input and outputs necessary to control the chiller. This module monitors refrigerant pressure, entering and leaving water temperatures and pressures, and outputs control for the slide valve oil heaters, and oil pump. The CCM is the connection point for optional demand limit, chilled water reset, 4 to 20 mA kW output, remote temperature reset, and refrigerant leak sensor.

OIL HEATER CONTACTOR (1C) — This contactor is located in the power panel (Fig. 16) and operates the heater at either 115 or 230 v. It is controlled by the PIC II to maintain oil temperature during chiller shutdown.

HOT GAS BYPASS CONTACTOR RELAY (3C) (Optional) — This relay, located in the power panel, controls the opening of the hot gas bypass valve. The PIC II energizes the relay during low load, high lift conditions.

CONTROL TRANSFORMERS (T1, T2) — These transformers convert incoming control voltage to 24 vac power for the 3 power panel contactor relays, CCM, and CVC.

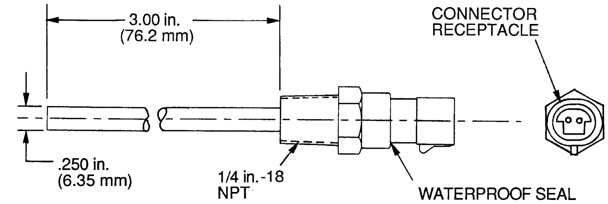


Fig. 13 — Control Sensors (Temperature)

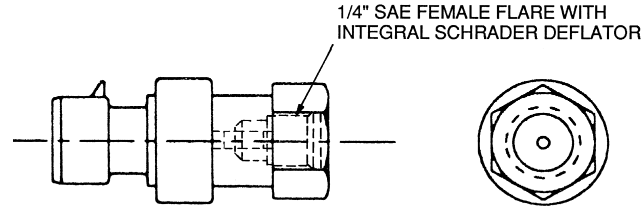


Fig. 14 — Control Sensors (Pressure Transducers, Typical)

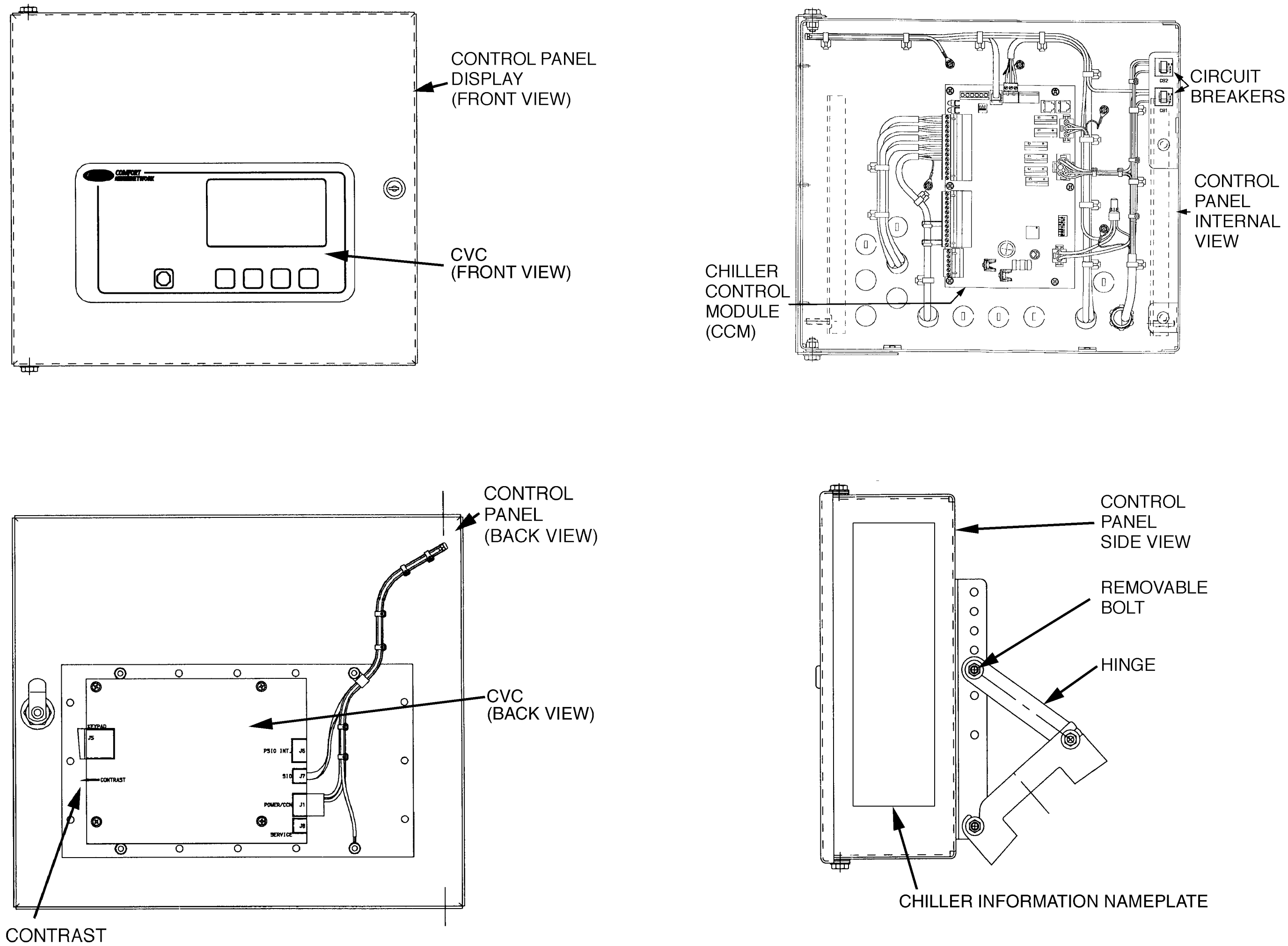


Fig. 15 — Control Panel

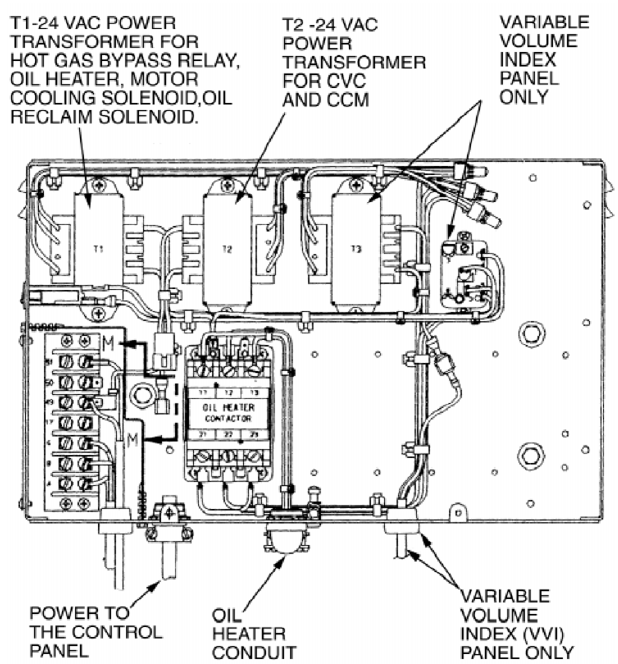


Fig. 16 — Power Panel

CVC Operation and Menus (Fig. 17-23)

GENERAL

- The CVC display automatically reverts to the default screen after 15 minutes if no softkey activity takes place (Fig. 17).
- If a screen other than the default screen is displayed on the CVC, the name of that screen is in the upper right corner (Fig. 18).
- The CVC may be set to display either English or SI units. Use the CVC configuration screen (accessed from the Service menu) to change the units. See the Service Operation section, page 46.
- Local Operation — The PIC II can be placed in local operating mode by pressing the LOCAL softkey. The PIC II then accepts commands from the CVC only and uses the Local Time Schedule to determine chiller start and stop times.
- CCN Operation — The PIC II can be placed in the CCN operating mode by pressing the CCN softkey. The PIC II then accepts modifications from any CCN interface or module (with the proper authority), as well as from the CVC. The PIC II uses the CCN time schedule to determine start and stop times.

ALARMS AND ALERTS — An alarm shuts down the compressor. An alert does not shut down the compressor, but it notifies the operator that an unusual condition has occurred. An alarm (*) or alert (!) is indicated on the STATUS screens on the far right field of the CVC display screen.

Alarms are indicated when the control center alarm light (!) flashes. The primary alarm message is displayed on the default screen. An additional, secondary message and troubleshooting information are sent to the ALARM HISTORY table.

When an alarm is detected, the CVC default screen will freeze (stop updating) at the time of alarm. The freeze enables the operator to view the chiller conditions at the time of alarm. The STATUS tables will show the updated information. Once all alarms have been cleared (by pressing the RESET softkey), the default CVC screen will return to normal operation.

CVC MENU ITEMS — To perform any of the operations described below, the PIC II must be powered up and have successfully completed its self test. The self test takes place automatically, after power-up.

Press the MENU softkey to view the list of menu structures: STATUS, SCHEDULE, SETPOINT, and SERVICE.

- The STATUS menu allows viewing and limited calibration or modification of control points and sensors, relays and contacts, and the options board.
- The SCHEDULE menu allows viewing and modification of the local and CCN time schedules and Ice Build time schedules.
- The SETPOINT menu allows set point adjustments, such as the entering chilled water and leaving chilled water set points.

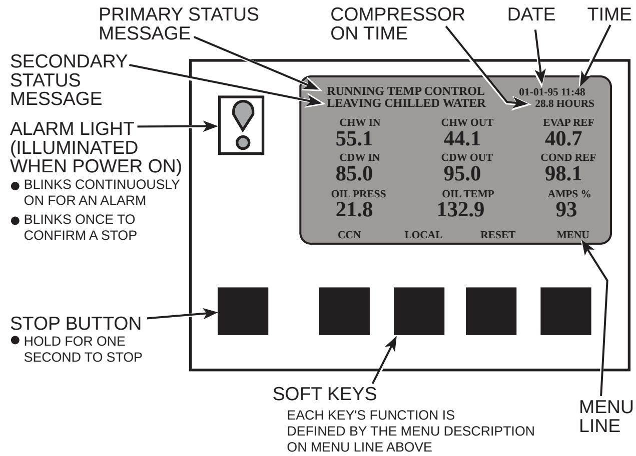


Fig. 17 — CVC Default Screen

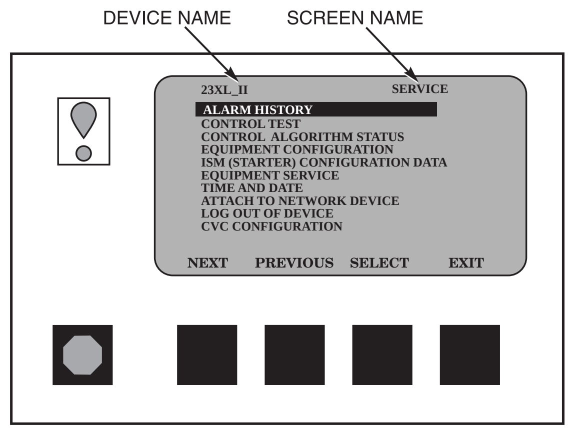


Fig. 18 — CVC Service Screen

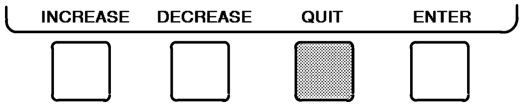
- The SERVICE menu can be used to view or modify information on the Alarm History, Control Test, Control Algorithm Status, Equipment Configuration, ISM Starter Configuration data, Equipment Service, Time and Date, Attach to Network Device, Log Out of Network Device, and CVC Configuration screens.

For more information on the menu structures, refer to Fig. 20.

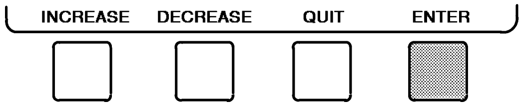
Press the softkey that corresponds to the menu structure to be viewed: STATUS, SCHEDULE, SETPOINT, or SERVICE. To view or change parameters within any of these menu structures, use the NEXT and PREVIOUS softkeys to scroll to the desired item or table. Use the SELECT softkey to select that item. The softkey choices that then appear depend on the selected table or menu. The softkey choices and their functions are described below.

BASIC CVC OPERATIONS (Using the Softkeys) — To perform any of the operations described below, the PIC II must be powered up and have successfully completed its self test.

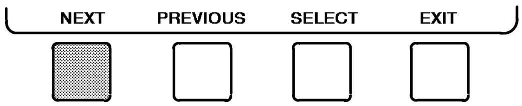
- Press [QUIT] to leave the selected decision or field without saving any changes.



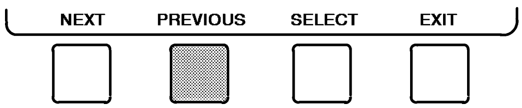
- Press [ENTER] to leave the selected decision or field and save changes.



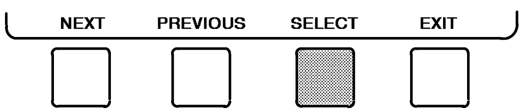
- Press [NEXT] to scroll the cursor bar down in order to highlight a point or to view more points below the current screen.



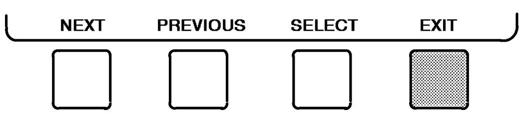
- Press [PREVIOUS] to scroll the cursor bar up in order to highlight a point or to view points above the current screen.



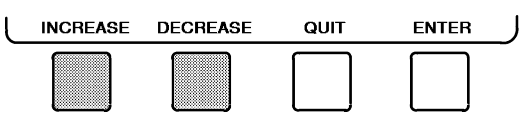
- Press [SELECT] to view the next screen level (highlighted with the cursor bar), or to override (if allowable) the highlighted point value.



- Press [EXIT] to return to the previous screen level.

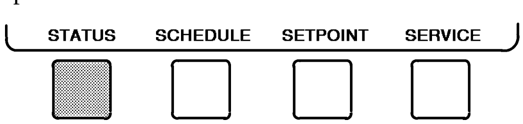


- Press [INCREASE] or [DECREASE] to change the highlighted point value.

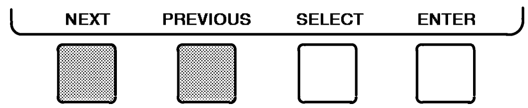


TO VIEW STATUS (Fig. 19) — The status table shows the actual value of overall chiller status such as CONTROL MODE, RUN STATUS, AUTO CHILLED WATER, RESET, and REMOTE RESET SENSOR.

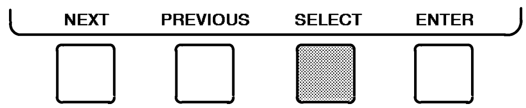
1. On the menu screen, press [STATUS] to view the list of point status tables.



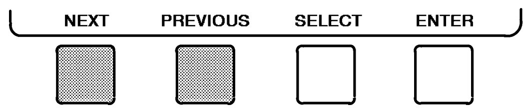
2. Press [NEXT] or [PREVIOUS] to highlight the desired status table. The list of tables is:
   - MAINSTAT — Overall chiller status
   - STARTUP — Status required to perform start-up of chiller
   - COMPRESS — Status of sensors related to the compressor
   - HEAT_EX — Status of sensors related to the heat exchangers
   - POWER — Status of motor input power
   - ISM_STAT — Status of motor starter
   - CVC_PSWD — Service menu password forcing access screen



3. Press [SELECT] to view the desired point status table.



4. On the point status table, press [NEXT] or [PREVIOUS] until the desired point is displayed on the screen.



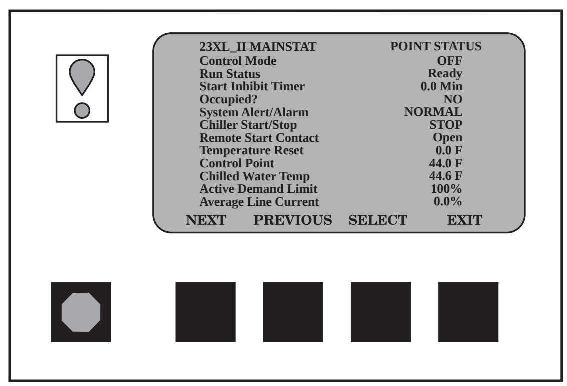
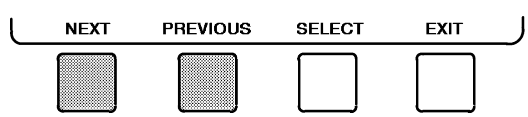


Fig. 19 — Example of Status Screen

OVERRIDE OPERATIONS

To Override a Value or Status

1. From any point status screen, press [NEXT] or [PREVIOUS] to highlight the desired value.



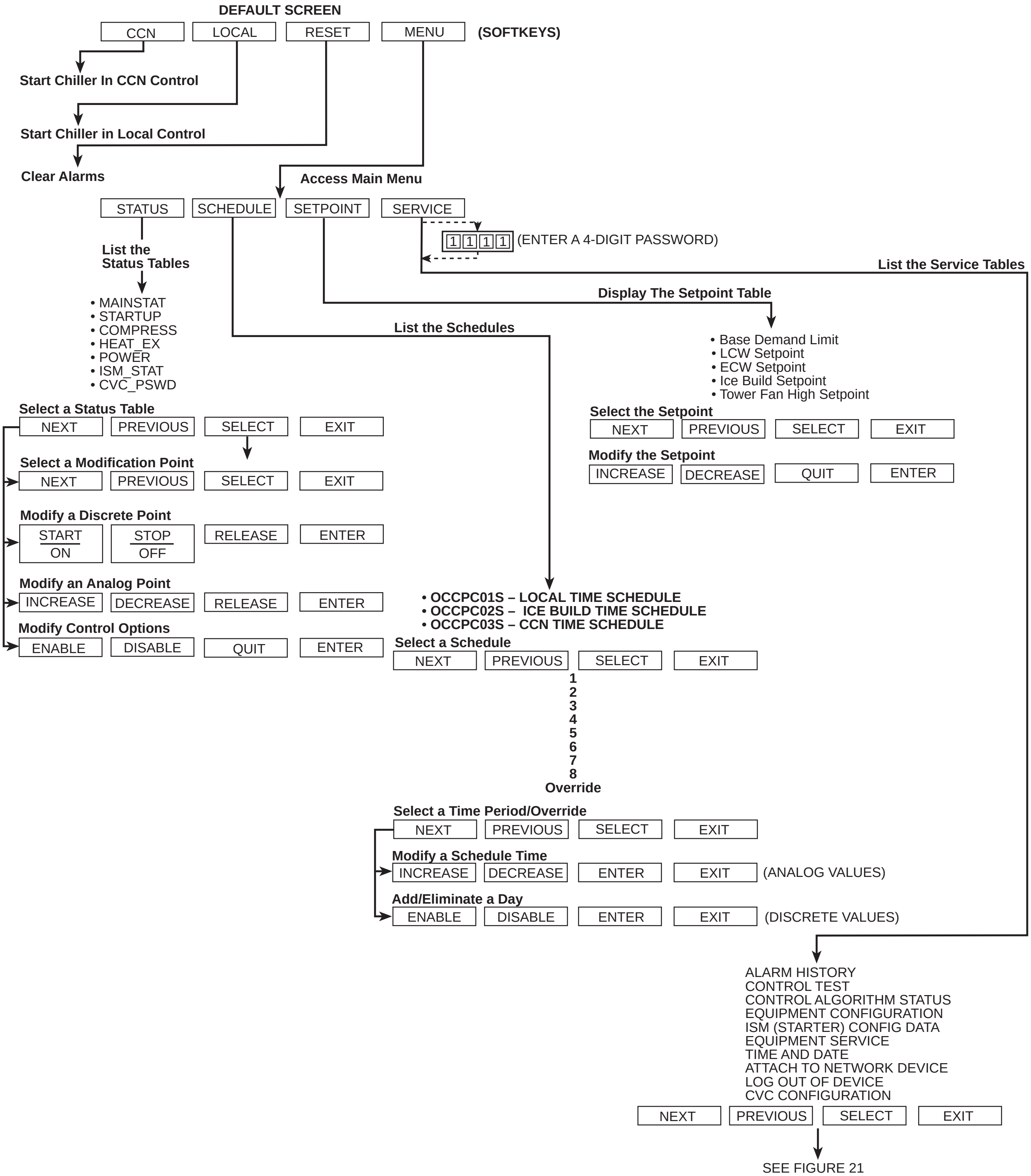


Fig. 20 — 23XL CVC Menu Structure

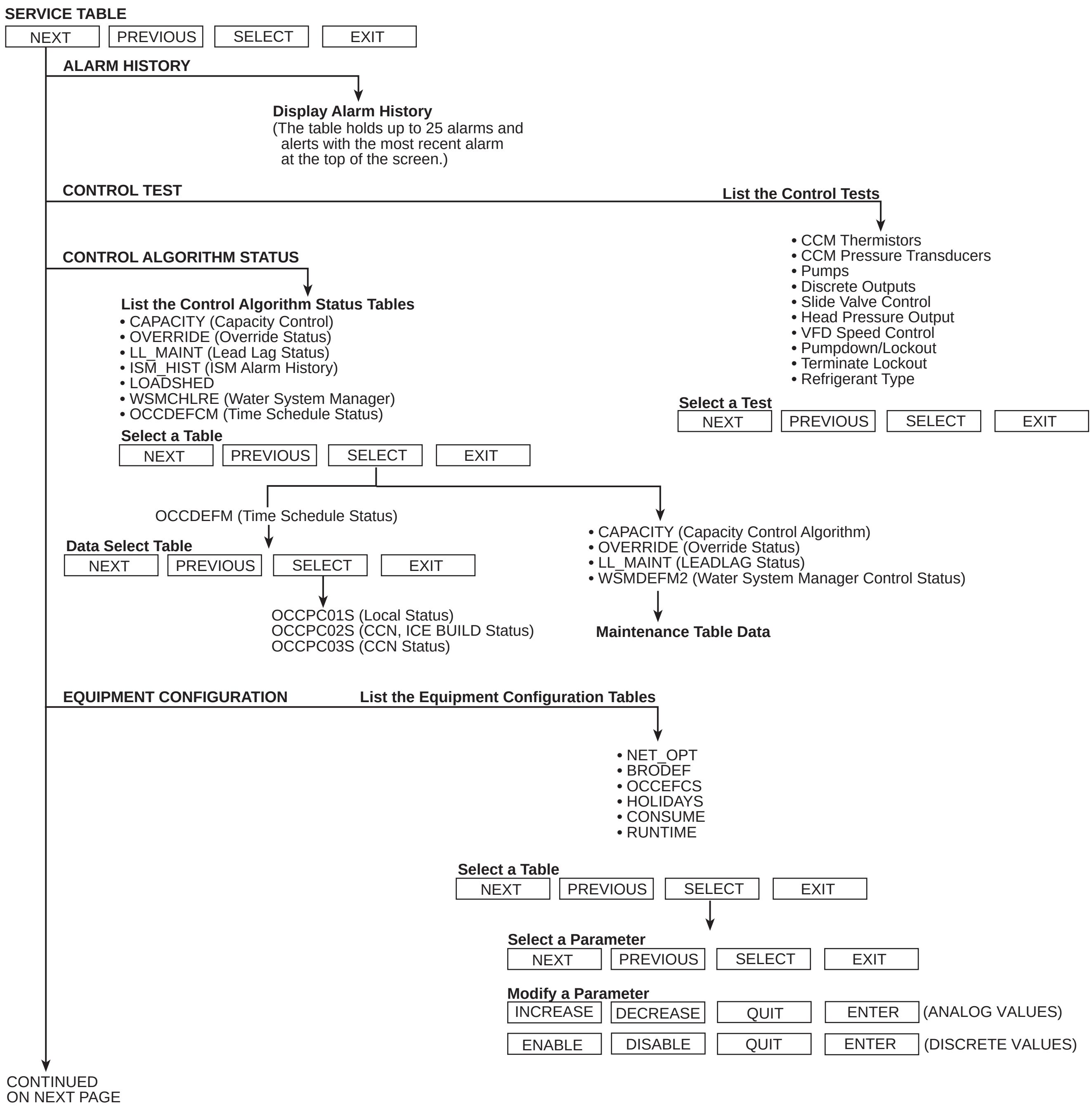


Fig. 21 — 23XL Service Menu Structure

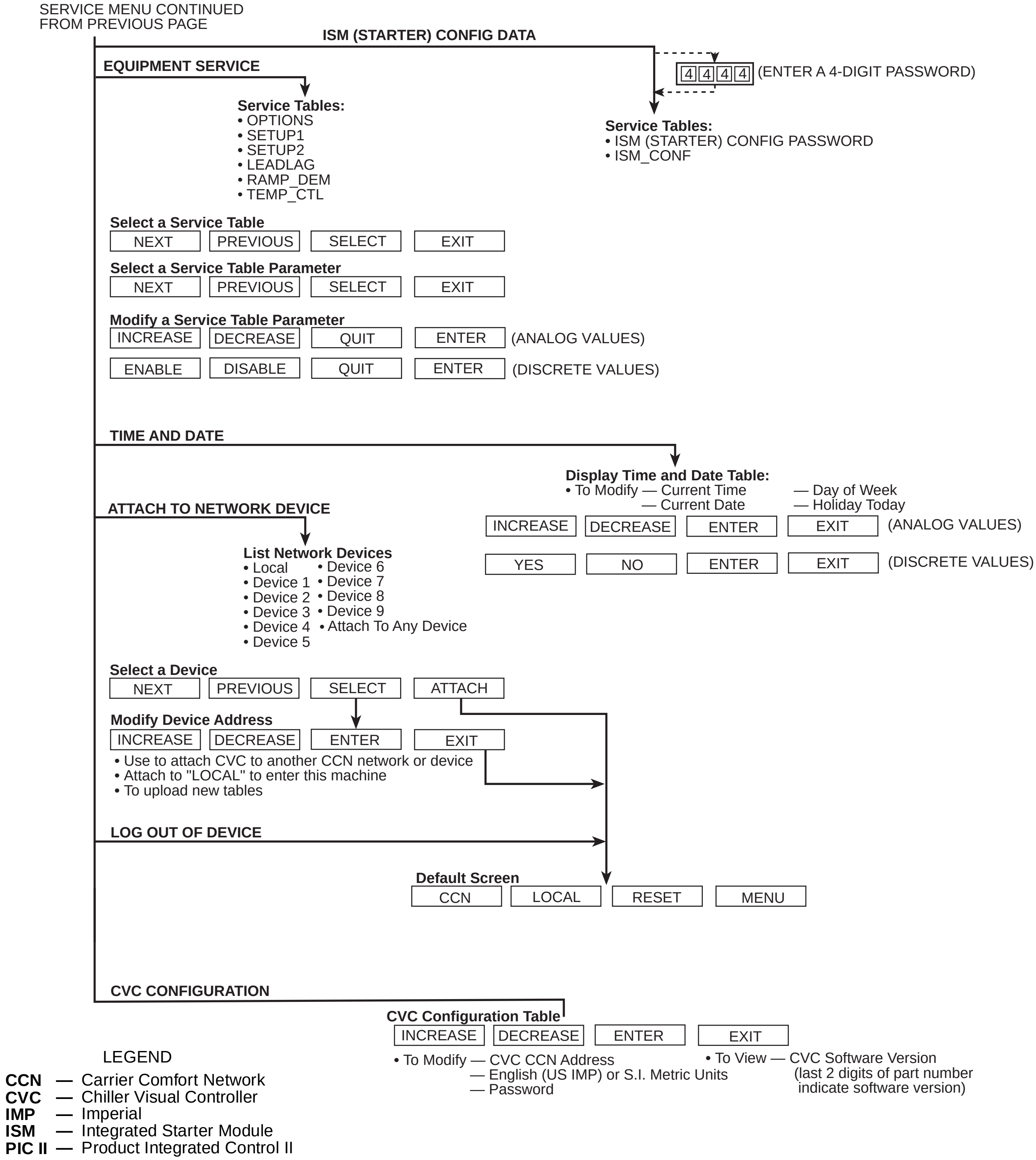
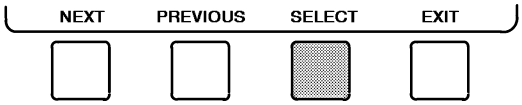
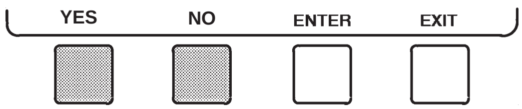


Fig. 21 — 23XL Service Menu Structure (cont)

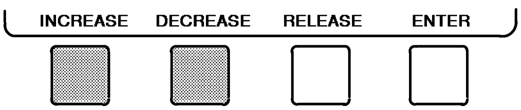
2. Press [SELECT] to select the highlighted value. Then:



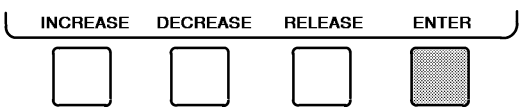
For Discrete Points — Press [YES] or [NO] to select the desired state.



For Analog Points — Press [INCREASE] or [DECREASE] to select the desired value.



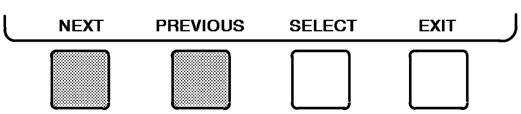
3. Press [ENTER] to register the new value.



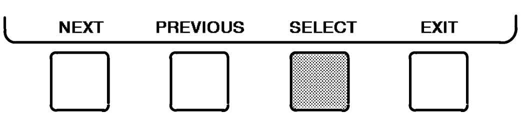
NOTE: When overriding or changing metric values, it is necessary to hold down the softkey for a few seconds in order to see a value change, especially on kilopascal values.

To Remove an Override

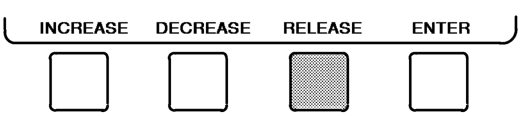
1. On the point status table press [NEXT] or [PREVIOUS] to highlight the desired value.



2. Press [SELECT] to access the highlighted value.



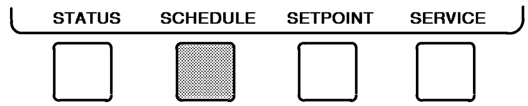
3. Press [RELEASE] to remove the override and return the point to the PIC II's automatic control.



Override Indication — An override value is indicated by "SUPVSR," "SERVC," or "BEST" flashing next to the point value on the STATUS table.

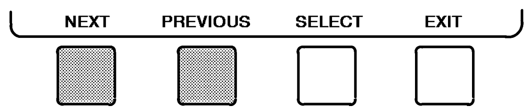
TIME SCHEDULE OPERATION (Fig. 22)

1. On the Menu screen, press [SCHEDULE].

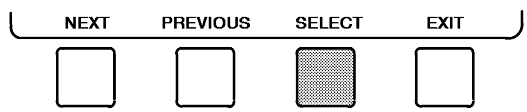


2. Press [NEXT] or [PREVIOUS] to highlight the desired schedule.

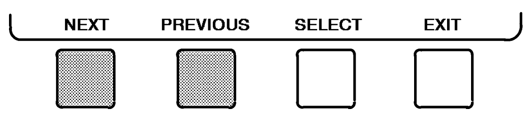
   OCCPC01S — LOCAL Time Schedule
   OCCPC02S — ICE BUILD Time Schedule
   OCCPC03S — CCN Time Schedule



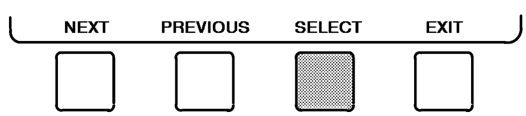
3. Press [SELECT] to view the desired time schedule.



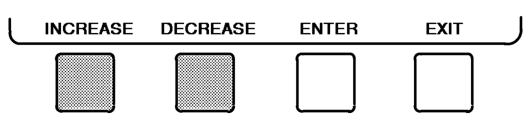
4. Press [NEXT] or [PREVIOUS] to highlight the desired period or override to change.



5. Press [SELECT] to access the highlighted period or override.



6. a Press [INCREASE] or [DECREASE] to change the time values. Override values are in one-hour increments, up to 4 hours.



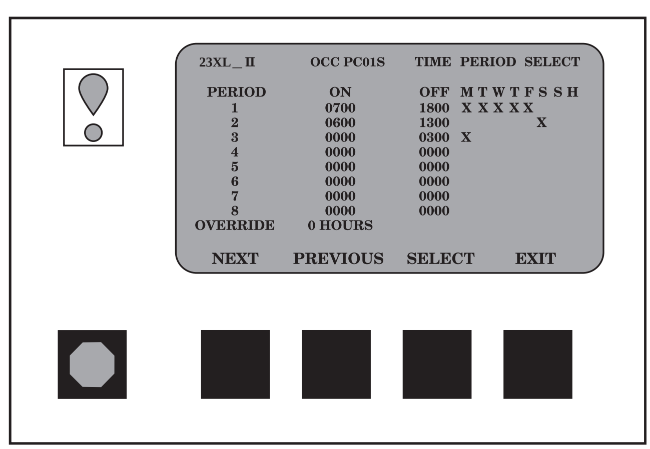
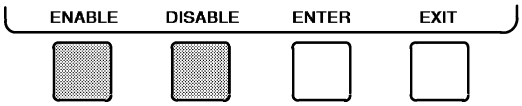
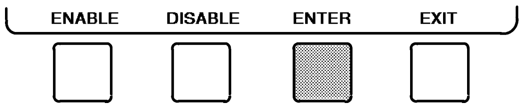


Fig. 22 — Example of Time Schedule Operation Screen

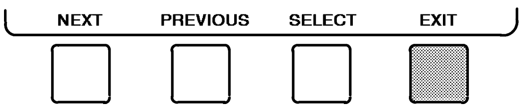
b. Press ENABLE to select days in the day-of-week fields. Press DISABLE to eliminate days from the period.



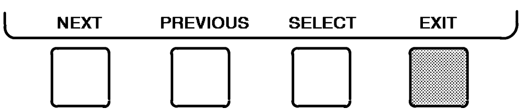
7. Press ENTER to register the values and to move horizontally (left to right) within a period.



8. Press EXIT to leave the period or override.



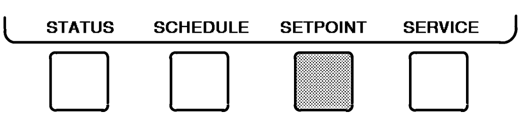
9. Either return to Step 4 to select another period or override, or press EXIT again to leave the current time schedule screen and save the changes.



10. The Holiday Designation (HOLIDEF table) may be found in the Service Operation section, page 46. The month, day, and duration for the holiday must be assigned. The Broadcast function in the BRODEF table also must be enabled for holiday periods to function.

TO VIEW AND CHANGE SET POINTS (Fig. 23)

1. To view the SETPOINT table, from the MENU screen press SETPOINT.



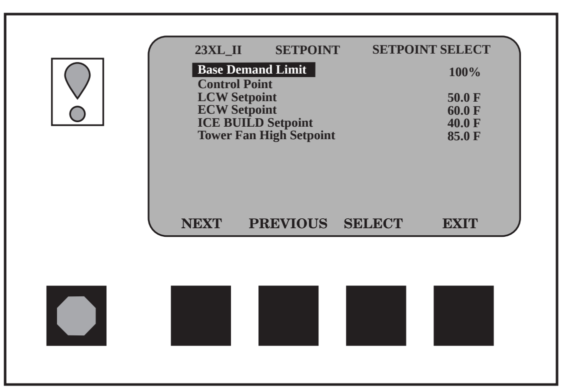
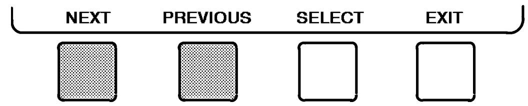
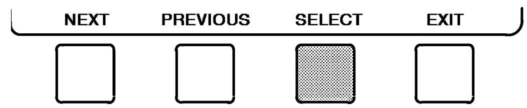


Fig. 23 — Example of Set Point Screen

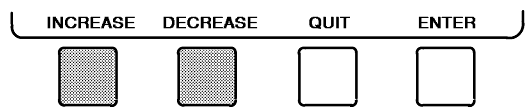
2. There are 5 set points on this screen: BASE DEMAND LIMIT, LCW SETPOINT (leaving chilled water set point), ECW SETPOINT (entering chilled water set point), ICE BUILD SETPOINT, and TOWER FAN HIGH SETPOINT. Only one of the chilled water set points can be active at one time. The set point that is active is determined from the SERVICE menu. See the Service Operation section, page 46. The ice build (ICE BUILD) function is also activated and configured from the SERVICE menu.
3. Press NEXT or PREVIOUS to highlight the desired set point entry.



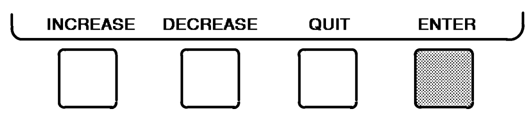
4. Press SELECT to modify the highlighted set point.



5. Press INCREASE or DECREASE to change the selected set point value.



6. Press ENTER to save the changes and return to the previous screen.



SERVICE OPERATION — To view the menu-driven programs available for Service Operation, see Service Operation section, page 46. For examples of CVC display screens, see Table 3.

Table 3 — CVC Display Data

IMPORTANT: The following notes apply to all Table 3 examples.

1. Only 12 lines of information appear on the CVC screen at any one time. Press the NEXT or PREVIOUS softkey to highlight a point or to view items below or above the current screen. Double-click the NEXT softkey to page forward; double-click the PREVIOUS softkey to page back.
2. To access the information shown in Examples 9 through 21, enter your 4-digit password after pressing the SERVICE softkey. If no softkeys are pressed for 15 minutes, the CVC automatically logs off (to prevent unrestricted access to PIC II controls) and reverts to the default screen. If this happens, you must re-enter your password to access the tables shown in Examples 9 through 21.
3. Terms in the Description column of these tables are listed as they appear on the CVC screen.
4. The CVC may be configured in English or Metric (SI) units using the CVC CONFIGURATION screen. See the Service Operation section, page 46, for instructions on making this change.
5. The items in the Reference Point Name column *do not appear on the CVC screen*. They are data or variable names used in CCN or Building Supervisor (BS) software. They are listed in these tables as a convenience to the operator if it is necessary to cross reference CCN/BS documentation or use CCN/BS programs. For more information, see the 23XL CCN literature.
6. Reference Point Names shown in these tables in all capital letters can be read by CCN and BS software. Of these capitalized names, those preceded by a dagger can also be changed (that is, written to) by the CCN, BS, and the CVC. Capitalized Reference Point Names preceded by two asterisks can be changed only from the CVC. Reference Point Names in lower case type can be viewed by CCN or BS only by viewing the whole table.
7. Alarms and Alerts: An asterisk *in the far right field of a CVC status screen* indicates that the chiller is in an alarm state; an exclamation point in the far right field of the CVC screen indicates an alert state. The asterisk (or exclamation point) indicates that the value on that line has exceeded (or is approaching) a limit. For more information on alarms and alerts, see the Alarms and Alerts section, page 19.

LEGEND

12T	—	Motor Overload
1CR	—	Control Relay
CCN	—	Carrier Comfort Network
CHW	—	Chilled Water
CR	—	Control Relay
CT	—	Current Transformer
CVC	—	Chiller Visual Controller
ECW	—	Entering Chilled Water
HGBP	—	Hot Gas Bypass
ISM	—	Integrated Starter Module
LCW	—	Leaving Chilled Water
LRA	—	Locked Rotor Amps
mA	—	Milliamps
P	—	Pressure
SS	—	Solid State
T	—	Temperature
SV	—	Slide Valve
VFD	—	Variable Frequency Drive
WSM	—	Water System Manager

EXAMPLE 1 — CVC DEFAULT SCREEN

The following data is displayed in the CVC Default screen.

DESCRIPTION	RANGE	UNITS	REFERENCE POINT NAME (ALARM HISTORY)	DISPLAY
(PRIMARY MESSAGE)				
(SECONDARY MESSAGE)				
(DATE AND TIME)				
Compressor Ontime	0-500000.0	HOURS	C_HRS	
Entering Chilled Water	–40-245	DEG F	ECW	CHW IN
Leaving Chilled Water	–40-245	DEG F	LCW	CHW OUT
Evaporator Temperature	–40-245	DEG F	ERT	EVAP REF
Entering Condenser Water	–40-245	DEG F	ECDW	CDW IN
Leaving Condenser Water	–40-245	DEG F	LCD	WCDW OUT
Condenser Temperature	–40-245	DEG F	CRT	COND REF
Oil Pressure	0-420	PSI	OILPD	OILPRESS
Oil Sump Temp	40-245	DEG F	OILT	OIL TEMP
Average Line Current	0-999	%	AMPS_%	AMPS %
	0-1		CCN	
	0-1		LOCAL	
	0-1		RESET	

NOTE: The last three entries are used to indicate operating mode to the PIC II. These values may be forced by the CVC only.

Table 3 — CVC Display Data (cont)

EXAMPLE 2 — MAINTSTAT DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU**.
2. Press **STATUS** (**MAINSTAT** will be highlighted).
3. Press **SELECT**.

DESCRIPTION	STATUS	UNITS	POINT
Control Mode	NOTE 1	NOTE 1	CMODE
Run Status	NOTE 2	NOTE 2	RUNSTAT
Start Inhibit Timer	0-15	min	T_START
Occupied ?	0/1	NO/YES	OCC
System Alert/Alarm	0-2	NOTE 3	SYS_ALM
***Chiller Start/Stop**	0/1	STOP/START	CHIL_S_S
***Remote Start Contact**	0/1	OFF/ON	REMCON
Temperature Reset	–30-30	DEG F	T_RESET
***Control Point**	10-120	DEG F	LCW_STPT
Chilled Water Temp	–40-245	DEG F	CHW_TMP
***Active Demand Limit**	40-100	%	DEM_LIM
Average Line Current	0-999	%	AMPS_%
Motor Percent Kilowatts	0-999	%	KW_P
Auto Demand Limit Input	4-20	mA	AUTODEM
Auto Chilled Water Reset	4-20	mA	AUTORES
Remote Reset Sensor	–40-245	DEG F	R_RESET
Total Compressor Starts	0-99999		C_STARTS
Starts in 12 Hours	0-8		STARTS
Compressor Ontime	0-500000.0	HOURS	C_HRS
***Service Ontime**	0-32767	HOURS	S_HRS
Ice Build Contact	0-1	OPEN/CLOSE	ICE_CON
Refrigerant Leak Sensor	0-20	mA	REF_LEAK

NOTES:
1. Reset, Off, Local, CCN
2. Timeout, Ready, Recycle, Prestart, Start-up, Ramping, Running, Demand, Override, Shutdown, Trippout, Pumpdown, Lockout
3. Normal, Alert, Alarm
4. All variables with capital letter point names are available for CCN read operation.
   Those shown with (*) support write operations for all CCN devices.

EXAMPLE 3 — STARTUP DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **STATUS**.
3. Scroll down to highlight **STARTUP**.
4. Press **SELECT**.

DESCRIPTION	STATUS	UNITS	POINT
Slide Valve Unload Timer	0-2	MIN	SV_TIMER
****Chilled Water Pump**	0-1	OFF/ON	CHWP
Chilled Water Flow	0-1	NO/YES	CHW_FLOW
****Condenser Water Pump**	0-1	OFF/ON	CDP
Condenser Water Flow	0-1	NO/YES	CDW_FLOW
Oil Pump Relay	0-1	OFF/ON	OILR
****Oil Delta P**	–67-2009	^PSI	OILPD
Compressor Start Relay	0-1	OFF/ON	CMPR
Compressor Start Contact	0-1	OPEN/CLOSED	1CR_AUX
Starter Trans Relay	0-1	OFF/ON	CMPTRANS
Compressor Run Contact	0-1	OPEN/CLOSED	RUN_AUX
****Tower Fan Relay Low**	0-1	OFF/ON	TFR_LOW
****Tower Fan Relay High**	0-1	OFF/ON	TFR_HIGH
Starter Fault	0-1	ALARM/NORMAL	STR_FLT
Spare Safety Input	0-1	ALARM/NORMAL	SAFETY
Shunt Trip Relay	0-1	OFF/ON	TRIPR
Oil Level Sensor	0-1	OPEN/CLOSED	OIL_LEV
ISM Fault Status	0-255		STRSTAT

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation.
Those shown with (**) shall support write operations for the CVC only.

Table 3 — CVC Display Data (cont)

EXAMPLE 4 — COMPRESS DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU**.
2. Press **STATUS**.
3. Scroll down to highlight **COMPRESS**.
4. Press **SELECT**.

DESCRIPTION	STATUS	UNITS	POINT
Slide Valve Load	0-5	SEC	SV_LD
Slide Valve Unload	0-5	SEC	SV_UNLD
Manual SV Load/Unload	–10-10	SEC	SV_MAN
Slide Valve Duty Cycle	–100-100	%	SV_DUTY
****Oil Delta P**	–6.7-200	PSI	OILPD
Oil Pressure Required	0-20	PSI	OILP__REQ
Oil Filter Data	0-120	PSI	OILF_PD
Oil Sump Temperature	–40-245	DEG F	OILT
Oil Heater Relay	0/1	OFF/ON	OILH
Comp Motor Winding Temp	–40-245	DEG F	MTRW
Rotor Inlet Temperature	–40-245	DEG F	ROTOR _ T
Discharge Temperature	–40-245	DEG F	CMPD
Discharge Superheat	–40-245	^F	SUPRHEAT
Variable Index Relay	0/1	OFF/ON	VAR_INDX
Target VFD Speed	1-100	%	VFD_OUT
Actual VFD Speed	0-110	%	VFD_ACT
Stall Protection Counts	0-5		spc
Spare Temperature 1	–40-245	DEG F	SPARE1
Spare Temperature 2	–40-245	DEG F	SPARE2

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation; those with (**) shall support write operations for CVC only.

EXAMPLE 5 — HEAT_EX DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU**.
2. Press **STATUS**.
3. Scroll down to highlight **HEAT_EX**.
4. Press **SELECT**.

DESCRIPTION	STATUS	UNITS	POINT
****Chilled Water Delta P**	–6.7-420	PSI	CHW_PD
Entering Chilled Water	–40-245	DEG F	ECW
Leaving Chilled Water	–40-245	DEG G	LCW
Chilled Water Delta T	–40-245	^F	CHW_DET
Chil Water Pulldown/Min	–20-20	^F	CHW_PULL
Evaporator Refrig Temp	–40-245	DEG F	ERT
****Evaporator Pressure**	–6.7-420	PSI	ERP
Evaporator Approach	0-99	^F	EVAP_APP
****Condenser Water Delta P**	–6.7-420	PSI	COND_PD
Entering Condenser Water	–40-245	DEG F	ECDW
Leaving Condenser Water	–40-245	DEG F	LCDW
Condenser Refrig Temp	–40-245	DEG F	CRT
****Condenser Pressure**	–6.7-420	PSI	CRP
Condenser Approach	0-99	^F	COND_APP
Hot Gas Bypass Relay	0/1	OFF/ON	HGBR
Stall/HGBP Active?	0/1	NO/YES	SHG_ACT
Active Delta P	0-200	PSI	dp_a
Active Delta T	0-200	^F	dt_c
Stall/HGBP Delta T	0-200	^F	dt_c
Head Pressure Reference	0-100	%	hpr

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation; those with (**) shall support write operations for CVC only.

Table 3 — CVC Display Data (cont)

EXAMPLE 6 — POWER DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU**.
2. Press **STATUS** .
3. Scroll down to highlight **POWER**.
4. Press **SELECT** **.**

DESCRIPTION	STATUS	UNITS	POINT
Average Line Current	0-999	%	%_AMPS
Actual Line Current	0-99999	AMPS	AMP_A
Average Line Voltage	0-999	%	VOLT_P
Actual Line Voltage	0-99999	VOLTS	VOLT_A
Power Factor	0.0-1.0		PF
Motor Kilowatts	0-99999	KW	KW_A
****Motor Kilowatt-Hours**	0-999999	KWH	KWH
Demand Kilowatts	0-99999	KW	DEM_KW
Line Current Phase 1	0-99999	AMPS	AMPS_1
Line Current Phase 2	0-99999	AMPS	AMPS_2
Line Current Phase 3	0-99999	AMPS	AMPS_3
Line Voltage Phase 1	0-99999	VOLTS	VOLTS_1
Line Voltage Phase 2	0-99999	VOLTS	VOLTS_2
Line Voltage Phase 3	0-99999	VOLTS	VOLTS_3
Ground Fault Phase 1	0-999	AMPS	GF_1
Ground Fault Phase 2	0-999	AMPS	GF_2
Ground Fault Phase 4	0-999	AMPS	GF_3
Frequency	0-99	HZ	FREQ
12T Sum Heat-Phase 1	0-200	%	HEAT1SUM
12T Sum Heat-Phase 2	0-200	%	HEAT2SUM
12T Sum Heat-Phase 3	0-200	%	HEAT3SUM

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation.
Those with (**) shall support write operations for CVC only.

EXAMPLE 7 — ISM_STAT SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **STATUS** .
3. Scroll down to highlight **ISM_STAT** .
4. Press **SELECT** .

DESCRIPTION	STATUS	UNITS	POINT
ISM Fault Status	0-223		ISMFLT
Single Cycle Dropout	0-1	NORMAL/ALARM	CYCLE_1
Phase Loss	0-1	NORMAL/ALARM	PH_LOSS
Overvoltage	0-1	NORMAL/ALARM	OV_VOLT
Undervoltage	0-1	NORMAL/ALARM	UN_VOLT
Current Imbalance	0-1	NORMAL/ALARM	AMP_UNB
Voltage Imbalance	0-1	NORMAL/ALARM	VOLT_UNB
Overload Trip	0-1	NORMAL/ALARM	OVERLOAD
Locked Rotor Trip	0-1	NORMAL/ALARM	LRATRIP
Starter LRA Trip	0-1	NORMAL/ALARM	SLRATRIP
Ground Fault	0-1	NORMAL/ALARM	GRND_FLT
Phase Reversal	0-1	NORMAL/ALARM	PH_REV
Frequency Out of Range	0-1	NORMAL/ALARM	FREQFLT
ISM Power on Reset	0-1	NORMAL/ALARM	ISM_POR
Phase 1 Fault	0-1	NORMAL/ALARM	PHASE_1
Phase 2 Fault	0-1	NORMAL/ALARM	PHASE_2
Phase 3 Fault	0-1	NORMAL/ALARM	PHASE_3
ICR Start Complete	0-1	FALSE/TRUE	START_OK
1M Start/Run Fault	0-1	NORMAL/ALARM	1M_FLT
2M Start/Run Fault	0-1	NORMAL/ALARM	2M_FLT
Pressure Trip Contact	0-1	NORMAL/ALARM	PRS_RIP
Starter Fault	0-1	NORMAL/ALARM	STRT_FLT
Motor Amps Not Sensed	0-1	NORMAL/ALARM	NO_AMPS
Starter Acceleration Fault	0-1	NORMAL/ALARM	ACCELFLT
High Motor Amps	0-1	NORMAL/ALARM	HIGHAMPS
1CR Stop Complete	0-1	FALSE/TRUE	STOP_OK
1M/2M Stop Fault	0-1	NORMAL/ALARM	1M2MSTOP
Motor Amps When Stopped	0-1	NORMAL/ALARM	AMPSTOP
Hardware Failure	0-1	NORMAL/ALARM	HARDWARE

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation.

Table 3 — CVC Display Data (cont)

EXAMPLE 8 — SETPOINT DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SETPOINT** (Base Demand Limit will be highlighted) .
3. Press **SELECT** .

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Base Demand Limit	40-100	%	DLM	100
Control Point				
LCW Setpoint	10-120	DEG F	lcw_sp	50.0
ECW Setpoint	15-120	DEG F	ecw_sp	60.0
Ice Build Setpoint	15-60	DEG F	ice_sp	40.0
Tower Fan High Setpoint	55-105	DEG F	tf2_sp	75

NOTE: No variables are available for CCN read operation; forcing shall not be supported on setpoint screens.

EXAMPLE 9 — CAPACITY DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS** .
4. Press **SELECT** .
5. Scroll down to highlight **CAPACITY**.

DESCRIPTION	STATUS	UNITS	POINT
Entering Chilled Water	–40-245	DEG F	ECW
Leaving Chilled Water	–40-245	DEG F	LCW
Capacity Control			
Control Point	7-120	DEG F	ctrlpt
Control Point Error	–99-99	^F	cperr
ECW Delta T	–99-99	^F	ecwdt
ECW Reset	–99-99	^F	ecwres
LCW Reset	–99-99	^F	lcwres
Total Error + Resets	–99-99	^F	error
Slide Valve Delta	–2-2	%	svd
Slide Valve Load	0-5	SEC	SV_LD
Slide Valve Unload	0-5	SEC	SV_UNLD
Variable Index Relay	0-1	OFF/ON	VARINDEX
Target VFD Speed	0-100	%	VFD_IN
Actual VFD Speed	0-100	%	VFD_ACT
VFD Gain	0.1-1.5		vfd_gain
Demand Limit Inhibit	0-1	%	DEM_INH
Amps/kW Ramp	0-100	%	DEMLIM

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation;
forcing shall not be supported on maintenance screens.

Table 3 — CVC Display Data (cont)

EXAMPLE 10 — OVERRIDE DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **OVERRIDE** **.**

DESCRIPTION	STATUS	UNITS	POINT
Comp Motor Winding Temp	–40-245	DEG F	MTRW
Comp Motor Temp Override	150-200	DEG F	MT_OVER
Condenser Pressure	0-420	PSI	CRP
Cond Press Override	150-260	PSI	CP_OVER
Evaporator Refrig Temp	–40-245	DEG F	ERT
Evap Ref Override Temp	2-245	DEG F	RT_OVER
Comp Discharge Temp	–40-245	DEG F	CMPD
Comp Discharge Alert	125-200	DEG F	CD_ALERT
Oil Filter Delta P	0-245	PSI	OILF_PD
Discharge Superheat	–20-999	^F	SUPRHEAT
Rotor Inlet Temperature	–40-245	DEG F	ROTOR_T
Condenser Refrig Temp	–40-245	DEG F	CRT

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation; forcing shall not be supported on maintenance screens.

EXAMPLE 11 — LL_MAINT DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **LL_MAINT.** **.**

DESCRIPTION	STATUS	UNITS	POINT
Lead Lag Control	NOTE 1		leadlag
LEADLAG: Configuration	NOTE 2		leadlag
Current Mode	NOTE 3		llmode
Load Balance Option	0/1	DSABLE/ENABLE	loadbal
LAG Start Time	2-60	MIN	lagstart
LAG Stop Time	2-60	MIN	lagstop
Prestart Fault Time	2-30	MIN	preflt
Pulldown: Delta T/Min	x.xx	^F	pull_dt
Satisfied ?	0/1	NO/YES	pull_sat
LEAD CHILLER in Control	0/1	NO/YES	leadctrl
LAG CHILLER: Mode	NOTE 3		lagmode
Run Status	NOTE 4		lagstat
Start/Stop	NOTE 5		lag_s_s
Recovery Start Request	0/1	NO/YES	lag_rec
STANDBY CHILLER: Mode	NOTE 3		stdmode
Run Status	NOTE 4		stdstat
Start/Stop	NOTE 5		std_s_s
Recovery Start Request	0/1	NO/YES	std_rec
Spare Temperature 1	–40-245	DEG F	SPARE_T1
Spare Temperature 2	–40-245	DEG F	SPARE_T2

NOTES:
1. DISABLE, LEAD, LAG, STANDBY, INVALID
2. DISABLE, LEAD, LAG, STANDBY, RECOVERY, CONFIG
3. Reset, Off, Local, CCN
4. Timeout, Ready, Recycle, Prestart, Startup, Ramping, Running, Demand, Override, Shutdown, Trippout, Pumpdown, Lockout
5. Stop, Start, Retain
6. All variables with CAPITAL LETTER point names are available for CCN read operation; forcing shall not be supported on maintenance screens.

Table 3 — CVC Display Data (cont)

EXAMPLE 12 — ISM_HIST DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **ISM_HIST** .

DESCRIPTION	STATUS	UNITS	POINT
ISM FAULT HISTORY			
Values At Last Fault:			
Line Current Phase 1	0-99999	AMPS	AMPS_1F
Line Current Phase 2	0-99999	AMPS	AMPS_2F
Line Current Phase 3	0-99999	AMPS	AMPS_3F
Line Voltage Phase 1	0-99999	VOLTS	VOLTS_1F
Line Voltage Phase 2	0-99999	VOLTS	VOLTS_2F
Line Voltage Phase 3	0-99999	VOLTS	VOLTS_3F
Ground Fault Phase 1	0-999	AMPS	GF_1F
Ground Fault Phase 2	0-999	AMPS	GF_2F
Ground Fault Phase 4	0-999	AMPS	GF_3F
12T Sum Heat-Phase 1	0-200	%	HEAT1SUMF
12T Sum Heat-Phase 2	0-200	%	HEAT2SUMF
12T Sum Heat-Phase 3	0-200	%	HEAT3SUMF
Line Frequency	0-99	HZ	FREQ_F
ISM FAULT STATUS	0-9999		ISM_STAT

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation; forcing shall not be supported on maintenance screens.

EXAMPLE 13 — WSMCHLRE DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **WSMCHLRE** .

DESCRIPTION	STATUS	UNITS	POINT
WSM Active?	0/1	NO/YES	WSMSTAT
Chilled Water Temp	0.0-99.9	DEG F	CHWTEMP
Equipment Status	0/1	OFF/ON	CHLRST
Commanded State	XXXXXXXX	TEXT	CHLRENA
CHW setpt Reset Value	0.0-25.0	DEG F	CHWRVAL
Current CHW Set Point	0.0-99.9	DEG F	CHWSTPT

NOTE: All variables with CAPITAL LETTER point names are available for CCN read operation; forcing shall not be supported on maintenance screens.

Table 3 — CVC Display Data (cont)

EXAMPLE 14 — NET_OPT DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT CONFIGURATION**.
4. Press **SELECT** .
5. Scroll down to highlight **NET_OPT** **.**

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Loadshed Function				
Group Number 1-16			ldsgrp	0
Demand Limit Decrease	0-06	%	ldsdelta	20
Maximum Loadshed Time	30-480	MIN	maxldstm	60
CCN Occupancy Config:				
Schedule Number	3-99		occpcxxe	3
Broadcast Option	0-1	DSABLE/ENABLE	occbrcst	DSABLE
Alarm Configuration				
Re-Alarm Time	0-1440	MIN		30
Alarm Routing	00000000-11111111			10000000

NOTE: No variables are available for CCN read or write operation.

EXAMPLE 15 — ISM_CONF DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **ISM (STARTER) CONFIG DATA**.
4. Press **SELECT** .
5. Scroll down to highlight **ISM_CONF** **.**

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Starter Type	0-2		starter	1
(0 = Full, 1 = Red, 2 = SS/VFD)				
Motor Rated Line Voltage	200-13200	VOLTS	v_fs	460
Volt Transformer Ratio:1	1-33		vt_rat	1
Overvoltage Threshold	105-115	%	overvolt	115
Undervoltage Threshold	85-95	%	undvolt	85
Over/Under Volt Time	1-10	SEC	uvuntime	5
Voltage % Imbalance	1-10	%	v_unbal	10
Voltage Imbalance Time	1-10	SEC	v_time	5
Motor Rated Load Amps	10-5000	AMPS	a_fs	200
Motor Locked Rotor Trip	100-60000	AMPS	motor_r	1000
Locked Rotor Start Delay	1-10	cycles	lrdelay	5
Starter LRA Rating	100-60000	AMPS	star_lr	2000
Motor Current CT Ratio:	13-1000		ct_turns	100
Current % Imbalance	5-40	%	c_unbal	15
Current Imbalance Time	1-10	SEC	c_time	5
3 Grnd Fault CT's? (1 = No)	0-1	NO/YES	gf_phase	YES
Ground Fault CT Ratio:1	150		gf_ctr	150
Ground Fault Current	1-25	AMPS	gf_amps	15
Ground Fault Start Delay	1-20	cycles	gf_delay	10
Ground Fault Persistence	1-10	cycles	gf_pers	5
Single Cycle Dropout	0/1	DSABLE/ENABLE	cycdrop	DSABLE
Frequency = 60 Hz? (No = 50)	0/1	NO/YES	freq	YES
Line Frequency Faulting	0/1	DSABLE/ENABLE	freq_en	DSABLE

NOTE: No variables are available for CCN read or write operation.

Table 3 — CVC Display Data (cont)

EXAMPLE 16 — OPTIONS DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **OPTIONS** .

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Auto Restart Option	0/1	DSABLE/ENABLE	astart	DSABLE
Remote Contacts Open	0/1	DSABLE/ENABLE	r_contact	DSABLE
Soft Stop Amps Threshold	40-100	%	softstop	100
Stall/Hot Gas Bypass				
Stall Limit/HGBP Option	0/1		stall_hgbp	0
Select: Stall=0, HGBP=1				
Min. Load Point (T1/P1)				
Stall/HGBP Delta T1	0.5-20	^F	hgb_dt1	1.5
Stall/HGBP Delta P1	30-170	PSI	hgb_dp1	150
Full Load Point (T2/P2)				
Stall/HGBP Delta T2	0.5-20	^F	hbg-dt2	4
Stall/HGBP Delta P2	30-250	PSI	hgb_dp2	200
Stall/HGBP Deadband	0.5-3	^F	hbg_db	1
Stall Protection				
Stall Delta % Amps	5-20	%	stall_a	10
Stall Time Period	7-10	MIN	stall_t	8
Ice Build Control				
Ice Build Option	0-1	DSABLE/ENABLE	ibopt	DSABLE
Ice Build Termination	0-2		ibterm	0
0=Temp, 1=Contacts, 2=Both				
Ice Build Recycle	0/1	DSABLE/ENABLE	ibrecyc	DSABLE
Refrigerant Leak Option	0/1	DSABLE/ENABLE	REF_OPT	DSABLE
Refrigerant Leak Alarm	4-20	mA	REF_LEAK	20
Head Pressure Reference				
Delta P @ 0% (4mA)	20-30	PSI	HPDP0	25
Delta P @ 100% (20mA)	35-50	PSI	HPDP100	35
Minimum Output	0-100	%	HPDPMIN%	0

NOTE: No variables are available for CCN read or write operation.

Table 3 — CVD Display Data (cont)

EXAMPLE 17 — SETUP1 DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE** .
4. Press **SELECT** .
5. Scroll down to highlight **SETUP1** .

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Comp Motor Temp Override	150-200	DEG F	MT_OVER	200
Cond Press Override	150-260	PSI	CP_OVER	230
Comp Discharge Alert	125-200	DEG F	CD_ALERT	200
Chilled Medium	0/1	WATER/BRINE	MEDIUM	WATER
Chilled Water Deadband	.5-2.0	^F	CW_DB	1.0
Evap Refrig Trippoint	0.0-40.0	DEG F	ERT_TRIP	33
Refrig Override Delta T	2.0-5.0	^F	REF_OVER	3
Condenser Freeze Point	–20 -35	DEG F	CDFREEZE	34
Evap Flow Delta P Cutout	0.5 - 50.0	PSI	EVAP_CUT	5.0
Cond Flow Delta P Cutout	0.5 - 50.0	PSI	COND_CUT	5.0
Water Flow Verify Time	0.5-5	MIN	WFLOW_T	5
Oil Filter Pressure Alert	1-15	PSI	OILFALRT	3
Recycle Control				
Recycle Restart Delta T	2.0-10.0	DEG F	rcycr_dt	5
Recycle Shutdown Delta	0.5-4.0	DEG F	rcycs_dt	1
Spars Alert/Alarm Enable				
Disable=0, Lo=1/3, Hi=2/4				
Spare Temp #1 Enable	0-4		sp1_en	0
Spare Temp #1 Limit	–40-245	DEG F	sp1_lim	245
Spare Temp #2 Enable	0-4		sp2_ en	0
Spare Temp #2 Limit	–40-245	DEG F	sp2_ lim	245
23XL Model TC Comp?	0-1	NO/YES	TC_23XL	1

NOTE: No variables are available for CCN read or write operation; forcing shall not be supported on service screens.

EXAMPLE 18 — SETUP2 DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE** .
4. Press **SELECT** .
5. Scroll down to highlight **SETUP2** .

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Capacity Control				
Proportional Inc Band	2-10		sv_inc	6.5
Proportional Dec Band	2-10		sv_dec	6.0
Proportional ECW Band	1-3		sw_ecw	2
VFD/Slide Valve Control				
VFD Option	0/1	DSABLE/ENABLE	vfd_opt	DSABLE
VFD Gain	0.1-1.5		vfd_gain	0.75
VFD Increase Step	1-5	%	vfd_step	2
VFD Minimum Speed	20-100	%	vfd_min	70
VFD Maximum Speed	50-100	%	vfd_max	100
Manual SV Temp Option	0-1	DSABLE/ENABLE	sv_opt	DSABLE

NOTE: No variables are available for CCN read or write operation; forcing shall not be supported on service screens.

Table 3 — CVD Display Data (cont)

EXAMPLE 19 — LEAD/LAG DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE** .
4. Press **SELECT** .
5. Scroll down to highlight **LEAD/LAG** **.**

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Lead Lag Control	0-3		leadlag	0
LEAD/LAG Configuration			leadlag	0
DSABLE=0, Lead=1				
LAG=2, STANDBY=3				
Load Balance Option	0/1	DSABLE/ENABLE	loadbal	DSABLE
Common Sensor Option	0/1	DSABLE/ENABLE	commsens	DSABLE
LAG % Capacity	25-75	%	lag_per	50
LAG Address	1-236		lag_add	92
LAG START Timer	2-60	MIN	lagstart	10
LAG STOP Timer	2-60	MIN	lagstop	10
PRESTART FAULT Timer	2-30	MIN	preft	5
STANDBY Chiller Optioin	0/1	DSABLE/ENABLE	stndopt	DSABLE
STANDBY % Capacity	25-75	%	stnd_per	50
STANDBY Address	1-236		stnd_add	93

NOTE: No variables are available for CCN read or write operation.

EXAMPLE 20 — RAMP_DEM DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE** .
4. Press **SELECT** .
5. Scroll down to highlight **RAMP_DEM** **.**

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Pulldown Ramp Type:	0/1		rampslct	1
Select: Temp=0, Load=1				
Demand Limit + kW Ramp				
Demand Limit Source	0/1		dem_src	0
Select: Amps=0, kW=1				
Motor Load Ramp % Min	5-20		kw_ramp	10
Demand Limit Prop Band	3-15	%	dem_app	10
Demand Limit At 20 mA	40-100	%	dem_20ma	40
20 mA Demand Limit Opt	0/1	DSABLE/ENABLE	dem_sel	DSABLE
Motor Rated Kilowatts	50-9999	kW	motor_kw	145
Demand Watts Interval	5-60	MIN	dw_int	15

NOTE: No variables are available for CCN read or write operation.

EXAMPLE 21 — TEMP_CTL DISPLAY SCREEN

To access this display from the **CVC default** screen:

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE** .
4. Press **SELECT** .
5. Scroll down to highlight **TMP_CTL**.

DESCRIPTION	STATUS	UNITS	POINT	DEFAULT
Control Point				
ECW Control Option	0/1	DSABLE/ENABLE	ecw_opt	DSABLE
Temp Pulldown Deg/Min	2-10	^F	tmp_ramp	3
Temperature Reset				
RESET TYPE 1				
Degrees Reset At 20 mA	–30- 30	^F	deg_20ma	10
RESET TYPE 2				
Remote Temp (No Reset)	–40-245	DEG F	res_rt	85
Remote Temp (Full Reset)	–40-245	DEG F	res_rt	65
Degrees Reset	–30-30	^F	deg_rt	10
RESET TYPE 3				
CHW Delta T (No Reset)	0-15	^F	restd_1	10
CHW Delta T (Full Reset)	0-15	^F	restd_2	0
Degrees Reset	–30-30	^F	deg_chw	5
Select/Enable Reset Type	0-3		res_sel	0

PIC II System Functions

NOTE: Words not part of paragraph headings and printed in all capital letters can be viewed on the CVC (e.g., LOCAL, CCN, RUNNING, ALARM, etc.) Words printed in both all capital letters and italics can also be viewed on the CVC and are parameters (*CONTROL MODE ADDED EXAMPLES*, etc.) with associated values (e.g., modes, temperatures, pressures, percentages, on, off, enable, disable, etc.).Words printed in all capital letters and in a box represent softkeys on the CVC (e.g., $\boxed{\text{ENTER}}$ and $\boxed{\text{EXIT}}$). See Table 3 for examples of the type of information that can appear on the CVC screens. Figures 17-23 give an overview of CVC operations and menus.

CAPACITY CONTROL — The PIC II controls the chiller capacity by modulating the slide valve in response to chilled water temperature deviation away from the *CONTROL POINT.* The *CONTROL POINT* may be changed by a CCN network device or is determined by the PIC II adding any active chilled water reset to the *SET POINT.* The PIC II uses the *PROPORTIONAL INC (Increase) BAND*, *PROPORTIONAL DEC (Decrease) BAND*, and the *PROPORTIONAL ECW (Entering Chilled Water) GAIN* to determine how fast or slow to respond. *CONTROL POINT* may be viewed or overridden from the MAINSTAT screen.

ECW CONTROL OPTION — If this option is enabled, the PIC II uses the *ENTERING CHILLED WATER* temperature to modulate the slide valve instead of the L*EAVING CHILLED WATER* temperature. The *ECW CONTROL OPTION* may be viewed on the TEMP_CTL screen, which is accessed from the EQUIPMENT SERVICE screen.

CONTROL POINT DEADBAND — This is the tolerance range on the chilled water/brine temperature control point. If the water temperature goes outside the *CHILLED WATER DEADBAND*, the PIC II opens or closes the slide valve until the temperature is within tolerance. The PIC II may be configured with a 0.5 to 2 F (0.3 to 1.1 C) deadband. *CHILLED WATER DEADBAND* may be viewed or modified on the SETUP1 screen, which is accessed from the EQUIPMENT SERVICE table.

For example, a 1º F (0.6º C) deadband setting controls the water temperature within ±0.5º F (0.3º C) of the control point. This may cause frequent slide valve movement if the chilled water load fluctuates frequently. A value of 1º F (0.6º C) is the default setting.

PROPORTIONAL BANDS AND GAIN — Proportional band is the rate at which the slide valve position is corrected in proportion to how far the chilled water/brine temperature is from the control point. Proportional gain determines how quickly the slide valve reacts to how quickly the temperature is moving from the *CONTROL POINT.* The proportional bands and gain may be viewed or modified from the SETUP2 screen, which is accessed from the EQUIPMENT SERVICE table.

<u>The Proportional Band</u> — There are two response modes, one for temperature response above the control point, the other for the response below the control point.

The temperature response above the control point is called the *PROPORTIONAL INC BAND*, and it can slow or quicken slide valve response to chilled water/brine temperatures above the *DEADBAND*. The *PROPORTIONAL INC BAND* can be adjusted from a setting of 2 to 10; the default setting is 6.5.

The response below the control point is called the *PROPORTIONAL DEC BAND*, and it can slow or quicken the slide valve response to chilled water temperature below the deadband plus the control point. The PROPORTIONAL DEC BAND can be adjusted on the CVC from a setting of 2 to 10. The default setting is 6.0.

NOTE: Increasing either of these settings causes the slide valve to respond more slowly than they would at a lower setting.

<u>*The PROPORTIONAL ECW BAND*</u> can be adjusted on the CVC display for values of 1, 2, or 3; the default setting is 2. Increase this setting to increase slide valve response to a change in entering chilled water temperature.

DEMAND LIMITING — The PIC II responds to the *ACTIVE DEMAND LIMIT* set point by limiting the opening of the slide valve. It compares the *ACTIVE DEMAND LIMIT* set point to the *DEMAND LIMIT SOURCE* (either the *AVERAGE LINE CURRENT* or the *MOTOR KW*), depending on how the control is configured. *DEMAND LIMIT SOURCE* is on the RAMP_DEM screen. The default source is the compressor motor current.

CHILLER TIMERS — The PIC II maintains 2 runtime clocks, known as *COMPRESSOR ONTIME* and *SERVICE ONTIME*. *COMPRESSOR ONTIME* indicates the total lifetime compressor run hours. This timer can register up to 500,000 hours before the clock turns back to zero. The *SERVICE ONTIME* is a reset table timer that can be used to indicate the hours since the last service visit or any other event. The time can be changed from the CVC to whatever value is desired. This timer can register up to 32,767 hours before it rolls over to zero.

The chiller also maintains a start-to-start timer and a stop-to-start timer. These timers limit how soon the chiller can be started. *START INHIBIT TIMER* is displayed on the MAINSTAT screen. See the Start-Up/Shutdown/Recycle Sequence section, page 47, for more information on this topic.

OCCUPANCY SCHEDULE — The chiller schedule, described in the Time Schedule Operation section (page 24), determines when the chiller can run. Each schedule consists of from 1 to 8 occupied or unoccupied time periods, set by the operator. The chiller can be started and run during an occupied time period (when *OCCUPIED ?* is set to YES on the MAINSTAT display screen). It cannot be started or run during an unoccupied time period (when *OCCUPIED ?* is set to NO on the MAINSTAT display screen). These time periods can be set for each day of the week and for holidays. The day begins with 0000 hours and ends with 2400 hours. The default setting for *OCCUPIED ?* is YES, unless an unoccupied time period is in effect.

These schedules can be set up to follow a building's occupancy schedule, or the chiller can be set so to run 100% of the time, if the operator wishes. The schedules also can be bypassed by forcing the *CHILLER START/STOP* parameter on the MAINSTAT screen to START. For more information on forced starts, see Local Start-Up, page 47.

The schedules also can be overridden to keep the chiller in an occupied state for up to 4 hours, on a one time basis. See the Time Schedule Operation section, page 24.

Figure 22 shows a schedule for a typical office building with a 3-hour, off-peak, cool-down period from midnight to 3 a.m., following a weekend shutdown. Holiday periods are in an unoccupied state 24 hours per day. The building operates Monday through Friday, 7:00 a.m. to 6:00 p.m., and Saturdays from 6:00 a.m. to 1:00 p.m. This schedule also includes the Monday midnight to 3:00 a.m. weekend cool-down schedule.

NOTE: This schedule is for illustration only and is not intended to be a recommended schedule for chiller operation.

Whenever the chiller is in the LOCAL mode, it uses Occupancy Schedule 01 (OCCPC01S). When the chiller is in the ICE BUILD mode, it uses Occupancy Schedule 02 (OCCPC02S). When the chiller is in CCN mode, it uses Occupancy Schedule 03 (OCCPC03S).

The *CCN SCHEDULE NUMBER* is configured on the NET_OPT display screen, accessed from the EQUIPMENT

CONFIGURATION table. See Table 3, Example 14. *SCHEDULE NUMBER* can be changed to any value from 03 to 99. If this number is changed on the NET_OPT screen, the operator must go to the ATTACH TO NETWORK DEVICE screen to upload the new number into the SCHEDULE screen. See Fig. 21.

Safety Controls — The PIC II monitors all safety control inputs and, if required, shuts down the chiller or limits the slide valve to protect the chiller from possible damage from any of the following conditions:

- high motor winding temperature
- high discharge temperature
- low discharge superheat temperature TC (frame 1 and 2) compressor chillers*
- low oil pressure
- low cooler refrigerant temperature
- condenser high pressure or low pressure
- inadequate water/brine cooler and condenser flow
- high, low, or loss of voltage
- ground fault (option)
- high oil filter pressure drop
- low oil level
- voltage imbalance
- current imbalance
- excessive motor acceleration time
- excessive starter transition time
- lack of motor current signal
- excessive motor amps
- excessive compressor stall
- temperature sensor and transducer faults

*Superheat is the difference between saturation temperature and sensible temperature. The high discharge temperature safety measures only sensible temperature.

Starter faults or optional protective devices within the starter can shut down the chiller. The protective devices you have for your application depend on what options were purchased.

⚠ CAUTION

If compressor motor overload occurs, check the motor for grounded or open phases before attempting a restart

If the PIC II control initiates a safety shutdown, it displays the reason for the shutdown (the fault) on the CVC display screen along with a primary and secondary message, energizes an alarm relay in the starter, and blinks the alarm light on the control panel. The alarm is stored in memory and can be viewed on the ALARM HISTORY and ISM_HIST screens on the CVC, along with a message for troubleshooting. If the safety shutdown was also initiated by a fault detected in the motor starter, the conditions at the time of the fault will be stored in ISM_HIST.

To give more precise information or warnings on the chiller's operating condition, the operator can define alert limits on various monitored inputs. Safety contact and alert limits are defined in Table 4. Alarm and alert messages are listed in the Troubleshooting Guide section, page 76.

Shunt Trip (Option) — The function of the shunt trip option on the PIC II is to act as a safety trip. The shunt trip is wired from an output on the ISM to a shunt trip equipped motor circuit breaker. If the PIC II tries to shut down the compressor using a normal shutdown procedure but is unsuccessful for 30 seconds, the shunt trip output is energized and causes the circuit breaker to trip off. If ground fault protection has been applied to the starter, the ground fault trip also energizes the shunt trip to trip the circuit breaker. Protective devices in the starter can also energize the shunt trip. The shunt trip feature can be tested using the Control Test feature.

Default Screen Freeze — When the chiller is in an alarm state, the default CVC display "freezes," that is, it stops updating. The first line of the CVC default screen displays a primary alarm message; the second line displays a secondary alarm message.

The CVC default screen freezes to enable the operator to see the conditions of the chiller *at the time of the alarm*. If the value in alarm is one normally displayed on the default screen, it flashes between normal and reverse video. The CVC default screen remains frozen until the condition that caused the alarm is remedied by the operator.

Knowledge of the operating state of the chiller at the time an alarm occurs is useful when troubleshooting. Additional chiller information can be viewed on the status screens and the ISM_HIST screen. Troubleshooting information is recorded in the ALARM HISTORY table, which can be accessed from the SERVICE menu.

To determine what caused the alarm, the operator should read both the primary and secondary default screen messages, as well as the alarm history. The primary message indicates the most recent alarm condition. The secondary message gives more detail on the alarm condition. Since there may be more than one alarm condition, another alarm message may appear after the first condition is cleared. Check the ALARM HISTORY screen for additional help in determining the reasons for the alarms. Once all existing alarms are cleared (by pressing the RESET softkey), the default CVC display returns to normal operation.

Ramp Loading — The ramp loading control slows down the rate at which the compressor loads up. This control can prevent the compressor from loading up during the short period of time when the chiller is started and the chilled water loop has to be brought down to *CONTROL POINT*. This helps reduce electrical demand charges by slowly bringing the chilled water to *CONTROL POINT*.

There are two methods of ramp loading with the PIC II. Ramp loading can be based on chilled water temperature or on motor load. Either method is selected from the RAMP__DEM screen.

1. Temperature ramp loading (*TEMP PULLDOWN DEG/MIN*) limits the degrees per minute rate at which either leaving chilled water or entering chilled water temperature decreases. This rate is configured by the operator on the TEMP_CTL screen. The lowest temperature ramp rate will also be used if chiller power has been off for 3 hours or more (even if the motor ramp load is selected as the ramp loading method.
2. Motor load ramp loading (*LOAD PULLDOWN*) limits the degrees per minute rate at which the compressor motor current or compressor motor load increases. The *LOAD PULLDOWN* rate is configured by the operator on the RAMP_DEM screen in amps or kilowatts.

If kilowatts is selected for the *DEMAND LIMIT SOURCE*, the *MOTOR RATED KILOWATTS* must be entered (information found on the chiller Requisition form).

The *TEMP PULLDOWN DEG/MIN* may be viewed or modified on the TEMP_CTL screen which is accessed from the EQUIPMENT SERVICE screen. *PULLDOWN RAMP TYPE*, *DEMAND LIMIT SOURCE*, and *MOTOR LOAD RAMP %/MIN* may be viewed or modified on the RAMP_DEM screen.

Capacity Override (Table 5) — Capacity overrides can prevent some safety shutdowns caused by exceeding the motor amperage limit, refrigerant low temperature safety limit, motor high temperature safety limit, and condenser high pressure limit. In all cases, there are 2 stages of compressor slide valve control.

1. The slide is prevented from closing further, and the status line on the CVC indicates the reason for the override.
2. The slide valve is opened until the condition decreases to below the first step set point. Then the slide valve is normal capacity control. Whenever the motor current demand limit set point (*ACTIVE DEMAND LIMIT*) is reached, it activates a capacity override, again, with a 2-step process. Exceeding 110% of the rated load amps for more than 30 seconds will initiate a safety shutdown.

Low Discharge Temperature Control — Low discharge superheat is protective limit for R-22, Frame 1 and 2 TC compressor chillers only. Monitoring of discharge superheat is initiated 30 minutes after a completed start-up. If the discharge superheat, calculated as COMPRESSOR DISCHARGE TEMPERATURE – CONDENSER REFRIGERANT TEMPERATURE, falls below 20 F (11.1 C) for 10 consecutive minutes, a "low discharge superheat" non-recycle shutdown alarm 240, will occur.

Oil Sump Temperature Control TC (Frame 1 and 2) Chillers Only — The oil sump temperature control is regulated by the PIC II using the oil heater relay when the chiller is shut down. The oil heater relay is energized whenever the chiller compressor is off, and the oil sump temperature is less than 140 F (60 C) or sump temperature is less than the cooler refrigerant temperature plus 53 F (29.4 C). The heater is then turned off when the oil sump temperature is:

1. More than 150 F (71 C).
2. The sump temperature is more than 142 F (61.1 C) and more than the cooler refrigerant temperature plus 55 F (12.8 C). (The heater is always off during start-up or when the compressor is running.)

⚠ WARNING

All oil filter isolation valves should always be left open, except when changing the oil or oil filter as defined in Changing Oil and Oil Filter section, page 73.

Table 4 — Protective Safety Limits and Control Settings

MONITORED PARAMETER	LIMIT	APPLICABLE COMMENTS
TEMPERATURE SENSOR OUT OF RANGE	–40 to 245 F (–40 to 118.3 C)	Must be outside range for 2 seconds.
PRESSURE TRANSDUCERS OUT OF RANGE	0.06 to 0.98 Voltage Ratio	Must be outside range for 3 seconds. Ratio = Input Voltage ÷ Voltage Reference
COMPRESSOR DISCHARGE TEMPERATURE	>220 F (104.4 C)	Preset, alert setting configurable.
MOTOR WINDING TEMPERATURE	>220 F (104.4 C)	Preset, alert setting configurable.
LOW DISCHARGE SUPERHEAT	Oil sump temp — condenser refrigerant temp is less than 20 F (11.1 C). Only applicable to TC (frame 1 and 2) chillers.	Preset, monitored 30 minutes after start-up completion must be outside range for 10 consecutive minutes.
OIL PRESSURE **— Dirty Oil Filter**	Oil pressure transducer less than condenser pressure — oil filter pressure alert starting 40 seconds after motor current > 10% and oil pressure verified	Must be outside range for 3 seconds; oil pressure alert setting configurable from 1 to 15 psi (6.9 to 103 kPa) on SETUP 1 table.
	Oil pressure transducer less than condenser pressure — 110 psi (758 kPa) starting 40 seconds after motor current > 10% and oil pressure verified	Must be outside range for 3 seconds.
— Low Oil Pressure	<Required oil pressure starting 120 seconds after motor current > 10%	Minimum required oil pressure based on system pressure ratio is between 7 psi (48 kPa) and 20 psi (137.9 kPa)
OIL LEVEL	Discrete	Preset: must be outside range for 15 seconds.
EVAPORATOR REFRIGERANT TEMPERATURE	<33 F (FOR WATER CHILLING) (0.6°C)	Preset, configurable chilled medium for water (SETUP1 table).
	<EVAP REFRIG TRIPPOINT (set point adjustable from 0 to 40 F [–18 to 4 C] for brine chilling)	Configure chilled medium for brine (SETUP1 table). Adjust EVAP REFRIG TRIPPOINT for proper cutout.
TRANSDUCER VOLTAGE	<4.5 vdc> 5.5 vdc	Preset
CONDENSER PRESSURE **— Switch**	263 ± 5 psig (1813 ± 34 kPa), reset at 180 ± 7 psig (1241 ± 48 kPa)	Preset
— Control	260 psig (1793 kPa)	Preset
LINE VOLTAGE **— High**	>150% for 1 second or >120% for 10 seconds	Preset, based on transformed line voltage to ISM. Also monitored at CVC and CCM power input.
— Low	<85% for 10 seconds or ≤80 for 5 seconds or <75% for 1 second	
— Single-Cycle	<50% for one cycle	
COMPRESSOR MOTOR LOAD	>110% for 30 seconds	Preset
	<5% with compressor running	Preset
	<5% with compressor off	Preset
STARTER ACCELERATION TIME (Determined by inrush current going below 100% compressor motor load)	>45 seconds	For chillers with reduced voltage mechanical and solid-state starters.
	>10 seconds	For chillers with full voltage starters (Configures on ISM_CONFIG table).
STARTER TRANSITION	>20 seconds	Reduced voltage starters only.
CONDENSER FREEZE PROTECTION	Energizes condenser pump relay if condenser refrigerant temperature or entering water temperature is below the configured condenser freeze point temperature. Deenergizes when the temperature is 5 F (3 C) above condenser freeze point temperature.	CONDENSER FREEZE POINT configured in SETUP1 table with a default setting of 34 F (1 C).

Table 5 — Capacity Overrides Table   Capacity Overrides

OVERRIDE CAPACITY CONTROL	FIRST STAGE SET POINT			SECOND STAGE SET POINT	OVERRIDE TERMINATION
	View/Modify on CVC Screen	Default Value	Configurable Range	Value	Value
HIGH CONDENSER PRESSURE	SETUP1	230 psig (1586 kPa)	150 to 260 psig (1032 to 1793 kPa)	>Override Set Point +10° F (6° C)	<Override Set Point
REFRIGERANT OVERRIDE DELTA TEMPERATURE (Low refrigerant temperature)	SETUP1	3° F (1.6° C)	2° to 5° F (1° to 3° C)	≤Trippoint + Override ΔT - 1° F (0.56° C)	>Trippoint + Override ΔT+2° F (1.2° C)
MANUAL SLIDE VALVE LOAD/UNLOAD	COMPRESS	Automatic	–10 to +10 sec	None	Release of Manual Control
MOTOR LOAD-ACTIVE DEMAND LIMIT	MAINSTAT	100%	40 to 100%	≥5% of Set Point	2% Lower Than Set Point
DISCHARGE SUPERHEAT FRAME 1 AND 2 R-22 ONLY	OVERRIDE	Calculated Minimum Superheat For Conditions	–20 to 999	2° F (1.1° C) Below Calculated Superheat	1° F (0.56° C) Above Calculated Minimum Superheat

Remote Start/Stop Controls — A remote device, such as a timeclock that uses a set of contacts, may be used to start and stop the chiller. However, the device should not be programmed to start and stop the chiller in excess of 2 or 3 times every 12 hours. If more than 8 starts in 12 hours (the *STARTS IN 12 HOURS* parameter on the MAINSTAT screen) occur, an excessive starts alarm displays, preventing the chiller from starting. The operator must press the RESET softkey on the CVC to override the starts counter and start the chiller. If the chiller records 12 starts (excluding recycle starts) in a sliding 12-hour period, it can be restarted only by pressing the RESET softkey followed by the LOCAL or CCN softkey. This ensures that, if the automatic system is malfunctioning, the chiller will not repeatedly cycle on and off. If the automatic restart after a power failure option (*AUTO RESTART OPTION* on the OPTIONS screen) is not activated when a power failure occurs, and if the remote contact is closed, the chiller will indicate an alarm because of the loss of voltage.

The contacts for remote start are wired into the starter at terminal strip J2, terminals 5 and 6 on the ISM. See the certified drawings for further details on contact ratings. The contacts must have 24 vac rating.

Spare Safety Inputs — Normally closed (NC) discrete inputs for additional field-supplied safeties may be wired to the spare protective limits input channel in place of the factory-installed jumper. (Wire multiple inputs in series.) The opening of any contact will result in a safety shutdown and a display on the CVC. Refer to the certified drawings for safety contact ratings.

Analog temperature sensors may also be added to the module (SPARE TEMP #1 and #2). The analog temperature sensors may be configured to cause an alert or alarm on the CCN network. The alert will not shut the chiller down. Configuring for alarm state will cause the chiller to shut down.

Spare Safety Alarm Contacts — One set of alarm contacts is provided in the starter. The contact ratings are provided in the certified drawings. The contacts are located on terminal strip JP, terminals 15 and 16.

Refrigerant Leak Detector — An input is available on the CCM module [terminal J15-5 (–) and J5-6 (+)] for a refrigerant leak detector. Enabling *REFRIGERANT LEAK OPTION* (OPTIONS screen) will allow the PIC II controls to go into an alarm state at a user configured level (*REFRIGERANT LEAK ALARM mA)*. The input is configured for 4 to 20 mA by setting the DIP switch 1 on SW2 at the ON position, or configured for 0 to 5 vdc by setting switch 1 at the OFF position. The output of the refrigerant leak detector is displayed as *REFRIGERANT LEAK SENSOR* on the MAINSTAT screen. For a 0 to 5 vdc input, 0 vdc input represents 4 mA displayed and 5 vdc input represents 20 mA displayed.

Condenser Pump Control — The chiller will monitor the condenser pressure (*CONDENSER PRESSURE*) and may turn on the condenser pump if the condenser pressure becomes too high while the compressor is shut down. The condenser pressure override (*COND PRESS OVERRIDE*) parameter is used to determine this pressure point. *COND PRESS OVERRIDE* is found in the SETUP1 display screen, which is accessed from the EQUIPMENT SERVICE table. The default value is 230 psig (862 kPa).

If the *CONDENSER PRESSURE* is greater than or equal to the *COND PRESS OVERRIDE*, and the entering condenser water temperature (*ENTERING CONDENSER WATER*) is less than 115 F (46 C), the condenser pump will energize to try to decrease the pressure. The pump will turn off when the condenser pressure is 3.5 psi (24.1 kPa) less than the pressure override or when the condenser refrigerant temperature (*CONDENSER REFRIG TEMP*) is within 3º F (1.7º C) of the entering condenser water temperature (*ENTERING CONDENSER WATER*).

Condenser Freeze Prevention — This control algorithm helps prevent condenser tube freeze-up by energizing the condenser pump relay. The PIC II controls the pump and, by starting it, helps to prevent the water in the condenser from freezing. The PIC II can perform this function whenever the chiller is not running except when it is either actively in pumpdown or in pumpdown/lockout with the freeze prevention disabled.

When the *CONDENSER REFRIG TEMP* is less than or equal to the *CONDENSER FREEZE POINT*, the *CONDENSER WATER PUMP* is energized until the *CONDENSER REFRIG TEMP* is greater than the *CONDENSER FREEZE POINT* plus 5º F (2.7º C) and the *ENTERING CONDENSER WATER TEMPERATURE* is greater than or equal to the *CONDENSER FREEZE POINT.* An alarm is generated if the chiller is in PUMPDOWN mode and the pump is energized. An alert is generated if the chiller is not in PUMPDOWN mode and the pump is energized. If the chiller is in RECYCLE SHUTDOWN mode, the mode will transition to a non-recycle shutdown.

Tower Fan Relay Low and High — Low condenser water temperature can cause the chiller to shut down when refrigerant temperature is low. The tower fan relays, located in the starter, are controlled by the PIC II to energize and deenergize as the pressure differential between cooler and condenser vessels changes. This prevents low condenser water temperature and maximizes chiller efficiency. The tower fan relay can only accomplish this if the relay has been added to the cooling tower temperature controller.

The tower fan relay low is turned on whenever the condenser water pump is running, flow is verified, and the difference between cooler and condenser pressure is more than 30 psid (207 kPad) for entering condenser water temperature greater than 65 F (18.3 C).

The tower fan relay low is turned off when the condenser pump is off, flow is stopped, or the cooler refrigerant temperature is less than the override temperature for *ENTERING CONDENSER WATER* temperature less than 62 F (16.7 C), or the differential pressure is less than 25 psid (172.4 kPad) for entering condenser water less than 80 F (27 C).

The tower fan relay high is turned on whenever the condenser water pump is running, flow is verified and the difference between cooler and condenser pressure is more than 35 psid (241.3 kPa) for entering condenser water temperature greater than the *TOWER FAN HIGH SETPOINT* (SETPOINT menu, default 75 F [23.9 C]).

The tower fan relay high is turned off when the condenser pump is off, flow is stopped, or the cooler refrigerant temperature is less than the override temperature and *ENTERING CONDENSER WATER* is less than 70 F (21.1 C), or the difference between cooler and condenser pressure is less than 28 Psid (193 kPa), or *ENTERING CONDENSER WATER* temperature is less than *TOWER FAN HIGH SETPOINT* minus 3 F (–16.1 C).

The TOWER FAN RELAY LOW and HIGH parameters are accessed from the STARTUP screen.

> IMPORTANT: A field-supplied water temperature control system for condenser water should be installed. The system should maintain the leaving condenser water temperature at a temperature that is 20º F (11º C) above the leaving chilled water temperature.

⚠ CAUTION

> The tower fan relay control is not a substitute for a condenser water temperature control. When used with a water temperature control system, the tower fan relay control can be used to help prevent low condenser water temperatures.

Auto. Restart After Power Failure — This option may be enabled or disabled and may be viewed or modified on the OPTIONS screen, which is accessed from the EQUIPMENT CONFIGURATION table. If the *AUTO. RESTART* option is enabled, the chiller will start up automatically after a power failure has occurred (after a single cycle dropout; low, high, or loss of voltage; and the power is within ±10% of normal). The 15- and 3-minute inhibit timers are ignored during this type of start-up.

When power is restored after the power failure, a power failure restart will be enabled and the control allowed to AUTORESTART the chiller, starting with the chilled water pump(s), if start-up conditions are met.

If power to the CVC module has been off for more than 3 hours or the timeclock has been set for the first time, start the compressor with the slowest temperature-based ramp load rate possible in order to minimize oil foaming.

Water/Brine Reset — Three types of chilled water or brine reset are available and can be viewed or modified on the TEMP_CTL screen, which is accessed from the EQUIPMENT SERVICE table.

The CVC default screen indicates when the chilled water reset is active. *TEMPERATURE RESET* on the MAINSTAT screen indicates the amount of reset. The CONTROL POINT will be determined by adding the *TEMPERATURE RESET* to the SETPOINT.

To activate a reset type, access the TEMP_CTL screen and input all configuration information for that reset type. Then, input the reset type number (1, 2, or 3) in the SELECT/ENABLE RESET TYPE input line.

RESET TYPE 1: 4 to 20 mA (0 to 5 vdc) *TEMPERATURE RESET* — Reset Type 1 is an automatic chilled water temperature reset based on a remote temperature sensor input configured for either an externally powered 4 to 20 mA or a 0 to 5 vdc signal. Reset Type 1 permits up to ±30 F (±16 C) of automatic reset to the chilled water set point.

The auto, chilled water reset is hardwired to terminals J5-3 (–) and J5-4 (+) on the CCM. Switch setting number 2 on SW2 will determine the type of input signal. With the switch set at the ON position the input is configured for an externally powered 4 to 20 mA signal. With the switch in the OFF position the input is configured for an external 0 to 5 vdc signal.

RESET TYPE 2: *REMOTE TEMPERATURE RESET* — Reset Type 2 is an automatic chilled water temperature reset based on a remote temperature sensor input signal. Reset Type 2 permits ±30º F (±16º C) of automatic reset to the set point based on a temperature sensor wired to the CCM module (see wiring diagrams or certified drawings). The temperature sensor must be wired to terminal J4-13 and J4-14.

To configure Reset Type 2, enter the temperature of the remote sensor at the point where no temperature reset will occur (*REMOTE TEMP [NO RESET]*). Next, enter the temperature at which the full amount of reset will occur (*REMOTE TEMP [FULL RESET]*). Then, enter the maximum amount of reset required to operate the chiller (*DEGREES RESET*). Reset Type 2 can now be activated.

RESET TYPE 3 — Reset Type 3 is an automatic chilled water temperature reset based on cooler temperature difference. Reset Type 3 adds ±30º F (±16º C) based on the temperature difference between the entering and leaving chilled water temperature.

To configure Reset Type 3, enter the chilled water temperature difference (the difference between entering and leaving chilled water) at which no temperature reset occurs (*CHW DELTA T [NO RESET]*). This chilled water temperature difference is usually the full design load temperature difference. Next, enter the difference in chilled water temperature at which the full amount of reset occurs (*CHW DELTA T [FULL RESET]*). Finally, enter the amount of reset (*DEGREES RESET*). Reset Type 3 can now be activated.

Demand Limit Control Option — The demand limit control option (*20 mA DEMAND LIMIT OPT*) is externally controlled by a 4 to 20 mA or 0 to 5 vdc signal from an energy management system (EMS). The option is set up on the RAMP_DEM screen. When enabled, 4 mA is the 100% demand set point with an operator-configured minimum demand at a 20 mA set point (*DEMAND LIMIT AT 20 mA*).

The auto. demand limit is hardwired to terminals J5-5 (–) and J5-6 (+) on the CCM. Switch setting number 1 on SW2 will determine the type of input signal. With the switch set at the ON position the input is configured for an externally powered 4 to 20 mA signal. With the switch in the OFF position the input is configured for an external 0 to 5 vdc signal.

Hot Gas Bypass (Optional) Algorithm (See Fig. 24 and 25) — If a hot gas bypass solenoid valve is present, and the hot gas bypass option on the OPTIONS table is enabled, this operator configurable feature can determine if load conditions are too low for the compressor and then take corrective action.

The algorithm first determines if corrective action is necessary. This is done by checking two sets of operator configured data points, which are the MINIMUM and the MAXIMUM Load Points, (T1/P1;T2/P2). These points have default settings for each type of refrigerant, HCFC-22 or HFC-134a, as defined on the OPTIONS table, and on Table 3. These settings and the algorithm logic are graphically displayed in Fig. 24 and 25. The two sets of load points on this graph (default settings are shown) describe a line which the algorithm uses to activate the hot gas bypass. Whenever the temperature difference between the entering and leaving chilled water is on the left side of the line on the graph (as defined by the MINIMUM and MAXIMUM Load Points), the algorithm will then energize the hot gas bypass valve to falsely load the chiller and prevent displacement of oil. If the actual values are on the right side of the line, the algorithm takes no action.

HEAD PRESSURE OUTPUT REFERENCE (See Fig. 26) — The PIC II control outputs a 4 to 20 mA signal for the configurable Delta P (condenser pressure – evaporator pressure) reference curve shown in Fig. 26. The Delta P at 100% (default at 35 psi). Delta P at 0% (default at 25 psi) and Minimum Reference Point are configurable in the EQUIPMENT SERVICE-OPTIONS table. When configuring this output, ensure that minimum requirements for oil pressure and proper condenser FLASC orifice performance are maintained.

Lead/Lag Control — The lead/lag control system automatically starts and stops a lag or second chiller in a 2-chiller water system. A third chiller can be added to the lead/lag system as a standby chiller to start up in case the lead or lag chiller in the system has shut down during an alarm condition and additional cooling is required.Refer to Fig. 20 and 21 for menu, table, and screen selection information.

NOTE: The lead/lag function can be configured on the LEADLAG screen, which is accessed from the SERVICE menu and EQUIPMENT SERVICE table. See Table 3, Example 19. Lead/lag status during chiller operation can be viewed on the LL_MAINT display screen, which is accessed from the SERVICE menu and CONTROL ALGORITHM STATUS table. See Table 3, Example 11.

Lead/Lag System Requirements:

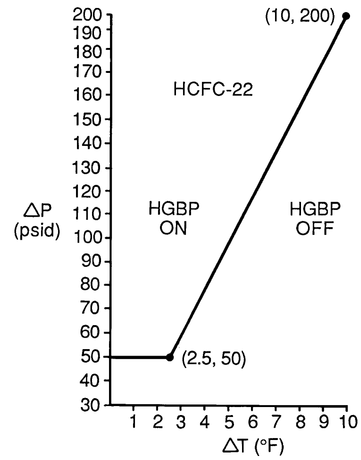
- all chillers in the system must have software capable of performing the lead/lag function
- water pumps MUST be energized from the PIC II controls
- water flows should be constant
- the CCN time schedules for all chillers must be identical

Operation Features:

- 2 chiller lead/lag
- addition of a third chiller for backup
- manual rotation of lead chiller
- load balancing if configured
- staggered restart of the chillers after a power failure
- chillers may be piped in parallel or in series chilled water flow

COMMON POINT SENSOR INSTALLATION — Lead/lag operation does not require a common chilled water point sensor. Common point sensors (Spare Temp #1 and #2) can be added to the CCM module, if desired. Spare Temp #1 and #2 are wired to plug J4 terminals 25-26 and 27-28 (J4 lower, respectively).

NOTE: If the common point sensor option is chosen on a chilled water system, each chiller should have its own common point sensor installed. Each chiller uses its own common point sensor for control when that chiller is designated as the lead chiller. The PIC II cannot read the value of common point sensors installed on the other chillers in the chilled water system.



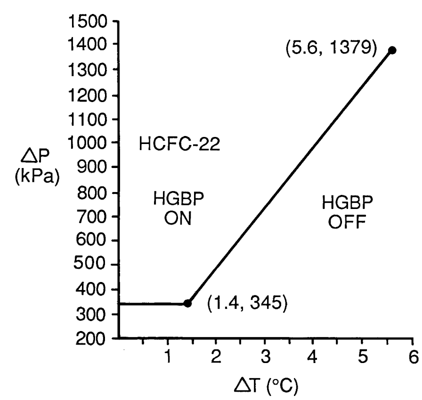
LEGEND

ΔP — Condenser Pressure-Cooler Pressure
ΔT — ECW-LCW
ECW — Entering Chilled Water Temperature
LCW — Leaving Chilled Water Temperature
HGBP — Hot Gas Bypass

DEFAULT VALUES:

POINT	HCFC-22	HFC-134a
ΔT_1	2.5	2.5
ΔP_1	50	30
ΔT_2	10	10
ΔP_2	200	170

Fig. 24 — 23XL Hot Gas Bypass (English)



LEGEND

ΔP — Condenser Pressure-Cooler Pressure
ΔT — ECW-LCW
ECW — Entering Chilled Water Temperature
LCW — Leaving Chilled Water Temperature
HGBP — Hot Gas Bypass

DEFAULT VALUES:

POINT	HCFC-22	HFC-134a
ΔT_1	1.4	1.4
ΔP_1	345	207
ΔT_2	5.6	5.6
ΔP_2	1379	1172

Fig. 25 — 23XL Hot Gas Bypass (SI)

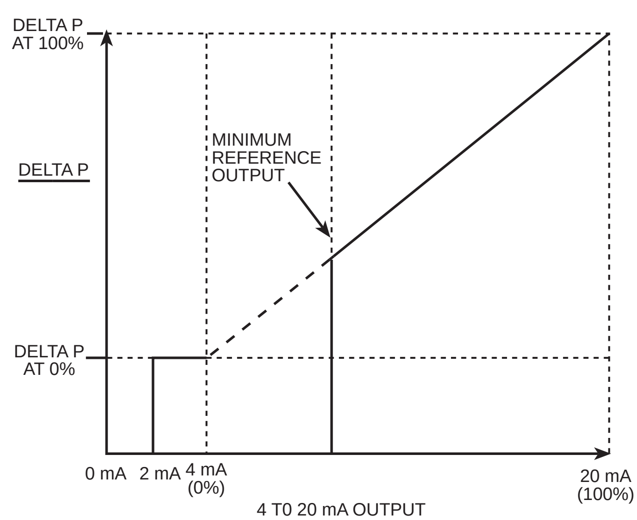


Fig. 26 — Head Pressure Output Reference Control

If leaving chilled water control (*ECW CONTROL OPTION* is set to 0 [DSABLE], TEMP_CTL screen) and a common point sensor is desired (*COMMON SENSOR OPTION* in LEADLAG screen selected as 1) then the sensor is wired in Spare Temp #1 position on the CCM.

If the entering chilled water control option (ECW CONTROL OPTION) is enabled (configured in TEMP_CTL screen) and a common point sensor is desired (COMMON SENSOR OPTION in LEADLAG screen selected as 1) then the sensor is wired in Spare Temp #2 position on the CCM.

When installing chillers in series, a common point sensor should be used. If a common point sensor is not used, the leaving chilled water sensor of the upstream chiller must be moved into the leaving chilled water pipe of the downstream chiller.

If return chilled water control is required on chillers piped in series, the common point return chilled water sensor should be installed. If this sensor is not installed, the return chilled water sensor of the downstream chiller must be relocated to the return chilled water pipe of the upstream chiller.

To properly control the common supply point temperature sensor when chillers are piped in parallel, the water flow through the shutdown chillers must be isolated so no water bypass around the operating chiller occurs. The common point sensor option must not be used if water bypass around the operating chiller is occurring.

CHILLER COMMUNICATION WIRING — Refer to the chiller's Installation Instructions, Carrier Comfort Network Interface section for information on chiller communication wiring.

LEAD/LAG OPERATION — The PIC II not only has the ability to operate 2 chillers in lead/lag, but it can also start a designated standby chiller when either the lead or lag chiller is faulted and capacity requirements are not met. The lead/lag option only operates when the chillers are in CCN mode. If any other chiller configured for lead/lag is set to the LOCAL or OFF modes, it will be unavailable for lead/lag operation.

<u>Lead/Lag Chiller Configuration and Operation</u>

- A chiller is designated the lead chiller when its *LEAD/LAG CONFIGURATION* value on the LEADLAG screen is set to “1.”
- A chiller is designated the lag chiller when its *LEAD/LAG CONFIGURATION* value is set to “2.”
- A chiller is designated as a standby chiller when its *LEAD/LAG CONFIGURATION* value is set to “3.”
- A value of “0” disables the lead/lag designation of a chiller.

To configure the *LAG ADDRESS* value on the LEADLAG screen, always enter the address of the other chiller on the system. For example, if you are configuring chiller A, enter the address for chiller B as the lag address. If you are configuring chiller B, enter the address for chiller A as the lag address. This makes it easier to rotate the lead and lag chillers.

If the address assignments in the *LAG ADDRESS* and *STANDBY ADDRESS* parameters conflict, the lead/lag function is disabled and an alert (!) message displays. For example, if the *LAG ADDRESS* matches the lead chiller's address, the lead/lag will be disabled and an alert (!) message displayed. The lead/lag maintenance screen (LL_MAINT) displays the message ‘INVALID CONFIG’ in the *LEAD/LAG: CONFIGURATION* and *CURRENT MODE* fields.

The lead chiller responds to normal start/stop controls such as the occupancy schedule, a forced start or stop, and remote start contact inputs. After completing start-up and ramp loading, the PIC II evaluates the need for additional capacity. If additional capacity is needed, the PIC II initiates the start-up of the chiller configured at the *LAG ADDRESS*. If the lag chiller is faulted (in alarm) or is in the OFF or LOCAL modes, the chiller at the *STANDBY ADDRESS* (if configured) is requested to start. After the second chiller is started and is running, the lead chiller monitors conditions and evaluates whether the capacity has been reduced enough for the lead chiller to sustain the system alone. If the capacity is reduced enough for the lead chiller to sustain the *CONTROL POINT* temperatures alone, then the operating lag chiller is stopped.

If the lead chiller is stopped in CCN mode for any reason other than an alarm (*) condition, the lag and standby chillers are also stopped. If the configured lead chiller stops for an alarm condition, the configured lag chiller takes the lead chiller's place as the lead chiller, and the standby chiller serves as the lag chiller.

If the configured lead chiller does not complete the start-up before the *PRESTART FAULT TIMER* (a user-configured value) elapses, then the lag chiller starts and the lead chiller shuts down. The lead chiller then monitors the start request from the acting lead chiller. The *PRESTART FAULT TIMER* is initiated at the time of a start request. The *PRESTART FAULT TIMER* provides a timeout if there is a prestart alert condition that prevents the chiller from starting in a timely manner. The *PRESTART FAULT TIMER* parameter is on the LEAD-LAG screen, which is accessed from the EQUIPMENT SERVICE table of the SERVICE menu.

If the lag chiller does not achieve start-up before the *PRESTART FAULT TIMER* elapses, the lag chiller stops, and the standby chiller is requested to start, if configured and ready.

<u>Standby Chiller Configuration and Operation</u> — A chiller is designated as a standby chiller when its *LEAD/LAG CONFIGURATION* value on the LEADLAG screen is set to “3.” The standby chiller can operate as a replacement for the lag chiller only if one of the other two chillers is in an alarm (*) condition (as shown on the CVC panel). If both lead and lag chillers are in an alarm (*) condition, the standby chiller defaults to operate in CCN mode, based on its configured occupancy schedule and remote contacts input.

<u>Lag Chiller Start-Up Requirements</u> — Before the lag chiller can be started, the following conditions must be met:

1. Lead chiller ramp loading must be complete.
2. Lead chilled water temperature must be greater than the *CONTROL POINT* temperature (see the MAINSTAT screen) plus 1/2 the *CHILLED WATER DEADBAND* temperature (see the SETUP1 screen).

   NOTE: The chilled water temperature sensor may be the leaving chilled water sensor, the return water sensor, the common supply water sensor, or the common return water sensor, depending on which options are configured and enabled.
3. Lead chiller *ACTIVE DEMAND LIMIT* (see theMAINSTAT screen) value must be greater than 95% of full load amps.
4. Lead chiller temperature pulldown rate (*TEMP PULLDOWN DEG/MIN* on the TEMP_CTL screen) of the chilled water temperature is less than 0.5º F (0.27º C) per minute.
5. The lag chiller status indicates it is in CCN mode and is not in an alarm condition. If the current lag chiller is in an alarm condition, the standby chiller becomes the active lag chiller, if it is configured and available.
6. The configured *LAG START TIMER* entry has elapsed. The *LAG START TIMER* starts when the lead chiller ramp loading is completed. The *LAG START TIMER* entry is on the LEADLAG screen, which is accessed from the EQUIPMENT SERVICE table of the SERVICE menu.

When all the above requirements have been met, the lag chiller is commanded to a STARTUP mode (SUPVSR flashing next to the point value on the STATUS table). The PIC II control then monitors the lag chiller for a successful start. If the lag chiller fails to start, the standby chiller, if configured is started.

Lag Chiller Shutdown Requirements — The following conditions must be met in order for the lag chiller to be stopped.

1. Lead chiller compressor motor average line current or load value (*MOTOR PERCENT KILOWATTS* on the MAINSTAT screen) is less than the lead chiller percent capacity.

   NOTE: Lead chiller percent capacity = 115 — *LAG PERCENT CAPACITY.* The *LAG PERCENT CAPACITY* parameter is on the LEADLAG screen, which is accessed from the EQUIPMENT SERVICE table on the SERVICE menu.
2. The lead chiller chilled water temperature is less than the *CONTROL POINT* temperature (see the MAINSTAT screen) plus the *CHILLED WATER DEADBAND* temperature (see the SETUP1 screen).
3. The configured *LAG STOP TIME* entry has elapsed. The *LAG STOP TIMER* starts when the lead chiller chilled water temperature is less than the chilled water CONTROL POINT plus 1/2 of the *CHILLED WATER DEADBAND* and the lead chiller compressor motor load (*MOTOR PERCENT KILOWATT* or *AVERAGE LINE CURRENT* on the MAINSTAT screen) is less than the lead chiller percent capacity.

NOTE: Lead chiller percent capacity = 115 — LAG PERCENT CAPACITY. The LAG PERCENT CAPACITY parameter is on the LEADLAG screen, which is accessed from the EQUIPMENT SERVICE table on the SERVICE menu.

FAULTED CHILLER OPERATION — If the lead chiller shuts down because of an alarm (*) condition, it stops communicating to the lag and standby chillers. After 30 seconds, the lag chiller becomes the acting lead chiller and starts and stops the standby chiller, if necessary.

If the lag chiller goes into alarm when the lead chiller is also in alarm, the standby chiller reverts to a stand-alone CCN mode of operation.

If the lead chiller is in an alarm (*) condition (as shown on the CVC panel), press the RESET softkey to clear the alarm. The chiller is placed in CCN mode. The lead chiller communicates and monitors the RUN STATUS of the lag and standby chillers. If both the lag and standby chillers are running, the lead chiller does not attempt to start and does not assume the role of lead chiller until either the lag or standby chiller shuts down. If only one chiller is running, the lead chiller waits for a start request from the operating chiller. When the configured lead chiller starts, it assumes its role as lead chiller.

If the lag chiller is the only chiller running when the lead chiller assumes its role as a lead chiller then the lag chiller will perform a *RECOVERY START REQUEST* (LL_MAINT screen). The lead chiller will start up when the following conditions are met.

1. Lag chiller ramp loading must be complete.
2. Lag *CHILLED WATER TEMP* (MAINSTAT screen) is greater than *CONTROL POINT* plus 1/2 the *CHILLED WATER DEADBAND* temperature.
3. Lag chiller *ACTIVE DEMAND LIMIT* value must be greater than 95% of full load amps.
4. Lag chiller temperature pulldown rate (*TEMP PULLDOWN DEG/MIN*) of the chilled water temperature is less than 0.5 F (0.27 C) per minute.
5. The standby chiller is not running as a lag chiller.
6. The configured *LAG START TIMER* has elapsed. The *LAG START TIMER* is started when ramp loading is completed.

LOAD BALANCING — When the *LOAD BALANCE OPTION* (see LEADLAG screen) is enabled, the lead chiller sets the *ACTIVE DEMAND LIMIT* in the lag chiller to the lead chiller's compressor motor load value *MOTOR PERCENT KILOWATTS* or *AVERAGE LINE CURRENT* on the MAINSTAT screen). This value has limits of 40% to 100%. When the lag chiller *ACTIVE DEMAND LIMIT* is set, the *CONTROL POINT* must be modified to a value of 3º F (1.67º C) less than the lead chiller's *CONTROL POINT* value. If the *LOAD BALANCE OPTION* is disabled, the *ACTIVE DEMAND LIMIT* and the *CONTROL POINT* are forced to the same value as the lead chiller.

AUTO. RESTART AFTER POWER FAILURE — When an auto. restart condition occurs, each chiller may have a delay added to the start-up sequence, depending on its lead/lag configuration. The lead chiller does not have a delay. The lag chiller has a 45-second delay. The standby chiller has a 90-second delay. The delay time is added after the chiller water flow is verified. The PIC II ensures adequate time for the slide valve to unload. After the slide valve unload timer (start-up screen) has expired, the 45 and 90 second delays for The lag and standby chillers occurs prior to energizing 1CR. The normal start-up sequence then continues. The auto. restart delay sequence occurs whether the chiller is in CCN or LOCAL mode and is intended to stagger the compressor motor starts. Preventing the motors from starting simultaneously helps reduce the inrush demands on the building power system.

Ice Build Control — The ice build control option automatically sets the *CONTROL POINT* of the chiller to a temperature that allows ice building for thermal storage.

NOTE: For ice build control to operate properly, the PIC II must be in CCN mode.

NOTE: See Fig. 20 and 21 for more information on ice build-related menus.

The PIC II can be configured for ice build operation.

- From the SERVICE menu, access the EQUIPMENT SERVICE table. From there, select the OPTIONS screen to enable or disable the *ICE BUILD OPTION*. See Table 3, Example 16.
- The *ICE BUILD SETPOINT* can be configured from the SETPOINT display, which is accessed from the PIC II main menu. See Table 3, Example 8.
- The ice build schedule can be viewed or modified from the SCHEDULE table. From this table, select the ice build schedule (OCCPC02S) screen. See Fig. 22 and the section on Time Schedule Operation, page 24, for more information on modifying chiller schedules.

The ice build time schedule defines the period(s) during which ice build is active if the ice build option is enabled. If the ice build time schedule overlaps other schedules, the ice build time schedule takes priority. During the ice build period, the *CONTROL POINT* is set to the *ICE BUILD SETPOINT* for temperature control. The *ICE BUILD RECYCLE* and *ICE BUILD TERMINATION* parameters, accessed from the OPTIONS screen, allow the chiller operator to recycle or terminate the ice build cycle. The ice build cycle can be configured to terminate if:

- the *ENTERING CHILLED WATER* temperature is less than the *ICE BUILD SETPOINT.* In this case, the operator sets the *ICE BUILD TERMINATION* parameter to 0 on the OPTIONS screen.
- the REMOTE CONTACT inputs from an ice level indicator are opened. In this case, the operator sets the *ICE BUILD TERMINATION* parameter to 1 on the OPTIONS screen.
- the chilled water temperature is less than the ice build set point and the remote contact inputs from an ice level indicator are open. In this case, the operator sets the *ICE BUILD TERMINATION* parameter to 2 on the OPTIONS screen.
- the end of the ice build time schedule has been reached.

ICE BUILD INITIATION — The ice build time schedule (OCCPC02S) is the means for activating the ice build option. The ice build option is enabled if:

- a day of the week and a time period on the ice build time schedule are enabled. The SCHEDULE screen shows an X in the day field and ON/OFF times are designated for the day(s),
- *and* the *ICE BUILD OPTION* is enabled.

The following events take place (unless overridden by a higher authority CCN device).

1. *CHILLER START/STOP* is forced to START.
2. The *CONTROL POINT* is forced to the *ICE BUILD SETPOINT.*
3. Any force (Auto) is removed from the *ACTIVE DEMAND LIMIT.*

NOTE: A parameter's value can be forced, that is, the value can be manually changed at the CVC by an operator, changed from another CCN device, or changed by other algorithms in the PIC II control system.

NOTE: Items 1-3 (shown above) do not occur if the chiller is configured and operating as a lag or standby chiller for lead/lag operation and is actively being controlled by a lead chiller. The lead chiller communicates the *ICE BUILD SET POINT,* the desired *CHILLER START/STOP* state, and the *ACTIVE DEMAND LIMIT* to the lag or standby chiller as required for ice build, if configured to do so.

START-UP/RECYCLE OPERATION — If the chiller is not running when ice build activates, the PIC II checks the following conditions, based on the *ICE BUILD TERMINATION* value, to avoid starting the compressor unnecessarily:

- if *ICE BUILD TERMINATION* is set to the TEMP option and the *ENTERING CHILLED WATER* temperature is less than or equal to the I*CE BUILD SETPOINT*;
- if *ICE BUILD TERMINATION* is set to the *CONTACTS* option and the remote contacts are open;
- if the I*CE BUILD TERMINATION* is set to the BOTH (temperature and contacts) option and the *ENTERING CHILLED WATER* temperature is less than or equal to the *ICE BUILD SETPOINT* and the remote contacts are open.

The *ICE BUILD RECYCLE* on the OPTIONS screen determines whether or not the chiller will go into an ice build RECYCLE mode.

- If the *ICE BUILD RECYCLE* is set to DSABLE (disable), the PIC II reverts to normal temperature control when the ice build function terminates.
- If the *ICE BUILD RECYCLE* is set to ENABLE, the PIC II goes into an *ICE BUILD RECYCLE* mode and the chilled water pump relay remains energized to keep the chilled water flowing when the ice build function terminates. If the temperature of the *ENTERING CHILLED WATER* increases above the *ICE BUILD SETPOINT* plus the *RECYCLE RESTART DELTA T* value, the compressor restarts and controls the chilled water/brine temperature to the *ICE BUILD SETPOINT.*

TEMPERATURE CONTROL DURING ICE BUILD — During ice build, the capacity control algorithm shall use the *CONTROL POINT* minus 5 F (–2.8 C) for control of the *LEAVING CHILLED WATER* temperature. See Table 3, example 9, the *CAPACITY CONTROL* parameter on the CAPACITY screen.) The *ECW CONTROL OPTION* and any temperature reset option shall be ignored, if enabled, during ice build. The *AUTO DEMAND LIMIT INPUT* shall also be ignored if enabled during ice build.

- *ECW CONTROL OPTION* and any temperature reset options (configured on TEMP_CTL screen).
- *20 mA DEMAND LIMIT OPT* (configured on RAMP_DEM screen).

TERMINATION OF ICE BUILD — The ice build function terminates under the following conditions:

1. Time Schedule — When the current time on the ice build time schedule (OCCPC02S) is *not* set as an ice build time period.
2. Entering Chilled Water Temperature — Compressor operation terminates, based on temperature, if the *ICE BUILD TERMINATION* parameter is set to 0 (TEMP), the *ENTERING CHILLED WATER* temperature is less than the *ICE BUILD SETPOINT,* and the ICE BUILD-RECYCLE is set to DSABLE. If the *ICE BUILD RECYCLE OPTION* is set to ENABLE, a recycle shutdown occurs and recycle start-up depends on the *LEAVING CHILLED WATER* temperature being greater than the *WATER/BRINE CONTROL POINT* plus the *RECYCLE RESTART DELTA T* temperature
3. Remote Contacts/Ice Level Input — Compressor operation terminates when the *ICE BUILD TERMINATION* parameter is set to 1 [CONTACTS] and the remote contacts are open and the *ICE BUILD RECYCLE* is set to DSABLE (0). In this case, the contacts provide ice level termination control. The contacts are used to stop the ice build function when a time period on the ice build schedule (OCCPC02S) *is* set for ice build operation. The remote contacts can still be opened and closed to start and stop the chiller when a specific time period on the ice build schedule is *not* set for ice build.
4. Entering Chilled Water Temperature and ICE BUILD Contacts — Compressor operation terminates when the *ICE BUILD TERMINATION* parameter is set to 2 (*BOTH*) and the conditions described above in items 2 and 3 for entering chilled water temperature and remote contacts have occurred.

NOTE: It is not possible to override the *CHILLER START/STOP*, *CONTROL POINT,* and *ACTIVE DEMAND LIMIT* variables from CCN devices (with a priority 4 or greater) during the ice build period. However, a CCN device can override these settings during 2-chiller lead/lag operation.

RETURN TO NON-ICE BUILD OPERATIONS — The ice build function forces the chiller to start, even if all other schedules indicate that the chiller should stop. When the ice build function terminates, the chiller returns to normal temperature control and start/stop schedule operation. The *CHILLER START/STOP* and *CONTROL POINT* return to normal operation. If the *CHILLER START/STOP* or *CONTROL POINT* has been forced (with a device of less than 4 priority) before the ice build function started, when the ice build function ends, the previous forces (of less than 4 priority) are not automatically restored.

Attach to Network Device Control — The Service menu includes the ATTACH TO NETWORK DEVICE screen. From this screen, the operator can:

- enter the time schedule number (if changed) for OCCPC03S, as defined in the NET_OPT screen
- attach the CVC to any CCN device, if the chiller has been connected to a CCN network. This may include other PIC- controlled chillers.
- upgrade software

Figure 27 shows the ATTACH TO NETWORK DEVICE screen. The *LOCAL* parameter is always the CVC module address of the chiller on which it is mounted. Whenever the controller identification of the CVC changes, the change is reflected automatically in the BUS and ADDRESS columns for the local device. See Fig. 21. Default address for local device is BUS 0 ADDRESS 1.

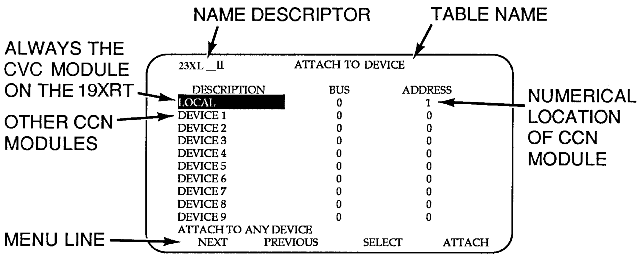


Fig. 27 — Example of Attach to Network Device Screen

When the ATTACH TO NETWORK DEVICE screen is accessed, information can not be read from the CVC on any device until one of the devices listed on that screen is attached. The CVC erases information about the module to which it was attached to make room for information on another device. Therefore, a CCN module must be attached when this screen is entered.

To attach any CCN device, highlight it using the SELECT softkey and press the ATTACH softkey. The message "UPLOADING TABLES, PLEASE WAIT" displays. The CVC then uploads the highlighted device or module. If the module address cannot be found, the message "COMMUNICATION FAILURE" appears. The CVC then reverts back to the ATTACH TO DEVICE screen. Try another device or check the address of the device that would not attach. The upload process time for each CCN module is different. In general, the uploading process takes 1 to 2 minutes. Before leaving the ATTACH TO NETWORK DEVICE screen, select the local device. Otherwise, the CVC will be unable to display information on the local chiller.

ATTACHING TO OTHER CCN MODULES — If the chiller CVC has been connected to a CCN Network or other PIC controlled chillers through CCN wiring, the CVC can be used to view or change parameters on the other controllers. Other PIC II chillers can be viewed and set points changed (if the other unit is in CCN control), if desired, from this particular CVC module.

If the module number is not valid, the "COMMUNICATION FAILURE" message will show and a new address number must be entered or the wiring checked. If the module is communicating properly, the "UPLOAD IN PROGRESS" message will flash and the new module can now be viewed.

Whenever there is a question regarding which module on the CVC is currently being shown, check the device name descriptor on the upper left hand corner of the CVC screen. See Fig. 27.

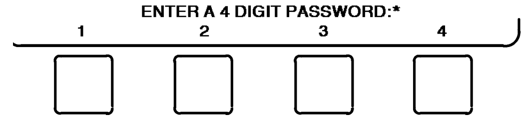
When the CCN device has been viewed, the ATTACH TO NETWORK DEVICE table should be used to attach to the PIC that is on the chiller. Move to the ATTACH TO NETWORK DEVICE table (LOCAL should be highlighted) and press the ATTACH softkey to upload the LOCAL device. The CVC for the 23XL will be uploaded and default screen will display.

NOTE: The CVC will not automatically reattach to the local module on the chiller. Press the ATTACH softkey to attach to the LOCAL device and view the chiller operation.

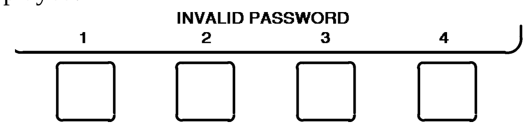
Service Operation — An overview of the tables and screens available for the SERVICE function is shown in Fig. 21.

TO ACCESS THE SERVICE SCREENS — When the SERVICE screens are accessed, a password must be entered.

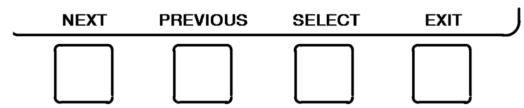
1. From the main MENU screen, press the SERVICE softkey. The softkeys now correspond to the numerals 1, 2, 3, 4.
2. Press the four digits of the password, one at a time. An asterisk (*) appears as each digit is entered.



NOTE: The initial factory-set password is 1-1-1-1. If the password is incorrect, an error message is displayed.



If this occurs, return to Step 1 and try to access the SERVICE screens again. If the password is correct, the softkey labels change to:



NOTE: The SERVICE screen password can be changed by entering the CVC CONFIGURATION screen under SERVICE menu. The password is located at the bottom of the menu.

The CVC screen displays the following list of available SERVICE screens:

- Alarm History
- Control Test
- Control Algorithm Status
- Equipment Configuration
- ISM (Starter) Config Data
- Equipment Service
- Time and Date
- Attach to Network Device
- Log Out of Device
- CVC Configuration

See Fig. 21 for additional screens and tables available from the SERVICE screens listed above. Use the EXIT softkey to return to the main MENU screen.

NOTE: To prevent unauthorized persons from accessing the CVC service screens, the CVC automatically signs off and password-protects itself if a key has not been pressed for 15 minutes. The sequence is as follows. Fifteen minutes after the last key is pressed, the default screen displays, the CVC screen light goes out (analogous to a screen saver), and the CVC logs out of the password-protected SERVICE menu. Other screen and menus, such as the STATUS screen can be accessed without the password by pressing the appropriate softkey.

TO LOG OUT OF NETWORK DEVICE — To access this screen and log out of a network device, from the default CVC screen, press the MENU and SERVICE softkeys. Enter the password and, from the SERVICE menu, highlight LOG OUT OF NETWORK DEVICE and press the SELECT softkey. The CVC default screen will now be displayed.

HOLIDAY SCHEDULING (Fig. 28) — The time schedules may be configured for special operation during a holiday period. When modifying a time period, the "H" at the end of the days of the week field signifies that the period is applicable to a holiday. (See Fig. 22.)

The broadcast function must be activated for the holidays configured on the HOLIDEF screen to work properly. Access the BRODEF screen from the EQUIPMENT CONFIGURATION table and select ENABLE to activate function. Note that when the chiller is connected to a CCN Network, only one chiller or CCN device can be configured as the broadcast device. The controller that is configured as the broadcaster is the device responsible for transmitting holiday, time, and daylight-savings dates throughout the network.

To access the BRODEF screen, see the SERVICE menu structure, Fig. 21.

To view or change the holiday periods for up to 18 different holidays, perform the following operation:

1. At the Menu screen, press SERVICE to access the Service menu.
2. If not logged on, follow the instructions for ATTACH TO NETWORK DEVICE or To Log Out. Once logged on, press NEXT until Equipment Configuration is highlighted.
3. Once Equipment Configuration is highlighted, press SELECT to access.
4. Press NEXT until HOLIDAYS is highlighted. This is the Holiday Definition table.
5. Press SELECT to enter the Data Table Select screen.This screen lists 18 holiday tables.
6. Press NEXT to highlight the holiday table that is to be viewed or changed. Each table is one holiday period, starting on a specific date, and lasting up to 99 days.
7. Press SELECT to access the holiday table. The Configuration Select table now shows the holiday start month and day, and how many days the holiday period will last.
8. Press NEXT or PREVIOUS to highlight the month, day, or duration.
9. Press SELECT to modify the month, day, or duration.
10. Press INCREASE or DECREASE to change these lected value.
11. Press ENTER to save the changes.
12. Press EXIT to return to the previous menu.

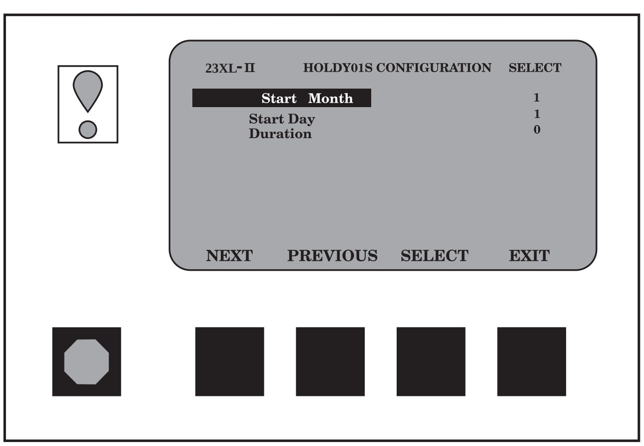


Fig. 28 — Example of Holiday Period Screen

START-UP/SHUTDOWN/ RECYCLE SEQUENCE (Fig. 29)

Local Start-Up — Local start-up (or a manual start-up) is initiated by pressing the LOCAL menu softkey on the default CVC screen. Local start-up can proceed when the chiller schedule indicates that the current time and date have been established as a run time and date, and after the internal 15-minute start-to-start and the 1-minute stop-to-start inhibit timers have expired. These timers are represented in the *START INHIBIT TIMER* and can be viewed on the MAINSTAT screen and DEFAULT screen. The timer must expire before the chiller will start. If the timers have not expired the *RUN STATUS* parameter on the MAINSTAT screen now reads TIMEOUT.

NOTE: The time schedule is said to be “occupied” if the *OCCUPIED ?* parameter on the MAINSTAT screen is set to YES. For more information on occupancy schedules, see the sections on Time Schedule Operation (page 24), Occupancy Schedule (page 37), and To Prevent Accidental Start-Up (page 66), and Fig. 22.

If the *OCCUPIED ?* parameter on the MAINSTAT screen is set to NO, the chiller can be forced to start as follows. From the default CVC screen, press the MENU and STATUS softkeys. Scroll to highlight MAINSTAT. Press the SELECT softkey. Scroll to highlight *CHILLER START/STOP*. Press the START softkey to override the schedule and start the chiller.

NOTE: The chiller will continue to run until this forced start is released, regardless of the programmed schedule. To release the forced start, highlight *CHILLER START/STOP* from the MAINSTAT screen and press the RELEASE softkey. This action returns the chiller to the start and stop times established by the schedule.

The chiller may also be started by overriding the time schedule. From the default screen, press the MENU and SCHEDULE softkeys. Scroll down and select the current schedule. Select OVERRIDE, and set the desired override time.

Another condition for start-up must be met for chillers that have the *REMOTE CONTACTS OPTION* on the EQUIPMENT SERVICE screen set to ENABLE. For these chillers, the *REMOTE CONTACTS INPUT* parameter on the MAINSTAT screen must be CLOSED. From the CVC default screen, press the MENU and STATUS softkeys. Scroll to highlight MAINSTAT and press the SELECT softkey. Scroll down the STATUS01 screen to highlight *REMOTE CONTACTS INPUT* and press the SELECT softkey. Then, press the CLOSE softkey. To end the override, select *REMOTE CONTACTS INPUT* and press the RELEASE softkey.

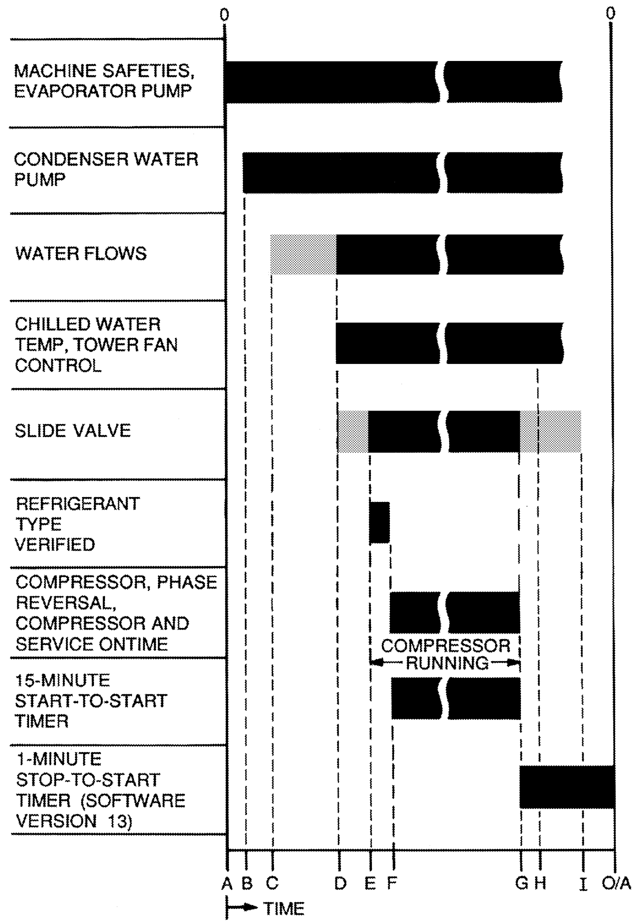
Once local start-up begins, the PIC II performs a series of pre-start tests to verify that all pre-start alerts and safeties are within the limits shown in Table 4. The *RUN STATUS* parameter on the MAINSTAT screen line now reads PRESTART. If a test is not successful, the start-up is delayed or aborted. If the tests are successful, the chilled water/brine pump relay energizes, and the MAINSTAT screen line now reads STARTUP.

Five seconds later, the condenser pump relay energizes. Thirty seconds later the PIC II monitors the chilled water and condenser water flow devices and waits until the *WATER FLOW VERIFY TIME* (operator-configured, default 5 minutes) expires to confirm flow. After flow is verified, the chilled water temperature is compared to *CONTROL POINT* plus *1/2 CHILLED WATER DEADBAND*. If the temperature is less than or equal to this value, the PIC II turns off the condenser pump relay and goes into a RECYCLE mode.

If the water/brine temperature is high enough, the start-up sequence continues and checks the slide valve unload timer. If the unload timer has expired, the PIC II then confirms the correct refrigerant type by comparing the cooler and condenser refrigerant temperature to the leaving water temperature for each vessel. If the refrigerant and leaving water temperatures are within 15 F (8 C) for each respective vessel, compressor start relay (1CR) energizes to start the compressor.

Compressor ontime and service ontime timers start, and the compressor starts in 12 hours counter and the number of starts over a 12-hour period counter advance by one.

Failure to verify any of the requirements up to this point will result in the PIC II aborting the start and displaying the applicable pre-start mode of failure on the CVC default screen. A pre-start failure does not advance the starts in 12 hours counter. Any failure after the 1CR relay has energized results in a safety shutdown, advances the starts in the12 hours counter by one, and displays the applicable shutdown status on the CVC display.



A — START INITIATED: Pre-start checks are made; evaporator pump started
B — Condenser water pump started (5 seconds after A)
C — Water flows verified (30 seconds to 5 minutes maximum)
D — Chilled water temperature checked against control point; tower fan control enabled; slide valve decrease timer checked to verify slide valve position
E — Refrigerant type verified (up to 3 minutes after D).
F — Compressor motor starts; phase reversal conditions monitored; compressor ontime and service ontime start; 15-minute inhibit timer starts (10 seconds after E)
G — Shutdown initiated: Compressor motor stops; compressor ontime and service ontime stop; 3-minute inhibit timer starts on PSIO Software Version 8 and 12 and 1-minute inhibit timer on PSIO Software Version 13 and higher; slide valve decrease activated for 1 minute
H — Evaporator pump deenergized (30 seconds after G); condenser pump and tower fan control may continue to operate if condenser pressure is high; evaporator pump may continue if in RECYCLE mode
I — Slide valve decrease timer expires (3 minutes after G)
O/A — Restart permitted (both inhibit timers expired) (minimum of 15 minutes after F; minimum of 1 minute after G)

Fig. 29 — Control Sequence

Shutdown Sequence — Chiller shutdown begins if any of the following occurs:

- the STOP button is pressed for at least one second (the alarm light blinks once to confirm the stop command)
- a recycle condition is present (see Chilled Water Recycle Mode section)
- the time schedule has gone into unoccupied mode
- the chiller protective limit has been reached and chiller is in alarm
- the start/stop status is overridden to stop from the CCN network or the CVC

When a stop signal occurs, the shutdown sequence first stops the compressor by deactivating the start relay (1CR). A status message of “SHUTDOWN IN PROGRESS, COMPRESSOR DEENERGIZED” is displayed, and the compressor ontime and service ontime stop.

The slide valve unload timer is activated for 2 minutes to move the slide valve to an open position. When the slide valve unload timer expires, compressor start relay (1CR) is deenergized. The cooler water pump is shut down 30 seconds later. The condenser pump is also shut down if the *ENTERING CONDENSER WATER* temperature is greater than or equal to 115 F (46.1) and the *CONDENSER REFRIG TEMP* is greater than the *CONDENSER FREEZE POINT* plus 5 F (3 C). The stop-to-start timer now begins to count down. If the start-to-start timer value is still greater than the value of the start-to-stop timer, then this time displays on the CVC.

Certain conditions that occur during shutdown can change this sequence.

- If the *AVERAGE LINE CURRENT* is greater than 15% after shutdown, or the starter contacts remain energized, the chilled water pump remains energized and the alarm is displayed.
- The condenser pump shuts down when the *CONDENSER PRESSURE* is less than the *CONDENSER PRESSURE OVERRIDE* threshold minus 3.5 psi (24.1 kPa) and the *CONDENSER REFRIG TEMP* is less than or equal to the *ENTERING CONDENSER WATER* temperature plus 3° F (1.6° C).
- If the chiller shuts down due to low refrigerant temperature, the chilled water pump continues to run until the *LEAVING CHILLED WATER* temperature is greater than the *CONTROL POINT* temperature, plus 5° F (3° C).

Automatic Soft Stop Amps Threshold — The soft stop amps threshold feature closes the slide valve of the compressor automatically if a non-recycle, non-alarm stop signal occurs before the compressor motor is deenergized.

If the STOP button is pressed, the slide valve unloads to a preset amperage percent, or the slide valve timer expires. The compressor then shuts off.

If the chiller enters an alarm state or if the compressor enters a RECYCLE mode, the compressor deenergizes immediately.

To activate the soft stop amps threshold feature, scroll to the bottom of OPTIONS screen on the CVC. Use the INCREASE or DECREASE softkey to set the SOFTSTOP AMPS THRESHOLD parameter to the percent of amps at which the motor will shut down. The default setting is 100% amps (no soft stop). The range is 40 to 100%.

When the soft stop amps threshold feature is being applied, a status message, “SHUTDOWN IN PROGRESS, COMPRESSOR UNLOADING” displays on the CVC.

The soft stop amps threshold function can be terminated and the compressor motor deenergized immediately by depressing the STOP button twice.

Chilled Water Recycle Mode — The chiller may cycle off and wait until the load increases to restart when the compressor is running in a lightly loaded condition. This cycling is normal and is known as “recycle.” A recycle shutdown is initiated when any of the following conditions are true:

- the chiller is in LCW control, the difference between the *LEAVING CHILLED WATER* temperature and *ENTERING CHILLED WATER* temperature is less than the *RECYCLE SHUTDOWN DELTA T* (found in the SETUP1 table) *and* the *LEAVING CHILLED WATER* temperature is below the *CONTROL POINT*, –5 F (–15.0 C) the *CONTROL POINT* has not increased in the last 5 minutes and ICE BUILD is not active.
- the *ECW CONTROL OPTION* is enabled, the difference between the *ENTERING CHILLED WATER* temperature and the *LEAVING CHILLED WATER* temperature is less than the *RECYCLE SHUTDOWN DELTA T* (found in the SETUP1 table), and the *ENTERING CHILLED WATER* temperature is below the *CONTROL POINT* –5 F (–15.0 C) and the *CONTROL POINT* has not increased in the last 5 minutes.
- the *LEAVING CHILLED WATER* temperature is within 3º F (2º C) of the *EVAP REFRIG TRIPPOINT.*

When the chiller is in RECYCLE mode, the chilled water pump relay remains energized so the chilled water temperature can be monitored for increasing load. The recycle control uses *RECYCLE RESTART DELTA T* to check when the compressor should be restarted. This is an operator-configured function which defaults to 5º F (3º C). This value can be viewed or modified on the SETUP1 table. The compressor will restart when the chiller is:

- in LCW CONTROL and the *LEAVING CHILLED WATER* temperature is greater than the *CONTROL POINT* plus the *RECYCLE RESTART DELTA T.*
- in ECW CONTROL and the *ENTERING CHILLED WATER* temperature is greater than the *CONTROL POINT* plus the *RECYCLE RESTART DELTA T.*

Once these conditions are met, the compressor initiates a start-up with a normal start-up sequence.

An alert condition may be generated if 5 or more recycle start-ups occur in less than 4 hours. Excessive recycling can reduce chiller life; therefore, compressor recycling due to extremely low loads should be reduced.

To reduce compressor recycling, use the time schedule to shut the chiller down during known low load operation period, or increase the chiller load by running the fan systems. If the hot gas bypass is installed, adjust the values to ensure that hot gas is energized during light load conditions. Increase the *RECYCLE RESTART DELTA T* on the SETUP1 table to lengthen the time between restarts.

The chiller should not be operated below design minimum load without a hot gas bypass installed.

Safety Shutdown — A safety shutdown is identical to a manual shutdown with the exception that, during a safety shutdown, the CVC displays the reason for the shutdown, the alarm light blinks continuously, and the spare alarm contacts are energized.

After a safety shutdown, the RESET softkey must be pressed to clear the alarm. If the alarm condition is still present, the alarm light continues to blink. Once the alarm is cleared, the operator must press the CCN or LOCAL softkeys to restart the chiller.

BEFORE INITIAL START-UP

Job Data Required

- list of applicable design temperatures and pressures (product data submittal)
- chiller certified prints
- starting equipment details and wiring diagrams
- diagrams and instructions for special controls or options
- 23XL Installation Instructions
- pumpout unit instructions

Equipment Required

- mechanic’s tools (refrigeration)
- digital volt-ohmmeter (DVM)
- clamp-on ammeter
- electronic leak detector
- absolute pressure manometer or wet-bulb vacuum indicator (Fig. 30)
- 500-v insulation tester (megohmmeter) for compressor motors with nameplate voltage of 600 v or less, or a 5000-v insulation tester for compressor motor rated above 600 v

Using the Optional Storage Tank and Pumpout System — Refer to Chillers with Storage Tanks section, page 71 for pumpout system preparation, refrigerant transfer, and chiller evacuation.

Remove Shipping Packaging — Remove any packaging material from the control center, power panel, motor cooling and oil reclaim solenoids, motor and bearing temperature sensor covers, and the factory-mounted starter.

Open Oil Circuit Valves — Check to ensure the oil filter isolation valves (Fig. 3 and 4) are open by removing the valve cap and checking the valve stem.

Tighten All Gasketed Joints — Gaskets normally relax by the time the chiller arrives at the jobsite. Tighten all gasketed joints to ensure a leak-tight chiller.

Check Chiller Tightness — Figure 31 outlines the proper sequence and procedures for leak testing.

23XL chillers are shipped with a full refrigerant and oil charge. Units may be ordered with the refrigerant shipped separately, and a 15 psig (103 kPa) nitrogen-holding charge in each vessel. To determine if there are any leaks, the chiller should be charged with a refrigerant tracer. Use an electronic leak detector to check all flanges and solder joints after the chiller is pressurized. If any leaks are detected, follow the leak test procedure.

If the chiller is spring isolated, keep all springs blocked in both directions to prevent possible piping stress and dam-age during the transfer of refrigerant from vessel to vessel during the leak test process, or any time refrigerant is being transferred. Adjust the springs when the refrigerant is in operating condition and the water circuits are full.

Refrigerant Tracer — Carrier recommends the use of an environmentally acceptable refrigerant tracer for leak testing with an electronic detector or halide torch.

Ultrasonic leak detectors can also be used if the chiller is under pressure.

⚠ WARNING

Do not use air or oxygen as a means of pressurizing the chiller. Mixtures of HFC-134a and air can undergo combustion.

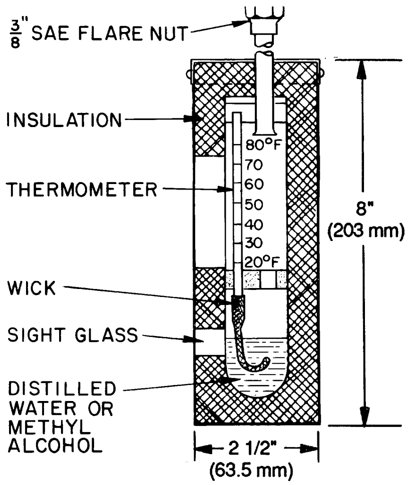


Fig. 30 — Typical Wet-Bulb Type Vacuum Indicator

Leak Test Chiller — Due to regulations regarding refrigerant emissions and the difficulties associated with separating contaminants from refrigerant, Carrier recommends the following leak test procedures. See Fig. 31 for an outline of the leak test procedures. Refer to Fig. 24 and 25 during pumpout procedures. See the Pumpout and Refrigerant Transfer Procedures Section on page 69. Refer to Tables 6A-6D for temperature/pressure relationships for HCFC-22 and HFC-134a refrigerants. See Fig. 32-35.

1. If the pressure readings are normal for chiller condition:
   a. Evacuate the holding charge from the vessels, if present.
   b. Raise the chiller pressure, if necessary, by adding refrigerant until pressure is at equivalent saturated pressure for the surrounding temperature.

> **⚠ WARNING**
>
> Never charge liquid refrigerant into the chiller if the pressure in the chiller is less than 68 psig (469 kPa) [35 psig (241 kPa)]. Charge as a gas only, with the cooler and condenser pumps running, until this pressure is reached, using PUMPDOWN and TERMINATE PUMPDOWN/LOCKOUT mode on the PIC. Flashing of liquid refrigerant at low pressures can cause tube freeze-up and considerable damage.

   c. Leak test chiller as outlined in Steps 3 - 7.
2. If the pressure readings are abnormal for chiller condition:
   a. Prepare to leak test chillers shipped with refrigerant. If chiller is shipped with refrigerant, proceed to Step 2h.
   b. Check for large leaks by connecting a nitrogen bottle and raising the pressure to 30 psig (207 kPa). Soap test all joints. If the test pressure holds for 30 minutes, prepare the test for small leaks (Steps 2g - h).
   c. Plainly mark any leaks which are found.
   d. Release the pressure in the system.
   e. Repair all leaks.
   f. Retest only those joints that were repaired.
   g. After successfully completing the test for large leaks, remove as much nitrogen, air, and moisture as possible, given the fact that small leaks may be present in the system. This can be accomplished by following the dehydration procedure, outlined in the Chiller Dehydration section, page 58.
   h. Slowly raise the system pressure to normal operating pressures for the refrigerant used in the chiller. Proceed with the test for small leaks (Steps 3 - 7).
3. Check the chiller carefully with an electronic leak detector or halide torch.
4. Leak Determination — If an electronic leak detector indicates a leak, use a soap bubble solution, if possible, to confirm. Total all leak rates for the entire chiller. Leakage at rates greater than 1 lb/year (0.45 kg/year) for the entire chiller must be repaired. Note total chiller leak rate on the start-up report.
5. If no leak is found during initial start-up procedures, complete the transfer of refrigerant gas from the storage tank to the chiller. Retest for leaks.
6. If no leak is found after a retest
   a. Transfer the refrigerant to the storage tank and perform a standing vacuum test as outlined in the Chiller Dehydration section, page 58.
   b. If the chiller fails this test, check for large leaks (Step 2b).
   c. Dehydrate the chiller if it passes the standing vacuum test. Follow the procedure in the Chiller Dehydration section. Charge chiller with refrigerant.
7. If a leak is found, pump the refrigerant back into the storage tank, or if isolation valves are present, pump into the vessel that is not leaking.

   Transfer the refrigerant until chiller pressure is at least equal to the pressure specified by the EPA under 40CFR Part 82.

   Repair the leak and repeat the procedure, beginning from Step 2h to ensure a leaktight repair. If chiller is opened to the atmosphere for an extended period, evacuate it before repeating leak test.

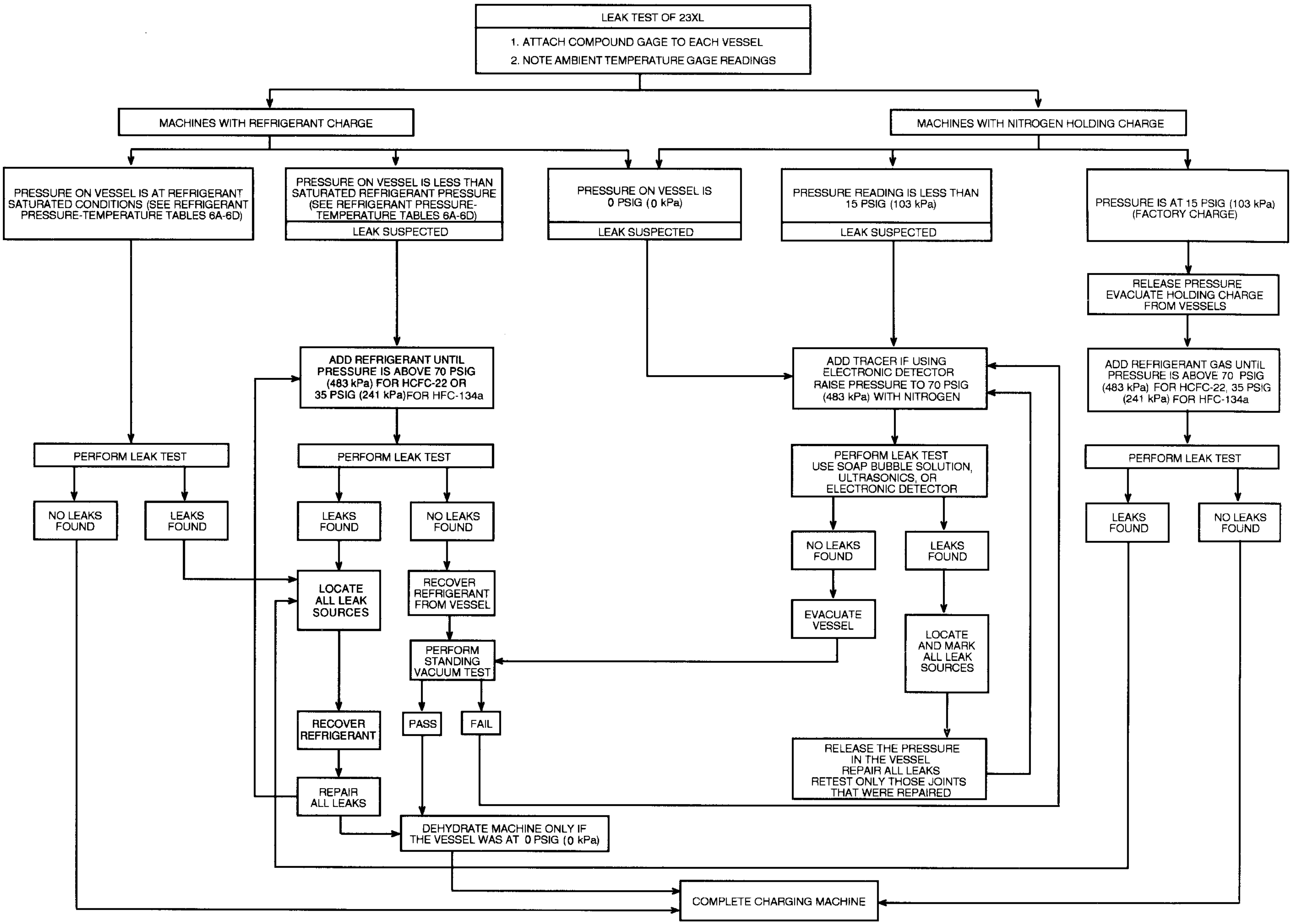


Fig. 31 — 23XL Leak Test Procedure

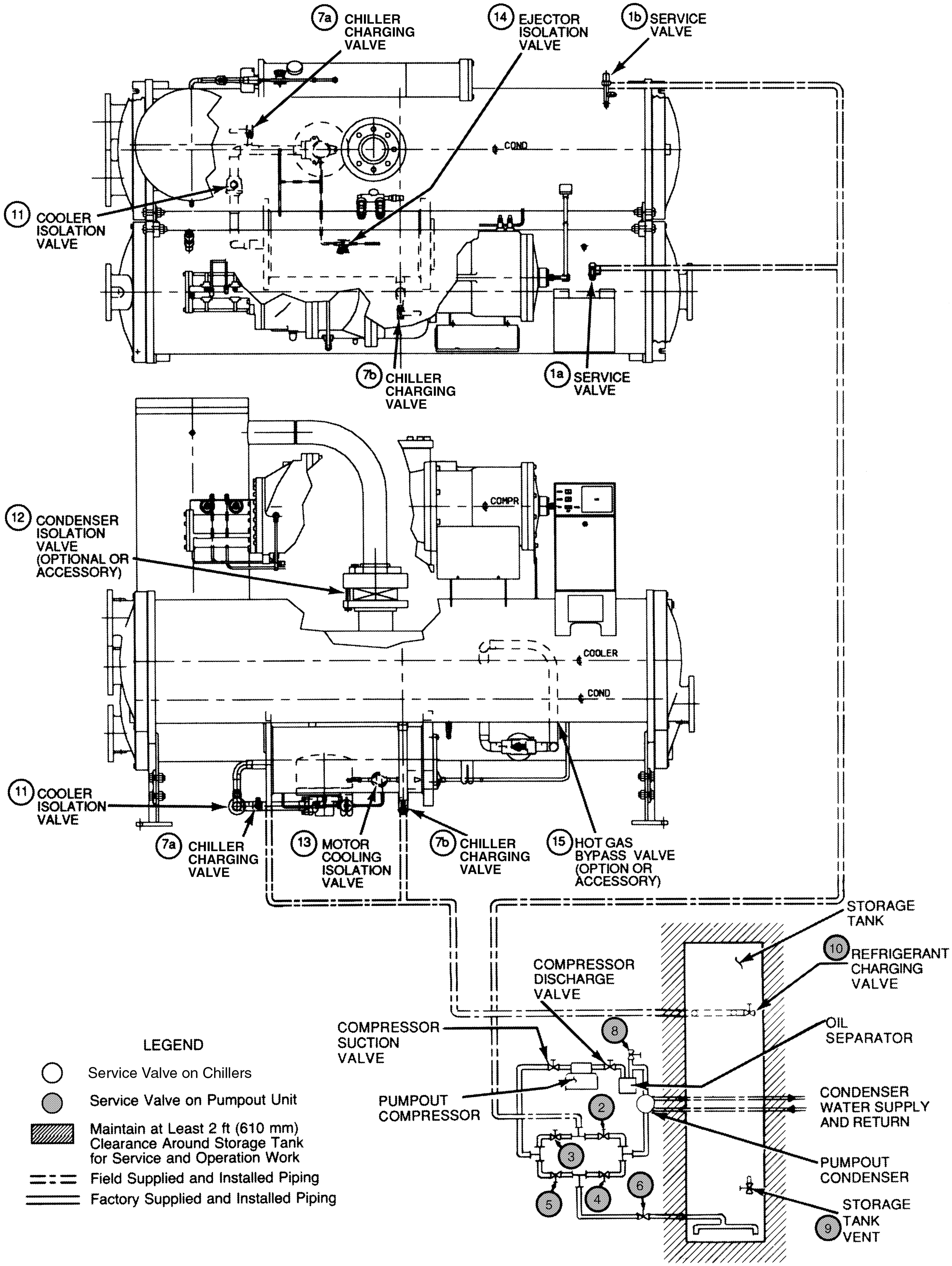


Fig. 32 — Typical Optional Pumpout System Piping Schematic with Storage Tank (TC Frame 1 and 2 Chillers)

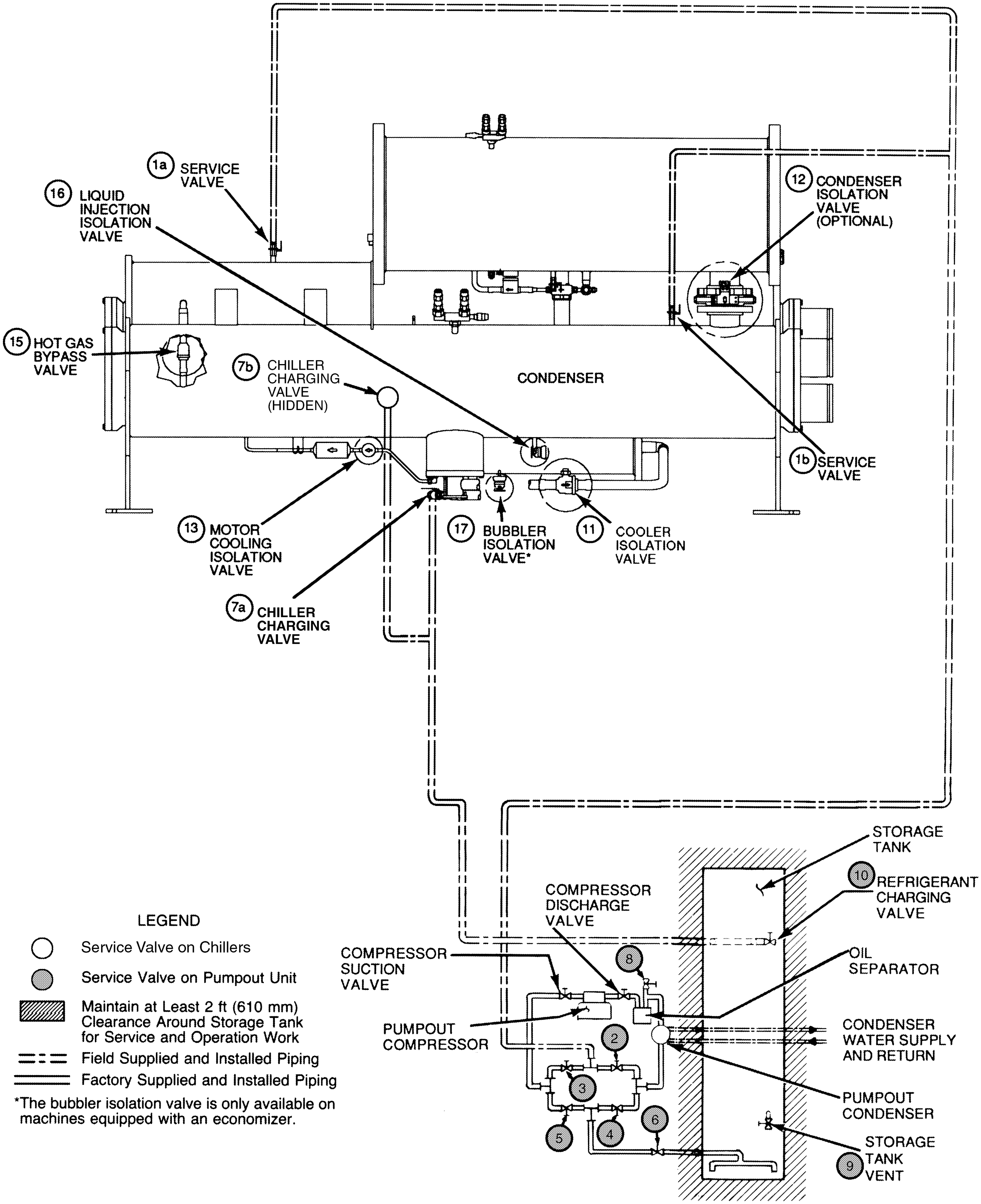


Fig. 33 — Typical Optional Pumpout System Piping Schematic With Storage Tank (TD Frame 4 Chillers)

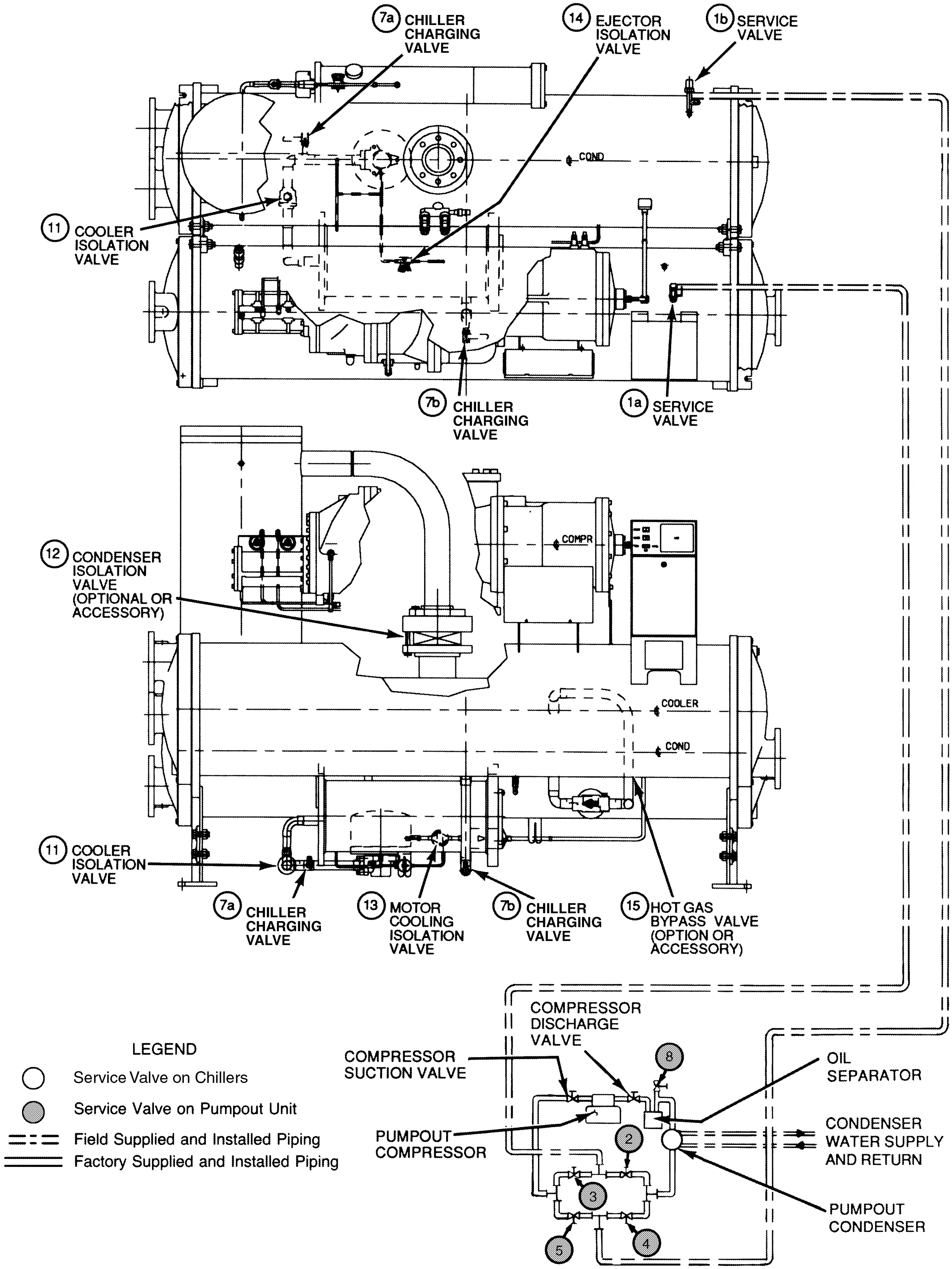


Fig. 34 — Typical Optional Pumpout System Piping Schematic Without Storage Tank (TC Frame 1 and 2 Chillers)

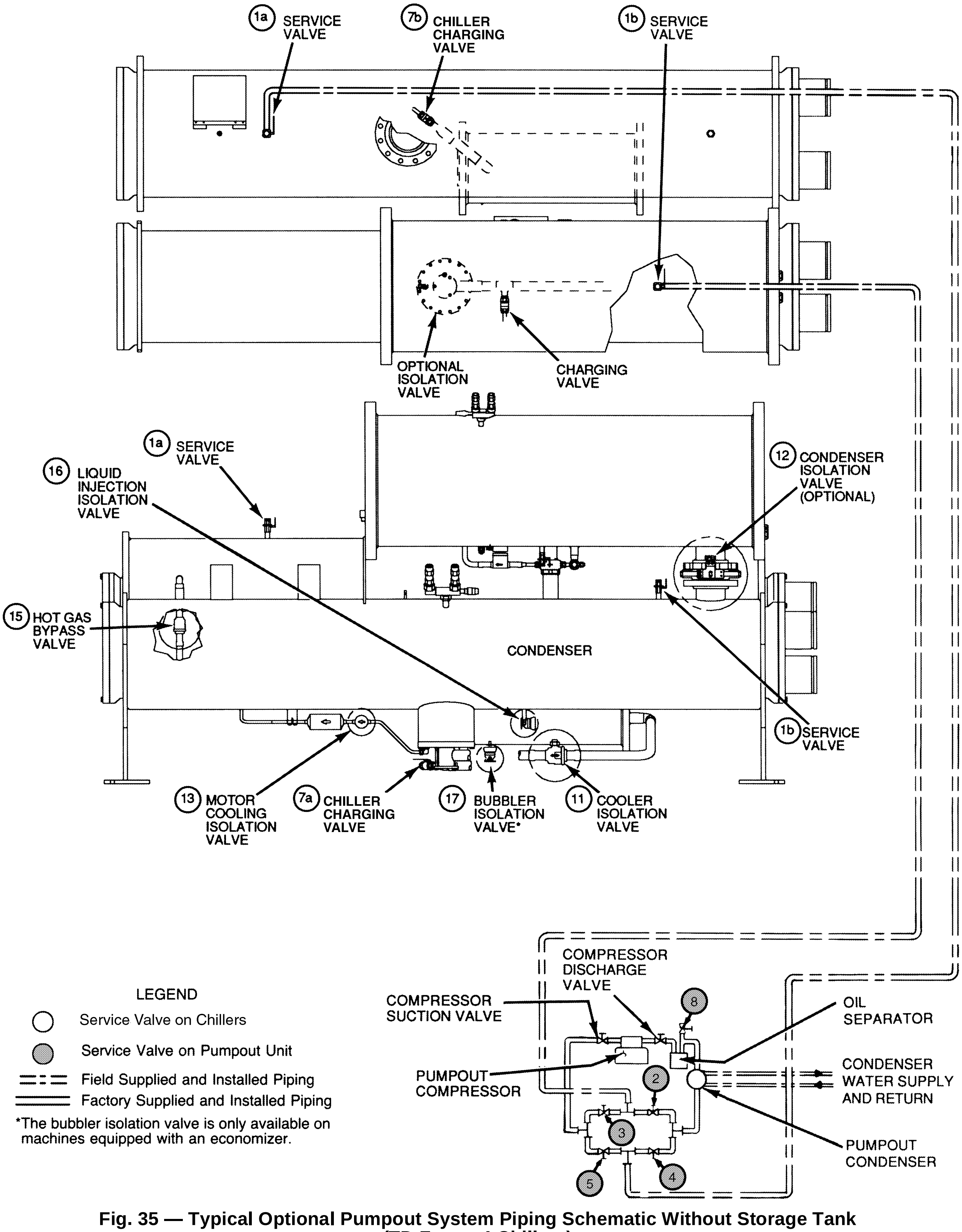


Fig. 35 — Typical Optional Pumpout System Piping Schematic Without Storage Tank (TD Frame 4 Chillers)

Table 6A — HCFC-22 Pressure — Temperature (F)

TEMPERATURE (F)	PRESSURE (psi)	
	Absolute	Gage
–50	11.67	6.154*
–48	12.34	4.829*
–46	13.00	3.445*
–44	13.71	2.002*
–42	14.45	0.498*
–40	15.22	0.526
–38	16.02	1.328
–36	16.86	2.163
–34	17.73	3.032
–32	18.63	3.937
–30	19.57	4.877
–28	20.55	5.853
–26	21.56	6.868
–24	22.62	7.921
–22	23.71	9.015
–20	24.85	10.15
–18	26.02	11.32
–16	27.24	12.54
–14	28.50	13.81
–12	29.81	15.11
–10	31.16	16.47
– 8	32.56	17.87
– 6	34.01	19.32
– 4	35.51	20.81
– 2	37.06	22.36
0	38.66	23.96
2	40.31	25.61
4	42.01	27.32
6	43.78	29.08
8	45.59	30.90
10	47.46	32.77
12	49.40	34.70
14	51.39	36.69
16	53.44	38.74
18	55.55	40.86
20	57.73	43.03
22	59.97	45.27
24	62.27	47.58
26	64.64	49.95
28	67.08	52.39
30	69.59	54.90
32	72.17	57.47
34	74.82	60.12
36	77.54	62.84
38	80.34	65.64
40	83.21	68.51
42	86.15	71.46
44	89.18	74.48
46	92.28	77.58
48	95.46	80.77
50	98.73	84.03
52	102.07	87.38
54	105.50	90.81
56	109.02	94.32
58	112.62	97.93
60	116.31	101.62
62	120.09	105.39
64	123.96	109.26
66	127.92	113.22
68	131.97	117.28
70	136.12	121.43
72	140.37	125.67
74	144.71	130.01
76	149.15	134.45
78	153.69	138.99
80	158.33	143.63
82	163.07	148.37
84	167.92	153.22
86	172.87	158.17
88	177.93	163.23
90	183.09	168.40
92	188.37	173.67
94	193.76	179.06
96	199.26	184.56
98	204.87	190.18
100	210.60	195.91
102	216.45	201.76
104	222.42	207.72
106	228.50	213.81
108	234.71	220.02
110	241.04	226.35
112	247.50	232.80
114	254.08	239.38
116	260.79	246.10
118	267.63	252.94
120	274.60	259.91
122	281.71	267.01
124	288.95	274.25
126	296.33	281.63
128	303.84	289.14
130	311.50	296.80
132	319.29	304.60
134	327.23	312.54
136	335.32	320.63
138	343.56	328.86
140	351.94	337.25
142	360.48	345.79
144	369.17	354.48
146	378.02	363.32
148	387.03	372.33
150	396.19	381.50
152	405.52	390.83
154	415.02	400.32
156	424.68	409.99
158	434.52	419.82
160	444.53	420.83

*Inches of mercury below one atmosphere.

Table 6B — HCFC-22 Pressure — Temperature (C)

TEMPERATURE (C)	PRESSURE (kPa)	
	Absolute	Gage
–18	264	163
–17	274	173
–16	284	183
–15	296	195
–14	307	206
–13	318	217
–12	330	229
–11	342	241
–10	354	253
– 9	367	266
– 8	380	279
– 7	393	292
– 6	407	306
– 5	421	320
– 4	436	335
– 3	451	350
– 2	466	365
– 1	482	381
0	498	397
1	514	413
2	531	430
3	548	447
4	566	465
5	584	483
6	602	501
7	621	520
8	641	540
9	660	559
10	681	580
11	701	600
12	723	622
13	744	643
14	766	665
15	789	688
16	812	711
17	836	735
18	860	759
19	885	784
20	910	809
21	936	835
22	962	861
23	989	888
24	1020	919
25	1040	939
26	1070	969
27	1100	1000
28	1130	1030
29	1160	1060
30	1190	1090
31	1220	1120
32	1260	1160
33	1290	1190
34	1320	1220
35	1360	1260
36	1390	1290
37	1420	1320
38	1460	1360
39	1500	1400
40	1530	1430
41	1570	1470
42	1610	1510
43	1650	1550
44	1690	1590
45	1730	1630
46	1770	1670
47	1810	1710
48	1850	1750
49	1900	1800
50	1940	1840
51	1980	1890
52	2030	1930
53	2080	1980
54	2130	2030
55	2170	2070
56	2220	2120
57	2270	2170
58	2320	2220
59	2370	2270
60	2430	2330
61	2480	2380
62	2530	2430
63	2590	2490
64	2640	2540
65	2700	2600
66	2760	2660
67	2820	2720
68	2870	2770
69	2930	2830
70	3000	2900

Table 6C — HFC-134a Pressure — Temperature (F)

TEMPERATURE, F	PRESSURE (psig)
0	6.50
2	7.52
4	8.60
6	9.66
8	10.79
10	11.96
12	13.17
14	14.42
16	15.72
18	17.06
20	18.45
22	19.88
24	21.37
26	22.90
28	24.48
30	26.11
32	27.80
34	29.53
36	31.32
38	33.17
40	35.08
42	37.04
44	39.06
46	41.14
48	43.28
50	45.48
52	47.74
54	50.07
56	52.47
58	54.93
60	57.46
62	60.06
64	62.73
66	65.47
68	68.29
70	71.18
72	74.14
74	77.18
76	80.30
78	83.49
80	86.17
82	90.13
84	93.57
86	97.09
88	100.70
90	104.40
92	108.18
94	112.06
96	116.02
98	120.08
100	124.23
102	128.47
104	132.81
106	137.25
108	141.79
110	146.43
112	151.17
114	156.01
116	160.96
118	166.01
120	171.17
122	176.45
124	181.83
126	187.32
128	192.93
130	198.66
132	204.50
134	210.47
136	216.55
138	222.76
140	229.09

Table 6D — HFC-134a Pressure — Temperature (C)

TEMPERATURE, C	PRESSURE (kPa)
-18.0	44.8
-16.7	51.9
-15.6	59.3
-14.4	66.6
-13.3	74.4
-12.2	82.5
-11.1	90.8
-10.0	99.4
-8.9	108.0
-7.8	118.0
-6.7	127.0
-5.6	137.0
-4.4	147.0
-3.3	158.0
-2.2	169.0
-1.1	180.0
0.0	192.0
1.1	204.0
2.2	216.0
3.3	229.0
4.4	242.0
5.0	248.0
5.6	255.0
6.1	261.0
6.7	269.0
7.2	276.0
7.8	284.0
8.3	290.0
8.9	298.0
9.4	305.0
10.0	314.0
11.1	329.0
12.2	345.0
13.3	362.0
14.4	379.0
15.6	396.0
16.7	414.0
17.8	433.0
18.9	451.0
20.0	471.0
21.1	491.0
22.2	511.0
23.3	532.0
24.4	554.0
25.6	576.0
26.7	598.0
27.8	621.0
28.9	645.0
30.0	669.0
31.1	694.0
32.2	720.0
33.3	746.0
34.4	773.0
35.6	800.0
36.7	828.0
37.8	857.0
38.9	886.0
40.0	916.0
41.1	946.0
42.2	978.0
43.3	1010.0
44.4	1042.0
45.6	1076.0
46.7	1110.0
47.8	1145.0
48.9	1180.0
50.0	1217.0
51.1	1254.0
52.2	1292.0
53.3	1330.0
54.4	1370.0
55.6	1410.0
56.7	1451.0
57.8	1493.0
58.9	1536.0
60.0	1580.0

Chiller Dehydration — Dehydration is recommended if the chiller has been open for a considerable period of time, if the chiller is known to contain moisture, or if there has been a complete loss of chiller holding charge or refrigerant pressure.

⚠ CAUTION

Do not start or megohm-test the compressor motor or oil pump motor, even for a rotation check, if the chiller is under dehydration vacuum. Insulation breakdown and severe damage may result.

⚠ WARNING

Inside-delta type starters must be disconnected by an isolation switch before placing the chiller under a vacuum because one lead of each phase is live with respect to ground even though there is not a complete circuit to run the motor. To be safe, isolate any starter before evacuating the chiller if you are not sure if there are live leads to the hermetic motor.

Dehydration can be done at room temperatures. Using a cold trap (Fig. 36) may substantially reduce the time required to complete the dehydration. The higher the room temperature, the faster dehydration takes place. At low room temperatures, a very deep vacuum is required to boil off any moisture. If low ambient temperatures are involved, contact a qualified service representative for the dehydration techniques required.

Perform dehydration as follows:

1. Connect a high capacity vacuum pump (5 cfm [.002 m^3/s] or larger is recommended) to the refrigerant charging valve (Fig. 2A and 2B). Tubing from the pump to the chiller should be as short in length and as large in diameter as possible to provide least resistance to gas flow.
2. Use an absolute pressure manometer or a wet bulb vacuum indicator to measure the vacuum. Open the shutoff valve to the vacuum indicator only when taking a reading. Leave the valve open for 3 minutes to allow the indicator vacuum to equalize with the chiller vacuum.
3. If the entire chiller is to be dehydrated, open all isolation valves (if present).
4. With the chiller ambient temperature at 60 F (15.6 C) or higher, operate the vacuum pump until the manometer reads 29.8 in. Hg vac, ref 30 in. bar. (0.1 psia) (–100.61 kPa) or a vacuum indicator reads 35 F (1.7 C). Operate the pump an additional 2 hours.

   Do not apply a greater vacuum than 29.82 in. Hg vac (757.4 mm Hg) or go below 33 F (.56 C) on the wet bulb vacuum indicator. At this temperature and pressure, isolated pockets of moisture can turn into ice. The slow rate of evaporation (sublimation) of ice at these low temperatures and pressures greatly increases dehydration time.
5. Valve off the vacuum pump, stop the pump, and record the instrument reading.
6. After a 2-hour wait, take another instrument reading. If the reading has not changed, dehydration is complete. If the reading indicates vacuum loss, repeat Steps 4 and 5.
7. If the reading continues to change after several attempts, perform a leak test up to the maximum 160 psig (1103 kPa) pressure. Locate and repair the leak, and repeat dehydration.

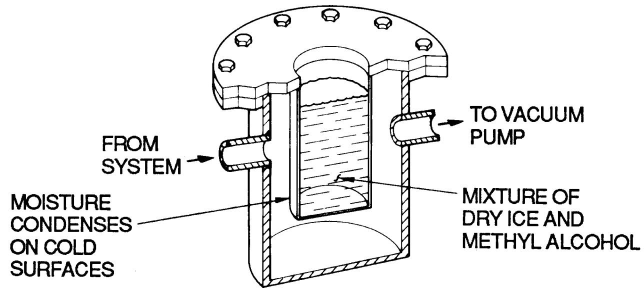


Fig. 36 — Dehydration Cold Trap

Inspect Water Piping — Refer to piping diagrams provided in the certified drawings and the piping instructions in the 23XL Installation Instructions manual. Inspect the piping to the cooler and condenser. Be sure that the flow directions are correct and that all piping specifications have been met.

Piping systems must be properly vented with no stress on waterbox nozzles and covers. Water flows through the cooler and condenser must meet job requirements. Measure the pressure drop across the cooler and the condenser.

⚠ CAUTION

Water must be within design limits, clean, and treated to ensure proper chiller performance and to reduce the potential of tube damage due to corrosion, scaling, or erosion. Carrier assumes no responsibility for chiller damage resulting from untreated or improperly treated water.

Check Optional Pumpout Compressor Water Piping — If the optional pumpout storage tank and/or pumpout system are installed, check to ensure the pumpout condenser water has been piped in. Check for field-supplied shutoff valves and controls as specified in the job data. Check for refrigerant leaks on field-installed piping. See Fig. 32-35.

Check Relief Valves — Be sure the relief valves have been piped to the outdoors in compliance with the latest edition of ANSI/ASHRAE Standard 15 and applicable local safety codes. Piping connections must allow for access to the valve mechanism for periodic inspection and leak testing.

The 23XL relief valves are set to relieve at the 300 psig (2069 kPa) chiller design pressure.

Inspect Wiring

⚠ WARNING

Do not check the voltage supply without proper equipment and precautions. Serious injury may result. Follow power company recommendations.

⚠ CAUTION

Do not apply any kind of test voltage, even for a rotation check, if the chiller is under a dehydration vacuum. Insulation breakdown and serious damage may result.

1. Examine the wiring for conformance to the job wiring diagrams and all applicable electrical codes.
2. On low-voltage compressors (600 v or less) connect a voltmeter across the power wires to the compressor starter and measure the voltage. Compare this reading to the voltage rating on the compressor and starter nameplates.

3. Compare the ampere rating on the starter nameplate to rating on the compressor nameplate. The overload trip amps must be 108% to 120%of the rated load amps.
4. The starter for a centrifugal compressor motor must contain the components and terminals required for PIC II refrigeration control. Check the certified drawings.
5. Check the voltage to the following components and compare it to the nameplate values: pumpout compressor starter and power panel.
6. Ensure that fused disconnects or circuit breakers have been supplied for the power panel and pumpout unit.
7. Ensure all electrical equipment and controls are properly grounded in accordance with job drawings, certified drawings, and all applicable electrical codes.
8. Ensure the customer's contractor has verified proper operation of the pumps, cooling tower fans, and associated auxiliary equipment. This includes ensuring motors are properly lubricated and have proper electrical supply and proper rotation.
9. For field-installed starters only, test the chiller compressor motor and its power lead insulation resistance with a 500-v insulation tester such as a megohmmeter. (Use a 5000-v tester for motors rated over 600 v.) Factory-mounted starters do not require a megohm test.
   a. Open the starter main disconnect switch and follow lockout/tagout rules.

⚠ CAUTION

If the motor starter is a solid-state starter, the motor leads must be disconnected from the starter before an insulation test is performed. The voltage generated from the tester can damage the starter solid-state components.

   b. With the tester connected to the motor leads, take 10-second and 60-second megohm readings as follows:

      6-Lead Motor — Tie all 6 leads together and test between the lead group and ground. Next tie the leads in pairs: 1 and 4, 2 and 5, and 3 and 6. Test between each pair while grounding the third pair.

      3-Lead Motor — Tie terminals 1, 2, and 3 together and test between the group and ground.

   c. Divide the 60-second resistance reading by the 10-second reading. The ratio, or polarization index, must be one or higher. Both the 10- and 60-second readings must be at least 50 megohms.

      If the readings on a field-installed starter are unsatisfactory, repeat the test at the motor with the power leads disconnected. Satisfactory readings in this second test indicate the fault is in the power leads.

      NOTE: Unit-mounted starters do not have to be megohm tested.
10. Tighten all wiring connections to the plugs on the ISM and CCM modules.
11. Ensure that the voltage selector switch inside the power panel is switched to the incoming voltage rating.

    On chillers with free-standing starters, inspect the power panel to ensure that the contractor has fed the wires into the bottom of the panel. Wiring into the top of the panel can cause debris to fall into the contactors. Clean and inspect the contactors if this has occurred.

Carrier Comfort Network Interface — The Carrier Comfort Network (CCN) communication bus wiring is supplied and installed by the electrical contractor. It consists of shielded, 3-conductor cable with drain wire.

The system elements are connected to the communication bus in a daisy chain arrangement. The positive pin of each system element communication connector must be wired to the positive pins of the system element on either side of it. The negative pins must be wired to the negative pins. The signal ground pins must be wired to the signal ground pins. See installation manual.

NOTE: Conductors and drain wire must be 20 AWG (American Wire Gage) minimum stranded, tinned copper. Individual conductors must be insulated with PVC, PVC/nylon, vinyl, Teflon, or polyethylene. An aluminum/polyester 100% foil shield and an outer jacket of PVC, PVC/nylon, chrome vinyl, or Teflon with a minimum operating temperature range of –4 F to 140 F (–20 C to 60 C) is required. See table below for cables that meet the requirements.

MANUFACTURER	CABLE NO.
Alpha	2413 or 5463
American	A22503
Belden	8772
Columbia	02525

When connecting the CCN communication bus to a system element, a color code system for the entire network is recommended to simplify installation and checkout. The following color code is recommended:

SIGNAL TYPE	CCN BUS CONDUCTOR INSULATION COLOR	CVC PLUG J1 PIN NO.
+	Red	1
Ground	White	2
–	Black	3

Check Starter

⚠ CAUTION

BE AWARE that certain automatic start arrangements *can engage the starter*. Open the disconnect *ahead* of the starter in addition to shutting off the chiller or pump.

Use the instruction and service manual supplied by the starter manufacturer to verify the starter has been installed correctly, to set up and calibrate the starter, and for complete troubleshooting information.

⚠ CAUTION

The main disconnect on the starter front panel may not deenergize all internal circuits. Open all internal and remote disconnects before servicing the starter.

MECHANICAL STARTER

1. Check all field wiring connections for tightness, clearance from moving parts, and correct connection.
2. Check the contactor(s) to ensure they move freely. Check the mechanical interlock between contactors to ensure that 1S and 2M contactors cannot be closed at the same time. Check all other electro-mechanical devices, such as relays, for free movement. If the devices do not move freely, contact the starter manufacturer for replacement components.
3. Some dashpot-type magnetic overload relays must be filled with oil on the jobsite. If the starter is equipped with devices of this type, remove the fluid cups from these magnetic overload relays. Add the dashpot oil to the cups according to the instructions supplied with the starter. The oil is usually shipped in a small container

attached to the starter frame near the relays. Use only the dashpot oil supplied with the starter. Do not substitute.

Solid-state overload relays do not have oil.

4. Reapply starter control power (*not main chiller power*) to check the electrical functions.

   Ensure the starter (with relay 1CR closed) goes through a complete and proper start cycle.

BENSHAW, INC. REDISTART MICRO SOLID-STATE STARTER

⚠ WARNING

This equipment is at line voltage when AC power is connected. Pressing the STOP button does not remove voltage.

1. Ensure all wiring connections are properly terminated to the starter.
2. Verify the ground wire to the starter is installed properly and is sufficient size.
3. Verify the motors are properly grounded to the starter.
4. Ensure all of the relays are properly seated in their sockets.
5. Verify the proper ac input voltage is brought into the starter according to the certified drawings.
6. Apply power to the starter.

Oil Charge — The oil charge for the 23XL compressor holds approximately 8 gal. (30 L) of oil.

The chiller is shipped with oil in the compressor. When the sump is full, the oil level should be no higher than the middle of the upper sight glass, and minimum level is the bottom of the lower sight glass (Fig. 2A and 2B). If oil is added, it must meet Carrier's specification for centrifugal compressor use as described in the Oil Specification section. Charge the oil through the oil charging valve located near the bottom of the transmission housing (Fig. 2A and 2B). The oil must be pumped from the oil container through the charging valve due to higher refrigerant pressure. The pumping device must be able to lift from 0 to 200 psig (0 to 1380 kPa) or above unit pressure. Oil should only be charged or removed when the chiller is shut down.

Power Up the Controls and Check the Oil Heater — Ensure that an oil level is visible in the compressor before energizing the controls. A circuit breaker in the starter energizes the oil heater and the control circuit. When first powered, the CVC should display the default screen within a short period of time.

The oil heater is energized by powering the control circuit. This should be done several hours before start-up to minimize oil-refrigerant migration. The oil heater is controlled by the PIC II and is powered through a contactor in the power panel. Starters contain a separate circuit breaker to power the heater and the control circuit. This arrangement allows the heater to energize when the main motor circuit breaker is off for service work or extended shutdowns. The oil heater relay status (*OIL HEATER RELAY*) can be viewed on the COMPRESS table on the CVC. Oil sump temperature can be viewed on the CVC default screen.

SOFTWARE VERSION — The software part number is labeled on the backside of the CVC module. The software version also appears on the CVC configuration screen as the last two digits of the software part number.

Software Configuration

⚠ WARNING

Do not operate the chiller before the control configurations have been checked and a Control Test has been satisfactorily completed. Protection by safety controls cannot be assumed until all control configurations have been confirmed.

As the 23XL unit is configured, all configuration settings should be written down. A log, such as the one shown on pages CL-1 to CL-12, provides a convenient list for configuration values.

Input the Design Set Points — Access the CVC set point screen and view/modify the base demand limit set point, and *either* the LCW set point or the ECW set point. The PIC II can control a set point to either the leaving or entering chilled water. This control method is set in the EQUIPMENT SERVICE (TEMP_CTL) table.

Input the Local Occupied Schedule (OCCPC01S) — Access the schedule OCCPC01S screen on the CVC and set up the occupied time schedule according to the customer's requirements. If no schedule is available, the default is factory set for 24 hours occupied, 7 days per week including holidays.

For more information about how to set up a time schedule, see the Controls section, page 14.

The CCN Occupied Schedule (OCCPC03S) should be configured if a CCN system is being installed or if a secondary time schedule is needed.

NOTE: The default CCN Occupied Schedule OCCPC03S is configured to be unoccupied.

Input Service Configurations — The following configurations require the CVC screen to be in the SERVICE portion of the menu.

- password
- input time and date
- CVC configuration
- service parameters
- equipment configuration
- automated control test

PASSWORD — When accessing the SERVICE tables, a password must be entered. All CVC are initially set for a password of 1-1-1-1.

INPUT TIME AND DATE — Access the TIME AND DATE table on the SERVICE menu. Input the present time of day, date, and day of the week. The *HOLIDAY TODAY* parameter should only be configured to YES if the present day is a holiday.

NOTE: Because a schedule is integral to the chiller control sequence, the chiller will not start until the time and date have been set.

CHANGE CVC CONFIGURATION IF NECESSARY — From the SERVICE table, access the CVC CONFIGURATION screen. From there, view or modify the CVC CCN address, change to English or SI units, and change the password. If there is more than one chiller at the jobsite, change the CVC address on each chiller so that each chiller has its own address. Note and record the new address. Change the screen to SI units as required, and change the password if desired.

TO CHANGE THE PASSWORD — The password may be changed from the CVC CONFIGURATION screen.

1. Press the MENU and SERVICE softkeys. Enter the current password and highlight CVC CONFIGURATION. Press the SELECT softkey. Only the last 5 entries on the CVC CONFIG screen can be changed: *BUS #*, *ADDRESS #*, *BAUD RATE*, *US IMP/METRIC*, and *PASSWORD*.
2. Use the ENTER softkey to scroll to *PASSWORD*. The first digit of the password is highlighted on the screen.
3. To change the digit, press the INCREASE or DECREASE softkey. When the desired digit is seen, press the ENTER softkey.
4. The next digit is highlighted. Change it, and the third and fourth digits in the same way the first was changed.
5. After the last digit is changed, the CVC goes to the *BUS* parameter. Press the EXIT softkey to leave that screen and return to the SERVICE menu.

⚠ CAUTION

Be sure to remember the password. Retain a copy for future reference. Without the password, access to the SERVICE menu will not be possible unless the CVC_PSWD menu on the STATUS screen is accessed by a Carrier representative.

TO CHANGE THE CVC DISPLAY FROM ENGLISH TO METRIC UNITS — By default, the CVC displays information in English units. To change to metric units, access the CVC CONFIGURATION screen:

1. Press the MENU and SERVICE softkeys. Enter the password and highlight CVC CONFIGURATION. Press the SELECT softkey.
2. Use the ENTER softkey to scroll to *US IMP/METRIC*.
3. Press the softkey that corresponds to the units desired for display on the CVC (e.g., US or METRIC).

MODIFY CONTROLLER IDENTIFICATION IF NECESSARY — The CVC module address can be changed from the CVC CONFIGURATION screen. Change this address for each chiller if there is more than one chiller at the jobsite. Write the new address on the CVC module for future reference.

INPUT EQUIPMENT SERVICE PARAMETERS IF NECESSARY — The EQUIPMENT SERVICE table has six service tables.

Configure SERVICE Tables — Access the SERVICE tables, depicted on the next page, to modify or view the following to jobsite parameters:

PARAMETER	TABLE
Starter Type	ISM_CONF — Select 0 for full voltage, 1 for reduced voltage, or 2 for solid state/variable frequency drive.
Motor Rated Line Voltage	ISM_CONF — Per chiller identification nameplate data.
Volt Transformer Ratio	ISM_CONF — Enter ratio (reduced to a ratio to 1) of power transformer wired to terminal J3 of ISM. If no transformer is used enter 1.
Motor Rated Load Amps	ISM_CONF — Per chiller identification nameplate data.
Motor Locked Rotor Trip	ISM_CONF — Per chiller identification nameplate data. Enter locked rotor delta amps (LR AMPS D-).
Starter LRA Rating	ISM_CONF — Enter value from nameplate in starter cabinet.
Motor Current CT Ratio	ISM_CONF — Enter ratio (reduced to a ratio to 1) of current transformers wired to terminal J4 of ISM.
Ground Fault Current Transformers	ISM_CONF — Enter 0 if three ground fault CTs are wired to terminal J5 of ISM. Enter 1 if one ground fault CT is used.
Ground Fault CTRatio	ISM_CONF — Enter ratio (reduced to a ratio to 1) of ground fault CT.
Single Cycle Dropout	ISM_CONF — ENABLE if motor protection required from drop in line voltage within one cycle.
Line Frequency	ISM_CONF — Enter YES for 60 Hz or NO for 50 Hz.
Line Frequency Faulting	ISM_CONF — ENABLE if motor protection required for drop in line frequency.
Stall/Hot Gas Bypass Option	OPTIONS — Default = 0 (Stall Limit) Enter 1 if HGBP is installed.
Minimum Load Points (T1/P1)	OPTIONS — Per job data — See modify load points section.
Full (Maximum) Load Points (T2/P2)	OPTIONS — Per job data — See modify load points section.
Chilled Medium	SETUP1 — Enter water or brine.
Evaporator Refrigerant Trippoint	SETUP1 — Usually 3° F (1.7° C) below design refrigerant temperature.
Evaporator Flow Delta P Cutout	SETUP1 — Enter 50% of design pressure drop to 0.5 psi (3.4 kPa).*
Condenser Flow Delta P Cutout	SETUP1 — Enter 50% of design pressure drop to 0.5 psi (3.4 kPa).*
Diffuser Option	SETUP2 — ENABLE for 5 size compressor only. See model number nomenclature.

*With variable flow systems this point may be configured to the lower end of the range.

NOTE: Other parameters on these screens are normally left at the default settings; however, they may be changed by the operator as required. The time and persistence settings on the ISM_CONF table can be adjusted to increase or decrease the sensitivity to a fault condition. Increasing time or persistence decreases sensitivity. Decreasing time or persistence increases sensitivity to the fault condition.

Modify Minimum and Maximum Load Points (ΔT1/P1; Δ T2/P2) If NecessaryT — These pairs of chiller load points, located on the OPTIONS screen, determine when to limit guide valve travel or open the hot gas bypass valve when stall prevention is needed. These points should be set based on individual chiller operating conditions.

If after configuring a value for these points, stall prevention is operating too soon or too late for conditions, these parameters should be changed by the operator.

An example of such a configuration is shown below.

Refrigerant: HCFC-134a

Estimated Minimum Load Conditions:

44 F (6.7 C) LCW
45.5 F (7.5 C) ECW
43 F (6.1 C) Suction Temperature
70 F (21.1 C) Condensing Temperature

Estimated Maximum Load Conditions:

44 F (6.7 C) LCW
4 F (12.2 C) ECW
42 F (5.6 C) Suction Temperature
8 F (36.7 C) Condensing Temperature

Calculate Maximum Load — To calculate the maximum load points, use the design load condition data. If the chiller full load cooler temperature difference is more than 15 F (8.3 C), estimate the refrigerant suction and condensing temperatures at this difference. Use the proper saturated pressure and temperature for the particular refrigerant used.

Suction Temperature:
42 F (5.6 C) = 37 psig (255 kPa) saturated
refrigerant pressure (HFC-134a)

Condensing Temperature:
98 F (36.7 C) = 120 psig (1827 kPa) saturated
refrigerant pressure (HFC-134a)

Maximum Load ΔT2:
54 – 44 = 10º F (12.2 – 6.7 = 5.5º C)

Maximum Load ΔP2:
120 – 37 = 83 psid (827 – 255 = 572 kPad)

To avoid unnecessary surge prevention, add about 10 psid (70 kPad) to |P2 from these conditions:

ΔT2 = 10º F (5.5º C)
ΔP2 = 93 psid (642 kPad)

Calculate Minimum Load — To calculate the minimum load conditions, estimate the temperature difference the cooler will have at 10% load, then estimate what the suction and condensing temperatures will be at this point. Use the proper saturated pressure and temperature for the particular refrigerant used.

Suction Temperature:
43 F (6.1 C) = 38 psig (262 kPa) saturated
refrigerant pressure (HFC-134a)

Condensing Temperature:
70 F (21.1 C) = 71 psig (490 kPa) saturated
refrigerant pressure (HFC-134a)

Minimum Load ΔT1 (at 20% Load): 2 F (1.1 C)

Minimum Load ΔP1:
71 – 38 = 33 psid (490 – 262 = 228 kPad)

Again, to avoid unnecessary surge prevention, add 20 psid (140 kPad) at ΔP1 from these conditions:
ΔT1 = 2 F (1.1 C)
ΔP1 = 53 psid (368 kPad)

If surge prevention occurs too soon or too late:

LOAD	STALL PREVENTION OCCURS TOO SOON	STALL PREVENTION OCCURS TOO LATE
At low loads (<50%)	Increase P1 by 10 psid (70 kPad)	Decrease P1 by 10 psid (70 kPad)
At high loads (>50%)	Increase P2 by 10 psid (70 kPad)	Decrease P2 by 10 psid (70 kPad)

The differential pressure (ΔP) and temperature (ΔT) can be monitored during chiller operation by viewing *ACTIVE DELTA P* and *ACTIVE DELTA T* (HEAT_EX screen). Comparing *STALL/HGBP DELTA T* to active *DELTA T* will determine when the STALL PREVENTION function will occur. The smaller the difference between the *STALL/HGBP DELTA T* and the *ACTIVE DELTA T* values, the closer to stall prevention.

MODIFY EQUIPMENT CONFIGURATION IF NECESSARY — The EQUIPMENT SERVICE table has screens to select, view, or modify parameters. Carrier's certified drawings have the configuration values required for the jobsite. Modify these values only if requested.

SERVICE Screen Modifications — Change the values on these screens according to specific job data. See the certified drawings for the correct values. Modifications can include:

- chilled water reset
- entering chilled water control (Enable/Disable)
- 4 to 20 mA demand limit
- auto restart option (Enable/Disable)
- remote contact option (Enable/Disable)

Owner-Modified CCN Tables — The following EQUIPMENT CONFIGURATION screens are described for reference only.

OCCDEFCS — The OCCDEFCS screen contains the Local and CCN time schedules, which can be modified here or on the SCHEDULE screen as described previously.

HOLIDAYS — From the HOLIDAYS screen, the days of the year that holidays are in effect can be configured. See the holiday paragraphs in the Controls section for more details.

BRODEF — The BRODEF screen defines the start and end of daylight savings time. Enter the dates for the start and end of daylight savings if required for your location. BRODEF also activates the Broadcast function which enables the holiday periods that are defined on the CVC to take effect.

Other Tables — The CONSUME, NET_OPT, and RUNTIME screens contain parameters used with a CCN system. See the applicable CCN manual for more information on these screens. These tables can only be defined from a CCN Building Supervisor.

Perform a Control Test — Check the safety controls status by performing an automated control test. Access the CONTROL TEST table and select a test to be performed function (Table 7).

The Automated Control Test checks all outputs and inputs for function. It will also set the refrigerant type. The compressor must be in the OFF mode to operate the controls test. The compressor can be put in OFF mode by pressing the STOP push-button on the CVC. Each test asks the operator to confirm the operation is occurring and whether or not to continue. If an error occurs, the operator can try to address the problem as the test is being done or note the problem and proceed to the next test.

When the control test is finished or the EXIT softkey is pressed, the test stops, and the CONTROL TEST menu displays. If a specific automated test procedure is not completed, access the particular control test to test the function when ready. The CONTROL TEST menu is described in the table below.

CCM Pressure Thermistors	Check of all thermistors.
CCM Pressure Transducers	Check of all transducers.
Pumps	Checks operation of pump outputs; pumps are activated. Also tests associated inputs such as flow or pressure.
Discrete Outputs	Activation of all on/off outputs individually.
Slide Valve	Check of the slide valve operation.
Pumpdown/Lockout	Pumpdown prevents the low refrigerant alarm during evacuation so refrigerant can be removed form the unit. Also locks the compressor off and starts the water pumps.
Terminate Lockout	To charge refrigerant and enable the chiller to run after pumpdown lockout.
Refrigerant Type	Sets type of refrigerant used: HFC-22 or HFC-134a.

NOTE: During any of the tests, an out-of-range reading will have an asterisk (*) next to the reading and a message will be displayed.

COOLER CONDENSER PRESSURE TRANSDUCER AND WATERSIDE FLOW DEVICE CALIBRATION — Calibration can be checked by comparing the pressure readings from the transducer to an accurate refrigeration gage reading. These readings can be viewed or calibrated from the HEAT_EX screen on the CVC. The transducer can be checked and calibrated at 2 pressure points. These calibration points are 0 psig (0 kPa) and between 25 and 250 psig (173 and 1724 kPa). To calibrate these transducers:

1. Shut down the compressor, cooler, and condenser pumps.

   NOTE: There should be no flow through the heat exchangers.
2. Disconnect the transducer in question from its Schrader fitting for cooler or condenser transducer calibration. For oil pressure or flow device calibration keep transducer in place.

   NOTE: If the cooler or condenser vessels are at 0 psig (0 kPa) or are open to atmospheric pressure, the transducers can be calibrated for zero without removing the transducer from the vessel.
3. Access the HEAT_EX screen and view the particular transducer reading (the *EVAPORATOR PRESSURE* or *CONDENSER PRESSURE* parameter on the HEAT_EX screen). To calibrate oil pressure or waterside flow device, view the particular reading (*CHILLED WATER DELTA P* and *CONDENSER WATER DELTA P* on the HEAT_EX screen). It should read 0 psi (0 kPa). If the reading is not 0 psi (0 kPa), but within ±5 psi (35 kPa), the value may be set to zero by pressing the SELECT softkey while the appropriate transducer parameter is highlighted on the CVC screen. Then press the ENTER softkey. The value will now go to zero. No high end calibration is necessary for flow devices.

   If the transducer value is not within the calibration range, the transducer returns to the original reading. If the pressure is within the allowed range (noted above), check the voltage ratio of the transducer. To obtain the voltage ratio, divide the voltage (dc) input from the transducer by the supply voltage signal (displayed in *CONTROL TEST* menu in the CCM PRESSURE TRANSDUCERS screen) or measure across the positive (+ red) and negative (– black) leads of the transducer. For example, the condenser transducer voltage input is measured at CCM terminals J2-4 and J2-5. The voltage ratio must be between 0.80 and 0.11 for the software to allow calibration. Pressurize the transducer until the ratio is within range. Then attempt calibration again.
4. A high pressure point can also be calibrated between 25 and 250 psig (172.4 and 1723.7 kPa) by attaching a regulated 250 psig (1724 kPa) pressure (usually from a nitrogen cylinder). The high pressure point can be calibrated by accessing the appropriate transducer parameter on the HEAT_EX screen, highlighting the parameter, pressing the SELECT softkey, and then using the INCREASE or DECREASE softkeys to adjust the value to the exact pressure on the refrigerant gage. Press the ENTER softkey to finish the calibration. Pressures at high altitude locations must be compensated for, so the chiller temperature/pressure relationship is correct.

The PIC II does not allow calibration if the transducer is too far out of calibration. In this case, a new transducer must be installed and re-calibrated.

Check Optional Pumpout System Controls and Compressor — Controls include an on/off switch, a 3-amp fuse, the compressor overloads, an internal thermostat, a compressor contactor, and a refrigerant high pressure cutout. The high pressure cutout is factory set to open at 161 psig (1110 kPa) and reset at 130 psig (896 kPa). Ensure the water-cooled condenser has been connected. Loosen the compressor holddown bolts to allow free spring travel. Open the compressor suction and discharge the service valves. Ensure oil is visible in the compressor sight glass. Add oil if necessary.

See the Pumpout and Refrigerant Transfer Procedures and Optional Pumpout System Maintenance sections, pages 69 and 76, for details on the transfer of refrigerant, oil specifications, etc.

High Altitude Locations — Because the chiller is initially calibrated at sea level, it is necessary to recalibrate the pressure transducers if the chiller has been moved to a high altitude location. See the calibration procedure in the Troubleshooting Guide section.

Table 7 — Control Test Menu Functions

TESTS TO BE PERFORMED	DEVICES TESTED
1. CCM Thermistors	Entering Chilled Water Leaving Chilled Water Entering Condenser Water Leaving Condenser Water Remote Reset Sensor Comp Discharge Temp Oil Sump Temp Comp Motor Winding Temp Spare Temperature 1 Space Temperature 2
2. CCM Pressure Transducers	Evaporator Pressure Condenser Pressure Spare Pressure Delta P Condenser Water Delta P Transducer Voltage Ref
3. Pumps	Chilled Water — Confirm Delta P Condenser Water — Confirm Delta P
4. Discrete Outputs	Oil Heater Relay Hot Gas Bypass Relay Tower Fan Relay Low Tower Fan Relay High Alarm Relay Shunt Trip Relay
5. Slide Valve	Load (close); Unload (open)
6. Pumpdown Lockout	When using pumpdown/lockout,observe freeze up precautions when removing charge: Instructs operator which valves to close and when. Starts chilled water and condenser water pumps and confirms flows. Monitors Evaporator pressure Condenser pressure Evaporator temperature during pumpout procedures Turns pumps off after pumpdown. Locks out compressor.
7. Terminate Lockout	Starts pumps and monitors flows. Instructs operator which valves to open and when. Monitors Evaporator pressure Condenser pressure Evaporator temperature during charging process Terminates compressor lockout.
8. Refrigerant Type	Sets the refrigerant type used: HFC-22 or HFC-134a.

Charge Refrigerant into Chiller

⚠ CAUTION

The transfer, addition, or removal of refrigerant in spring isolated chillers may place severe stress on external piping if springs have not been blocked in both up and down directions.

⚠ WARNING

Always operate the condenser and chilled water pumps during charging operations to prevent freeze-ups.

The standard 23XL chiller is shipped with the refrigerant already charged in the vessels. However, the 23XL may be ordered with a nitrogen holding charge of 15 psig (103 kPa). Evacuate the nitrogen from the entire chiller, and charge the chiller from refrigerant cylinders.

CHILLER EQUALIZATION WITHOUT A PUMPOUT UNIT

⚠ WARNING

When equalizing refrigerant pressure on the 23XL chiller after service work or during the initial chiller start-up, *do not use the discharge isolation valve to equalize*. Either the motor cooling isolation valve or the charging hose (connected between the pumpout valves on top of the cooler and condenser) should be used as the equalization valve.

To equalize the pressure differential on a refrigerant isolated 23XL chiller, use the terminate lockout function of the CONTROL TEST on the SERVICE menu. This helps to turn on pumps and advises the operator on proper procedures.

The following steps describe how to equalize refrigerant pressure in an isolated 23XL chiller without a pumpout unit.

1. Access terminate lockout function on the CONTROL TEST screen.
2. IMPORTANT: Turn on the chilled water and condenser water pumps to prevent freezing.
3. Slowly open the refrigerant cooling isolation valve. The chiller cooler and condenser pressures will gradually equalize. This process takes approximately 15 minutes.
4. Once the pressures have equalized, the cooler isolation valve, the condenser isolation valve, and the hot gas isolation valve may now be opened. Refer to Fig. 32-35, for the location of the valves.

⚠ WARNING

Whenever turning the discharge isolation valve, be sure to reattach the valve locking device. This prevents the valve from opening or closing during service work or during chiller operation.

CHILLER EQUALIZATION WITH PUMPOUT UNIT — The following steps describe how to equalize refrigerant pressure on an isolated 23XL chiller using the pumpout unit.

1. Access the terminate lockout function on the CONTROL TEST screen.
2. IMPORTANT: Turn on the chilled water and condenser water pumps to prevent possible freezing.
3. Open valve 4 on the pumpout unit and open valves 1a and 1b on the chiller cooler and condenser, Fig. 32-35. Slowly open valve 2 on the pumpout unit to equalize the pressure. This process takes approximately 15 minutes.
4. Once the pressures have equalized, the discharge isolation valve, cooler isolation valve, optional hot gas bypass isolation valve, and the refrigerant isolation valve can be opened. Close valves 1a and 1b, and all pumpout unit valves.

⚠ WARNING

Whenever turning the discharge isolation valve, be sure to reattach the valve locking device. This prevents the valve from opening or closing during service work or during chiller operation.

The full refrigerant charge on the 23XL will vary with chiller components and design conditions, as indicated on the job data specifications. An approximate charge may be determined by adding the condenser charge to the cooler charge as listed in Table 8.

⚠ WARNING

Always operate the condenser and chilled water pumps whenever charging, transferring, or removing refrigerant from the chiller.

Use the CONTROL TEST terminate lockout function to monitor conditions and start the pumps.

If the chiller has been shipped with a holding charge, the refrigerant is added through the refrigerant charging valve (Fig. 32-35, valves 7a and 7b) or to the pumpout charging connection. First evacuate the nitrogen holding charge from the chiller vessels. Charge the refrigerant as a gas until the system pressure exceeds 68 psig (469 kPa) for R-22, and 35 psig (141 kPa) for HFC-134a. After the chiller is beyond this pressure the refrigerant should be charged as a liquid until all the recommended refrigerant charge has been added.

TRIMMING REFRIGERANT CHARGE — The 23XL chiller is shipped with the correct charge for the design duty of the chiller. Trimming the charge can best be accomplished when the design load is available. To trim the charge, check the temperature difference between the leaving chilled water temperature and cooler refrigerant temperature at full load design conditions. If necessary, add or remove refrigerant to bring the temperature difference to design conditions or minimum differential.

INITIAL START-UP

Preparation — Before starting the chiller, verify:

1. Power is on to the main starter, oil pump relay, tower fan starter, oil heater relay, and the chiller control panel.
2. Cooling tower water is at proper level and at-or-below design entering temperature.
3. Chiller is charged with refrigerant and all refrigerant and oil valves are in their proper operating positions.
4. Oil is at the proper level in the reservoir sight glasses.
5. Oil reservoir temperature is above 140 F (60 C) or refrigerant temperature plus 50º F (28º C).
6. Valves in the evaporator and condenser water circuits are open.

NOTE: If the pumps are not automatic, ensure water is circulating properly.

⚠ WARNING

Do not permit water or brine that is warmer than 110 F (43 C) to flow through the cooler or condenser. Refrigerant overpressure may discharge through the relief valves and result in the loss of refrigerant charge.

7. Access the CONTROL TEST screen. Scroll down on the *TERMINATE LOCKOUT* option. Press the SELECT (to enable the chiller to start) and answer YES to restart unit to operating mode. The chiller is locked out at the factory in order to prevent accidental start-up.

Dry Run to Test Start-Up Sequence

1. Disengage the main motor disconnect on the starter front panel. This should only disconnect the motor power. Power to the controls, oil pump, and starter control circuit should still be energized.
2. Observe the default screen on the CVC: the Status message in the upper left-hand corner reads, “Manually Stopped.” Press the CCN or LOCAL softkey to start. If the chiller controls do not go into a start mode, go to the Schedule screen and override the schedule or change the occupied time. Press the LOCAL softkey to begin the start-up sequences.
3. Verify the chilled water and condenser water pumps have energized.
4. Verify the oil pump has started and is pressurizing the lubrication system. After the oil pump has run about 11 seconds, the starter energizes and goes through its start-up sequence.
5. Check the main contactor for proper operation.
6. The PIC II eventually shows an alarm for motor amps not sensed. Reset this alarm and continue with the initial start-up.

Check Oil Pressure and Compressor Stop

1. Two minutes after start-up, note the oil pressure reading on the CVC default screen. The value is equal to the difference between the oil and evaporator pressure transducer readings. The minimum oil pressure is 7 to 20 psi (48 to 137 kPa). The oil and evaporator pressure transducer readings can be observed on the COMPRESS and HEAT-EX table. A normal full load reading is approximately 120 psi (827 kPa) [78 psi (538 kPa)].
2. Press the STOP softkey and listen for any unusual sounds from the compressor as it coasts to a stop.

Table 8 — Refrigerant Charges

COOLER SIZE	ECONOMIZER	REFRIGERANT			
		HCFC-22		HFC-134a	
		lb	kg	lb	kg
10,11	NO	600	272	*	*
	YES	650	295	*	*
20,21	NO	700	318	*	*
	YES	750	340	*	*
40	NO	900	408	800	363
	YES	1000	454	850	386
41	NO	1000	454	850	386
	YES	1100	499	900	408
42	NO	1100	499	900	408
	YES	1200	544	950	431
43	NO	1200	544	950	431
	YES	1300	590	1000	454

*Not available or retrofitable when using HFC-134a.

To Prevent Accidental Start-Up — A chiller STOP override setting may be entered to prevent accidental start-up during service or whenever necessary. Access the MAINSTAT screen and using the NEXT or PREVIOUS softkeys, highlight the *CHILLER START/STOP* parameter. Override the current START value by pressing the SELECT softkey. Press the STOP softkey followed by the ENTER softkey. The word SUPVSR! displays on the CVC indicating the override is in place.

To restart the chiller the STOP override setting must be removed. Access the MAINSTAT screen and using NEXT or PREVIOUS softkeys highlight *CHILLER START/STOP*. The 3 softkeys that appear represent 3 choices:

- START — forces the chiller ON
- STOP — forces the chiller OFF
- RELEASE — puts the chiller under remote or schedule control.

To return the chiller to normal control, press the RELEASE softkey followed by the ENTER softkey. For more information, see Local Start-Up, page 47.

The default CVC screen message line indicates which command is in effect.

Check Chiller Operating Condition — Check to be sure that chiller temperatures, pressures, water flows, and oil and refrigerant levels indicate the system is functioning properly.

Instruct the Customer Operator — Ensure the operator(s) understand all operating and maintenance procedures. Point out the various chiller parts and explain their function as part of the complete system.

COOLER-CONDENSER — Float chamber, relief valves, refrigerant charging valve, temperature sensor locations, pressure transducer locations, Schrader fittings, waterboxes and tubes, and vents and drains.

OPTIONAL PUMPOUT STORAGE TANK AND PUMPOUT SYSTEM — Transfer valves and pumpout system, refrigerant charging and pumpdown procedure, and relief devices.

MOTOR COMPRESSOR ASSEMBLY — Guide vane actuator, transmission, motor cooling system, oil cooling system, temperature and pressure sensors, oil sight glasses, integral oil pump, isolatable oil filter, extra oil and motor temperature sensors, synthetic oil, and compressor serviceability.

MOTOR COMPRESSOR LUBRICATION SYSTEM — Oil pump, cooler filter, oil heater, oil charge and specification, operating and shutdown oil level, temperature and pressure, and oil charging connections.

CONTROL SYSTEM — CCN and LOCAL start, reset, menu, softkey functions, CVC operation, occupancy schedule, set points, safety controls, and auxiliary and optional controls.

AUXILIARY EQUIPMENT — Starters and disconnects, separate electrical sources, pumps, and cooling tower.

DESCRIBE CHILLER CYCLES — Refrigerant, motor cooling, lubrication, and oil reclaim.

REVIEW MAINTENANCE — Scheduled, routine, and extended shutdowns, importance of a log sheet, importance of water treatment and tube cleaning, and importance of maintaining a leak-free chiller.

SAFETY DEVICES AND PROCEDURES — Electrical disconnects, relief device inspection, and handling refrigerant.

CHECK OPERATOR KNOWLEDGE — Start, stop, and shutdown procedures, safety and operating controls, refrigerant and oil charging, and job safety.

REVIEW THE START-UP OPERATION, AND MAINTENANCE MANUAL.

OPERATING INSTRUCTIONS

Operator Duties

1. Become familiar with the chiller and related equipment before operating the chiller.
2. Prepare the system for start-up, start and stop the chiller, and place the system in a shutdown condition.
3. Maintain a log of operating conditions and document any abnormal readings.
4. Inspect the equipment, make routine adjustments, and perform a Control Test. Maintain the proper oil and refrigerant levels.
5. Protect the system from damage during shutdown periods.
6. Maintain the set point, time schedules, and other PIC functions.

Prepare the Chiller for Start-Up — Follow the steps described in the Initial Start-Up section, page 65.

To Start the Chiller

1. Start the water pumps, if they are not automatic.
2. On the CVC default screen, press the LOCAL or CCN softkey to start the system. If the chiller is in the OCCUPIED mode and the start timers have expired, the start sequence will start. Follow the procedure described in the Start-Up/Shutdown/Recycle Sequence section, page 47.

Check the Running System — After the compressor starts, the operator should monitor the CVC display and observe the parameters for normal operating conditions:

1. The oil sump temperature should be 20 to 40 F (11 to 20 C) above the condenser refrigerant temperature. At start-up, the oil sump temperature will rapidly decrease. It will then slowly rise to the compressor discharge temperature. After start-up, the minimum oil sump temperature should be 20 F (11 C) above the condenser refrigerant temperature. The oil sump temperature is dependent upon the compressor discharge refrigerant temperature.
2. When the compressor is running, the oil sump should be at least $^3/_4$ full. The liquid level should be visible in the separator sight glass.
3. The oil pressure displayed on the CVC default screen is equal to the difference between the oil pressure and evaporator pressure transducer readings. Typically the reading will be 4 to 20 psi (28 to 138 kPa) [1.4 to 7 psi (9.7 to 48.3 kPa)] at initial start-up until oil pressure ramp up is complete. The full load reading is approximately 120 psi (821 kPa) [78 psi (538 kPa)].
4. The moisture indicator (dry-eye) sight glass on the refrigerant motor cooling line should indicate refrigerant flow and a dry condition.
5. The condenser pressure and temperature varies with the chiller design conditions. Typically the pressure will range between 100 and 210 psig (690 to 1450 kPa) [60 to 135 psig (329 to 780 kPa)] with a corresponding temperature range of 60 to 105 F (15 to 41 C). The condenser entering water temperature may be controlled below the specified design entering

water temperature to save on compressor kilowatt requirements but, not be below 55 F (12.8 C).

6. Cooler pressure and temperature also will vary with the design conditions. Typical pressure range will be between 60 and 80 psig (410 and 550 kPa) [30 to 40 psig (204 to 260 kPa)] with temperature ranging between 34 and 45 F (1 and 8 C).
7. The compressor may operate at full capacity for a short time after the pulldown ramping has ended, even though the building load is small. The active electrical demand setting can be overridden to limit the compressor IkW, or the pulldown rate can be decreased to avoid a high demand charge for the short period of high demand operation. Pulldown rate can be based on load rate or temperature rate. It is accessed on the Equipment SERVICE screen, RAMP_DEM table (Table 3, Example 20).

To Stop the Chiller

1. The occupancy schedule starts and stops the chiller automatically once the time schedule is configured.
2. By pressing the STOP button for one second, the alarm light blinks once to confirm the button has been pressed. The compressor will then follow the normal shutdown sequence as described in the Controls section. The chiller will not restart until the CCN or LOCAL softkey is pressed. The chiller is now in the OFF control mode.

   If the chiller fails to stop, in addition to action that the PIC will initiate, the operator should open the slide valve to reduce chiller load by overriding the slide valve count to –20. Then, the operator should open the main disconnect.

> IMPORTANT: Do not attempt to stop the chiller by opening an isolating knife switch. High intensity arcing may occur.

Do not restart the chiller until the problem is diagnosed and corrected.

After Limited Shutdown — No special preparations should be necessary. Follow the regular preliminary checks and starting procedures.

Preparation for Extended Shutdown — The refrigerant should be transferred into the pumpout storage tank (if supplied; see Pumpout and Refrigerant Transfer Procedures) to reduce chiller pressure and the possibility of leaks. Maintain a holding charge of 5 to 10 lbs (2.27 to 4.5 kg) of refrigerant or nitrogen to prevent air from leaking into the chiller.

If freezing temperatures are likely to occur in the chiller area, drain the chilled water, condenser water, and the pumpout condenser water circuits to avoid freeze-up. Keep the waterbox drains open.

Leave the oil charge in the chiller with the oil heater and controls energized to maintain the minimum oil reservoir temperature.

After Extended Shutdown — Ensure the water system drains are closed. It may be advisable to flush the water circuits to remove any soft rust which may have formed. This is a good time to brush the tubes and inspect the Schrader fittings on the waterside flow devices for fouling, if necessary.

Check the cooler pressure on the CVC default screen and compare it to the original holding charge that was left in the chiller. If (after adjusting for ambient temperature changes) any loss in pressure is indicated, check for refrigerant leaks. See Check Chiller Tightness section, page 49.

Recharge the chiller by transferring refrigerant from the pumpout storage tank (if supplied). Follow the Pumpout and Refrigerant Transfer Procedures section, this page. Observe freeze-up precautions.

Carefully make all regular preliminary and running system checks. Perform a Control Test before start-up. If the oil level appears abnormally high, the oil may have absorbed refrigerant. TD frame 4 chillers are able to start with an abnormally high oil level. Ensure that the oil temperature is above refrigerant temperature plus 35º F (19º C) (TC frame 1 and 2 chillers only).

NOTE: TD frame 4 chillers do not have an oil heater.

Cold Weather Operation — When the entering condenser water drops very low (55 F [13 C] minimum), the operator should automatically cycle the cooling tower fans off to keep the temperature up. Piping may also be arranged to bypass the cooling tower. The PIC II controls have a low limit tower fan output that can be used to assist in this control (terminal 11 and 12 on ISM).

Slide Valve Operation — Manual operation of the slide valve to check control operation, or to control the valve in an emergency operation, is possible by overriding the manual slide valve count. Access the Status COMPRESS table on the CVC and highlight *MANUAL SLIDE VALVE*. To control slide valve movement, enter a desired count value. The *MANUAL SLIDE VALVE LOAD/UNLOAD* has an allowable input range of plus or minus 10 to provide up to 10 seconds of slide valve movement in the selected direction. If the counts are positive then the slide valve position will increase to load the compressor and vice versa. To release the valve to PIC II control press the RELEASE softkey.

NOTE: The valve can be increased with manual control to override the pulldown rate during start-up. However, motor current above the electrical demand setting, capacity overrides, and chilled water below control point will override the manual count and decrease the slide valve position. For descriptions of capacity overrides and set points, see the Controls section.

Entering a 0 count value will cause the slide valve to maintain a HOLD state. In this condition, the slide valve will respond to maintain the chilled water (ΔT) temperature when the override occurs.

Refrigeration Log — A refrigeration log, such as the one shown in Fig. 37, provides a convenient checklist for routine inspection and maintenance, and provides a continuous record of chiller performance. It is an aid in scheduling routine maintenance and in diagnosing chiller problems.

Keep a record of the chiller pressures, temperatures, and liquid levels on a sheet similar to that shown. Automatic recording of PIC II data is possible through the use of CCN devices such as the Data Collection module and a Building Supervisor. Contact your Carrier representative for more information.

Plant ________________ MODEL NO. __________________ SERIAL NO. __________________ REFRIGERANT TYPE __________________

DATE____	COOLER							CONDENSER							COMPRESSOR								OPER-ATOR INITIALS	REMARKS
TIME	Refrigerant		Water					Refrigerant		Water					ROTOR INLET TEMP	DISCHARGE TEMP	Oil				Motor			
	Press.	Temp	Pressure			Temp		Press.	Temp	Pressure			Temp				Press.	Filter Diff. Press	Temp	Level	Voltage	FLA ____		
			In	Out	GPM	In	Out			In	Out	GPM	In	Out								Amperage		

REMARKS: Indicate shutdowns on safety controls, repairs made, oil or refrigerant added or removed, operating hours, start counts, and air exhausted. Include amounts.

Fig. 37 — Refrigeration Log: Carrier 23XL Hermetic Screw Refrigeration

PUMPOUT AND REFRIGERANT TRANSFER PROCEDURES

Preparation — The 23XL may come equipped with an optional pumpout storage tank, pumpout system, or pumpout compressor. The refrigerant can be pumped for service work to either the chiller compressor evaporator vessel or chiller condenser vessel by using the optional pumpout system. If a pumpout storage tank is supplied, the refrigerant can be isolated in the storage tank. The following procedures describe how to transfer refrigerant from vessel to vessel and perform chiller evacuations.

⚠ WARNING

Always run the chiller cooler and condenser water pumps and always charge or transfer refrigerant as a gas when the chiller pressure is less than 30 psig (207 kPa). Below these pressures, liquid refrigerant flashes into gas, resulting in extremely low temperatures in the cooler/condenser tubes and possibly causing tube freeze-up.

⚠ WARNING

During transfer of refrigerant into and out of the optional storage tank, carefully monitor the storage tank level gage. Do not fill the tank more than 90% of capacity to allow for refrigerant expansion. Overfilling may result in damage to the tank or personal injury.

⚠ CAUTION

Do not mix refrigerants from chillers that use different compressor oils. Compressor damage can result.

Operating the Optional Pumpout Unit

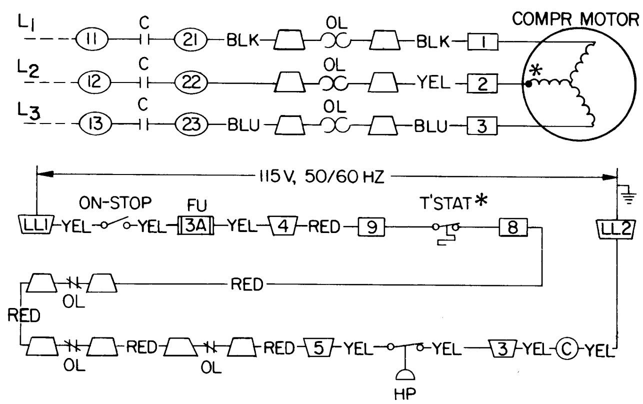
1. Be sure that the suction and the discharge service valves on the optional pumpout compressor are open (backseated) during operation. Rotate the valve stem fully counterclockwise to open. Frontseating the valve closes the refrigerant line and opens the gage port to compressor pressure.
2. Ensure that the compressor holddown bolts have been loosened to allow free spring travel.
3. Open the refrigerant inlet valve on the pumpout compressor.
4. Oil should be visible in the pumpout unit compressor sight glass under all operating conditions and during shutdown. If oil is low, add oil as described under Optional Pumpout System Maintenance section, page 76. The pump-out unit control wiring schematic is detailed in Fig. 38.

TO READ REFRIGERANT PRESSURES during pumpout or leak testing:

1. The CVC display on the chiller control panel is suitable for determining refrigerant-side pressures and low (soft) vacuum. To assure the desired range and accuracy when measuring evacuation and dehydration, use a quality vacuum indicator or manometer. This can be placed on the Schrader connections on each vessel (Fig. 11 and 12) by removing the pressure transducer.
2. To determine pumpout storage tank pressure, a 30 in. –0-400 psi (–101-0-2769 kPa) gage is attached to the storage tank.
3. Refer to Fig. 32-35, and 39 for valve locations and numbers.

⚠ CAUTION

Transfer, addition, or removal of refrigerant in spring-isolated chillers may place severe stress on external piping if springs have not been blocked in both up and down directions.



LEGEND

C — Contactor
FU — Fuse, 3 Amps
HP — High-Pressure Cutout
OL — Compressor Overload
T'STAT — Internal Thermostat
Compressor Terminal
Contactor Terminal
Overload Terminal
Pumpout Unit Terminal

*Bimetal thermal protector imbedded in motor winding.

Fig. 38 — 23XL Pumpout Unit Wiring Schematic

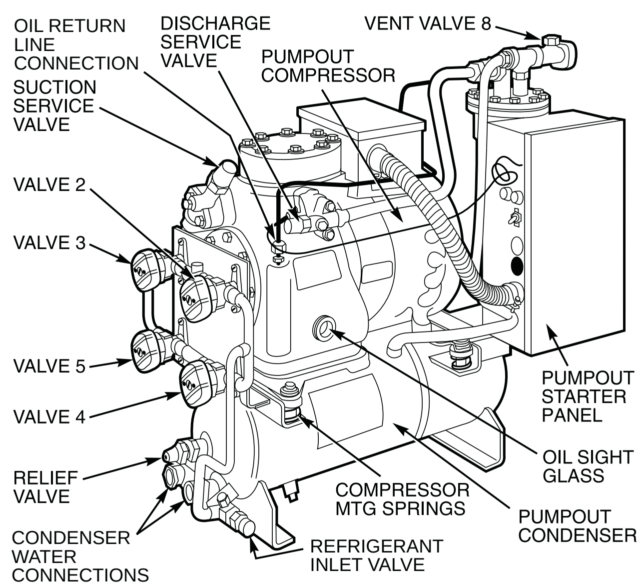


Fig. 39 — Optional Pumpout Unit

Chillers with Isolation Valves

TRANSFER ALL REFRIGERANT TO CHILLER CONDENSER VESSEL — For chillers with isolation valves, refrigerant can be stored in one chiller vessel or the other without the need for an external storage tank.

1. Push refrigerant into the chiller condenser.
   a. Valve positions:

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION				C	C		C		C	C	C

   b. Using the PIC II controls, turn off the chiller water pumps and pumpout condenser water. If the chiller water pumps are not controlled through the PIC II, turn them off manually.
   c. Turn on the pumpout compressor to push the liquid refrigerant out of the chiller cooler vessel.
   d. When all liquid refrigerant has been pushed into the chiller condenser vessel, close chiller isolation valve 11.
   e. Access the PUMPDOWN LOCKOUT screen on the PIC II CONTROL TEST table to turn on the chiller water pumps. If the chiller water pumps are not controlled by the PIC II, turn them on manually.
   f. Turn off the pumpout compressor.
2. Evacuate the refrigerant gas from chiller cooler vessel.
   a. Close pumpout compressor valves 2 and 5, and open valves 3 and 4.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION			C			C	C	C	C	C	C

   b. Turn on the pumpout condenser water.
   c. Run the pumpout compressor until the chiller cooler vessel pressure reaches 18 in. Hg vac (40 kPa abs.). Monitor pressures on the CVC and on refrigerant gages.
   d. Close valve 1a.
   e. Turn off the pumpout compressor.
   f. Close valves 1b, 3, and 4.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION	C	C	C	C	C	C	C	C	C	C	C

   g. Turn off the pumpout condenser water.
   h. Proceed to the PUMPDOWN/LOCKOUT function accessed from the CONTROL TEST table to turn off the chiller water pumps and lock out the chiller compressor. Turn off the chiller water pumps manually if they are not controlled by the PIC II.

TRANSFER ALL REFRIGERANT TO CHILLER COOLER VESSEL

1. Push the refrigerant into the chiller cooler vessel.
   a. Valve positions:

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION			C			C	C		C	C	C

   b. Turn off the chiller water pumps (either through the PIC II controls or manually, if necessary) and the pumpout condenser water.
   c. Turn on the pumpout compressor to push the refrigerant out of the chiller condenser.
   d. When all liquid refrigerant is out of the chiller condenser, close the cooler isolation valve 11.
   e. Turn off the pumpout compressor.
2. Evacuate the refrigerant gas from the chiller condenser vessel.
   a. Access the PUMPDOWN LOCKOUT function accessed from the CVC CONTROL TEST table to turn on the chiller water pumps. Turn the chiller water pumps on manually if they are not controlled by the PIC II.
   b. Close pumpout unit valves 3 and 4; open valves 2 and 5.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION				C	C		C	C	C	C	C

   c. Turn on the pumpout condenser water.
   d. Run the pumpout compressor until the chiller condenser pressure reaches 18 in. Hg vac (40 kPa abs.). Monitor pressure at the CVC and at refrigerant gages.
   e. Close valve 1b.
   f. Turn off the pumpout compressor.
   g. Close valves 1a, 2, and 5.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION	C	C	C	C	C	C	C	C	C	C	C

   h. Turn off the pumpout condenser water.
   i. Proceed to the PUMPDOWN LOCKOUT test from the CVC CONTROL TEST table to turn off the chiller water pumps and lock out the chiller compressor. Turn off the chiller water pumps manually if they are not controlled by the PIC II.

RETURN CHILLER TO NORMAL OPERATING CONDITIONS

1. Ensure vessel that was opened has been evacuated.
2. Access the TERMINATE LOCKOUT function CVC from the CONTROL TEST table to view vessel pressures and turn on chiller water pumps. If the chiller water pumps are not controlled by the PIC II, turn them on manually.
3. Open valves 1a, 1b, and 3.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION			C		C	C	C	C	C	C	C

4. Slowly open valve 5, gradually increasing pressure in the evacuated vessel to 35 psig (141 kPa). Feed refrigerant slowly to prevent tube freeze up.
5. Leak test to ensure vessel integrity.
6. Open valve 5 fully.

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION			C		C		C	C	C	C	C

7. Open valve 11 to equalize the liquid refrigerant level between the vessels.
8. Close valves 1a, 1b, 3, and 5.
9. Open isolation valves 12, 13, and 14 (if present).

VALVE	1a	1b	2	3	4	5	8	11	12	13	14
CONDITION	C	C	C	C	C	C	C				

10. Proceed to the TERMINATE LOCKOUT screen (accessed from the CONTROL TEST table) to turn off the water pumps and enable the chiller compressor for start-up. If the chiller water pumps are not controlled by the PIC II, turn them off manually.

Chillers with Storage Tanks — If the chiller has a separate storage tank, or the chiller does not have isolation valves, refer to the following procedure. See Fig. 32-35.

TRANSFER REFRIGERANT FROM PUMPOUT STORAGE TANK TO CHILLER

1. Equalize refrigerant pressure.
   a. Use the PIC II terminate lockout function on the PUMPDOWN LOCKOUT screen, accessed from the CONTROL TEST table to turn on the water pumps and monitor pressures.

> **⚠ WARNING**
>
> If the chilled water and condenser water pumps are not controlled by the PIC II, these pumps must be started and stopped manually at the appropriate times during the refrigerant transfer procedure.

   b. Close pumpout unit valves 2, 4, 5, 8, and 10, and close chiller charging valve 7; open chiller isolation valves 11, 12, 13, and 14 (if present).
   c. Open pumpout unit/storage tank valves 3 and 6, open chiller valves 1a and 1b.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION			C		C	C		C	C	C				

> **⚠ WARNING**
>
> Follow steps D and E carefully to prevent damage from freeze-up.

   d. Slowly open valve 5 to increase chiller pressure to 68 psig 35 psig (141 kPa) for HFC-134a. Feed refrigerant slowly to prevent freeze up.
   e. Open valve 5 fully after the pressure rises above the freeze point of the refrigerant. Open liquid line valves 7 and 10 until refrigerant pressure equalizes.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION			C		C				C					

2. Transfer the remaining refrigerant.
   a. Close valve 5 and open valve 4.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION			C						C					

   b. Turn off the chiller water pumps using the CVC (or manually, if necessary).
   c. Turn off the pumpout condenser water, and turn on the pumpout compressor to push liquid out of the storage tank.
   d. Close liquid line valve 7.
   e. Turn off the pumpout compressor.
   f. Close valves 3 and 4.
   g. Open valves 2 and 5.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION				C	C			C	C					

   h. Turn on the pumpout condenser water.
   i. Run the pumpout compressor until the pumpout storage tank pressure reaches 5 psig (34 kPa) (18 in. Hg [40 kPa absolute] if repairing the tank).
   j. Turn off the pumpout compressor.
   k. Close valves 1a, 1b, 2, 5, 6, and 10.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION	C	C	C	C	C	C	C	C	C	C				

   l. Turn off pumpout condenser water.

TRANSFER REFRIGERANT FROM CHILLER TO PUMPOUT STORAGE TANK

1. Equalize refrigerant pressure.
   a. Valve positions:

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION			C		C	C		C	C					

   b. Slowly open valve 5. When the pressures are equalized, open liquid line valve 7 to allow liquid refrigerant to drain by gravity into the pumpout storage tank.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION			C		C				C					

2. Transfer the remaining liquid.
   a. Turn off the pumpout condenser water. Place the valves in the following positions:

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION				C	C				C					

   b. Run the pumpout compressor for approximately 30 minutes; then close valve 10.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION				C	C				C	C				

   c. Turn off the pumpout compressor.
3. Remove any remaining refrigerant.
   a. Turn on the chiller water pumps using the PUMPDOWN LOCKOUT screen, accessed from the CONTROL TEST table. Turn on the pumps manually, if they are not controlled by the PIC II.
   b. Turn on the pumpout condenser water.
   c. Place valves in the following positions:

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION			C			C			C	C				

   d. Run the pumpout compressor until the chiller pressure reaches 30 psig (207 kPa) for HFC-134a. Then, shut off the pumpout compressor. Warm condenser water will boil off any entrapped liquid refrigerant and the chiller pressure will rise.
   e. When the pressure rises to 40 psig (276 kPa) for HFC-134a, turn on the pumpout compressor until the pressure again reaches 30 psig (207 kPa), and then turn off the pumpout compressor. Repeat this process until the pressure no longer rises. Then, turn on the pumpout compressor and pump until the pressure reaches18 in. Hg. (40 kPa absolute).
   f. Close valves 1a, 1b, 3, 4, 6, 7, and 10.

VALVE	1a	1b	2	3	4	5	6	7	8	10	11	12	13	14
CONDITION	C	C	C	C	C	C	C	C	C	C				

   g. Turn off the pumpout condenser water and continue to use the PIC II PUMPDOWN LOCKOUT screen functions, which lock out the chiller compressor for operation.
4. Establish a vacuum for service.

   To conserve refrigerant, operate the pumpout compressor until the chiller pressure is reduced to 18 in. Hg vac., ref 30 in. bar. (40 kPa abs.) following Step 3e.

GENERAL MAINTENANCE

Refrigerant Properties — HCFC-22 and HFC-134a are the standard refrigerants in the 23XL. At normal atmospheric pressure, HCFC-22 will boil at –41 F (–40.5 C) and HFC-134a will boil at –14 F (–25 C), and must, therefore, be kept in pressurized containers or storage tanks. The refrigerants are practically odorless when mixed with air. Both refrigerants are non-combustible at atmospheric pressure. Read the Material Safety Data Sheet and the latest ASHRAE Safety Guide for Mechanical Refrigeration to learn more about safe handling of these refrigerants.

> **⚠ WARNING**
>
> HCFC-22 and HFC-134a will dissolve oil and some non-metallic materials, dry the skin, and, in heavy concentrations, may displace enough oxygen to cause asphyxiation. In handling this refrigerant, protect the hands and eyes and avoid breathing fumes.

Adding Refrigerant — Follow the procedures described in the Charge Refrigerant into Chiller section, page 64.

> **⚠ WARNING**
>
> Always use the compressor pumpdown function in the Control Test mode to turn on the evaporator pump and lock out the compressor when transferring refrigerant. Liquid refrigerant may flash into a gas and cause possible freeze-up when the chiller pressure is below 65 psig (448 kPa) [30 psig (207 kPa)].

Removing Refrigerant — If the optional pumpout system is used, the 23XL refrigerant charge may be transferred to a storage vessel or within the condenser or cooler if isolation valves are present. Follow procedures in the Pumpout and Refrigerant Transfer Procedures section when removing refrigerant from the storage tank to the chiller.

Adjusting the Refrigerant Charge — If the addition or removal of refrigerant is required for improved chiller performance, follow the procedures given under the Trim Refrigerant Charge section, on this page.

Refrigerant Leak Testing — Because HCFC-22 and HFC-134a are above atmospheric pressure at room temperature, leak testing can be performed with refrigerant in the chiller. Use an electronic leak detector, halide leak detector, soap bubble solution, or ultra-sonic leak detector. Be sure that the room is well ventilated and free from concentration of refrigerant to keep false readings to a minimum. Before making any necessary repairs to a leak, transfer all refrigerant from the leaking vessel.

Refrigerant Leak Rate — ASHRAE recommends that chillers should be immediately taken off line and repaired if the refrigerant leakage rate for the entire chiller is more than 10% of the operating refrigerant charge per year.

Additionally, Carrier recommends that leaks totalling less than the above rate but more than a rate of 1 lb (0.5 kg) per year should be repaired during annual maintenance or whenever the refrigerant is pumped over for other service work.

Test After Service, Repair, or Major Leak — If all refrigerant has been lost or if the chiller has been opened for service, the chiller or the affected vessels must be pressured and leak tested. Refer to the Leak Test Chiller section to perform a leak test.

> **⚠ WARNING**
>
> HCFC-22 and HFC-134a will dissolve oil and some non-metallic materials, dry the skin, and, in heavy concentrations, may displace enough oxygen to cause asphyxiation. In handling this refrigerant, protect the hands and eyes and avoid breathing fumes.

REFRIGERANT TRACER — Use an environmentally acceptable refrigerant as a tracer for leak test procedures.

TO PRESSURIZE WITH DRY NITROGEN — Another method of leak testing is to pressure with nitrogen only and use soap bubble solution or an ultrasonic leak detector to determine if leaks are present. This should only be done if all refrigerant has been evacuated from the vessel.

1. Connect a copper tube from the pressure regulator on the cylinder to the refrigerant charging valve. Never apply full cylinder pressure to the pressurizing line. Follow the listed sequence.
2. Open the charging valve fully.
3. Slowly open the cylinder regulating valve.
4. Observe the pressure gage on the chiller and close the regulating valve when the pressure reaches test level. Do not exceed 140 psig (965 kPa).
5. Close the charging valve on the chiller. Remove the copper tube if no longer required.

Repair the Refrigerant Leak, Retest, and Apply Standing Vacuum Test — After pressurizing the chiller, test for leaks with a soap bubble solution, an electronic leak detector, a halide torch, or an ultrasonic leak detector. Bring the chiller back to atmospheric pressure, repair any leaks found, and retest.

After retesting and finding no leaks, apply a standing vacuum test. Then dehydrate the chiller. Refer to the Chiller Dehydration in the Before Initial Start-Up section, page 58.

Trim Refrigerant Charge — If it becomes necessary to adjust the refrigerant charge to obtain optimum chiller performance, operate the chiller at design load and then add or remove refrigerant slowly until the difference between leaving chilled water temperature and the cooler refrigerant temperature reaches design conditions. *Do not overcharge*. For superheat information, see the Troubleshooting section on page 76.

Refrigerant may be added either through the optional storage tank or directly into the chiller as described in the section entitled, Refrigerant Charging.

To remove any excess refrigerant, follow the procedure in Transfer Refrigerant from Chiller to Pumpout Storage Tank section, Steps 1a, b on page 71.

WEEKLY MAINTENANCE

Check the Lubrication System — Mark the oil level on the sight glasses and observe the level each week while the chiller is shut down.

If the level goes below the sight glass, the oil reclaim system will need to be checked for proper operation. If additional oil is required, add it through the oil charging valve (Fig. 2A and 2B). A hand pump is required for adding oil against refrigerant pressure. The oil charge is approximately 4.2 gal (15.9 L) for TC frame 1 and 2 chillers and 10 gal (38 L) for TD frame 4 chillers. The oil *must* meet Carrier's specifications for the 23XL chillers. Refer to Changing Oil and Oil Filter section. Any oil that is added should be logged by noting the amount and date in Fig. 37 on page 68. Any oil that is added due to oil loss not related to service will eventually return to the sump. It must be removed when the level is above the sight glass.

NOTE: TD frame 4 chillers do not use an oil heater.

On TC frame 1 and 2 chillers, a 500-watt oil heater is controlled by the PIC II to maintain oil temperature above 140 F (60 C) [120 F (48.9 C)] or refrigerant temperature plus 35 F (19 C) when the compressor is off (see the Controls section on page 13). The CVC Status-COMPRESS table displays whether the heater is energized or not. If the PIC II shows that the heater is energized, but the sump is not heating up, the power to the oil heater may be off or the oil level may be too low. Check the oil level, the oil heater contactor voltage, and oil heater resistance.

The PIC II will not permit compressor start-up if the oil temperature is too low (TC fame 1 and 2 chillers). The control will continue with start-up only after the temperature is within limits.

SCHEDULED MAINTENANCE

Establish a regular maintenance schedule based on the actual chiller requirements such as chiller load, run hours, and water quality. The time intervals listed in this section are offered as guides to service only.

Service Ontime — The CVC will display a *SERVICE ONTIME* value on the MAINSTAT table. This value should be reset to zero by the service person or the operator each time major service work is completed so that time between service can be seen.

Inspect the Control Panel — Maintenance is generally limited to general cleaning and tightening of connections. Vacuum the cabinet to eliminate dust build-up. In the event of chiller control malfunctions, refer to the Troubleshooting Guide section for control checks and adjustments.

⚠ CAUTION

Be sure power to the control panel is off when cleaning and tightening connections inside the control panel.

Check Safety and Operating Controls Monthly — To ensure chiller protection, the Automated Control Test in the service menu should be done at least once per month. See Table 4 for safety control settings.

Changing Oil and Oil Filter — If the pressure drop across the filter has approached the OIL FILTER PRESS ALERT value on the Equipment Service, Service1 table, change oil filter as needed. Otherwise, change the oil filter on a yearly basis.

Change the oil after the first year of operation. Then, change the oil at least every three years, or as needed. However, if a continuous oil monitoring system is present and/or a yearly oil analysis is performed, the time between oil changes may be extended. The 23XL TC frame 1 and 2 chillers use approximately 4.2 gal (15.9 L) of oil. The 23XL TD frame 4 chillers use approximately 10 gal (38 L) of oil. See Oil Specification section on page 74 for additional information.

⚠ CAUTION

This product is hygroscopic. Containers should remain tightly sealed in a clean and dry environment to prevent moisture absorption from the air.

TC FRAME 1 AND 2 CHILLERS — The 23XL oil sump can be isolated to change the oil filter and oil while the refrigerant remains inside the chiller. Use the following procedure to change the oil and oil filter (if required):

IMPORTANT: Remove oil from TC frame 1 and 2 chillers before changing the oil filter. Refer to Fig. 2A and 3.

1. Make sure the compressor is off and the disconnect for the compressor is open.
2. Open the control and oil heater circuit breaker in order to turn off the power to the oil heater.
3. Close the 3 oil sump isolation valves. One isolation valve is upstream and one isolation valve is downstream of the oil sump. The third isolation valve is in the oil sump vent line.

⚠ WARNING

Be sure the power to the oil heater is off when the oil sump is isolated and full. If the oil heater remains energized, over-pressurization of the oil sump could result in the failure of the oil solenoid valve, discharge of hot oil, and personal injury.

4. Connect an oil charging hose to the oil drain valve. See Fig. 3. Place the other end of the oil charging hose in a clean container suitable for used oil. A portion of the oil drained from the sump should be used as an oil sample and should be sent to a laboratory for proper analysis. *Do not contaminate this sample.*
5. Slowly open the drain valve in order to drain the oil from the sump.

⚠ WARNING

The oil sump is at high pressure. Relieve pressure slowly.

6. Once the oil has been drained, place absorbent material under the oil sump to catch any oil that may leak out once the oil sump cover is opened. Continue with Steps 7, 8, and 9 if a new oil filter is required. Proceed to Step 10 if no oil filter change is required.
7. Remove the 6 bolts from the end of the oil sump and remove the oil sump cover.
8. Remove the oil filter retaining spring. Remove and properly discard the oil filter.
9. Insert a new oil filter. Seat the filter retaining spring against the flange stop. Install the oil sump cover with a new O-ring. Insert and tighten the 6 bolts that secure the oil sump cover.
10. Evacuate the oil sump by placing a vacuum pump on the drain valve. Follow normal evacuation procedures. Shut off the drain valve when the oil sump has been evacuated. Charge new oil through the drain valve.

11. Add oil (approximately 4.2 gal [15.9 L]) until it can be seen at the lower edge of the oil sump sight glass. The oil sight glass will not fill completely since a small amount of gas will be trapped inside, even under vacuum conditions.
12. Open all 3 isolation valves (previously closed in Step 3). Apply power to the controls and oil heater.
13. The oil level will rise once the refrigerant gets absorbed into the oil.

TD FRAME 4 CHILLERS — Use the following procedures to change the oil filter and/or oil on TD frame 4 chillers. Oil can remain in TD frame 4 chillers when changing the oil filter. Refer to Fig. 2B and 4.

Changing Oil Filter

1. Make sure the compressor is off and the disconnect for the compressor starter is open.
2. Close both oil filter isolation valves. See Fig. 4.
3. Place a container underneath the oil filter assembly.
4. Slowly open the vent plug, located on top of the oil filter housing, to relieve pressure. *Do not remove the plug*. When a Schrader valve is provided, use it to relieve the pressure.
5. Remove the filter canisters by unscrewing the retainer nut. The filter may now be removed and disposed of properly.
6. Install new oil filter. Install the new O-ring. Tighten the retainer nut.
7. Partially open the isolation valve located near the oil separator. Bleed the excess air from the vent plug. Once oil starts escaping from the vent plug, close the isolation valve. Tighten the vent plug on top of the oil filter housing.
8. If a Schrader valve is supplied, evacuate the oil filter by connecting the vacuum pump to the Schrader valve.

Changing Oil

NOTE: A hand pump or portable electric oil pump will be required to complete the following operation.

1. Transfer the refrigerant into the condenser (for vessel that can be isolated) or storage tank.
2. When the chiller pressure equals a maximum of 5 psi (34 kPa), drain the oil by opening the oil charging valve, located on the bottom of the oil separator.
3. Change the oil filter as described in the Changing Oil Filter section for TD frame 4 chillers.
4. Charge the oil separator with approximately 10 gal (39 L) of oil. The oil level should be in the center of the lower sight glass.

Oil Specification — If oil is to be added, it must meet the following Carrier specifications:

- Carrier Part Number PP23BZ104
- Oil type . . . . Inhibited polyolester-based synthetic compressor lubricant suitable for use in screw compressors where high viscosity and compatibility with HCFC-22 and HFC-134a refrigerants is required.
- ISO Viscosity Grade 220
- Specific Gravity 0.981
- Viscosity, cSt at 40 C (104 F) . . . . 210 to 230
  cSt at 100 C (212 F) . . . . 18 to 21
  SSU at 100 F (38 C) . . . . 1005 ± 45
  SSU at 210 F (99 C) . . . . 91 ± 7
- Floc Point (maximum) . . . . –90 F (–68 C)
- Pour Point (maximum) . . . . –6 F (–21 C)
- Flash Point (minimum) . . . . 428 F (220 C)
- Moisture Content (maximum) . . . . 100 ppm
- Acid Number (maximum) . . . . . . 0.5 mg KOH/gram
- Miscibility Range with HCFC-22 . . . . . . –90 to 200 F (–68 to 93 C)
  with HFC-134a . . . . . . –4 to 180 F (–2 to 82 C)

⚠ CAUTION

This product is hygroscopic. Containers should remain tightly sealed in a clean and dry environment to prevent moisture absorption from the air.

This oil (part number PP-23-BZ-104) may be ordered from your local Carrier representative.

Oil Separator Coalescer

TC FRAME 1 AND 2 CHILLERS — The oil separator coalescing element is replaceable and has an estimated life of 15 years. Proper maintenance procedures require the coalescer to be changed approximately 100 hours after a major compressor teardown or chiller overhaul.

TD FRAME 4 CHILLERS — TC frame 4 chillers do not have a replaceable oil coalescer.

Refrigerant Filter/Drier — A refrigerant filter/drier, located on the motor cooling line should be changed once a year, or as necessary, if filter condition indicates a need for less or more frequent replacement. Change the filter with the chiller pressure at 0 psig (0 kPa) by transferring the refrigerant to the condenser vessel, (if isolation valves are present) or a storage tank. A moisture indicator (dry eye) sight glass is located beyond this filter to indicate the volume of moisture in the refrigerant. If the moisture indicator indicates moisture, locate the source of water immediately by performing a thorough leak check.

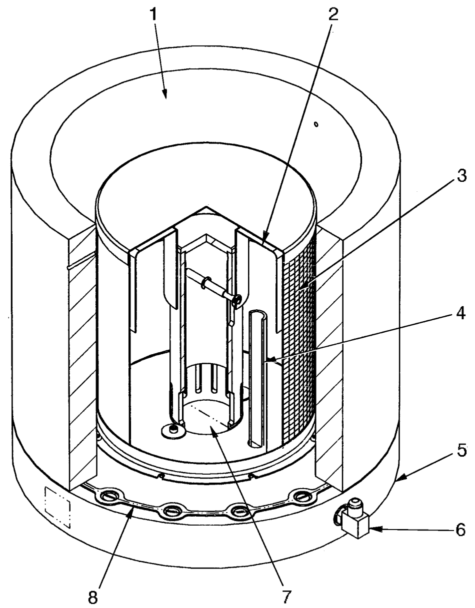
Refrigerant Strainers (TC Frame 1 and 2 Chillers Only) — The oil reclaim system has two strainers. One is located on the eductor suction line, and one on the condenser gas line. Replace these strainers once per year, or as necessary if strainer condition indicates a need for less or more frequent replacement. Change these strainers with the cooler/compressor vessel at 0 psig (0 kPa) by transferring the refrigerant charge to a storage vessel or the condenser.

Inspect Refrigerant Float System — Perform this inspection every 5 years or when the condenser is opened for service.

1. Transfer the refrigerant into the cooler vessel or into a pumpout storage tank.
2. Remove the float access cover.
3. Clean the chamber and valve assembly thoroughly. Be sure the valve moves freely. Ensure that all openings are free of obstructions.
4. Examine the cover gasket and replace if necessary.

See Fig. 40 for a view of the float valve design. For linear float valve designs, inspect the orientation of the float slide pin. It must be pointed toward the bubbler tube for proper operation.

Inspect Relief Valves and Piping — The relief valves on this chiller protect the system against the potentially dangerous effects of overpressure. To ensure against damage to the equipment and possible injury to personnel, these devices must be kept in peak operating condition.



LEGEND

1 — Refrigerant Inlet from FLASC Chamber
2 — Linear Float Assembly
3 — Float Screen
4 — Bubble Line
5 — Float Cover
6 — Bubble Line Connection
7 — Refrigerant Outlet to Cooler
8 — Gasket

Fig. 40 — 23XL Float Valve Design

As a minimum, the following maintenance is required.

1. At least once a year, disconnect the vent piping at the valve outlet and carefully inspect the valve body and mechanism for any evidence of internal corrosion or rust, dirt, scale, leakage, etc.
2. If corrosion or foreign material is found, do not attempt to repair or recondition. *Replace the valve.*
3. If the chiller is installed in a corrosive atmosphere or the relief valves are vented into a corrosive atmosphere, make valve inspections at more frequent intervals.

Compressor Bearing Maintenance — The key to good bearing maintenance is proper lubrication. Use the proper grade of oil, maintained at recommended level, temperature, and pressure. Inspect the lubrication system regularly and thoroughly.

Excessive bearing wear can be detected through increased vibration. If this symptom appears, contact an experienced and responsible service organization to perform vibration analysis on the compressor.

Compressor Rotor Check — Use Carrier specified oil. Excessive compressor rotor wear is shown by a lack of performance. If a lack of performance is noted, have the compressor rotors inspected by a trained service person.

The rotors can be visually inspected once every 5 to 10 years or as needed depending on chiller operating conditions.

Inspect the Heat Exchanger Tubes

COOLER — Inspect and clean the cooler tubes at the end of the first operating season. Because these tubes have internal ridges, a rotary-type tube cleaning system is necessary to fully clean the tubes. Upon inspection, the tube condition will determine the scheduled frequency for cleaning, and will indicate whether water treatment is adequate in the chilled water/brine circuit. Inspect the entering and leaving chilled water temperature sensors for signs of corrosion or scale. Replace the sensor if corroded or remove any scale if found.

CONDENSER — Since this water circuit is usually an open-type system, the tubes may be subject to contamination and scale. Clean the condenser tubes with a rotary tube cleaning system at least once per year and more often if the water is contaminated. Inspect the entering and leaving condenser water sensors for signs of corrosion or scale. Replace the sensor if corroded or remove any scale if found.

Higher than normal condenser pressures, together with the inability to reach full refrigeration load, usually indicate dirty tubes or air in the chiller. If the refrigeration log indicates a rise above normal condenser pressures, check the condenser refrigerant temperature against the leaving condenser water temperature. If this reading is more than what the design difference is supposed to be, then the condenser tubes may be dirty or water flow may be incorrect. Because HCFC-22 and HFC-134a are high-pressure refrigerants, air usually does not enter the chiller; instead the refrigerant leaks out.

During the tube cleaning process, use brushes especially designed to avoid scraping and scratching the tube wall. Contact your Carrier representative to obtain these brushes. *Do not use wire brushes.*

⚠ CAUTION

Hard scale may require chemical treatment for its prevention or removal. Consult a water treatment specialist for proper treatment.

Water Leaks — Water is indicated during chiller operation by the refrigerant moisture indicator on the refrigerant motor cooling line. See Fig. 11 and 12. Water leaks should be repaired immediately.

⚠ CAUTION

Chiller must be dehydrated after repair of water leaks. See Chiller Dehydration section, page 58.

Water Treatment — Untreated or improperly treated water may result in corrosion, scaling, erosion, or algae. The services of a qualified water treatment specialist should be obtained to develop and monitor a treatment program.

⚠ CAUTION

Water must be within design flow limits, clean, and treated to ensure proper chiller performance and to reduce the potential of tubing damage due to corrosion, scaling, erosion, and algae. Carrier assumes no responsibility for chiller damage resulting from untreated or improperly treated water.

Inspect the Starting Equipment — Before working on any starter, shut off the chiller, and open all disconnects supplying power to the starter.

⚠ WARNING

The disconnect on the starter front panel does not deenergize all internal circuits. Open all internal and remote disconnects before servicing the starter.

⚠ WARNING

Never open isolating knife switches while equipment is operating. Electrical arcing can cause serious injury.

Inspect starter contact surfaces for wear or pitting on mechanical-type starters. Do not sandpaper or file silverplated contacts. Follow the starter manufacturer's instructions for contact replacement, lubrication, spare parts ordering, and other maintenance requirements.

Periodically vacuum or blow off accumulated debris on the internal parts with a high-velocity, low-pressure blower.

Power connections on newly installed starters may relax and loosen after a month of operation. Turn power off and retighten. Recheck annually thereafter.

⚠ CAUTION

Loose power connections can cause voltage spikes, overheating, malfunctioning, or failures.

Check Pressure Transducers — Once a year, the pressure transducers should be checked against a pressure gage reading. Check all 7 transducers: the oil pressure transducer, the condenser pressure transducer, the cooler pressure transducer, and the waterside pressure transducers (consisting of 4 flow devices: 2 cooler, 2 condenser).

Note the evaporator and condenser pressure readings on the HEAT_EX screen on the CVC (*EVAPORATOR PRESSURE* and *CONDENSER PRESSURE*). Attach an accurate set of refrigeration gages to the cooler and condenser Schrader fittings. Compare the two readings. If there is a difference in readings, the transducer can be calibrated as described in the Troubleshooting Guide section. Oil differential pressure (*OIL PUMP DELTA P* on the COMPRESS screen) should be zero whenever the compressor is off.

Optional Pumpout System Maintenance — For compressor maintenance details, refer to the 06D, 07D Installation, Start-Up, and Service Instructions.

OPTIONAL PUMPOUT COMPRESSOR OIL CHARGE — Use oil conforming to Carrier specifications for reciprocating compressor usage. Oil requirements are as follows:

- HCFC-22 and HFC-134a
  ISO Viscosity 68
- Viscosity SSU 100 F (38 C) 300
- Carrier Part Number PP23BZ-103

The total oil charge, 4.5 pints (2.6 L), consists of 3.5 pints (2.0 L) for the compressor and one additional pint (0.6 L) for the oil separator.

Oil should be visible in one of the compressor sight glasses during operation and at shutdown. Always check the oil level before operating the compressor. Before adding or changing oil, relieve the refrigerant pressure as follows:

1. Attach a pressure gage to the gage port of either compressor service valve.
2. Close the suction service valve and open the discharge line to the storage tank or the chiller.
3. Operate the compressor until the crankcase pressure drops to 2 psig (13 kPa).
4. Stop the compressor and isolate the system by closing the discharge service valve.
5. Slowly remove the oil return line connection (Fig. 39). Add oil as required.
6. Replace the connection and reopen the compressor service valves.

OPTIONAL PUMPOUT SAFETY CONTROL SETTINGS (Fig. 41) — The optional pumpout system high-pressure switch should open at 220 ± 5 psig (1517 ± 34 kPa) and should reset automatically on pressure drop to 190 psig (1310 kPa) for HCFC-22 chillers. For chillers using HFC-134a, the switch opens at 161 psig (1110 kPa) and closes at 130 psig (896 kPa).

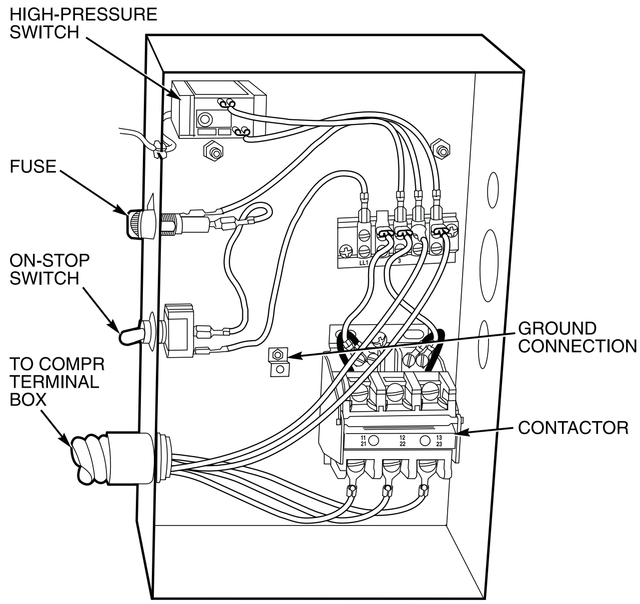


Fig. 41 — Optional Pumpout System Controls

Check the switch setting by operating the pumpout compressor and slowly throttling the pumpout condenser water.

Ordering Replacement Chiller Parts — When ordering Carrier specified parts, the following information must accompany an order.

- chiller model number and serial number
- name, quantity, and part number of the part required
- delivery address and method of shipment

TROUBLESHOOTING GUIDE

Overview — The PIC II has many features to help the operator and technician troubleshoot a 23XL chiller.

- The CVC shows the chiller's actual operating conditions and can be viewed while the unit is running.
- The CVC default screen freezes when an alarm occurs. The freeze enables the operator to view the chiller conditions at the time of alarm. The STATUS screens continue to show current information. Once all alarms have been cleared (by correcting the problems and pressing the RESET softkey), the CVC default screen returns to normal operation.
- The CONTROL ALGORITHM STATUS screens (which include the CAPACITY, OVERRIDE, LL_MAINT, ISM_HIST, LOADSHED, WSMCHLRS, and OCCDEFCM screens) display information that helps to diagnose problems with chilled water temperature control, chilled water temperature control overrides, hot gas bypass, surge algorithm status, and time schedule operation.
- The Control Test feature facilitates the proper operation and test of temperature sensors, pressure transducers, the guide vane actuator, oil pump, water pumps, tower control, and other on/off outputs while the compressor is stopped. It also has the ability to lock off the compressor and turn on water pumps for pumpout operation. The CVC shows the temperatures and pressures required during these operations.
- From other SERVICE tables, the operator or technician can access configured items, such as chilled water resets, override set points, etc.

- If an operating fault is detected, an alarm message is generated and displayed on the CVC default screen. A more detailed message — along with a diagnostic message — is also stored into the ALARM HISTORY table.

Checking Display Messages — The first area to check when troubleshooting the 23XL chiller is the CVC display. If the alarm light is flashing, check the primary and secondary message lines on the CVC default screen (Fig. 17). These messages will indicate where the fault is occurring. These messages contain the alarm message with a specified code. This code or state appears with each alarm and alert message. The ALARM HISTORY table on the CVC SERVICE menu also contains an alarm message to further expand on the alarm. For a complete list of possible alarm messages, see Table 9. If the alarm light starts to flash while accessing a menu screen, press the EXIT softkey to return to the default screen to read the alarm message. The STATUS screen can also be accessed to determine where an alarm exists.

Checking Temperature Sensors — All temperature sensors are thermistor-type sensors. This means that the resistance of the sensor varies with temperature. All sensors have the same resistance characteristics. If the controls are on, determine sensor temperature by measuring voltage drop; if the controls are powered off, determine sensor temperature by measuring resistance. Compare the readings to the values listed in Table 10A or 10B.

RESISTANCE CHECK — Turn off the control power and, from the module, disconnect the terminal plug of the sensor in question. With a digital ohmmeter, measure sensor resistance between receptacles as designated by the wiring diagram. The resistance and corresponding temperature are listed in Table 10A or 10B. Check the resistance of both wires to ground. This resistance should be infinite.

VOLTAGE DROP — The voltage drop across any energized sensor can be measured with a digital voltmeter while the control is energized. Table 10A or 10B lists the relationship between temperature and sensor voltage drop (volts dc measured across the energized sensor). Exercise care when measuring voltage to prevent damage to the sensor leads, connector plugs, and modules. Sensors should also be checked at the sensor plugs. Check the sensor wire at the sensor for 5 vdc if the control is powered on.

⚠ CAUTION

Relieve all refrigerant pressure or drain the water before replacing the temperature sensors.

CHECK SENSOR ACCURACY — Place the sensor in a medium of known temperature and compare that temperature to the measured reading. The thermometer used to determine the temperature of the medium should be of laboratory quality with 0.5º F (.25º C) graduations. The sensor in question should be accurate to within 2º F (1.2º C).

See Fig. 11 and 12 for sensor locations. The sensors are immersed directly in the refrigerant or water circuits. The wiring at each sensor is easily disconnected by unlatching the connector. These connectors allow only one-way connection to the sensor. When installing a new sensor, apply a pipe sealant or thread sealant to the sensor threads.

DUAL TEMPERATURE SENSORS — For servicing convenience, there are 2 sensors on the motor temperature sensor. If one of the sensors is damaged, the other can be used by simply moving a wire. The number 2 terminal in the sensor terminal box is the common line. To use the second sensor, move the wire from the number 1 position to the number 3 position.

Checking Pressure Transducers — There are 8 pressure transducers on 23XL chillers. They determine cooler, condenser, oil pressure, and cooler and condenser flow. The cooler and condenser transducers are also used by the PIC II to determine the refrigerant temperatures. The oil pressure valve (oil pressure transducer — evap pressure transducer) is calculated by the CCM.

All pressure transducers should be calibrated prior to initial start-up. However, at high altitude locations, it is necessary to calibrate the transducers to ensure the proper refrigerant temperature/pressure relationship. Each transducer is supplied with 5 vdc power from the CCM. If the power supply fails, a transducer voltage reference alarm occurs. If the transducer reading is suspected of being faulty, check the supply voltage. It should be 5 vdc ± .5 v displayed in CONTROL TEST under CCM Pressure Transducers. If the supply voltage is correct, the transducer should be recalibrated or replaced.

COOLER CONDENSER PRESSURE TRANSDUCER AND WATERSIDE FLOW DEVICE CALIBRATION — Calibration can be checked by comparing the pressure readings from the transducer to an accurate refrigeration gage reading. These readings can be viewed or calibrated from the HEAT_EX screen on the CVC. The transducer can be checked and calibrated at 2 pressure points. These calibration points are 0 psig (0 kPa) and between 25 and 250 psig (173 and 1724 kPa). To calibrate these transducers:

1. Shut down the compressor, cooler, and condenser pumps.

   NOTE: There should be no flow through the heat exchangers.

2. Disconnect the transducer in question from its Schrader fitting for cooler or condenser transducer calibration. For oil pressure or flow device calibration keep transducer in place.

   NOTE: If the cooler or condenser vessels are at 0 psig (0 kPa) or are open to atmospheric pressure, the transducers can be calibrated for zero without removing the transducer from the vessel.

3. Access the HEAT_EX screen and view the particular transducer reading (the *EVAPORATOR PRESSURE* or *CONDENSER PRESSURE* parameter on the HEAT_EX screen). To calibrate oil pressure or waterside flow device, view the particular reading (*CHILLED WATER DELTA P* and *CONDENSER WATER DELTA P* on the HEAT_EX screen, and *OIL PUMP DELTA P* on the COMPRESS screen). It should read 0 psi (0 kPa). If the reading is not 0 psi (0 kPa), but within ± 5 psi (35 kPa), the value may be set to zero by pressing the SELECT softkey while the appropriate transducer parameter is highlighted on the CVC screen. Then press the ENTER softkey. The value will now go to zero. No high end calibration is necessary for *OIL PUMP DELTA P* or flow devices.

   If the transducer value is not within the calibration range, the transducer returns to the original reading. If the pressure is within the allowed range (noted above), check the voltage ratio of the transducer. To obtain the voltage ratio, divide the voltage (dc) input from the transducer by the supply voltage signal (displayed in *CONTROL TEST* menu in the CCM PRESSURE TRANSDUCERS screen) or measure across the positive (+ red) and negative (– black) leads of the transducer. For example, the condenser transducer voltage input is measured at CCM terminals J2-4 and J2-5. The voltage ratio must be between 0.80 and 0.11 for the software to allow calibration. Pressurize the transducer until the ratio is within range. Then attempt calibration again.

4. A high pressure point can also be calibrated between 25 and 250 psig (172.4 and 1723.7 kPa) by attaching a regulated 250 psig (1724 kPa) pressure (usually from a nitrogen cylinder). The high pressure point can be calibrated by accessing the appropriate transducer parameter on the HEAT_EX screen, highlighting the parameter, pressing the SELECT softkey, and then using the INCREASE or DECREASE softkeys to adjust the value to the exact pressure on the refrigerant gage. Press the ENTER softkey to finish the calibration. Pressures at high altitude locations must be compensated for, so the chiller temperature/pressure relationship is correct.

The PIC II does not allow calibration if the transducer is too far out of calibration. In this case, a new transducer must be installed and re-calibrated.

TRANSDUCER REPLACEMENT — Since the transducers are mounted on Schrader-type fittings, there is no need to remove refrigerant from the vessel when replacing the transducers. Disconnect the transducer wiring by pulling up on the locking tab while pulling up on the weather-tight connecting plug from the end of the transducer. *Do not pull on the transducer wires.* Unscrew the transducer from the Schrader fitting. When installing a new transducer, do not use pipe sealer (which can plug the sensor). Put the plug connector back on the sensor and snap into place. Check for refrigerant leaks.

⚠ WARNING

Be sure to use a back-up wrench on the Schrader fitting whenever removing a transducer, since the Schrader fitting may back out with the transducer, causing a large leak and possible injury to personnel.

Control Algorithms Checkout Procedure — One of the tables on the CVC SERVICE menu is CONTROL ALGORITHM STATUS. The maintenance screens may be viewed from the CONTROL ALGORITHM STATUS table to see how a particular control algorithm is operating.

These maintenance screens are very useful in helping to determine how the control temperature is calculated and guide vane positioned and for observing the reactions from load changes, control point overrides, hot gas bypass, surge prevention, etc. The tables are:

CAPACITY	Capacity Control	This table shows all values used to calculate the chilled water/brine control point.
OVERRIDE	Override Status	Details of all chilled water control override values.
HEAT_EX	Surge/HGBP Status	The surge and hot gas bypass control algorithm status is viewed from this screen. All values dealing with this control are displayed.
LL_MAINT	LEAD/LAG Status	Indicates LEAD/LAG operation status.
OCCDEFCM	Time Schedules Status	The Local and CCN occupied schedules are displayed here to help the operator quickly determine whether the schedule is in the “occupied” mode or not.
WSMDEFME	Water System Manager Status	The water system manager is a CCN module that can turn on the chiller and change the chilled water control point. This screen indicates the status of this system.

Control Test — The Control Test feature can check all the thermistor temperature sensors, pressure transducers, pumps and their associated flow devices, the slide valve, and other control outputs such as hot gas bypass. The tests can help to determine whether a switch is defective or a pump relay is not operating, as well as other useful troubleshooting issues. During pumpdown operations, the pumps are energized to prevent freeze-up and the vessel pressures and temperatures are displayed. The Pumpdown/Lockout feature prevents compressor start-up when there is no refrigerant in the chiller or if the vessels are isolated. The Terminate Lockout feature ends the Pumpdown/Lockout after the pumpdown procedure is reversed and refrigerant is added.

LEGEND TO TABLES 9A-9J

CM — Chiller Control Module
CCN — Carrier Comfort Network
CVC — Chiller Visual Controller
CHW — Chilled Water
ISM — Integrated Starter Module
PIC II — Product Integrated Control II
VFD — Variable Frequency Drive

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides

A. MANUAL STOP

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
MANUALLY STOPPED — PRESS	CCN OR LOCAL TO START	PIC II in OFF mode, press CCN or LOCAL softkey to start unit.
TERMINATE PUMPDOWN MODE	TO SELECT CCN OR LOCAL	Enter the CONTROL TEST table and select TERMINATE LOCKOUT to unlock compressor.
SHUTDOWN IN PROGRESS	COMPRESSOR UNLOADING	Chiller unloading before shutdown due to soft/stop feature.
SHUTDOWN IN PROGRESS	COMPRESSOR DEENERGIZED	Chiller compressor is being commanded to stop. Water pumps are deenergized within one minute.
ICE BUILD	OPERATION COMPLETE	Chiller shutdown from Ice Build operation.

B. READY TO START

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
READY TO START IN XX MIN	UNOCCUPIED MODE	Time schedule for PIC II is unoccupied. Chillers will start only when occupied.
READY TO START IN XX MIN	REMOTE CONTACTS OPEN	Remote contacts are open. Close contacts to start.
READY TO START IN XX MIN	STOP COMMAND IN EFFECT	Chiller START/STOP on MAINSTAT manually forced to stop. Release point to start.
READY TO START IN XX MIN	OCCUPIED MODE	Chiller timer counting down. Unit ready to start.
READY TO START IN XX MIN	REMOTE CONTACTS CLOSED	Chiller timer counting down. Unit ready to start. Remote contact enabled and closed.
READY TO START IN XX MIN	START COMMAND IN EFFECT	Chiller START/STOP on MAINSTAT manually forced to start. Release value to start under normal control.
READY TO START IN XX MIN	RECYCLE RESTART PENDING	Chiller in recycle mode.
READY TO START	UNOCCUPIED MODE	Time schedule for PIC II is unoccupied. Chiller will start when occupied. Make sure the time and date are correct. Change values in TIME AND DATE screen.
READY TO START	REMOTE CONTACTS OPEN	Remote contacts have stopped the chiller. Close contacts to start.
READY TO START	STOP COMMAND IN EFFECT	Chiller START/STOP on MAINSTAT manually forced to stop. Release point to start.
READY TO START	OCCUPIED MODE	Chiller timers complete, unit start will commence.
READY TO START	REMOTE CONTACTS CLOSED	Chiller timer counting down. Unit ready for start.
READY TO START	START COMMAND IN EFFECT	Chiller START/STOP on MAINSTAT has been manually forced to start. Chiller will start regardless of time schedule or remote contact status.
STARTUP INHIBITED	LOADSHED IN EFFECT	CCN loadshed module commanding chiller top stop.

C. IN RECYCLE SHUTDOWN

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
RECYCLE RESTART PENDING	OCCUPIED MODE	Unit in recycle mode, chilled water temperature is not sufficiently above set point to start.
RECYCLE RESTART PENDING	REMOTE CONTACT CLOSED	Unit in recycle mode, chilled water temperature is not sufficiently above set point to start.
RECYCLE RESTART PENDING	START COMMAND IN EFFECT	Chiller START/STOP on MAINSTAT manually forced to start, chilled water temperature is not sufficiently above set point to start.
RECYCLE RESTART PENDING	ICE BUILD MODE	Chiller in ICE BUILD mode. Chilled fluid temperature is satisfied for ICE BUILD conditions.

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

D. PRE-START ALERTS: These alerts only delay start-up. When alert is corrected, the start-up will continue. No reset is necessary.

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
100	**PRESTART ALERT**	STARTS LIMIT EXCEEDED	100->Excessive compressor starts (8 in 12 hours)	Depress the RESET softkey if additional start is required. Reassess start-up requirements.
102	**PRESTART ALERT**	HIGH MOTOR TEMPERATURE	102->Comp Motor Winding Temp [VALUE] exceeded limit of [LIMIT]*.	Check motor sensors for wiring and accuracy. Check motor cooling line for proper operation, or restrictions. Check for excessive starts within a short time span.Check configurable range in SETUP1 screen.
103	**PRESTART ALERT**	HIGH DISCHARGE TEMP	103->Comp Discharge Temp [VALUE] exceeded limit of [LIMIT]*.	Allow discharge sensor to cool. Check for sensor wiring and accuracy. Check for excessive starts. Check configurable range in SETUP1 screen.
104	**PRESTART ALERT**	LOW REFRIGERANT TEMP	104->Evaporator Refrig Temp [VALUE] exceeded limit of [LIMIT]*.	Check transducer wiring and accuracy. Check for low chilled fluid supply temperatures. Check refrigerant charge.
105	**PRESTAR ALERT**	LOW OIL TEMPERATURE	105->Oil Sump Temp [VALUE] exceeded limit of [LIMIT]*.	Check oil heater contactor/relay and power. Check oil level and oil pump operation.
106	**PRESTART ALERT**	HIGH CONDENSER PRESSURE	106->Condenser Pressure [VALUE] exceeded limit of [LIMIT]*.	Check transducer wiring and accuracy. Check for high condenser water temperatures.
107	**PRESTART ALERT**	LOW LINE VOLTAGE	107->Average Line Voltage [VALUE] exceeded limit of [LIMIT]*.	Check voltage supply. Check voltage transformers. Consult power utility if voltage is low.
108	**PRESTART ALERT**	HIGH LINE VOLTAGE	108->Average Line Voltage [VALUE] exceeded limit of [LIMIT]*.	Check voltage supply. Check power transformers. Consult power utility if voltage is high.

*[LIMIT] is shown on the CVC as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert. [VALUE] is the actual pressure, temperature, voltage, etc., at which the control tripped.

E. START-UP IN PROGRESS

PRIMARY MESSAGE	SECONDARY MESSAGE	CAUSE/REMEDY
STARTUP IN PROGRESS	OCCUPIED MODE	Chiller is starting. Time schedule is occupied.
STARTUP IN PROGRESS	REMOTE CONTACT CLOSED	Chiller is starting. Remote contacts are enabled and closed.
STARTUP IN PROGRESS	START COMMAND IN EFFECT	Chiller is starting. Chiller START/STOP in MAINSTAT manually forced to start.
AUTORESTART IN PROGRESS	OCCUPIED MODE	Chiller is starting after power failure. Time schedule is occupied.
AUTORESTART IN PROGRESS	REMOTE CONTACT CLOSED	Chiller is starting after power failure. Remote contacts are enabled and closed.
AUTORESTART IN PROGRESS	START COMMAND IN EFFECT	Chiller is starting after power failure. Chiller START/STOP on MAINSTAT manually forced to start.

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

F. NORMAL RUN

PRIMARY MESSAGE	SECONDARY MESSAGE	CAUSE/REMEDY
RUNNING — RESET ACTIVE	4-20 mA SIGNAL	Auto chilled water reset active based on external input.
RUNNING — RESET ACTIVE	REMOTE TEMP SENSOR	Auto chilled water reset active based on external input.
RUNNING — RESET ACTIVE	CHW TEMP DIFFERENCE	Auto chilled water reset active based on cooler ∆T.
RUNNING — TEMP CONTROL	LEAVING CHILLED WATER	Default method of temperature control.
RUNNING — TEMP CONTROL	ENTERING CHILLED WATER	Entering Chilled Water (ECW) control enabled in TEMP_CTL screen
RUNNING — TEMP CONTROL	TEMPERATURE RAMP LOADING	Ramp Loading in effect. Use RAMP_DEM screen to modify.
RUNNING — DEMAND LIMITED	BY DEMAND RAMP LOADING	Ramp Loading in effect. Use RAMP_DEM screen to modify.
RUNNING — DEMAND LIMITED	BY LOCAL DEMAND SETPOINT	Demand limit set point is less than actual demand.
RUNNING — DEMAND LIMITED	BY 4-20 mA SIGNAL	Demand limit is active based on external auto demand limit option.
RUNNING — DEMAND LIMITED	BY CCN SIGNAL	Demand limit is active based on control limit signal from CCN.
RUNNING — DEMAND LIMITED	BY LOADSHED/REDLINE	Demand limit is active based on LOADSHED screen set-up.
RUNNING — TEMP CONTROL	HOT GAS BYPASS	Hot gas bypass option is energized. See stall prevention in the control section.
RUNNING — DEMAND LIMITED	BY LOCAL SIGNAL	Active demand limit manually overridden on MAINSTAT table.
RUNNING —TEMP CONTROL	ICE BUILD MODE	Chiller is running under Ice Build temperature control.

G. NORMAL RUN WITH OVERRIDES

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
120	**RUN CAPACITY LIMITED**	HIGH CONDENSER PRESSURE	120->Condenser Pressure [VALUE] exceeded limit of [LIMIT]*.	Check for high condenser water temperatures. Check setting in SETUP1.
121	**RUN CAPACITY LIMITED**	HIGH MOTOR TEMPERATURE	121->Comp Motor Winding Temp [VALUE] exceeded limit of [LIMIT]*.	Check motor cooling lines. Check for closed valves. Check setting in SETUP1.
122	**RUN CAPACITY LIMITED**	LOW EVAP REFRIG TEMP	122->Evaporator Refrig Temp [VALUE] exceeded limit of [LIMIT]*.	Check refrigerant charge. Check for low entering cooler temperatures.
123	**RUN CAPACITY LIMITED**	HIGH COMPRESSOR LIFT	123->Stall Prevention Override: Lift Too High For Compressor.	Check for high condenser water temperatures or low suction temperature.
124	**RUN CAPACITY LIMITED**	MANUAL SLIDE VALVE	124->Run Capacity Limited: Manual Slide Valve Control.	Slide valve point has been forced in MAINSTAT screen. Release force to continue normal operation.
125	**RUN CAPACITY LIMITED**	LOW DISCHARGE SUPERHEAT	No messages.	Check oil charge. Check refrigerant charge.
126	**RUN CAPACITY OVERRIDE**	ROTOR INLET TEMPERATURE	126->Run Capacity Override: Rotor Inlet Temp.	

*[LIMIT] is shown on the CVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. [VALUE] is the actual pressure, temperature, voltage, etc., at which the control has recorded at the time of the fault condition.

H. OUT-OF-RANGE SENSOR ALARMS

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
260	**SENSOR FAULT**	LEAVING CHILLED WATER	260->Sensor Fault: Leaving Chilled Water	Check sensor resistance or voltage drop. Check for proper wiring.
261	**SENSOR FAULT**	ENTERING CHILLED WATER	261->Sensor Fault: Entering Chilled Water	Check sensor resistance or voltage drop. Check for proper wiring.
262	**SENSOR FAULT**	CONDENSER PRESSURE	262->Sensor Fault: Condenser Pressure	Check sensor wiring.
263	**SENSOR FAULT**	EVAPORATOR PRESSURE	263->Sensor Fault: Evaporator Pressure	Check sensor wiring.
264	**SENSOR FAULT**	ROTOR INLET TEMP	264->Sensor Fault: Rotor Inlet Temp	Check sensor resistance or voltage drop. Check for proper wiring.
265	**SENSOR FAULT**	COMPRESSOR MOTOR TEMP	265->Sensor Fault: Comp Motor Winding Temp	Check sensor resistance or voltage drop. Check for proper wiring.
266	**SENSOR FAULT**	OIL SUMP TEMP	266->Sensor Fault: Oil Sump Temp	Check sensor resistance or voltage drop. Check for proper wiring.
267	**SENSOR FAULT**	COMP OIL PRESS DIFF	267->Sensor Fault: Oil Sump Temp	Check sensor resistance or voltage drop. Check for proper wiring.
268	**SENSOR FAULT**	CHILLED WATER FLOW	269->Sensor Fault: Chilled Water Delta P	Check sensor wiring and accuracy.
269	**SENSOR FAULT**	COND WATER FLOW	270->Sensor Fault: Cond Water Delta P	Check sensor wiring and accuracy.

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

I. CHILLER PROTECT LIMIT FAULTS

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
200	PROTECTIVE LIMIT	1M CONTACT FAULT	200->1M Aux Contact Fault; Check 1M Contactor and Aux	
201	PROTECTIVE LIMIT	2M CONTACT FAULT	201->2M Aux Contact Fault; Check 2M Contactor and Aux	
202	PROTECTIVE LIMIT	MOTOR AMPS NOT SENSED	202->Motor Amps Not Sensed — Average Line Current [VALUE]	Check for wiring of current transformers to the ISM. Check main circuit breaker for trip.
203	FAILURE TO START	EXCESS ACCELERATION TIME	203->Motor Acceleration Fault — Average Line Current [VALUE]	Check to be sure that the inlet guide vanes are closed at start-up. Check starter for proper operation. Reduce unit pressure if possible.
204	FAILURE TO STOP	1M/2M CONTACT FAULT	204->1M/2M Aux Contact Stop Fault; Check 1M/2M Contactors and Aux	
205	FAILURE TO STOP	MOTOR AMPS WHEN STOPPED	205->Motor Amps When Stopped — Average Line Current [VALUE]	
206	PROTECTIVE LIMIT	STARTER FAULT	206->Starter Fault Cutout; Check Optional Starter Contacts	
207	PROTECTIVE LIMIT	HIGH CONDENSER PRESSURE	207->High Cond Pressure cutout. [VALUE] exceeded limit of [LIMIT]*.	Check for high condenser water temperatures, low water flow, fouled tubes. Check for division plate/gasket bypass. Check for noncondensables. Check transducer wiring and accuracy.
208	PROTECTIVE LIMIT	EXCESSIVE MOTOR AMPS	208->Compressor Motor Amps [VALUE] exceeded limit of[LIMIT]*.	Check motor current for proper calibration. Check inlet guide vane actuator.
209	PROTECTIVE LIMIT	LINE PHASE LOSS	209->Line Phase Loss; Check ISM Fault History to Identify Phase	Check transformers to ISM. Check power distribution bus. Consult power company.
210	PROTECTIVE LIMIT	LINE VOLTAGE DROPOUT	210->Single Cycle Line Voltage Dropout	
211	PROTECTIVE LIMIT	HIGH LINE VOLTAGE	211->High Average Line Voltage [VALUE]	Check transformers to ISM. Check distribution bus. Consult power company.
212	PROTECTIVE LIMIT	LOW LINE VOLTAGE	212->Low Average Line Voltage [VALUE]	Check transformers to ISM. Check distribution bus. Consult power company.
213	PROTECTIVE LIMIT	STARTER MODULE RESET	213->Starter Module Power-On Reset When Running	
214	PROTECTIVE LIMIT	POWER LOSS	214->Power Loss: Loss When Running	Check transformers to ISM. Check distribution bus. Consult power company.
215	PROTECTIVE LIMIT	LINE CURRENT IMBALANCE	215->Line Current Imbalance; Check ISM Fault History to Identify Phase	
216	PROTECTIVE LIMIT	LINE VOLTAGE IMBALANCE	216->Line Voltage Imbalance; Check ISM Fault History to Identify Phase	
217	PROTECTIVE LIMIT	MOTOR OVERLOAD TRIP	217->Motor Overload Trip; Check ISM configurations	Check ISM configuration.
218	PROTECTIVE LIMIT	MOTOR LOCKED ROTOR TRIP	218->Motor Locked Rotor Amps exceeded; Check Motor & ISM Config	Check ISM configuration.
219	PROTECTIVE LIMIT	STARTER LOCK ROTOR TRIP	219->Starter Locked Rotor Amps Rating exceeded	Check ISM configuration.
220	PROTECTIVE LIMIT	GROUND FAULT	220->Ground Fault Trip; Check Motor and Current Transformers	
221	PROTECTIVE LIMIT	PHASE REVERSAL TRIP	221->Phase Reversal Trip; Check Power Supply	
222	PROTECTIVE LIMIT	LINE FREQUENCY TRIP	222->Line Frequency — [VALUE] exceeded limit of [LIMIT].* Check Power Supply.	
223	PROTECTIVE LIMIT	STARTER MODULE FAILURE	223->Starter Module Hardware Failure	

*[LIMIT] is shown on the CVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. [VALUE] is the actual pressure, temperature, voltage, etc., at which the control tripped.

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

I. CHILLER PROTECT LIMIT FAULTS (cont)

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
227	**PROTECTIVE LIMIT**	OIL PRESS SENSOR FAULT	227->Oil Delta P [VALUE] exceeded limit of [LIMIT]*.	Check transducer wiring and accuracy. Check power supply to pump. Check pump operation. Check transducer calibration.
228	**PROTECTIVE LIMIT**	LOW OI PRESSURE	228->Oil Delta P [VALUE] exceeded limit of [LIMIT].*	Check transducer wiring and accuracy. Check power supply to pump. Check pump operation. Check oil level. Check for partially closed service valves. Check oil filters. Check for foaming oil at start-up. Check transducer calibration.
229	**PROTECTIVE LIMIT**	LOW CHILLED WATER FLOW	229->Low Chilled Water Flow; Check Delta P Config & Calibration	Perform pump control test. Check transducer accuracy and wiring. Check water valves. Check transducer calibration.
230	**PROTECTIVE LIMIT**	LOW CONDENSER WATER FLOW	230->Low Condenser Water Flow; Check Delta P Config & Calibration	Perform pump control test. Check transducer accuracy and wiring. Check water valves. Check transducer calibration.
231	**PROTECTIVE LIMIT**	HIGH DISCHARGE TEMP	231->Comp Discharge Temp [VALUE] exceeded limit of [LIMIT].*	Check sensor resistance or voltage drop. Check for proper wiring. Check for proper condenser flow and temperature. Check for proper inlet guide vane and diffuser actuator operation. Check for fouled tubes or noncondensables in the system.
232	**PROTECTIVE LIMIT**	LOW REFRIGERANT TEMP	232->Evaporator Refrig Temp [VALUE] exceeded limit of [LIMIT]*.	Check for proper refrigerant charge. Check float operation. Check for proper fluid flow and temperature. Check for proper inlet guide vane operation.
233	**PROTECTIVE LIMIT**	HIGH MOTOR TEMPERATURE	233->Comp Motor Winding Temp [VALUE] exceeded limit of [LIMIT]*.	Check motor sensors wiring and accuracy. Check motor cooling line for proper operation, or restrictions. Check for excessive starts within a short time span.
234	**PROTECTIVE LIMIT**	OIL LEVEL SENSOR	234->Check oil level in separator.	Check for low oil level. Check the oil level switch wiring and accuracy.
235	**PROTECTIVE LIMIT**	HIGH CONDENSER PRESSURE	235->Condenser Pressure [VALUE] exceeded limit of [LIMIT]*.	Check for high condenser water temperatures, low water flow, fouled tubes. Check for division plate/gasket bypass. Check for noncondensables. Check transducer wiring and accuracy.
236	**PROTECTIVE LIMIT**	CCN OVERRIDE STOP	236->CCN Override Stop while in LOCAL run mode	CCN has signaled the chiller to stop. Reset and restart when ready. If the signal was sent by the CVC, release the stop signal on the STATUS01 table.
237	**PROTECTIVE LIMIT**	SPARE SAFETY DEVICE	237->Spare Safety Device	Spare safety input has tripped or factory installed jumper is not present.
238	**PROTECTIVE LIMIT**	EXCESSIVE COMPR STALL	238->Compressor Stall: Check condenser water temp and flow	Check condenser flow and temperatures. Check stall protection configuration.
239	**PROTECTIVE LIMIT**	TRANSDUCER VOLTAGE FAULT	239->Transducer Voltage Ref [VALUE] exceeded limit of [LIMIT]*.	
240	**PROTECTIVE LIMIT**	LOW DISCHARGE SUPERHEAT	240->Check for Oil in Refrigerant or Overcharge of Refrigerant	
241	**LOSS OF COMMUNICATION**	WITH STARTER MODULE	241->Loss of Communication With Starter.	Check wiring to ISM.
242	**LOSS OF COMMUNICATION**	WITH CCM MODULE	242->Loss of Communication With CCM.	Check wiring to CCM.
243	**POTENTIAL FREEZE-UP**	EVAP PRESS/TEMP TOO LOW	243->Evaporator Refrig Temp [VALUE] exceeded limit of [LIMIT]*.	Check for proper refrigerant charge. Check float operation. Check for proper fluid flow and temperature. Check for proper inlet guide vane operation.
244	**POTENTIAL FREEZE-UP**	COND PRESS/TEMP TOO LOW	244->Condenser Refrig Temp [VALUE] exceeded limit of [LIMIT]*.	
245	**PROTECTIVE LIMIT**	VFD SPEED OUT OF RANGE	245->Actual VFD Speed [TARGET VFD] exceeded limit of [SPEED ± 10%]*.	

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

I. CHILLER PROTECT LIMIT FAULTS (cont)

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
246	**PROTECTIVE LIMIT**	DIRTY OIL FILTER	246->Oil Filter DELTA P [VALUE] exceeded limit of [LIMIT]. Check oil system.	
247	**PROTECTIVE LIMIT**	MOTOR ROTATION INCORRECT	247->Check motor wiring for phase reversal.	
248	**PROTECTIVE LIMIT**	SPARE TEMPERATURE #1	248->Spare Temperature #1 [VALUE] exceeded limit of [LIMIT]*.	
249	**PROTECTIVE LIMIT**	SPARE TEMPERATURE #2	249->Spare Temperature #2 [VALUE] exceeded limit of [LIMIT]*.	
250	**PROTECTIVE LIMIT**	REFRIGERANT LEAK SENSOR	250->Refrigerant Leak Sensor [VALUE] exceeded Limit of [LIMIT].	
251	**PROTECTIVE LIMIT**	ISM CONFIG CONFLICT	251->ISM Config Conflict (ISM Uploaded); Verify to Reset Alarm	
252	**PROTECTIVE LIMIT**	ISM CONFIG CONFLICT	252->ISM Config Conflict (ISM Downloading); Verify to Reset Alarm	
253	**FAILURE TO START**	CHECK REFRIGERANT TYPE	253->Startup Terminated. Check Refrigerant Type.	

*[LIMIT] is shown on the CVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. [VALUE] is the actual pressure, temperature, voltage, etc., at which the control tripped.

J. CHILLER ALERTS

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
140	**SENSOR ALERT**	LEAVING COND WATER TEMP	140->Sensor Fault: Check Leaving Cond Water Sensor	Check sensor resistance or voltage drop. Check for proper wiring.
141	**SENSOR ALERT**	ENTERING COND WATER TEMP	141->Sensor Fault: Check Entering Cond Water Sensor	Check sensor resistance or voltage drop. Check for proper wiring.
142	**LOW OIL PRESSURE ALERT**	CHECK OIL FILTER	142->Low Oil Pressure Alert. Check Oil Filter.	Check for partially or closed shut-off valves. Check oil filter. Check oil level. Check transducer wiring and accuracy.
143	**AUTORESTART PENDING**	LINE PHASE LOSS	143->Line Phase Loss	Power loss has been detected in any phase. Chiller automatically restarting.
144	**AUTORESTART PENDING**	LINE VOLTAGE DROP OUT	144->Single Cycle Line Voltage Dropout	A drop in line voltage has been detected within 2 voltage cycles. Chiller automatically restarting if restart is enabled.
145	**AUTORESTART PENDING**	HIGH LINE VOLTAGE	145>Line Overvoltage — Average Line Volt [VALUE]	Check line power.
146	**AUTORESTART PENDING**	LOW LINE VOLTAGE	146->Line Undervoltage — Average Line Volt [VALUE]	Check line power.
147	**AUTORESTART PENDING**	STARTER MODULE RESET	147->Starter Module Power-On Reset When Running	ISM has detected a hardware fault and has reset. Chiller automatically restarting.
148	**AUTORESTART PENDING**	POWER LOSS	148->Control Power-Loss When Running	Check control power.
149	**SENSOR ALERT**	HIGH DISCHARGE TEMP	149->Comp Discharge Temp [VALUE] exceeded limit of [LIMIT]*.	Check sensor resistance or voltage drop. Check for proper wiring. Check for proper condenser flow and temperature. Check for high lift or low load. Check for proper slide valve operation. Check for fouled tubes or noncondensables in the refrigerant system.

Table 9 — CVC Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

J. CHILLER ALERTS (cont)

STATE	PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
151	**CONDENSER PRESSURE ALERT**	PUMP RELAY ENERGIZED	151->High Condenser Pressure [VALUE]: Pump Energized to Reduce Pressure.	Check sensor wiring and accuracy. Check condenser flow and fluid temperature. Check for fouled tubes. This alarm is not caused by the High Pressure Switch.
152	**RECYCLE ALERT**	EXCESSIVE RECYCLE STARTS	152->Excessive recycle starts.	Chiller load is too low to keep compressor on line and there has been more than 5 starts in 4 hours. Increase chiller load, adjust hot gas bypass, increase RECYCLE RESTART DELTA T from SETUP1 Screen.
153	**no message: ALERT only**	no message; ALERT only	153->Lead/Lag Disabled: Duplicate Chiller Address; Check Configuration	Illegal chiller address configuration in Lead/Lag screen. Both chillers require a different address.
154	**POTENTIAL FREEZE-UP**	COND PRESS/TEMP TOO LOW	154->Condenser freeze up prevention	The condenser pressure transducer is reading a pressure that could freeze the condenser tubes. Check for condenser refrigerant leaks. Check fluid temperature. Check sensor wiring and accuracy. Place the chiller in PUMPDOWN mode if the vessel is evacuated.
155	**OPTION SENSOR FAULT**	REMOTE RESET SENSOR	155->Sensor Fault/Option Disabled: Remote Reset Sensor	Check sensor resistance or voltage drop. Check for proper wiring.
156	**OPTION SENSOR FAULT**	AUTO CHILLED WATER RESET	156->Sensor Fault/Option Disabled:Auto Chilled Water Reset	Check sensor resistance or voltage drop. Check for proper wiring.
157	**OPTION SENSOR FAULT**	AUTO DEMAND LIMIT INPUT	157->Sensor Fault/Option Disabled: Auto Demand Limit Input	Check sensor resistance or voltage drop. Check for proper wiring.
158	**SENSOR ALERT**	SPARE TEMPERATURE #1	158->Spare Temperature #1 [VALUE] exceeded limit of [LIMIT].*	Check sensor resistance or voltage drop. Check for proper wiring.
159	**SENSOR ALERT**	SPARE TEMPERATURE #2	159->Spare Temperature #2 [VALUE] exceeded limit of [LIMIT].*	Check sensor resistance or voltage drop. Check for proper wiring.
160	**MACHINE ALERT**	DIRTY OIL FILTER	160->Oil Filter Delta P [VALUE] exceeds limit of [LIMIT]. Check oil solenoid and filter.	Check sensor(s). Check filter.

*[LIMIT] is shown on the CVC as the temperature, pressure, voltage, etc., set point predefined or selected by the operator as an override, alert, or alarm condition. [VALUE] is the actual pressure, temperature, voltage, etc., at which the control tripped.

Table 10A — Thermistor Temperature (F) vs Resistance/VoltageDrop

TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (Ohms)
–25	4.821	98,010
–24	4.818	94,707
–23	4.814	91,522
–22	4.806	88,449
–21	4.800	85,486
–20	4.793	82,627
–19	4.786	79,871
–18	4.779	77,212
–17	4.772	74,648
–16	4.764	72,175
–15	4.757	69,790
–14	4.749	67,490
–13	4.740	65,272
–12	4.734	63,133
–11	4.724	61,070
–10	4.715	59,081
–9	4.705	57,162
–8	4.696	55,311
–7	4.688	53,526
–6	4.676	51,804
–5	4.666	50,143
–4	4.657	48,541
–3	4.648	46,996
–2	4.636	45,505
–1	4.624	44,066
0	4.613	42,679
1	4.602	41,339
2	4.592	40,047
3	4.579	38,800
4	4.567	37,596
5	4.554	36,435
6	4.540	35,313
7	4.527	34,231
8	4.514	33,185
9	4.501	32,176
10	4.487	31,202
11	4.472	30,260
12	4.457	29,351
13	4.442	28,473
14	4.427	27,624
15	4.413	26,804
16	4.397	26,011
17	4.381	25,245
18	4.366	24,505
19	4.348	23,789
20	4.330	23,096
21	4.313	22,427
22	4.295	21,779
23	4.278	21,153
24	4.258	20,547
25	4.241	19,960
26	4.223	19,393
27	4.202	18,843
28	4.184	18,311
29	4.165	17,796
30	4.145	17,297
31	4.125	16,814
32	4.103	16,346
33	4.082	15,892
34	4.059	15,453
35	4.037	15,027
36	4.017	14,614
37	3.994	14,214
38	3.968	13,826
39	3.948	13,449
40	3.927	13,084
41	3.902	12,730
42	3.878	12,387
43	3.854	12,053
44	3.828	11,730
45	3.805	11,416
46	3.781	11,112
47	3.757	10,816
48	3.729	10,529
49	3.705	10,250
50	3.679	9,979
51	3.653	9,717
52	3.627	9,461
53	3.600	9,213
54	3.575	8,973
55	3.547	8,739
56	3.520	8,511
57	3.493	8,291
58	3.464	8,076
59	3.437	7,868
60	3.409	7,665
61	3.382	7,468
62	3.353	7,277
63	3.323	7,091
64	3.295	6,911
65	3.267	6,735
66	3.238	6,564
67	3.210	6,399
68	3.181	6,238
69	3.152	6,081
70	3.123	5,929
71	3.093	5,781
72	3.064	5,637
73	3.034	5,497
74	3.005	5,361
75	2.977	5,229
76	2.947	5,101
77	2.917	4,976
78	2.884	4,855
79	2.857	4,737
80	2.827	4,622
81	2.797	4,511
82	2.766	4,403
83	2.738	4,298
84	2.708	4,196
85	2.679	4,096
86	2.650	4,000
87	2.622	3,906
88	2.593	3,814
89	2.563	3,726
90	2.533	3,640
91	2.505	3,556
92	2.476	3,474
93	2.447	3,395
94	2.417	3,318
95	2.388	3,243
96	2.360	3,170
97	2.332	3,099
98	2.305	3,031
99	2.277	2,964
100	2.251	2,898
101	2.217	2,835
102	2.189	2,773
103	2.162	2,713
104	2.136	2,655
105	2.107	2,597
106	2.080	2,542
107	2.053	2,488
108	2.028	2,436
109	2.001	2,385
110	1.973	2,335
111	1.946	2,286
112	1.919	2,239
113	1.897	2,192
114	1.870	2,147
115	1.846	2,103
116	1.822	2,060
117	1.792	2,018
118	1.771	1,977
119	1.748	1,937
120	1.724	1,898
121	1.702	1,860
122	1.676	1,822
123	1.653	1,786
124	1.630	1,750
125	1.607	1,715
126	1.585	1,680
127	1.562	1,647
128	1.538	1,614
129	1.517	1,582
130	1.496	1,550
131	1.474	1,519
132	1.453	1,489
133	1.431	1,459
134	1.408	1,430
135	1.389	1,401
136	1.369	1,373
137	1.348	1,345
138	1.327	1,318
139	1.308	1,291
140	1.291	1,265
141	1.289	1,240
142	1.269	1,214
143	1.250	1,190
144	1.230	1,165
145	1.211	1,141
146	1.192	1,118
147	1.173	1,095
148	1.155	1,072
149	1.136	1,050
150	1.118	1,029
151	1.100	1,007
152	1.082	986
153	1.064	965
154	1.047	945
155	1.029	925
156	1.012	906
157	0.995	887
158	0.978	868
159	0.962	850
160	0.945	832
161	0.929	815
162	0.914	798
163	0.898	782
164	0.883	765
165	0.868	750
166	0.853	734
167	0.838	719
168	0.824	705
169	0.810	690
170	0.797	677
171	0.783	663
172	0.770	650
173	0.758	638
174	0.745	626
175	0.734	614
176	0.722	602
177	0.710	591
178	0.700	581
179	0.689	570
180	0.678	561
181	0.668	551
182	0.659	542
183	0.649	533
184	0.640	524
185	0.632	516
186	0.623	508
187	0.615	501
188	0.607	494
189	0.600	487
190	0.592	480
191	0.585	473
192	0.579	467
193	0.572	461
194	0.566	456
195	0.560	450
196	0.554	445
197	0.548	439
198	0.542	434
199	0.537	429
200	0.531	424
201	0.526	419
202	0.520	415
203	0.515	410
204	0.510	405
205	0.505	401
206	0.499	396
207	0.494	391
208	0.488	386
209	0.483	382
210	0.477	377
211	0.471	372
212	0.465	367
213	0.459	361
214	0.453	356
215	0.446	350
216	0.439	344
217	0.432	338
218	0.425	332
219	0.417	325
220	0.409	318
221	0.401	311
222	0.393	304
223	0.384	297
224	0.375	289
225	0.366	282

Table 10B — Thermistor Temperature (C) vs Resistance/Voltage Drop

TEMPERATURE (C)	VOLTAGE DROP (V)	RESISTANCE (Ohms)
–40	4.896	168 230
–39	4.889	157 440
–38	4.882	147 410
–37	4.874	138 090
–36	4.866	129 410
–35	4.857	121 330
–34	4.848	113 810
–33	4.838	106 880
–32	4.828	100 260
–31	4.817	94 165
–30	4.806	88 480
–29	4.794	83 170
–28	4.782	78 125
–27	4.769	73 580
–26	4.755	69 250
–25	4.740	65 205
–24	4.725	61 420
–23	4.710	57 875
–22	4.693	54 555
–21	4.676	51 450
–20	4.657	48 536
–19	4.639	45 807
–18	4.619	43 247
–17	4.598	40 845
–16	4.577	38 592
–15	4.554	38 476
–14	4.531	34 489
–13	4.507	32 621
–12	4.482	30 866
–11	4.456	29 216
–10	4.428	27 633
–9	4.400	26 202
–8	4.371	24 827
–7	4.341	23 532
–6	4.310	22 313
–5	4.278	21 163
–4	4.245	20 079
–3	4.211	19 058
–2	4.176	18 094
–1	4.140	17 184
0	4.103	16 325
1	4.065	15 515
2	4.026	14 749
3	3.986	14 026
4	3.945	13 342
5	3.903	12 696
6	3.860	12 085
7	3.816	11 506
8	3.771	10 959
9	3.726	10 441
10	3.680	9 949
11	3.633	9 485
12	3.585	9 044
13	3.537	8 627
14	3.487	8 231
15	3.438	7 855
16	3.387	7 499
17	3.337	7 161
18	3.285	6 840
19	3.234	6 536
20	3.181	6 246
21	3.129	5 971
22	3.076	5 710
23	3.023	5 461
24	2.970	5 225
25	2.917	5 000
26	2.864	4 786
27	2.810	4 583
28	2.757	4 389
29	2.704	4 204
30	2.651	4 028
31	2.598	3 861
32	2.545	3 701
33	2.493	3 549
34	2.441	3 404
35	2.389	3 266
36	2.337	3 134
37	2.286	3 008
38	2.236	2 888
39	2.186	2 773
40	2.137	2 663
41	2.087	2 559
42	2.039	2 459
43	1.991	2 363
44	1.944	2 272
45	1.898	2 184
46	1.852	2 101
47	1.807	2 021
48	1.763	1 944
49	1.719	1 871
50	1.677	1 801
51	1.635	1 734
52	1.594	1 670
53	1.553	1 609
54	1.513	1 550
55	1.474	1 493
56	1.436	1 439
57	1.399	1 387
58	1.363	1 337
59	1.327	1 290
60	1.291	1 244
61	1.258	1 200
62	1.225	1 158
63	1.192	1 118
64	1.160	1 079
65	1.129	1 041
66	1.099	1 006
67	1.069	971
68	1.040	938
69	1.012	906
70	0.984	876
71	0.949	836
72	0.920	805
73	0.892	775
74	0.865	747
75	0.838	719
76	0.813	693
77	0.789	669
78	0.765	645
79	0.743	623
80	0.722	602
81	0.702	583
82	0.683	564
83	0.665	547
84	0.648	531
85	0.632	516
86	0.617	502
87	0.603	489
88	0.590	477
89	0.577	466
90	0.566	456
91	0.555	446
92	0.545	436
93	0.535	427
94	0.525	419
95	0.515	410
96	0.506	402
97	0.496	393
98	0.486	385
99	0.476	376
100	0.466	367
101	0.454	357
102	0.442	346
103	0.429	335
104	0.416	324
105	0.401	312
106	0.386	299
107	0.370	285

Control Modules — Turn controller power off before servicing controls. This ensures safety and prevents damage to the controller.

The CVC, CCM, and ISM modules perform continuous diagnostic evaluations of the hardware to determine its condition. Proper operation of all modules is indicated by LEDs (light-emitting diodes) located on the circuit board of the CVC, CCM, and ISM.

There is one green LED located on the CCM and ISM boards respectively, and one red LED located on the CVC, CCM, and ISM boards respectively.

RED LED (Labeled as STAT) — If the red LED:

- blinks continuously at a 2-second interval, the module is operating properly
- is lit continuously, there is a problem that requires replacing the module
- is off continuously, the power should be checked
- blinks 3 times per second, a software error has been discovered and the module must be replaced

If there is no input power, check the fuses and circuit breaker. If the fuse is good, check for a shorted secondary of the transformer or, if power is present to the module, replace the module.

GREEN LED (Labeled as COM) — These LEDs indicate the communication status between different parts of the controller and the network modules and should blink continuously.

Notes on Module Operation

1. The chiller operator monitors and modifies configurations in the microprocessor by using the 4 softkeys and the CVC. Communications between the CVC and the CCM is accomplished through the SIO (Sensor Input/Output) bus, which is a phone cable. The communication between the CCM and ISM is accomplished through the sensor bus, which is a 3-wire cable.
2. If a green LED is on continuously, check the communication wiring. If a green LED is off, check the red LED operation. If the red LED is normal, check the module address switches (Fig. 42-44).

   All system operating intelligence resides in the CVC. Some safety shutdown logic resides in the ISM in case communications are lost between the ISM and CVC. Outputs are controlled by the CCM and ISM as well.
3. Power is supplied to the modules within the control panel via 24-vac power sources.

   The transformers are located within the power panel, with the exception of the ISM, which operates from a 115-vac power source and has its own 24-vac transformer located in the module.

   In the power panel, T1 supplies power to the compressor oil heater, oil pump, and optional hot gas bypass, and T2 supplies power to both the CVC and CCM.

   Power is connected to Plug J1 on each module.

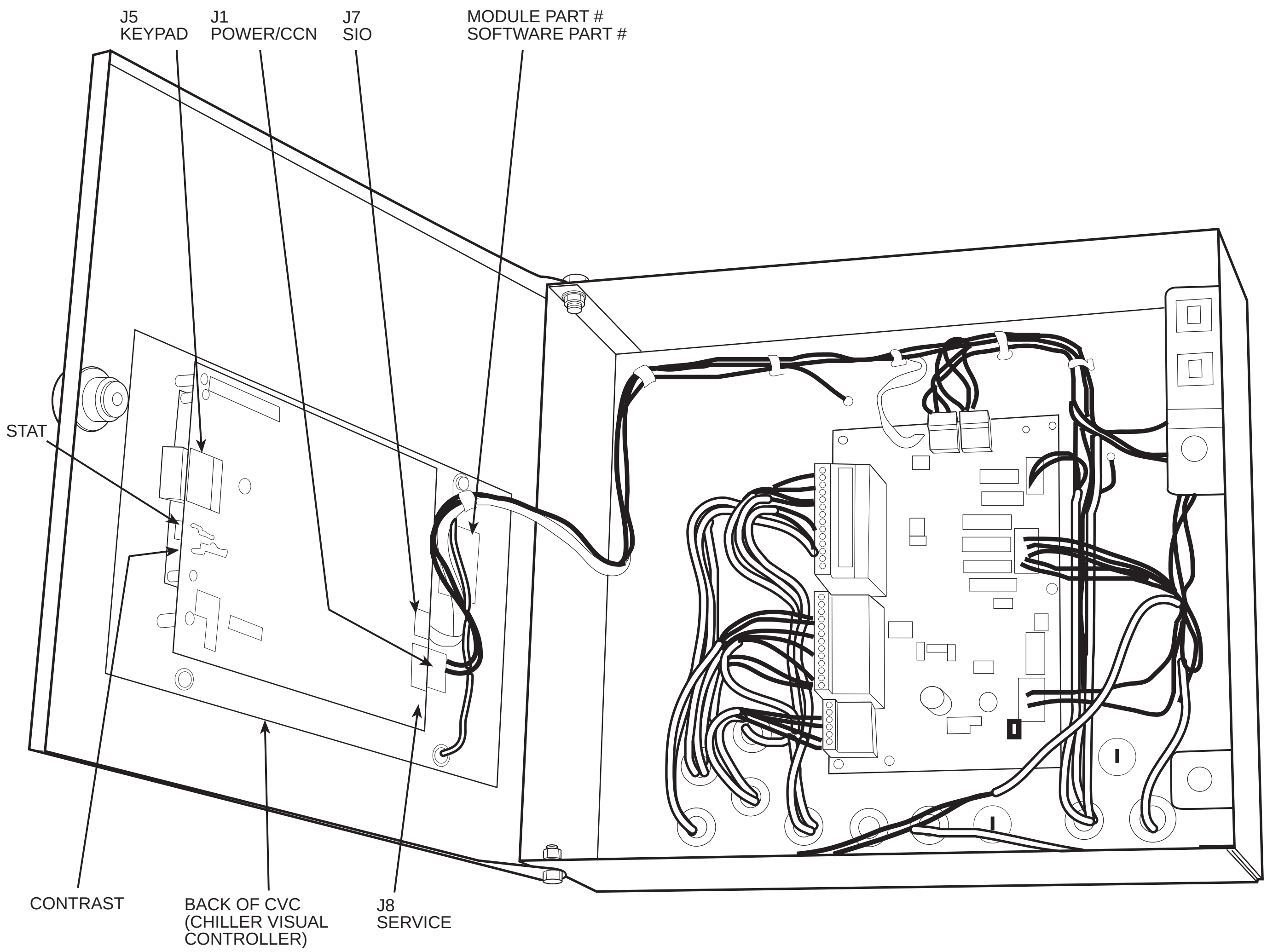


Fig. 42 — Rear of CVC (Chiller Visual Controller)

Chiller Control Module (CCM) (Fig. 43)

INPUTS — Each input channel has 2 or 3 terminals. Refer to individual chiller wiring diagrams for the correct terminal numbers for your application.

OUTPUTS — Output is 24 vac. There are 2 terminals per output. Refer to the chiller wiring diagram for your specific application for the correct terminal numbers.

Integrated Starter Module (ISM) (Fig. 44)

INPUTS — Inputs on strips J3-5 and J3 are analog and discrete (on/off) inputs. The specific application of the chiller determines which terminals are used. Refer to the individual chiller wiring diagram for the correct terminal numbers for your application.

OUTPUTS — Outputs are 24 vac and wired to strip J9. There are 2 terminals per output.

Replacing Defective Processor Modules — The module replacement part number is printed on a small label on the rear of the CVC module. The chiller model and serial numbers are printed on the chiller nameplate located on an exterior corner post. The proper software is factory-installed by Carrier in the replacement module. When ordering a replacement chiller visual controller (CVC) module, specify the complete replacement part number, full chiller model number, and chiller serial number. The installer must configure the new module to the original chiller data. Follow the procedures described in the Software Configuration section on page 60.

⚠ CAUTION

Electrical shock can cause personal injury. Disconnect all electrical power before servicing.

INSTALLATION

1. Verify the existing CVC module is defective by using the procedure described in the Troubleshooting Guide section, page 76, and the Control Modules section, page 88. Do not select the ATTACH TO NETWORK DEVICE table if the CVC indicates a communication failure.
2. Data regarding the CVC configuration should have been recorded and saved. This data must be reconfigured into the new CVC. If this data is not available, follow the procedures described in the Software Configuration section.

   If a CCN Building Supervisor or Service Tool is available, the module configuration should have already been uploaded into memory. When the new module is installed, the configuration can be downloaded from the computer.

   Any communication wires from other chillers or CCN modules should be disconnected to prevent the new CVC module from uploading incorrect run hours into memory.
3. To install this module, record values for the *TOTAL COMPRESSOR STARTS* and the *COMPRESSOR ONTIME* from the MAINSTAT screen on the CVC.
4. Power off the controls.
5. Remove the old CVC.
6. Install the new CVC module. Turn the control power back on.
7. The CVC now automatically attaches to the local network device.
8. Access the MAINSTAT table and highlight the *TOTAL COMPRESSOR STARTS* parameter. Press the SELECT softkey. Increase or decrease the value to match the starts value recorded in Step 3. Press the ENTER softkey when you reach the correct value. Now, move the highlight bar to the *COMPRESSOR ONTIME* parameter. Press the SELECT softkey. Increase or decrease the run hours value to match the value recorded in Step 2. Press the ENTER softkey when the correct value is reached.
9. Complete the CVC installation. Following the instructions in the Input Service Configurations section, page 60, input all the proper configurations such as the time, date, etc. Check the pressure transducer calibrations. PSIO installation is now complete.

Solid-State Starters — Troubleshooting information pertaining to the Benshaw, Inc., solid-state starter may be found in the following paragraphs and in the Carrier REDISTART MICRO Instruction Manual supplied by the starter vendor.

Attempt to solve the problem by using the following preliminary checks before consulting the troubleshooting tables found in the Benshaw manual.

⚠ WARNING

1. Motor terminals or starter output lugs or wire should not be touched without disconnecting the incoming power supply. The silicon control rectifiers (SCRs) although technically turned off still have AC mains potential on the output of the starter.
2. Power is present on all yellow wiring throughout the system even though the main circuit breaker in the unit is off.

With power off:

- Inspect for physical damage and signs of arcing, overheating, etc.
- Verify the wiring to the starter is correct.
- Verify all connections in the starter are tight.
- Check the control transformer fuses.

TESTING SILICON CONTROL RECTIFIERS IN THE-BENSHAW, INC., SOLID-STATE STARTERS — If an SCR is suspected of being defective, use the following procedure as part of a general troubleshooting guide.

1. Verify power is applied.
2. Verify the state of each SCR light-emitting diode (LED) on the micropower card.

   NOTE: All LEDs should be lit. If any red or green side of these LEDs is not lit, the line voltage is not present or one or more SCRs has failed.
3. Check incoming power. If voltage is not present check the incoming line. If voltage is present, proceed to Steps 4 through 11.

   NOTE: If after completing Steps 4 - 11 all measurements are within specified limits, the SCRs are functioning normally. If after completing Steps 4 - 11 resistance measurements are outside the specified limits, the motor leads on the starter power lugs T1 through T6 should be removed and the steps repeated. This will identify if abnormal resistance measurements are being influenced by the motor windings.
4. Remove power from the starter unit.

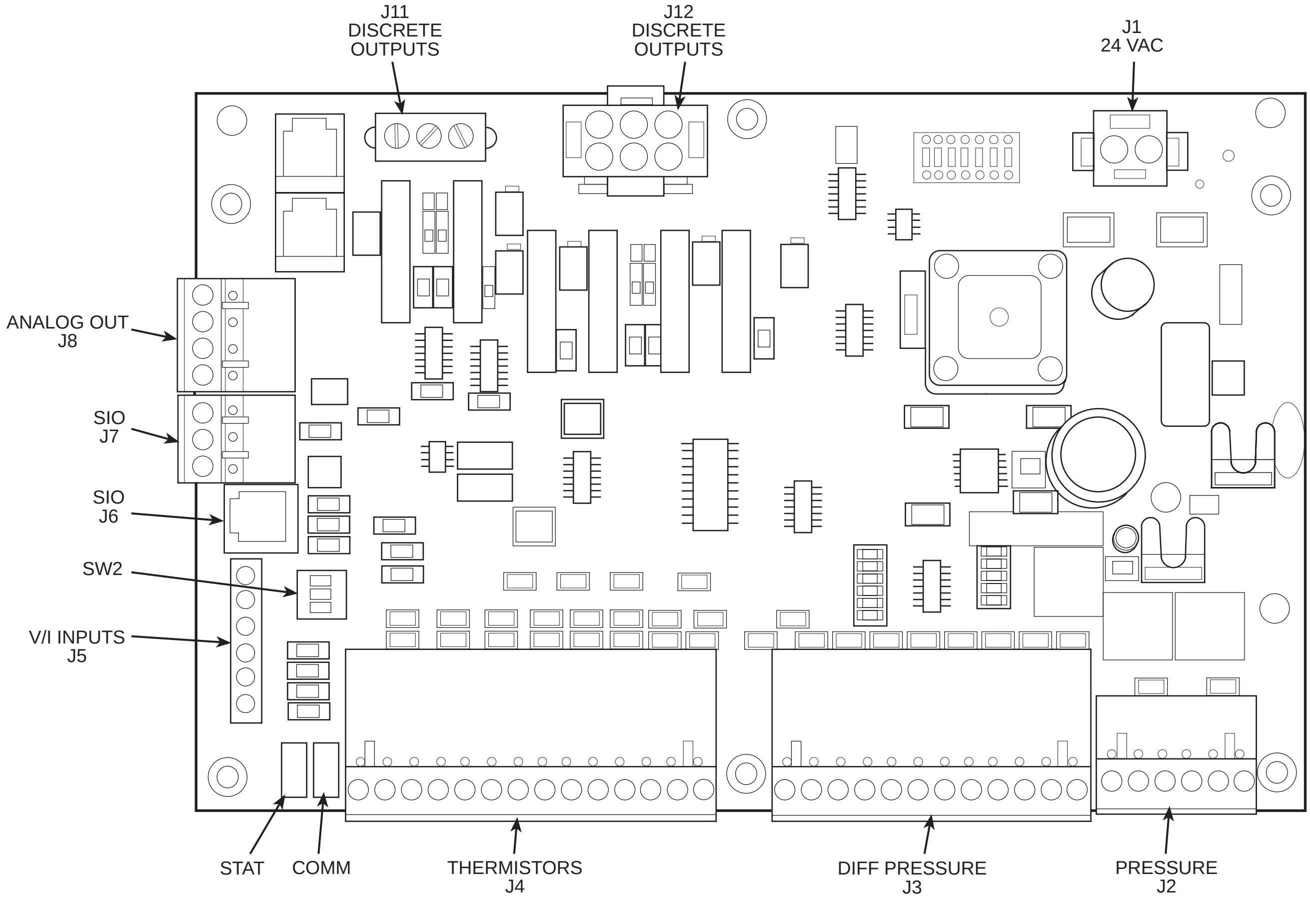


Fig. 43 — Chiller Control Module (CCM)

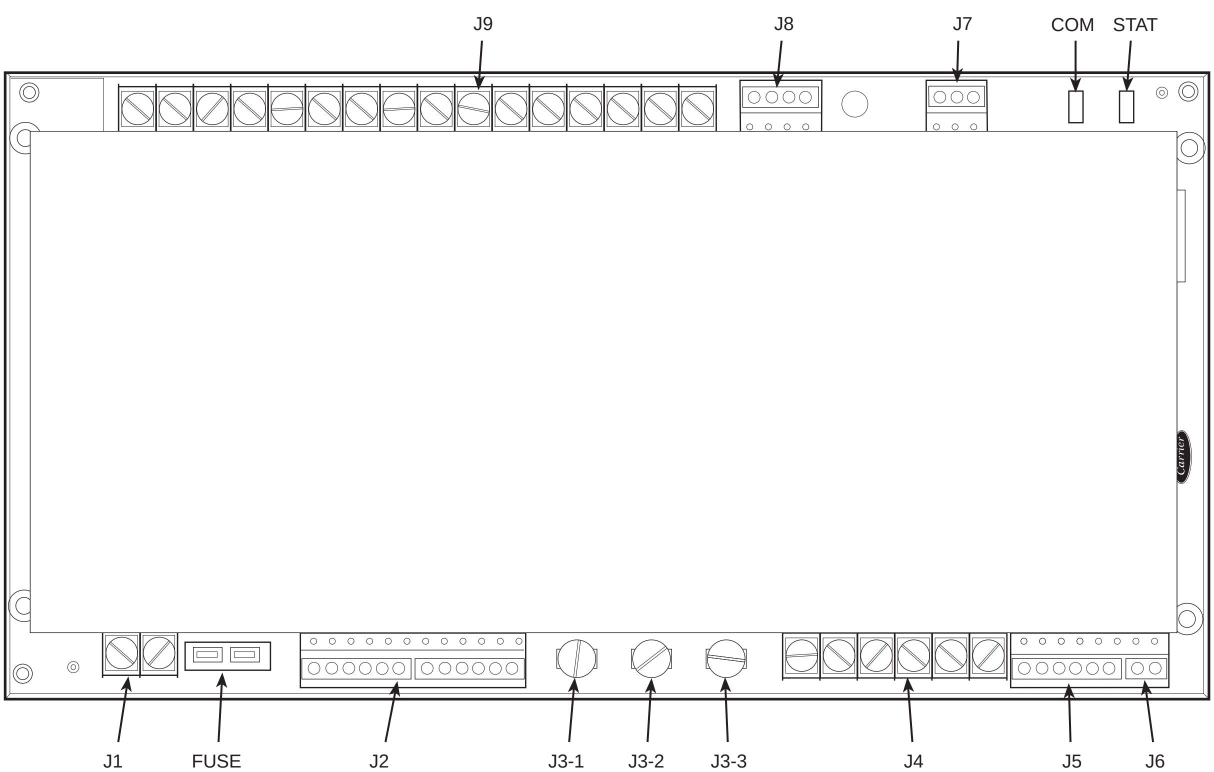


Fig. 44 — Integrated Starter Module (ISM)

5. Using an ohmmeter, perform the following resistance measurements and record the results:

MEASURE BETWEEN	SCR PAIRS BEING CHECKED	RECORDED VALUE
T1 and T6	3 and 6	
T2 and T4	2 and 5	
T3 and T5	1 and 4	

If all measured values are greater than 5K ohms, proceed to Step 10. If any values are less than 5K ohms, one or more of the SCRs in that pair is shorted.

6. Remove both SCRs in the pair (See SCR Removal/Installation).
7. Using an ohmmeter, measure the resistance (anode to cathode) of each SCR to determine which device has failed.

   NOTE: Both SCRs may be defective, but typically, only one is shorted. If both SCRs provide acceptable resistance measurements, proceed to Step 10.
8. Replace the defective SCR(s).
9. Retest the “pair” for resistance values indicated above.
10. On the right side of the firing card, measure the resistance between the red and white gate/cathode leads for each SCR (1 through 6). A measurement between 5 and 50 ohms is normal. Abnormally high values may indicate a failed gate for that SCR.

⚠ CAUTION

If any red or white SCR gate leads are removed from the firing card or an SCR, care must be taken to ensure the leads are replaced EXACTLY as they were (white wires to gates, and red wires to cathodes on both the firing card and SCR), or damage to the starter and/or motor may result.

11. Replace the SCRs and retest the pair.

SCR REMOVAL/INSTALLATION — Refer to Fig. 45.

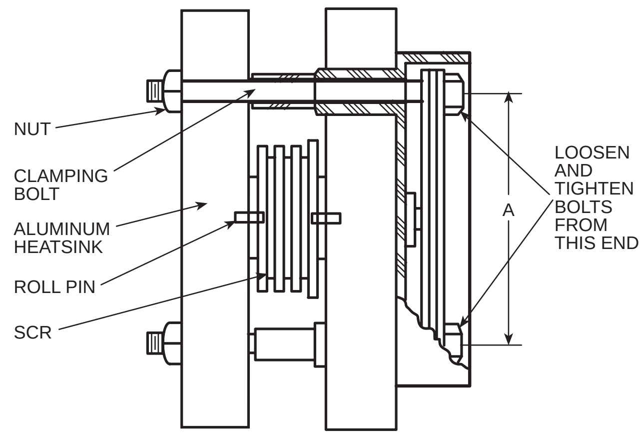
1. Remove the SCR by loosening the clamping bolts on each side of the SCR,
2. After the SCR has been removed and the bus work is loose, apply a thin coat of either silicon based thermal joint compound or a joint compound for aluminum or copper wire connections to the contact surfaces of the replacement SCR. This allows for improved heat dissipation and electrical conductivity.
3. Place the SCR between the roll pins on the heatsink assemblies so the roll pins fit into the small holes in each side of the SCR.

   NOTE: Ensure the SCR is installed so the cathode side is the side from which the red wire extends. The heatsink is labeled to show the correct orientation.
4. Hand tighten the bolts until the SCR contacts the heat sink.
5. Using quarter-turn increments, alternating between clamping bolts, apply the appropriate number of whole turns referencing the table in Fig. 45.

⚠ CAUTION

Care must be taken to prevent nut rotation while tightening the bolts. If the nut rotates while tightening the bolt, SCR replacement must be started over.

6. Reconnect the red (cathode) wire from the SCR and the white (anode-gate) wire to the appropriate location on the firing card (i.e., SCR1 wires to firing card terminal G1-white wire, and K1-red wire).
7. Reconnect all other wiring and bus work.
8. Return starter to normal operation.



SCR PART NUMBER BISCR	CLAMP SIZE	A DIMENSION (in.)	NO. OF TURNS	BOLT LENGTH (in.)
6601218	1030	2.75 (70 mm)	$1^1/_2$	3.0 (76 mm)
6601818	1030	2.75 (70 mm)	$1^1/_2$	3.0 (76 mm)
8801230	1035	2.75 (70 mm)	$1^3/_4$	3.5 (89 mm)
8801830	1035	2.75 (70 mm)	$1^3/_4$	3.0 (89 mm)
15001850	2040	4.00 (102 mm)	$2^3/_4$	4.0 (102 mm)
15001850	2050	4.00 (102 mm)	$2^3/_4$	5.0 (127 mm)
220012100	Consult Benshaw Representative			
330018500	Consult Benshaw Representative			

Fig. 45 — SCR Installation

Physical Data — For operator convenience during troubleshooting, additional details regarding compressor torque specifications, physical data, electrical data, and wiring schematics may be found in Tables 11-18 and Fig. 46-52.

Table 11 — 23XL Heat Exchanger Weights

SIZE	ENGLISH								SI							
	Dry Wt (lb)*		Machine Charge						Dry Wt (kg)*		Machine Charge					
			Refrigerant (lb)				Water (gal)				Refrigerant (kg)				Water (L)	
	Cooler Only†	Cond Only	Economizer		No Economizer		Cooler	Cond	Cooler Only†	Cond Only	Economizer		No Economizer		Cooler	Cond
			HCFC-22	HFC-134a	HCFC-22	HFC-134a					HCFC-22	HFC-134a	HCFC-22	HFC-134		
10	2480	2890	650	**	600	**	34	39.2	1125	1310	295	**	272	**	130	105
11	2650	3020	650	**	600	**	4	44.4	1202	1370	295	**	272	**	152	168
20	2845	3250	750	**	700	**	45	49.2	1291	1474	340	**	318	**	170	186
21	3000	3445	750	**	700	**	49	56.4	1361	1156	340	**	318	**	186	214
40	5030	4690	1000	850	900	800	49.2	51.6	2282	2127	454	386	408	363	186	195
41	5180	4835	1100	900	1000	850	54	57	2350	2193	499	408	454	386	204	216
42	5345	5005	1200	950	1100	900	60	63	2424	2270	544	431	499	408	227	239
43	5525	5185	1300	1000	1200	950	66	70	2506	2352	590	454	544	431	250	264

LEGEND

NIH — Nozzle-In-Head

*Weight based on: 035 in. wall copper Turbo-B2 tubes in cooler, Turbo chill in condenser.
2-pass, 150 psi NIH waterbox arrangements (sizes 10, 11, 20, 21)
3-pass, 300 psi NIH waterbox arrangements (sizes 40, 41, 42, 43)

†Weight of optional economizer is not included and must be added to cooler weight.

**Not available.

NOTE: Standard shipment is with refrigerant charged, so be sure to add refrigerant charge to dry weight.

Table 12 — 23XL Compressor Weights

23XL UNIT	COMPRESSOR SIZE (Tons)	ASSEMBLY	
		lb	kg
TC Frame 1	C2	2270	1029
	C4	2300	1043
TC Frame 2	C6	2400	1088
TD Frame 4	D4	3300	1497
	D6	3400	1542

Table 13 — 23XL Component Weights

COMPONENT	FRAME 1 AND 2		FRAME 4	
	lb	kg	lb	kg
Oil Separator	1180	535	2880*	1306*
Economizer†	296	134	560	254
Muffler	170	77	*	*
Discharge Piping:				
Pipe	44	20		
Isolation Valve†	30	14	30	14
Adaptor Flange	76	34	76	34
Power Panel	20	9	20	9
Starter†	500	227	500	227
Control Center	31	14	31	14

*The TD frame 4 muffler is included in the oil separator weight.
†Optional.

Table 14A — 23XL Waterbox Cover Weights (Frame 1 and 2 Machines)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	PSI (kPa)	FRAME 1		FRAME 2	
			lbs	kg	lbs	kg
COOLER OR CONDENSER	NIH, 1 Pass	150 (1034)	118	54	128	58
	NIH, 2 Pass (Plain)		100	46	148	67
	NIH, 2 Pass (With Pipe Nozzles)		185	84	200	91
	NIH, 3 Pass	150 (1034)	166	76	180	82

LEGEND

NIH — Nozzle-In-Head

*These weights are given for reference only. They have been included in heat exchanger weights shown in Table 4.

NOTE: Add 30 lb (14 Kg) for bolts.

Table 14B — 23XL Waterbox Cover Weight (Frame 4 Machines)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	ENGLISH (lb)				SI (kg)			
		Frame 4, Std Nozzles		Frame 4, Flanged		Frame 4, Std Nozzles		Frame 4, Flanged	
		150 psig	300 psig	150 psig	300 psig	1034 kPa	2068 kPa	1034 kPa	2068 kPa
COOLER	NIH, 1 Pass Cover	284	414	324	491	129	188	147	223
	NIH, 2 Pass Cover	285	411	341	523	129	187	155	237
	NIH, 3 Pass Cover	292	433	309	469	133	197	140	213
	NIH, Plain End Cover	243	292	243	292	110	133	110	133
	MWB Cover	CS	621	CS	621	CS	282	CS	282
	Plain End Cover	CS	482	CS	482	CS	219	CS	219
CONDENSER	NIH, 1 Pass Cover	306	446	346	523	139	202	157	237
	NIH, 2 Pass Cover	288	435	344	547	131	197	156	248
	NIH, 3 Pass Cover	319	466	336	502	145	212	153	228
	NIH, Plain End Cover	226	271	226	271	103	123	103	123
	MWB Cover	CS	474	CS	474	CS	215	CS	215
	Plain End Cover	CS	359	CS	359	CS	163	CS	163

LEGEND

CS — Contact Syracuse
MWB — Marine Waterbox
NIH — Nozzle-In-Head

*These weights are given for reference only. The 150 psig (1034 kPa) standard waterbox cover weights have been included in the heat exchanger weights shown in Table 11.

Table 15 — Optional Storage Tank and/or Pumpout System Physical Data

UNIT SIZE	TANK OUTSIDE DIAMETER		DRY WEIGHT		MAXIMUM REFRIGERANT CAPACITY							
					ASHRAE/ANSI 15				ARI 495			
					HCFC-22		HFC-134a		HCFC-22		HFC-134a	
	in.	mm	lb	kg	lb	kg	lb	kg	lb	kg	lb	kg
28	24.00	610	2200	998	1840	835	1865	845	1645	747	1665	755
52	27.25	692	3270	1606	3525	1599	3570	1619	3155	1431	3195	1449

LEGEND

ANSI — American National Standards Institute
ARI — Air Conditioning and Refrigeration Institute
ASHRAE — American Society of Heating, Refrigeration, and Air Conditioning Engineers

NOTES:
1. ANSI/ASHRAE 15 — Safety Code for Mechanical Refrigeration
2. Dry weights include the pumpout condensing unit weight of 210 lbs (95 kg).

Table 16 — Optional Storage Tank and/or Pumpout System Electrical Data

MOTOR CODE	CONDENSER UNIT	VOLTS-PH-HZ	MAX RLA	LRA
1	19EA47-748	575-3-60	3.8	23.0
4	19EA42-748	200/208-3-60	10.9	63.5
5	19EA44-748	230-3-60	9.5	57.5
6	19EA46-748	400/460-3-50/60	4.7	28.8

LEGEND

LRA — Locked Rotor Amps
RLA — Rated Load Amps

Table 17A — 23XL Waterbox Cover Weights (TC Frame 1 and 2 Chillers)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	PSI (kPa)	FRAME 1		FRAME 2	
			lbs	kg	lbs	kg
Cooler or Condenser	NIH, 1 Pass	150 (1034)	118	54	128	58
	NIH, 2 Pass (Plain)		100	46	148	67
	NIH, 2 Pass (With Pipe Nozzles)		185	84	200	91
	NIH, 3 Pass	150 (1034)	166	76	180	82

LEGEND

NIH — Nozzle-In-Head

*These weights are given for reference only. They have been included in heat exchanger weights shown in Table 11.

NOTE: Add 30 lb (14 Kg) for bolts.

Table 17B — 23XL Waterbox Cover Weight (TD Frame 4 Chillers)*

HEAT EXCHANGER	WATERBOX DESCRIPTION	ENGLISH (lb)				SI (kg)			
		Frame 4, Std Nozzles		Frame 4, Flanged		Frame 4, Std Nozzles		Frame 4, Flanged	
		150 psig	300 psig	150 psig	300 psig	1034 kPa	2068 kPa	1034 kPa	2068 kPa
COOLER	NIH, 1 Pass Cover	284	414	324	491	129	188	147	223
	NIH, 2 Pass Cover	285	411	341	523	129	187	155	237
	NIH, 3 Pass Cover	292	433	309	469	133	197	140	213
	NIH, Plain End Cover	243	292	243	292	110	133	110	133
	MWB Cover	CS	621	CS	621	CS	282	CS	282
	Plain End Cover	CS	482	CS	482	CS	219	CS	219
CONDENSER	NIH, 1 Pass Cover	306	446	346	523	139	202	157	237
	NIH, 2 Pass Cover	288	435	344	547	131	197	156	248
	NIH, 3 Pass Cover	319	466	336	502	145	212	153	228
	NIH, Plain End Cover	226	271	226	271	103	123	103	123
	MWB Cover	CS	474	CS	474	CS	215	CS	215
	Plain End Cover	CS	359	CS	359	CS	163	CS	163

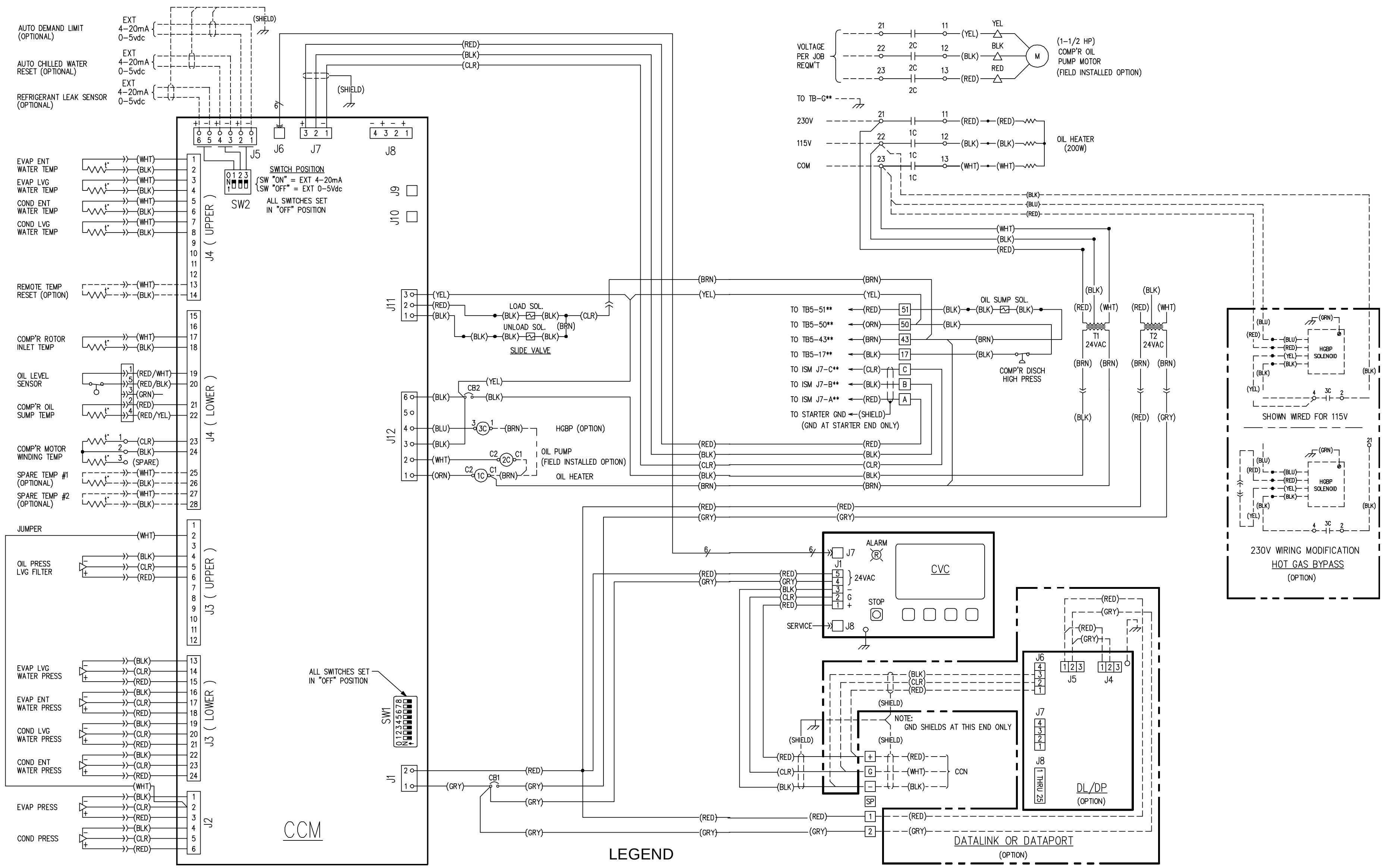
LEGEND

CS — Contact Syracuse
MWB — Marine Waterbox
NIH — Nozzle-In-Head

*These weights are given for reference only. The 150 psig (1034 kPa) standard waterbox cover weights have been included in the heat exchanger weights shown in Table 11.

Table 18 — 23XL Compressor Torque Specification Chart for Metric amd American Fasteners

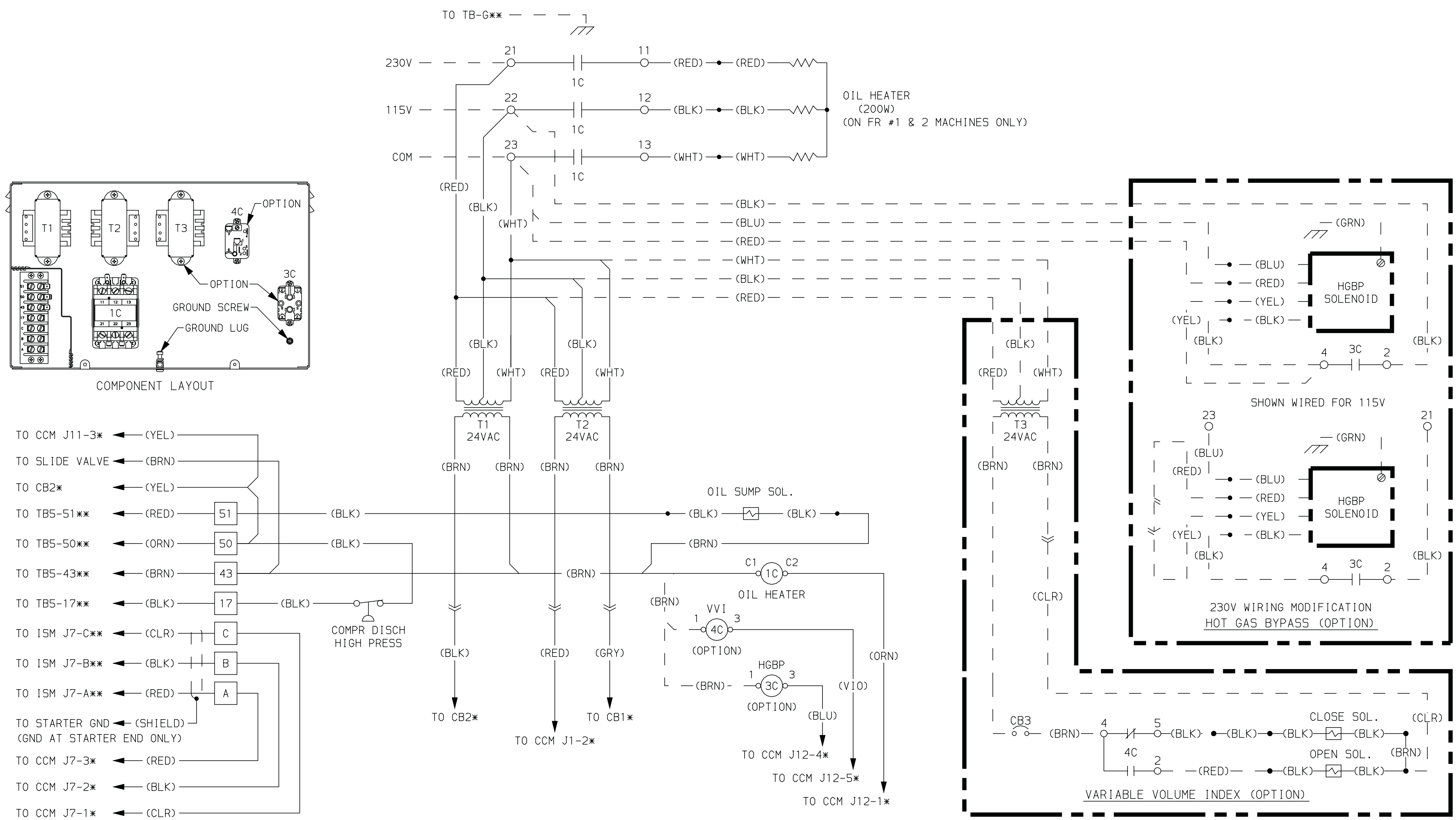
ITEM	CAP SCREW SIZE AND TYPE	GRADE	ASSEMBLY LOCATION	TORQUE Nm	TORQUE Lb-Ft	TORQUE Lb-in.
CAP SCREW	M5 X 0.8 X 12 S.H.	10.9	1. FUSITE-MOTOR CASING 2. SLIDE SEAL RETAINER-CYLINDER STOP	4.1-5.4	3-4	36-48
	M6 X 1 X 16 S.H.		1. CONTROL VALVES-SLIDE CASING 2. SLIDE SEAL ADAPTOR-SEPARATOR PLATE (FRAME 1 AND 2 ONLY) 3. SLIDE SEAL ADAPTOR-SLIDE CASING PLUG (FRAME 4 ONLY)	6.8-9.6	5-7	60-84
	M10 X 1.5 X 35 H.H.		1. BRG RETAINER-MALE ROTOR 2. BRG RETAINER-FEMALE ROTOR	41-47	30-35	N/A
	M10 X 1.5 X 40 S.H.		1. SLIDE VALVE COVER-SLIDE CASING 2. SLIDE CASING-SEPARATOR PLATE (TC FRAME 1 AND 2 ONLY)	61-68	45-50	N/A
	M10 X 1.5 X 50 H.H.		MOTOR ROTOR-MALE ROTOR	20-27	15-20	N/A
	M12 X 1.75 X 40 S.H.		SERVICE VALVE PAD-MOTOR COVER	103-115	75-85	N/A
	M12 X 1.75 X 50 S.H.		TC FRAME 1 AND 2 ONLY 1. MOTOR COVER-MOTOR CASING 2. SEPARATOR PLATE-OUTLET CASING 3. DISCHARGE COVER-OUTLET CASING	103-115	75-85	N/A
	M12 X 1.75 X 60 S.H.		1. MOTOR END PLATE-MOTOR COVER-MOTOR CASING (FRAME 1 AND 2 ONLY) 2. MOTOR COVER-MOTOR CASING (TD FRAME 4 ONLY) 3. SLIDE CASING-OUTLET CASING (TD FRAME 4 ONLY)			
	M12 X 1.75 X 70 S.H.		TD FRAME 4 ONLY MOTOR END PLATE-MOTOR COVER-MOTOR CASING			
	M12 X 1.75 X 80 S.H.		TC FRAME 1 AND 2 ONLY SLIDE CASING-SEPARATOR PLATE-OUTLET CASING			
	M12 X 1.75 X 90 S.H.		TD FRAME 4 ONLY SLIDE CASING (BOTTOM)-OUTLET CASING			
	FRAME 1 AND 2 M16 X 2 X 55 S.H. FRAME 4 M16 X 2 X 70 S.H.		1. ROTOR CASING-INLET CASING AND OUTLET CASING 2. MOTOR CASING-INLET CASING 3. OPEN DRIVE END COVER-INLET CASING 4. DISCHARGE COVER-OUTLET CASING (TD FRAME 4 ONLY)	252-280	185-205	N/A
	M20 X 2.5 X 70 S.H.		INLET FLANGES-INLET CASING (TC FRAME 1 AND 2 ONLY)	485-513	355-375	N/A
	M22 X 2.5 X 80 S.H.		TD FRAME 4 ONLY INLET FLANGES-INLET CASING	697-724	510-530	N/A
SET SCREW	M10 X 1.5 X 16 S.S.	10.9	TD FRAME 4 ONLY OPEN DRIVE SEAL ADAPTER	41-47	30-35	N/A
	M10 X 1.5 X 30 S.S.		STATOR KEY LOCK	13-20	10-15	120-180
PIPE PLUG	1/8 NPTF	N/A	INLET CASING	20-27	15-20	180-240
	1/4 NPTF		TD FRAME 4 ONLY SLIDE CASING	27-34	20-25	240-300
HEX PLUG	7/16-20	N/A	1. INLET CASING 2. SLIDE CASING	13-16	10-12	130-140
	9/16-18		1. MOTOR CASING 2. OUTLET CASING 3. ROTOR CASING 4. SLIDE CASING	23-26	17-19	210-230
	3/4-16		1. OUTLET CASING 2. SLIDE CASING (TC FRAME 1 AND 2 ONLY)	60-65	44-48	530-570
	1 1/16-12		1. INLET CASING 2. ROTOR CASING 3. OUTLET CASING	112-125	83-92	1000-1100
	1 3/16-12		TD FRAME 4 OUTLET CASING	125-140	92-103	1100-1240
TERMINAL PIN	5/8-11	N/A	1. TERMINAL NUTS 2. MOTOR LEAD	23-26	17-19	N/A
	1 3/16-12		1. TERMINAL PIN BODY 2. MOTOR CASING	27-34	20-25	N/A
LOCKNUT	M20 X 1	N/A	SLIDE VALVE ASSEMBLY	68-75	50-55	N/A
	M35 X 1.5		SLIDE VALVE ASSEMBLY	95-102	70-75	N/A
RELIEF VALVE	1 5/8-12 UN-2A	N/A	ROTOR CASING	345-379	254-279	N/A
PLUG, ORIFICE	M8 X 1.25	N/A	1. INLET CASING 2. OPEN DRIVE END COVER (TC FRAME 1 AND 2 ONLY)	19-24	14-18	168-216
WAFER HEAD SCREW	M6 X 1	N/A	TD FRAME 4 ONLY SLIDE VALVE ASSEMBLY	13-15	10-11	120-130



LEGEND

CB — Circuit Breaker
CCM — Chiller Control Module
CVC — Chiller Visual Controller
COMPR — Compressor
COND — Cond
DL/DP — Datalink or Dataport
DISCH — Discharge
ENT — Entering
EVAP — Evaporator
EXT — External
GND — Ground
HGBP — Hot Gas Bypass
ISM — Integrated Starter Module
LVG — Leaving
PRESS — Pressure
REQMT — Requirement
SW — Switch
TEMP — Temperature
TB — Terminal Board
VVI — Variable Volume Index
☐ Denotes Power Panel Terminal
** Denotes Motor Starter Panel Conn.
○ Denotes Component Terminal
● Wire Splice
→≻ Denotes Conductor Male/Female Connector
▬ ▬ Option Wiring

Fig. 46 — 23XL Chiller Control Schematic



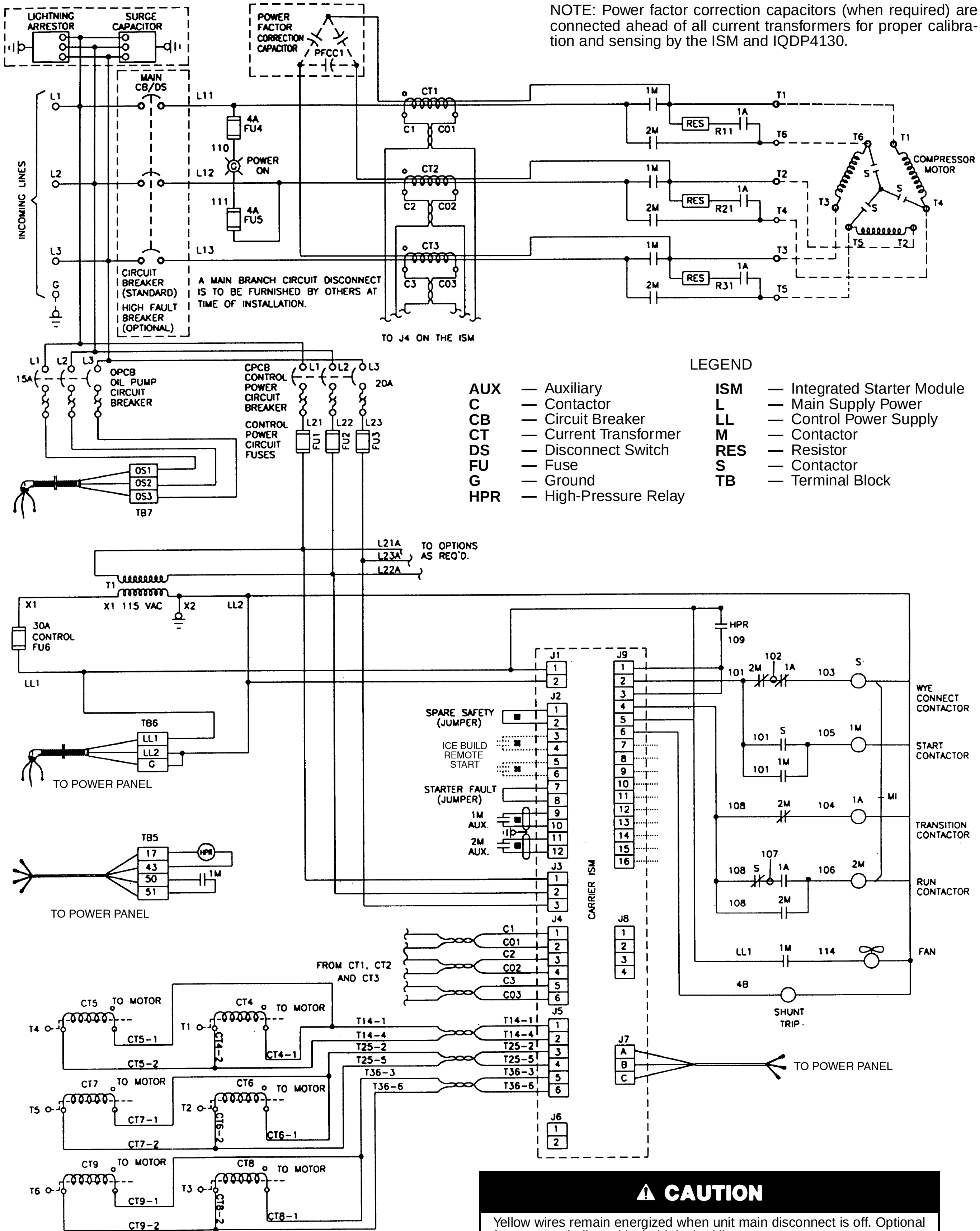
LEGEND

CB — Circuit Breaker
CCM — Chiller Control Module
HGBP — Hot Gas Bypass
ISM — Integrated Starter Module
TB — Terminal Board
VVI — Variable Volume Index
□ Denotes Power Panel Terminal

○ Denotes Component Terminal
● Wire Splice
—·— Option Wiring
→≻ Denotes Conductor Male/Female Conn.
* Denotes Control Panel Conn.
** Denotes Motor Starter Panel Conn.

Fig. 47 — Power Panel Wiring Schematic

NOTE: Power factor correction capacitors (when required) are connected ahead of all current transformers for proper calibration and sensing by the ISM and IQDP4130.



LEGEND

AUX	— Auxiliary	**ISM**	— Integrated Starter Module
C	— Contactor	**L**	— Main Supply Power
CB	— Circuit Breaker	**LL**	— Control Power Supply
CT	— Current Transformer	**M**	— Contactor
DS	— Disconnect Switch	**RES**	— Resistor
FU	— Fuse	**S**	— Contactor
G	— Ground	**TB**	— Terminal Block
HPR	— High-Pressure Relay		

⚠ CAUTION

Yellow wires remain energized when unit main disconnect is off. Optional features are indicated by bold dashed lines.

Dry Contact

Field Connection

For connection diagram refer to 261143 D4.

Fig. 48 — Cutler-Hammer Wye Delta Unit Mounted Starter Wiring Schematic (Low Voltage)

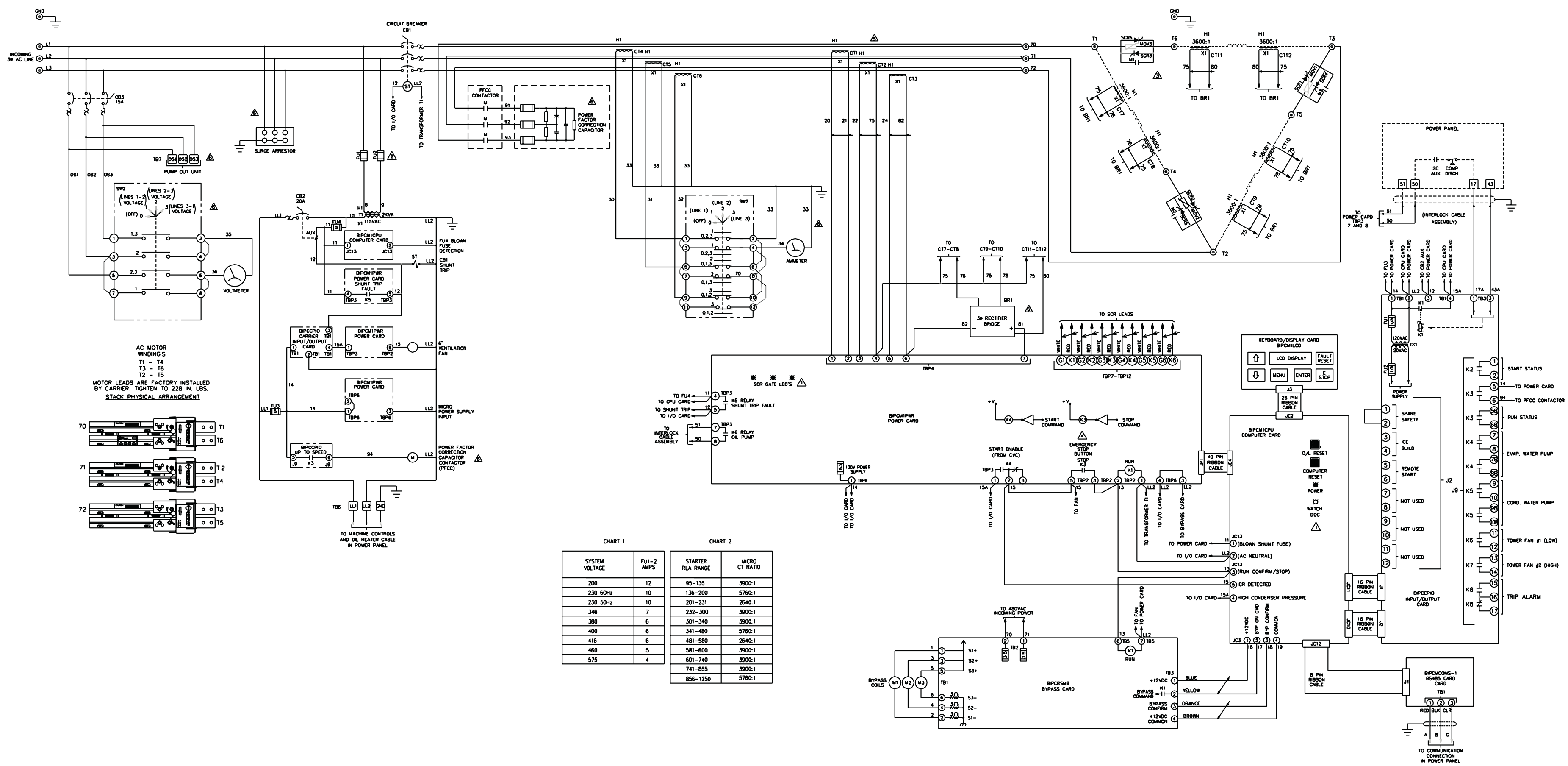


CHART 1

SYSTEM VOLTAGE	FU1-2 AMPS
200	12
230 60Hz	10
230 50Hz	10
346	7
380	6
400	6
416	6
460	5
575	4

CHART 2

STARTER RLA RANGE	MICRO CT RATIO
95-135	3900:1
136-200	5760:1
201-231	2640:1
232-300	3900:1
301-340	3900:1
341-480	5760:1
481-580	2640:1
581-600	3900:1
601-740	3900:1
741-855	3900:1
856-1250	5760:1

Fig. 49 — Benshaw, Inc. Solid-State Unit Mounted Starter Wiring Schematic (Low Voltage)

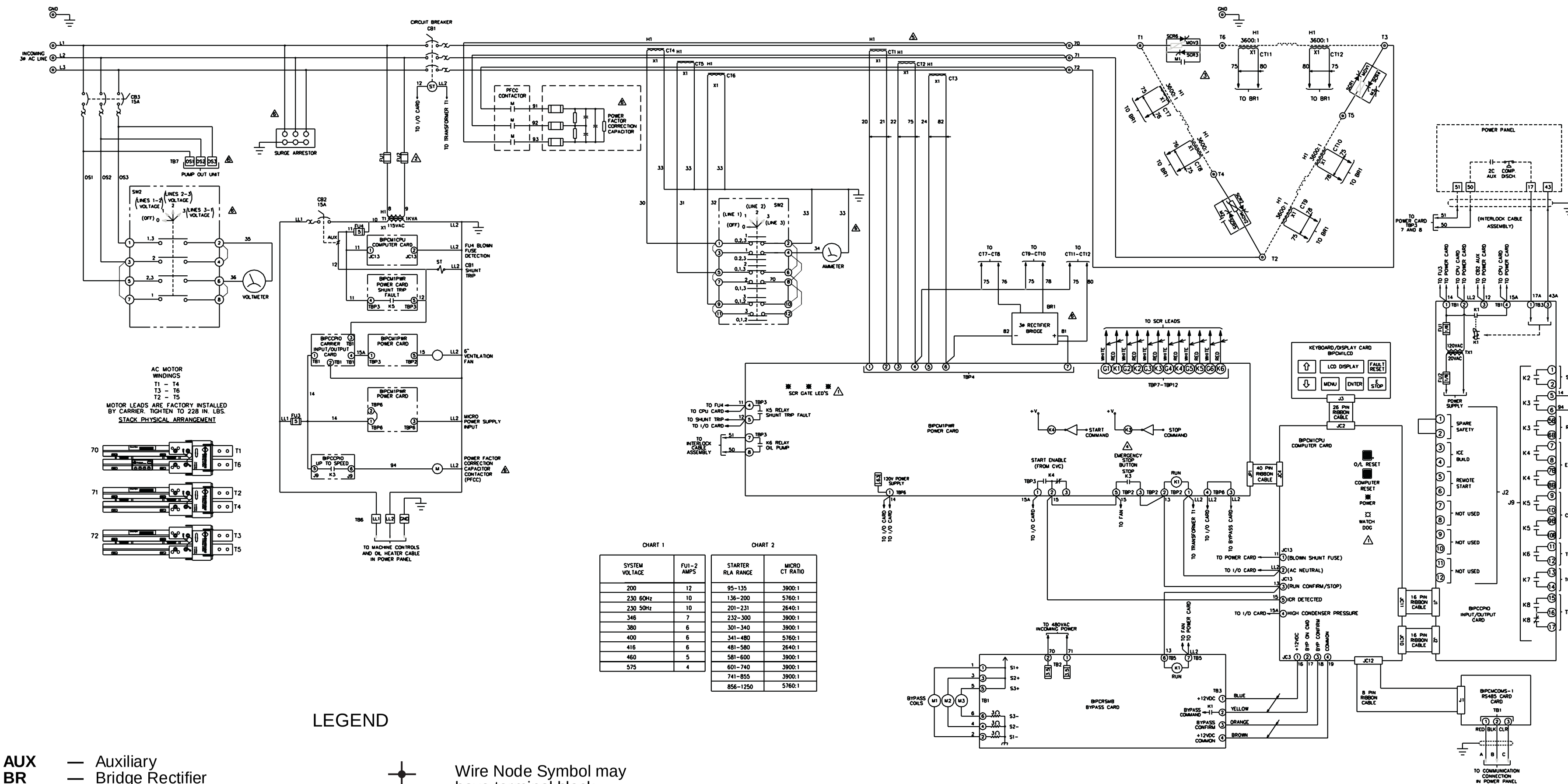


CHART 1

SYSTEM VOLTAGE	FU1-2 AMPS
200	12
230 60Hz	10
230 50Hz	10
346	7
380	6
400	6
416	6
460	5
575	4

CHART 2

STARTER RLA RANGE	MICRO CT RATIO
95-135	3900:1
136-200	5760:1
201-231	2640:1
232-300	3900:1
301-340	3900:1
341-480	5760:1
481-580	2640:1
581-600	3900:1
601-740	3900:1
741-855	3900:1
856-1250	5760:1

LEGEND

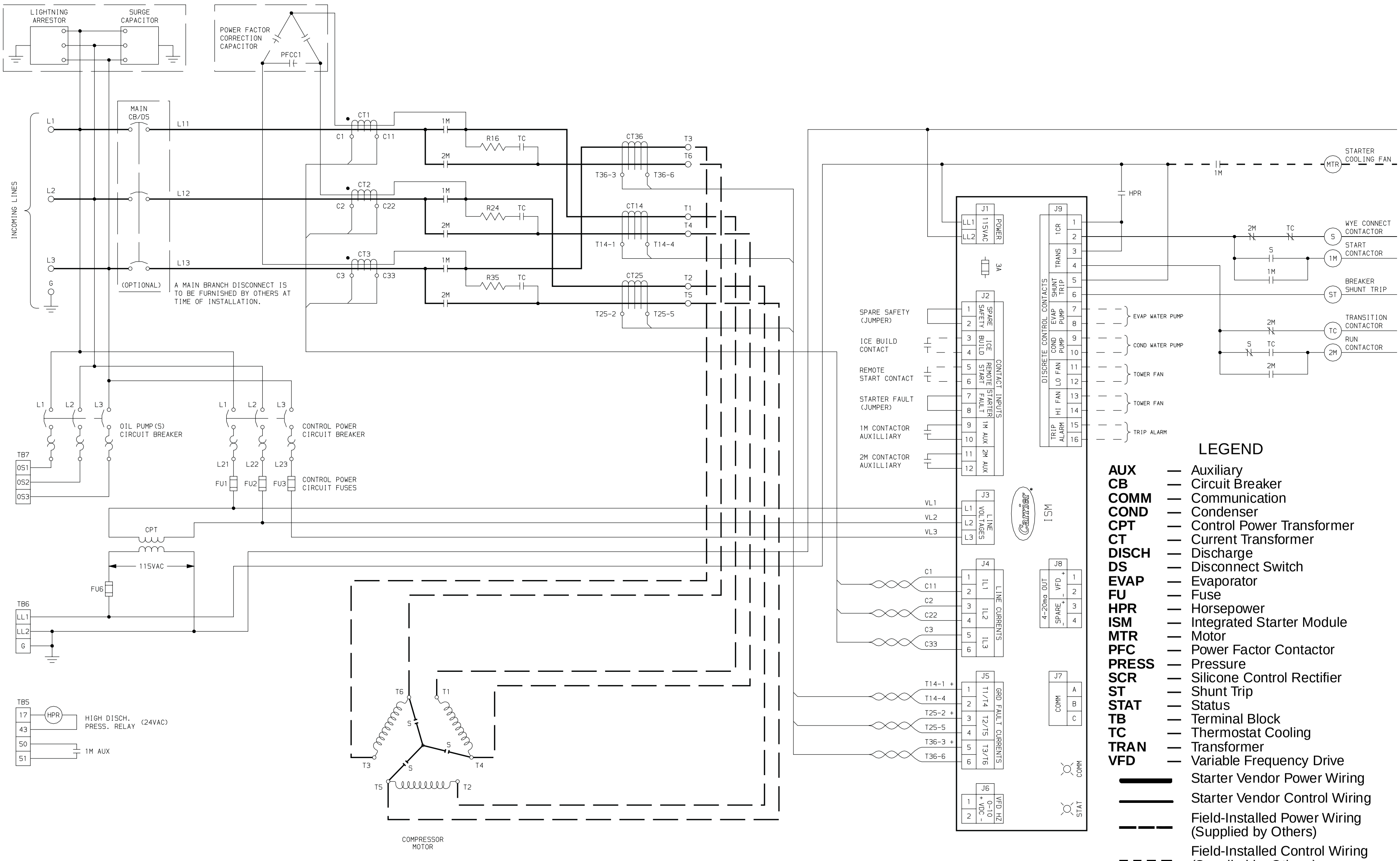
AUX — Auxiliary
BR — Bridge Rectifier
CB — Circuit Breaker
COMM — Communication
COND — Condenser
CPU — Central Processing Unit
CVC — Chiller Visual Controller
CT — Current Transformer
EVAP — Evaporator
FU — Fuse
G — Ground
L — Main Supply Power
LL — Control Power Supply
M — Contactor
O/L — Overload Reset
S — Contactor
SCR — Silicone Controller Rectifier
ST — Shunt Trip
TB — Terminal Block

Wire Node Symbol may have terminal block
Benshaw supplied terminal block
Terminal Strip
Power Connection
PC Board Terminals
Twisted Pair
Twisted Shielded Pair
Shield Wire
Field Wiring

NOTES:

1. LED status with power applied and prior to run command. "ON" "OFF"
2. Transformer T1 primary fuses FU1/FU2 value dependent on system voltage and model, per Chart 1. Transformer connections per transformer nameplate connection diagram.
3. MOVs are used on power stack assemblies for system voltages of 200 through 460 vac (as shown). Resistor/capacitor networks (DVDTs) are used on power stack assemblies in place of MOVs for a system voltage of 575 vac (not shown).
4. K3 relay shown in deenergized state. K3 contact will close when power is applied. K3 contact will open on stop command or system faul

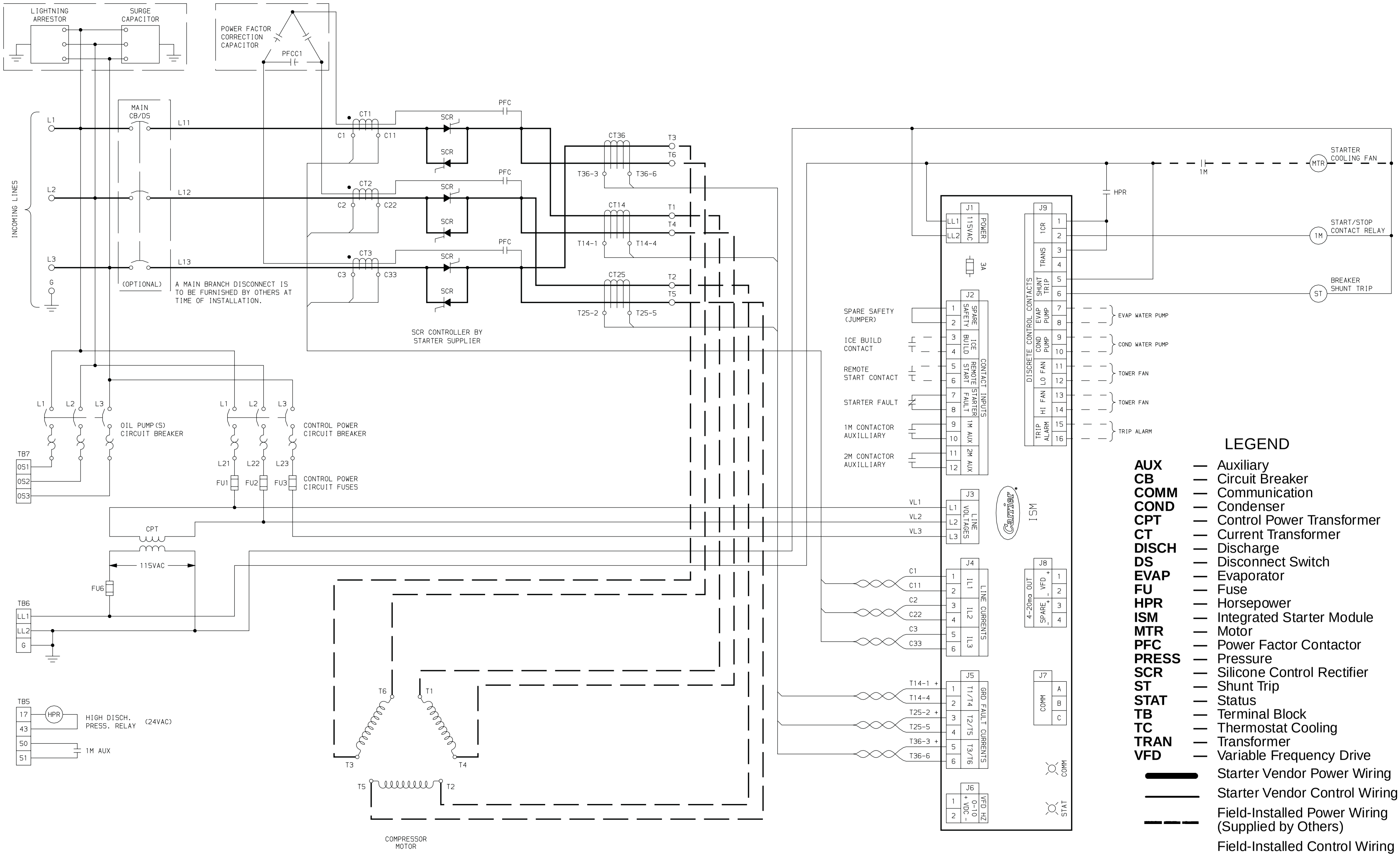
Fig. 49 — Benshaw, Inc. Solid-State Unit Mounted Starter Wiring Schematic (Low Voltage) (cont)



LEGEND

AUX — Auxiliary
CB — Circuit Breaker
COMM — Communication
COND — Condenser
CPT — Control Power Transformer
CT — Current Transformer
DISCH — Discharge
DS — Disconnect Switch
EVAP — Evaporator
FU — Fuse
HPR — Horsepower
ISM — Integrated Starter Module
MTR — Motor
PFC — Power Factor Contactor
PRESS — Pressure
SCR — Silicone Control Rectifier
ST — Shunt Trip
STAT — Status
TB — Terminal Block
TC — Thermostat Cooling
TRAN — Transformer
VFD — Variable Frequency Drive
Starter Vendor Power Wiring
Starter Vendor Control Wiring
Field-Installed Power Wiring (Supplied by Others)
Field-Installed Control Wiring (Supplied by Others)
Option — Starter Vendor Wiring
Twisted Pair Wiring By Starter Vendor
Customer Terminal Connection

Fig. 50 — Typical Wye Delta Free-Standing Starter Wiring Schematic (Low Voltage)



LEGEND

AUX — Auxiliary
CB — Circuit Breaker
COMM — Communication
COND — Condenser
CPT — Control Power Transformer
CT — Current Transformer
DISCH — Discharge
DS — Disconnect Switch
EVAP — Evaporator
FU — Fuse
HPR — Horsepower
ISM — Integrated Starter Module
MTR — Motor
PFC — Power Factor Contactor
PRESS — Pressure
SCR — Silicone Control Rectifier
ST — Shunt Trip
STAT — Status
TB — Terminal Block
TC — Thermostat Cooling
TRAN — Transformer
VFD — Variable Frequency Drive

Starter Vendor Power Wiring
Starter Vendor Control Wiring
Field-Installed Power Wiring (Supplied by Others)
Field-Installed Control Wiring (Supplied by Others)
Option — Starter Vendor Wiring
Twisted Pair Wiring By Starter Vendor
Customer Terminal Connection

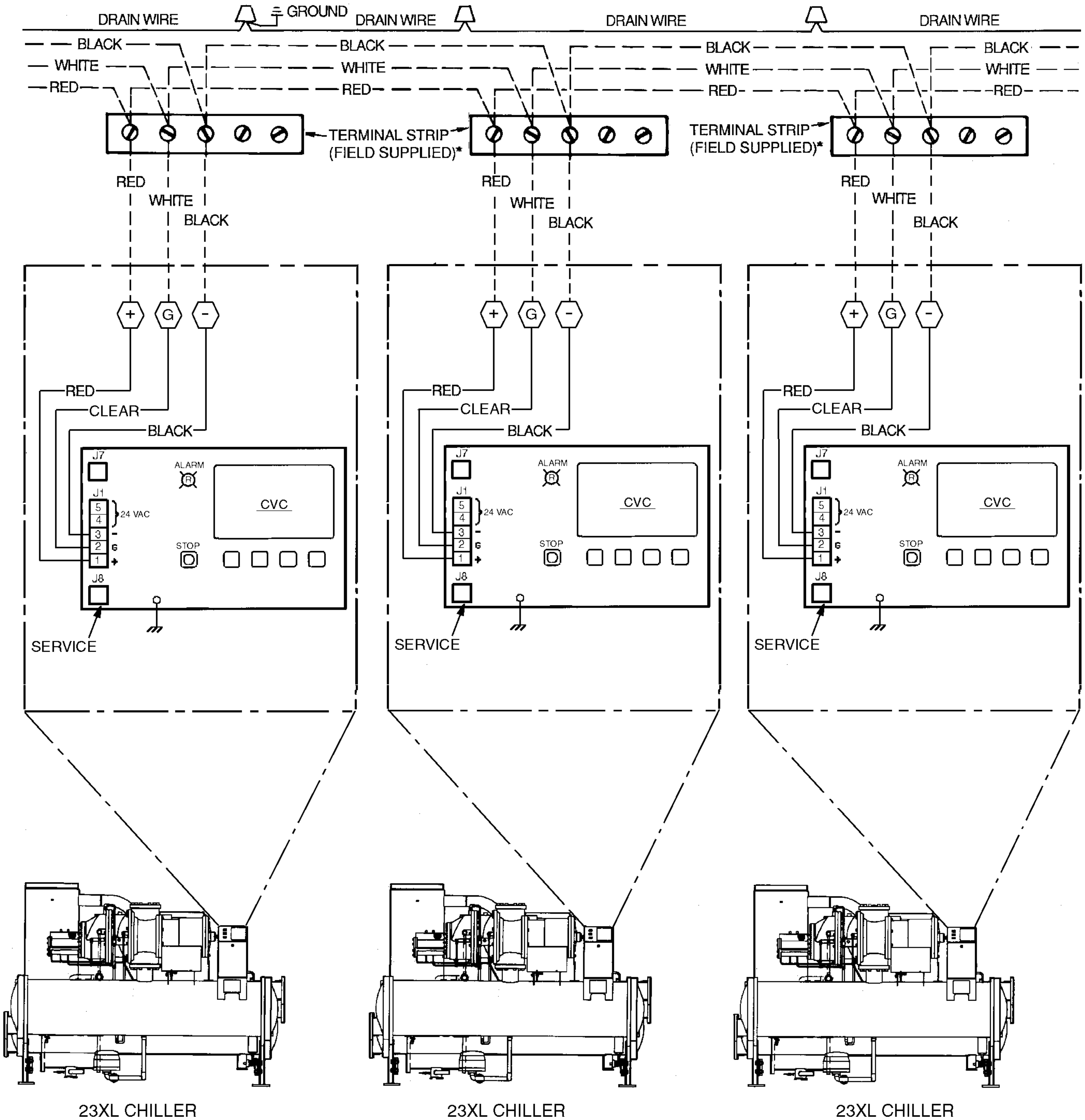
NOTES:

PFC — Power Factor Contactor

1M CONTACT AUX — Closes when SCR's are gated (ON)
— Opens when SCR's are not gated (OFF)

2M CONTACT AUX — Closes when motor is at full voltage (up to speed)

Fig. 51 — Typical Solid-State Free-Standing Starter Wiring Schematic (Low Voltage)



LEGEND

———	Factory Wiring
- - - -	Field Wiring
□	Component Terminal
⬡	Control Panel Terminal

*Field supplied terminal strip must be located in the control center.

Fig. 52 — Typical COMM1 CCN Communication Wiring for Multiple Chillers

INDEX

INITIAL START-UP CHECKLIST
FOR 23XL HERMETIC SCREW LIQUID CHILLER
(Remove and use for job file.)

CUT ALONG DOTTED LINE

CUT ALONG DOTTED LINE

MACHINE INFORMATION:

NAME ____________________________________ JOB NO. ___________________________
ADDRESS _________________________________ MODEL ____________________________
CITY _________________ STATE _____________ ZIP ____________ S/N ______________

DESIGN CONDITIONS

	TONS	BRINE	FLOW RATE	TEMPERATURE IN	TEMPERATURE OUT	PRESSURE DROP	PASS	SUCTION TEMPERATURE	CONDENSER TEMPERATURE
COOLER									******
CONDENSER								******	

COMPRESSOR: Volts _____________ RLA _______________ OLTA _____________
STARTER: Mfg ______________ Type ______________ S/N _____________

CONTROL/OIL HEATER: Volts ☐ 115 ☐ 230
REFRIGERANT: Type: ______ Charge ______

CARRIER OBLIGATIONS:
Assemble . . . . Yes ☐ ☐ No
Leak Test . . . . Yes ☐ ☐ No
Dehydrate . . . . Yes ☐ ☐ No
Charging . . . . Yes ☐ ☐ No
Operating Instructions _____________________ Hrs.

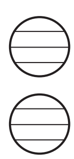
START-UP TO BE PERFORMED IN ACCORDANCE WITH APPROPRIATE MACHINE START-UP INSTRUCTIONS
JOB DATA REQUIRED:

1. Machine Installation Instructions . . . . Yes ☐ No ☐
2. Machine Assembly, Wiring and Piping Diagrams . . . . . . Yes ☐ No ☐
3. Starting Equipment Details and Wiring Diagrams . . . . . . Yes ☐ No ☐
4. Applicable Design Data (see above) . . . . Yes ☐ No ☐
5. Diagrams and Instructions for Special Controls . . . . Yes ☐ No ☐

INITIAL MACHINE PRESSURE: _______________

	YES	NO
Was Machine Tight?		
If Not, Were Leaks Corrected?		
Was Machine Dehydrated After Repairs?		

CHECK OIL LEVEL AND RECORD:



3/4
1/2 Top sight glass
1/4

3/4
1/2 Bottom sight glass
1/4

ADD OIL: Yes ☐ No ☐
Amount: _________________

RECORD PRESSURE DROPS: Cooler _______________ Condenser _________________

CHARGE REFRIGERANT: Initial Charge _______________ Final Charge After Trim _______________

INSPECT WIRING AND RECORD ELECTRICAL DATA:
RATINGS:

Motor Voltage ___________ Motor(s) Amps___________ Starter LRA Rating___________

Line Voltages: Motor _____________ Controls/Oil Heater ___________

FIELD-INSTALLED STARTERS ONLY:

Check continuity T1 to T1, etc. (Motor to starter, disconnect motor leads T4, T5, T6.) Do not megger solid-state starters; disconnect leads to motor and megger the leads.

MEGGER MOTOR	"PHASE TO PHASE"			"PHASE TO GROUND"		
	T1-T2	T1-T3	T2-T3	T1-G	T2-G	T3-G
10-Second Readings:						
60-Second Readings:						
Polarization Ratio:						

STARTER: Electro-Mechanical ☐ Solid-State ☐ Manufacturer ______________
Serial Number _____________

Motor Load Current Transformer Ratio ____ : ____
Solid-State Overloads Yes ☐ No ☐

CONTROLS: SAFETY, OPERATING, ETC.

Perform Controls Test (Yes/No) _______

PIC II CAUTION
COMPRESSOR MOTOR AND CONTROL PANEL **MUST** BE PROPERLY AND INDIVIDUALLY CONNECTED BACK TO THE EARTH GROUND IN THE STARTER (IN ACCORDANCE WITH CERTIFIED DRAWINGS).

Yes ____

RUN MACHINE: Do these safeties shut down machine?

Condenser Water Flow	Yes ☐	No ☐
Chilled Water Flow	Yes ☐	No ☐
Pump Interlocks	Yes ☐	No ☐

INITIAL START:

Line Up All Valves in Accordance With Instruction Manual: _______

Start Water Pumps and Establish Water Flow _______

Oil Level OK and Oil Temperature OK _______ Oil Pressure _______

Restart Compressor, Bring Up To Speed. Shut Down. Any Abnormal Coastdown Noise? Yes* ☐ No ☐
*If yes, determine cause.

START MACHINE AND OPERATE. COMPLETE THE FOLLOWING:
A: Trim charge and record under Charge Refrigerant Into Chiller section on page 64.
B: Complete any remaining control calibration and record under Controls section (pages 14-47).
C: Take at least two sets of operational log readings and record.
E: After machine has been successfully run and set up, shut down and mark shutdown oil and refrigerant levels.
F: Give operating instructions to owner's operating personnel. Hours Given: _________ Hours
G: Call your Carrier factory representative to report chiller start-up.

SIGNATURES:

CARRIER
TECHNICIAN ____________________________

CUSTOMER
REPRESENTATIVE __________________________

DATE ______________

DATE ______________

CUT ALONG DOTTED LINE

CUT ALONG DOTTED LINE

Carrier COMFORT NETWORK

23XL PIC II SETPOINT TABLE CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Base Demand Limit	40 to 100	%	100	
LCW Setpoint	10 to 120	DEG F	50.0	
ECW Setpoint	15 to 120	DEG F	60.0	
Ice Build Setpoint	15 to 60	DEG F	40.0	
Tower Fan High Setpoint	55 to 105	DEG F	75	

CVC Software Version Number: ____________________

CVC Controller Identification: BUS: ________________________ ADDRESS: ______________________________

Carrier COMFORT NETWORK

23XL PIC II TIME SCHEDULE CONFIGURATION SHEET OCCPC01S

	Day Flag									Occupied Time					Unoccupied Time			
	M	T	W	T	F	S	S	H										
Period 1:																		
Period 2:																		
Period 3:																		
Period 4:																		
Period 5:																		
Period 6:																		
Period 7:																		
Period 8:																		

NOTE: Default setting is OCCUPIED 24 hours/day.

ICE BUILD 23XL PIC II TIME SCHEDULE CONFIGURATION SHEET OCCPC02S

	Day Flag									Occupied Time					Unoccupied Time			
	M	T	W	T	F	S	S	H										
Period 1:																		
Period 2:																		
Period 3:																		
Period 4:																		
Period 5:																		
Period 6:																		
Period 7:																		
Period 8:																		

NOTE: Default setting is UNOCCUPIED 24 hours/day.

23XL PIC II TIME SCHEDULE CONFIGURATION SHEET OCCPC03S

	Day Flag									Occupied Time					Unoccupied Time			
	M	T	W	T	F	S	S	H										
Period 1:																		
Period 2:																		
Period 3:																		
Period 4:																		
Period 5:																		
Period 6:																		
Period 7:																		
Period 8:																		

NOTE: Default setting is OCCUPIED 24 hours/day.

CUT ALONG DOTTED LINE

CUT ALONG DOTTED LINE

23XL PIC II ISM_CONF TABLE CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Starter Type (0=Full, 1=Red, 2=SS/VFD)	0 to 2		1	
Motor Rated Line Voltage	200 to 13200	VOLTS	460	
Volt Transformer Ratio: 1	1 to 35		1	
Overvoltage Threshold	105 to 115	%	115	
Undervoltage Threshold	85 to 95	%	85	
Over/Under Volt Time	1 to 10	SEC	5	
Voltage % Imbalance	1 to 10	%	10	
Voltage Imbalance Time	1 to 10	SEC	5	
Motor Rated Load Amps	10 to 5000	AMPS	200	
Motor Locked Rotor Trip	100 to 60000	AMPS	1000	
Locked Rotor Start Delay	1 to 10	cycles	5	
Starter LRA Rating	100 to 60000	AMPS	2000	
Motor Current CT Ratio: 1	3 to 1000		100	
Current % Imbalance	5 to 40	%	15	
Current Imbalance Time	1 to 10	SEC	5	
3 Grnd Fault CT’s? (1=No)	0/1	NO/YES	YES	
Ground Fault CT Ratio: 1	150		150	
Ground Fault Current	1 to 25	AMPS	15	
Ground Fault Start Delay	1 to 20	cycles	10	
Ground Fault Persistence	1 to 10	cycles	5	
Single Cycle Dropout	0/1	DSABLE/ENABLE	DSABLE	
Frequency-60 Hz? (No=50)	0/1	NO/YES	YES	
Line Frequency Faulting	0/1	DSABLE/ENABLE	DSABLE	

23XL PIC II OPTIONS TABLE CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Auto Restart Option	0/1	DSABLE/ENABLE	DSABLE	
Remote Contacts Option	0/1	DSABLE/ENABLE	DSABLE	
Soft Stop Amps Threshold	40 to 100	%	100	
Stall/Hot Gas Bypass				
Stall Limit/HGBP Option Select: Stall=0, HGBP=1	0/1		0	
Min. Load Point (T1/P1)				
Stall/HGBP Delta T1	0.5 to 20	ˆF	1.5	
Stall/HGBP Delta P1	30 to 170	PSI	150	
Full Load Point (T2/P2)				
Stall/HGBP Delta T2	0.5 to 20	ˆF	4	
Stall/HGBP Delta P2	30 to 250	PSI	200	
Stall/HGBP Deadband	0.5 to 3	ˆF	1	
Stall Protection				
Stall Delta % Amps	5 to 20	%	10	
Stall Time Period	7 to 10	MIN	8	
Ice Build Control				
Ice Build Option	0/1	DSABLE/ENABLE	DSABLE	
Ice Build Termination 0=Temp, 1=Contacts, 2=Both	0 to 2		0	
Ice Build Recycle	0/1	DSABLE/ENABLE	DSABLE	
Refrigerant Leak Option	0/1	DSABLE/ENABLE	DSABLE	
Refrigerant Leak Alarm mA	4 to 20	mA	20	
Head Pressure Reference				
Delta P @ 0% (4 mA)	20-30	PSI	25	
Delta P @ 100% (20 mA)	35-50	PSI	35	
Minimum Output	0-100	%	0	

23XL PIC II SETUP1 TABLE CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Comp Motor Temp Override	150 to 200	DEG F	200	
Cond Press Override	150 to 260	PSI	230	
Comp Discharge Alert	125 to 200	DEG F	200	
Chilled Medium	0/1	WATER/BRINE	WATER	
Chilled Water Deadband.	5 to 2.0	ˆF	1.0	
Evap Refrig Trippoint	0.0 to 40.0	DEG F	33	
Refrig Override Delta T	2.0 to 5.0	ˆF	3	
Condenser Freeze Point	–20 to 35	DEG F	34	
Evap Flow Delta P Cutout	0.5 to 50.0	PSI	5.0	
Cond Flow Delta P Cutout	0.5 to 50.0	PSI	5.0	
Water Flow Verify Time	0.5 to 5	MIN	5	
Oil Filter Pressure Alert	1-15	PSI	3	
Recycle Control				
Recycle Restart Delta T	2.0 to 10.0	DEG F	5	
Recycle Shutdown Delta	0.5 to 4.0	DEG F	1	
SPARE ALERT/ALARM ENABLE Disable=0, Lo=1/3, Hi=2/4				
Spare Temp #1 Enable	0 to 4		0	
Spare Temp #1 Limit	–40 to 245	DEG F	245	
Spare Temp #2 Enable	0 to 4		0	
Spare Temp #2 Limit	–40 to 245	DEG F	245	
23XL Model TC Comp?	0/1	NO/YES	1	

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23XL PIC II SETUP2 TABLE CONFIGURATION SHEET

DESCRIPTION	STATUS	UNITS	DEFAULT	VALUE
Capacity Control				
Proportional Inc Band	2 to 10		6.5	
Proportional Dec Band	2 to 10		6.0	
Proportional ECW Gain	1 to 3		2.0	
VFD/Slide Valve Control				
VFD Option	0/1	DSABLE/ENABLE	DSABLE	
VFD Gain	0.1 to 1.5		0.75	
VFD Increase Step	1 to 5	%	2	
VFD Minimum Speed	20 to 100	%	0	
VFD Maximum Speed	50 to 100	%	100	
Manual SV Temp Option	0/1	DSABLE/ENABLE	DSABLE	

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Carrier COMFORT NETWORK

23XL PIC II LEADLAG TABLE CONFIGURATION SHEET

DESDRIPTION	RANGE	UNITS	DEFAULT	VALUE
Lead Lag Control				
LEAD/LAG Configuration DSABLE=0, LEAD=1, LAG=2, STANDBY=3	0 to 3		0	
Load Balance Option	0/1	DSABLE/ENABLE	DSABLE	
Common Sensor Option	0/1	DSABLE/ENABLE	DSABLE	
LAG Percent Capacity	25 to 75	%	50	
LAG Address	1 to 236		92	
LAG START Timer	2 to 60	MIN	10	
LAG STOP Timer	2 to 60	MIN	10	
PRESTART FAULT Timer	2 to 30	MIN	5	
STANDBY Chiller Option	0/1	DSABLE/ENABLE	DSABLE	
STANDBY Percent Capacity	25 to 75	%	50	
STANDBY Address	1 to 236		93	

23XL PIC II RAMP_DEM TABLE CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Pulldown Ramp Type: Select: Temp=0, Load=1	0/1		1	
Demand Limit + kW Ramp				
Demand Limit Source Select: Amps=0, kW=1	0/1		0	
Motor Load Ramp % Min	5 to 20		10	
Demand Limit Prop Band	3 to 15	%	10	
Demand Limit At 20 mA	40 to 100	%	40	
20 mA Demand Limit Opt	0/1	DSABLE/ENABLE	DSABLE	
Motor Rated Kilowatts	50 to 9999	kW	145	
Demand Watts Interval	5 to 60	MIN	15	

23XL PIC II TEMP_CTL TABLE CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Control Point				
ECW Control Option	0/1	DSABLE/ENABLE	DSABLE	
Temp Pulldown Deg/Min	2 to 10	ˆF	3	
Temperature Reset				
RESET TYPE 1				
Degrees Reset At 20 mA	–30 to 30	ˆF	10	
RESET TYPE 2				
Remote Temp (No Reset)	–40 to 245	DEG F	85	
Remote Temp (Full Reset)	–40 to 245	DEG F	65	
Degrees Reset	–30 to 30	ˆF	10	
RESET TYPE 3				
CHW Delta T (No Reset)	0 to 15	ˆF	10	
CHW Delta T (Full Reset)	0 to 15	ˆF	0	
Degrees Reset	–30 to 30	ˆF	5	
Select/Enable Reset Type	0 to 3		0	

23XL BROADCAST (BRODEF) CONFIGURATION SHEET

DESCRIPTION	RANGE	UNITS	DEFAULT	VALUE
Time Broadcast Enable	0/1	DSABLE/ENABLE	DSABLE	
Daylight Savings				
Start Month	1 to 12		4	
Start Day of Week	1 to 7		7	
Start Week	1 to 5		3	
Start Time	00:00 to 24:00	HH:MM	02:00	
Start Advance	0 to 360	MIN	60	
Stop Month	1 to 12		10	
Stop Day of Week	1 to 7		7	
Stop Week	1 to 5		3	
Stop Time	00:00 to 24:00		02:00	
Stop Back	0 to 360	MIN	60	

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