



Start-Up, Operation, and Maintenance Instructions

SAFETY CONSIDERATIONS

Centrifugal 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 machine instructions as well as those listed in this guide.

▲ DANGER

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 ASHRAE 15 (American Society of Heating, Refrigeration and Air Conditioning Engineers). The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation.

PROVIDE adequate ventilation in accordance with ASHRAE 15, latest edition, 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 machine 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 machine.

▲ 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 machine 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 panels, switches, starters, or oil heater 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 siphon 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 machine. The introduction of the wrong refrigerant can cause damage or malfunction to this machine.

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

DO NOT ATTEMPT TO REMOVE fittings, covers, etc., while machine is under pressure or while machine 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 machine 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 machine. 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 fans, or pumps. Shut off the machine 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 19EF unit, 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 so that you may become familiar with the control system before performing start-up procedures. Procedures in this manual are arranged in the sequence required for proper machine 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 boards and when connecting or disconnecting terminal plugs. Circuit boards can easily be damaged. 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 cause interference to radio communications. It 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 anti-static shipping bag.

ABBREVIATIONS

Frequently used abbreviations in this manual include:

CCN	— Carrier Comfort Network
CCW	— Counterclockwise
CW	— Clockwise
ECW	— Entering Chilled Water
ECDW	— Entering Condenser Water
EMS	— Energy Management System
HGBP	— Hot Gas Bypass
I/O	— Input/Output
LCD	— Liquid Crystal Display
LCDW	— Leaving Condenser Water
LCW	— Leaving Chilled Water
LED	— Light-Emitting Diode
LID	— Local Interface Device
OLTA	— Overload Trip Amps
PIC	— Product Integrated Control
PSIO	— Processor Sensor Input/Output Module
RLA	— Rated Load Amps
SCR	— Silicon Control Rectifier
SMM	— Starter Management Module

MACHINE FAMILIARIZATION (Fig. 1 and 2)

Machine Information Plate — The information plate is located on the left side of the machine control center panel.

System Components — The components include the cooler and condenser heat exchangers in separate vessels, motor-compressor, lubrication package, control center, economizer, and 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.

Cooler — This vessel (also known as the evaporator) is located underneath the compressor. The cooler is maintained at lower temperature/pressure so that evaporating refrigerant can remove heat from water 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 in order to remove heat from the refrigerant.

Economizer — During normal operation, this vessel functions as an economizer, returning flash gas to the second stage of the compressor and increasing the efficiency of the refrigerant cycle.

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

Control Center — The control center is the user interface for controlling the machine. It regulates the machine's capacity as required to maintain proper leaving chilled water temperature. The control center:

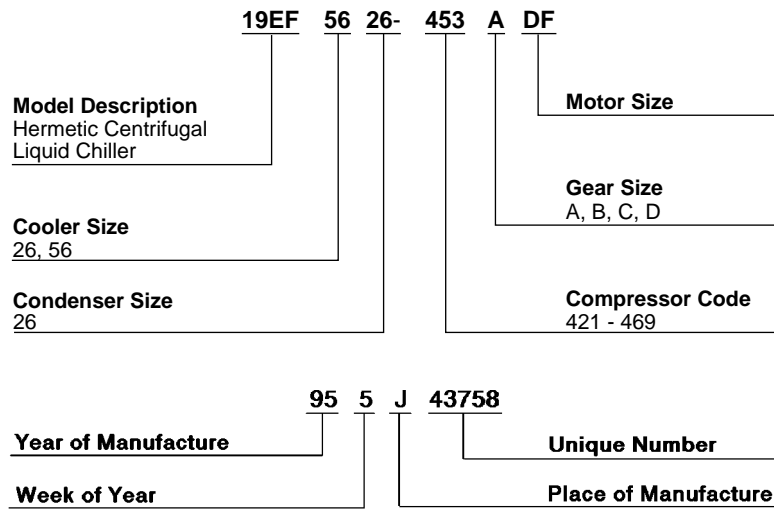
- registers cooler, condenser, and lubricating system pressures
- shows machine operating conditions and alarm shutdown conditions
- records the total machine operating hours and how many hours the machine has been running
- sequences machine start, stop, and recycle under microprocessor control
- provides access to other CCN (Carrier Comfort Network) devices

Motor Starter — The starter allows for the proper starting and disconnecting of the electrical energy for the compressor-motor, oil pump, oil heater, and control center. This component is freestanding.

REFRIGERATION CYCLE (Fig. 3)

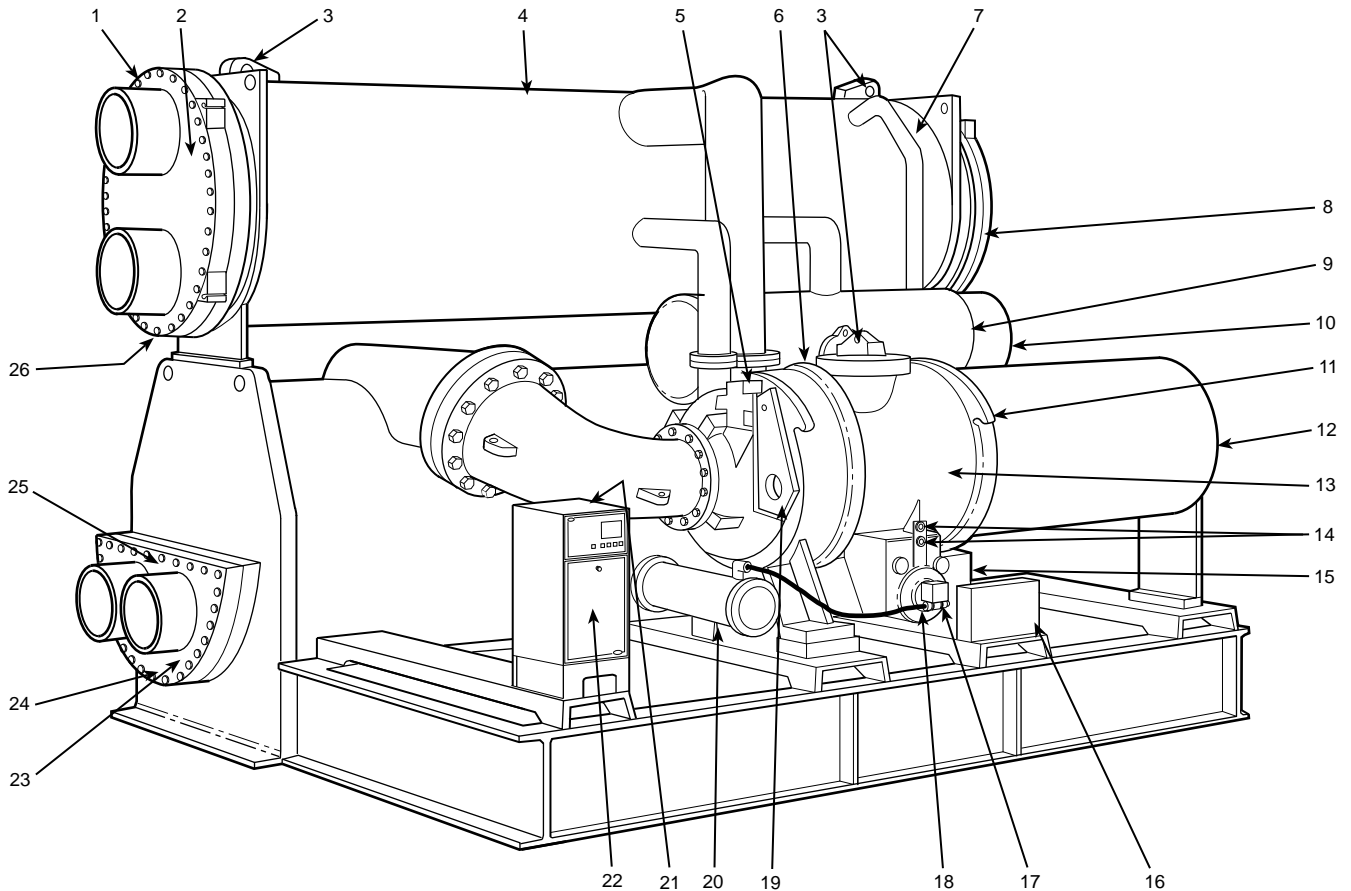
The machine compressor continuously draws large quantities of refrigerant vapor from the cooler at a rate set by the amount of guide vane opening. This compressor suction reduces the pressure within the cooler and causes the remaining refrigerant to boil vigorously at low temperature (typically 38 to 42 F [3 to 6 C]).

The energy required for boiling is obtained as heat from the water (or brine) flowing through the cooler tubes. With heat removed, the chilled water (brine) can then be used for air conditioning or for process liquid cooling.



SERIAL NUMBER BREAKDOWN

Fig. 1 — 19EF Identification



- | | |
|--|---|
| 1 — Condenser Waterbox Vent | 15 — Oil Heater |
| 2 — Condenser Waterbox Cover | 16 — Power Panel |
| 3 — Machine Lifting Lugs | 17 — Oil Charging Valve |
| 4 — Condenser | 18 — Oil Pump |
| 5 — Guide Vane Actuator | 19 — Actuator Drive Cover |
| 6 — Economizer Low Side Float Cover (Hidden) | 20 — Oil Cooler |
| 7 — Hot Gas Bypass Line | 21 — Machine Identification Label (Not Shown) |
| 8 — Condenser Waterbox Cover | 22 — Control Center |
| 9 — Economizer | 23 — Cooler NIH Waterbox Cover |
| 10 — High Side Float Box Cover | 24 — Cooler Waterbox Drain |
| 11 — Cooler Relief Valves (Hidden) | 25 — Cooler Waterbox Vent |
| 12 — Motor Terminals (Hidden) | 26 — Condenser Waterbox Drain |
| 13 — Compressor | |
| 14 — Oil Level Sight Glasses | |
- NIH — Nozzle In Head

Fig. 2 — Typical 19EF Installation

After removing heat from the water, the refrigerant vapor passes through the compressor first stage, is compressed and discharged into the compressor second stage. Here it is mixed with flash-economizer gas and is further compressed.

Compression raises the refrigerant temperature above that of the water flowing through the condenser tubes. When the warm (typically 95 to 105 F [35 to 41 C]) refrigerant is discharged into the condenser, the relatively cool condensing water removes some of the heat and the vapor condenses into a liquid. In water chilling machines, further removal of heat occurs in the thermal subcooler at the bottom of the condenser. Here the liquified refrigerant is subcooled by contact with the coolest (entering water) condenser tubes.

The liquid refrigerant drains into the flash economizer where a valve system helps maintain pressure intermediate between the condenser and the cooler pressure. At this lower pressure, part of the liquid refrigerant flashes to gas, thus cooling the remaining liquid. The flash gas is returned directly to the compressor second stage. Here it is mixed with gas already compressed by the first stage impeller. Since the

economizer gas has to pass through only half the compression cycle to reach condenser pressure, there is a savings in power, hence the term “economizer.”

The cooled liquid refrigerant in the economizer is metered through the low-side float chamber to the cooler. Because cooler pressure is lower than the economizer pressure, some of the liquid flashes and cools the remainder to cooler temperature. The cycle is now complete.

MOTOR COOLING CYCLE

Refrigerant liquid from a sump at the bottom of the condenser is subcooled by passage through a line immersed in the refrigerant within the cooler. The liquid then enters the compressor motor end where it sprays on and cools the compressor rotor and stator. It then collects in the base of the motor casing and drains back into the cooler. Refrigerant gas is vented from the compressor motor casing and returns to the upper portion of the cooler through a check valve. Differential pressure between condenser and cooler maintains the refrigerant flow.

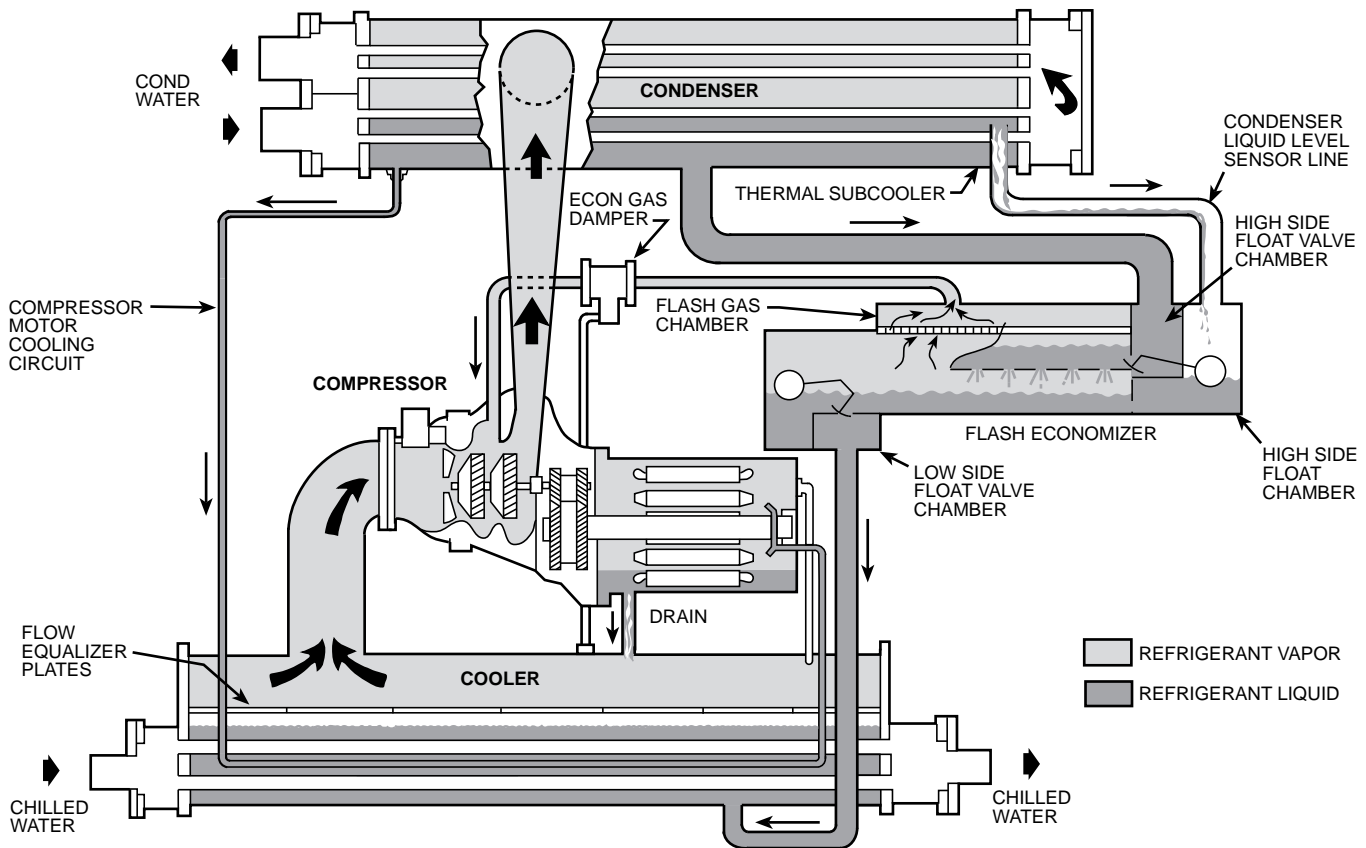


Fig. 3 — 19EF Refrigeration Cycle

LUBRICATION CYCLE

Summary — The compressor oil pump and oil reservoir are located in the compressor base. Oil is pumped through an oil cooler and a filter to remove heat and foreign particles. Part of the oil flow is directed to the compressor motor-end bearings and seal. The remaining flow lubricates the compressor transmission, thrust and journal bearings and seal. Oil is then returned to the reservoir to complete the cycle (Fig. 4; specific items called out below).

Details — Oil is charged into reservoir (1) through a hand valve (2) which also functions as an oil drain. If there is refrigerant in the machine, a pump is required for charging. Sight glasses (5) on reservoir wall permit observation of oil level.

The motor-driven oil pump (6) discharges oil to an oil cooler (7) at a rate and pressure controlled by an oil regulator (8). The differential pressure (supply versus return) is registered at the machine control center. Oil differential pressure is maintained between 18 to 25 psi (124 to 172 kPa). The oil pump discharges oil to the oil filter assembly (Item 21). The oil is then piped to the oil cooler (Item 7).

Water flow through the oil cooler is manually adjusted by a ball valve (9) to maintain the oil at an operating temperature, at the reservoir, of approximately 145 F (63 C). During machine shutdown, the oil temperature is also maintained at 140 to 150 F (60 to 66 C) by an immersion heater (10) so that absorption of refrigerant by the oil is minimized.

After it leaves the oil cooler, the oil is filtered (21) and a portion flows to the motor-end bearing (12) and seal. The remainder lubricates the compressor transmission (14) and the thrust and journal bearings (15). Thrust bearing temperature is indicated at the Local Interface Device (LID). Oil from each circuit returns by gravity to the reservoir.

A demister (17) and (18), by centrifugal action, draws refrigerant gas from the transmission area to the motor shell. The resulting pressure difference prevents oil in the transmission cavity from leaking into the motor shell.

Several safety devices monitor the lubrication system:

- In the event of a power failure, a small oil reservoir (1) supplies sufficient oil reserve to ensure continued lubrication until all compressor parts have come to a complete stop.
- Sensor (20) monitors thrust bearing temperatures and shuts off machine if temperature rises above a selected point.
- Oil low-pressure cutout shuts down machine or prevents start if oil pressure is not adequate.

The PIC (Product Integrated Control) measures the temperature of the oil in the sump and maintains the temperature during shutdown (see Controls, Oil Sump Temperature Control section, page 27). This temperature is read on the LID default screen.

During the machine start-up, the PIC will energize the oil pump and provide 15 seconds of prelubrication to the bearings after pressure is verified before starting the compressor. During shutdown, the oil pump will run for 60 seconds after the compressor actually shuts down for the purpose of post-lubrication. The oil pump can also be energized for testing purposes in control test.

Ramp loading can slow the rate of guide vane opening to minimize oil foaming at start-up. If the guide vanes open quickly, the sudden drop in suction pressure can cause any refrigerant in the oil to flash. The resulting oil foam cannot be pumped efficiently; oil pressure falls off, and lubrication is poor. If oil pressure falls below 13 psi (90 kPa) differential, the PIC will shut down the compressor.

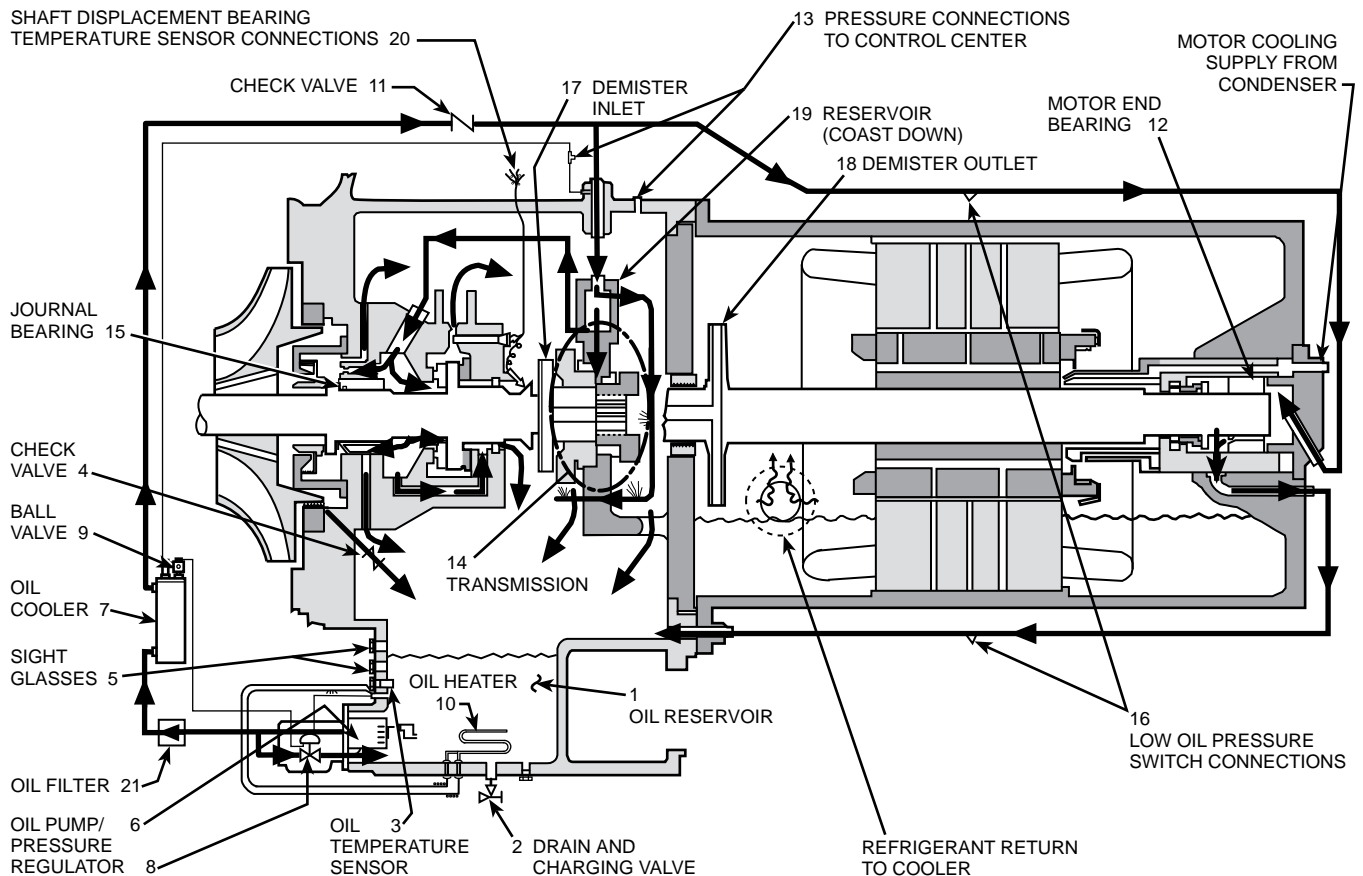


Fig. 4 — 19EF Lubrication Cycle

Oil Reclaim System — The oil reclaim system operates to return oil back to the oil reservoir by recovering it from the compressor section.

During normal machine operation, refrigerant containing a small amount of oil is pulled up from the cooler by the compressor.

Oil reclaim is accomplished by returning the system oil through the check valve. As oil builds up behind the second stage impeller, it is drained by the check valve back into the oil reservoir. An oil/refrigerant mixture is drawn up from the operating level of the cooler and is discharged into the guide vane housing. This assists the oil return system at low load operating conditions.

SOLID-STATE STARTER

The 19EF may be supplied with a solid-state, reduced-voltage starter. This starter provides on-off control of the compressor motor as its primary function. Using this type of starter reduces the peak starting torque, reduces the motor inrush current, and decreases mechanical shock. This is summed up by the phrase “soft starting.”

Solid-state starters operate 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 and current are then ramped up in a desired period of time. The voltage is reduced through the use of silicon control rectifiers (SCR). Once full voltage is reached, a bypass contactor is energized to bypass the SCRs.

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.)

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

VOLATILE MEMORY — *Volatile memory* is memory incapable of being sustained if power is lost and subsequently restored.

⚠ CAUTION

The memory of the PSIO and LID modules are volatile. If the battery in a module is removed or damaged, all programming will be lost.

General — The 19EF hermetic centrifugal liquid chiller contains a microprocessor-based control center that monitors and controls all operations of the machine. The microprocessor control system matches the cooling capacity of the machine to the cooling load while providing state-of-the-art machine protection. The system controls cooling load within the set point plus the deadband by sensing the leaving chilled water or brine temperature, and regulating the inlet guide vane via a mechanically linked actuator motor. The guide vane is a variable flow prewhirl assembly that controls the refrigeration effect in the cooler by regulating the amount of refrigerant vapor flow into the compressor. An increase in guide vane opening increases capacity. A decrease in guide vane opening decreases capacity. Machine protection is provided by the processor which monitors the digital and

analog inputs and executes capacity overrides or safety shut-downs, if required.

PIC System Components — The Product Integrated Control (PIC) is the control system on the machine. See Table 1. The PIC controls the operation of the machine by monitoring all operating conditions. The PIC can diagnose a problem and let the operator know what the problem is and what to check. It promptly positions the guide vanes to maintain leaving chilled water temperature. It can interface with auxiliary equipment such as pumps and cooling tower fans to turn them on only 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 the hot gas bypass valve, if installed.

The PIC can be interfaced with the Carrier Comfort Network (CCN) if desired. It can communicate with other PIC-equipped chillers and other CCN devices.

The PIC consists of 3 modules housed inside the 3 major components. The component names and the control voltage contained in each component are listed below (also see Table 1):

- control center
 - all extra low-voltage wiring (24 v or less)
- power panel
 - 115 v control voltage
 - up to 600 v for oil pump power
- starter cabinet
 - machine power wiring (per job requirement)

Table 1 — Major PIC Components and Panel Locations*

PIC COMPONENT	PANEL LOCATION
Processor Sensor Input/Output Module (PSIO)	Control Center
Starter Management Module (SMM)	Starter Cabinet
Local Interface Device (LID)	Control Center
6-Pack Relay Board	Control Center
8-Input Modules (Optional)	Control Center
Oil Heater Contactor (1C)	Power Panel
Oil Pump Contactor (2C)	Power Panel
Hot Gas Bypass Relay (3C) (Optional)	Power Panel
Control Transformers (T1-T4)	Power Panel
Control and Oil Heater Voltage Selector (S1)	Power Panel
Temperature Sensors	See Fig. 5
Pressure Transducers	See Fig. 5

*See Fig. 5-9.

PROCESSOR MODULE (PSIO) — The PSIO is the brain of the PIC. This module contains all of the operating software needed to control the machine. The 19EF uses 3 pressure transducers and 8 thermistors to sense pressures and temperatures. These are connected to the PSIO module. The PSIO also provides outputs to the: guide vane actuator; oil pump; oil heater; hot gas bypass (optional); and alarm contact. The PSIO communicates with the LID, the SMM, and the optional 8-input modules for user interface, starter management, and optional features.

STARTER MANAGEMENT MODULE (SMM) — This module is located within the starter cabinet. This module initiates PSIO commands for starter functions such as start/stop of the compressor, start/stop of the condenser and chilled water pumps, start/stop of the tower fan, spare alarm contacts, and the shunt trip. The SMM monitors starter inputs such as flow switches, line voltage, remote start contact, spare safety, condenser high pressure, oil pump interlock, motor current signal, starter 1M and run contacts, and kW transducer input (optional). The SMM contains logic capable of safely shutting down the machine if communication with the PSIO is lost.

LOCAL INTERFACE DEVICE (LID) — The LID is mounted to the control center and allows the operator to interface with the PSIO or other CCN devices. It is the input center for all local machine set points, schedules, set-up functions, and

options. The LID has a STOP button, an alarm light, 4 buttons for logic inputs, and a display. The function of the 4 buttons or “softkeys” are menu driven and are shown on the display directly above the key.

6-PACK RELAY BOARD — This device is a cluster of 6 pilot relays located in the control center. It is energized by the PSIO for the oil pump, oil heater, alarm, and optional hot gas bypass relay.

8-INPUT MODULES — One optional module is factory installed in the control center when ordered. There can be up to 2 of these modules per chiller with 8 spare inputs each. They are used whenever chilled water reset, demand reset, or reading a spare sensor is required. The sensors or 4 to 20 mA signals are field-installed.

The spare temperature sensors must have the same temperature/resistance curve as the other temperature sensors on this unit. These sensors are 5,000 ohm at 75 F (25 C).

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

OIL PUMP CONTACTOR (2C) — This contactor is located in the power panel. It operates all 200 to 575-v oil pumps. The PIC energizes the contactor to turn on the oil pump as necessary.

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 energizes the relay during low load, high lift conditions.

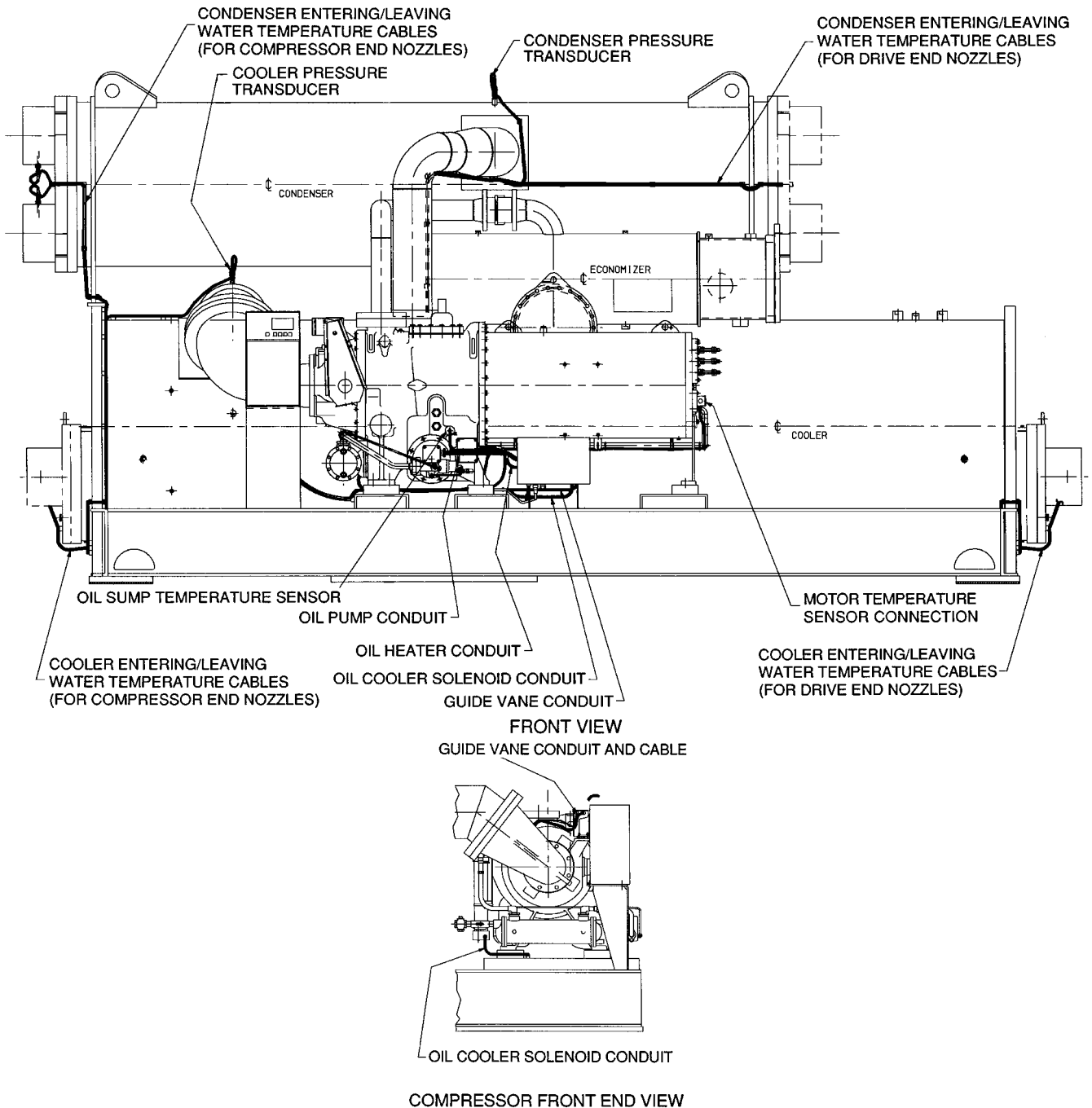
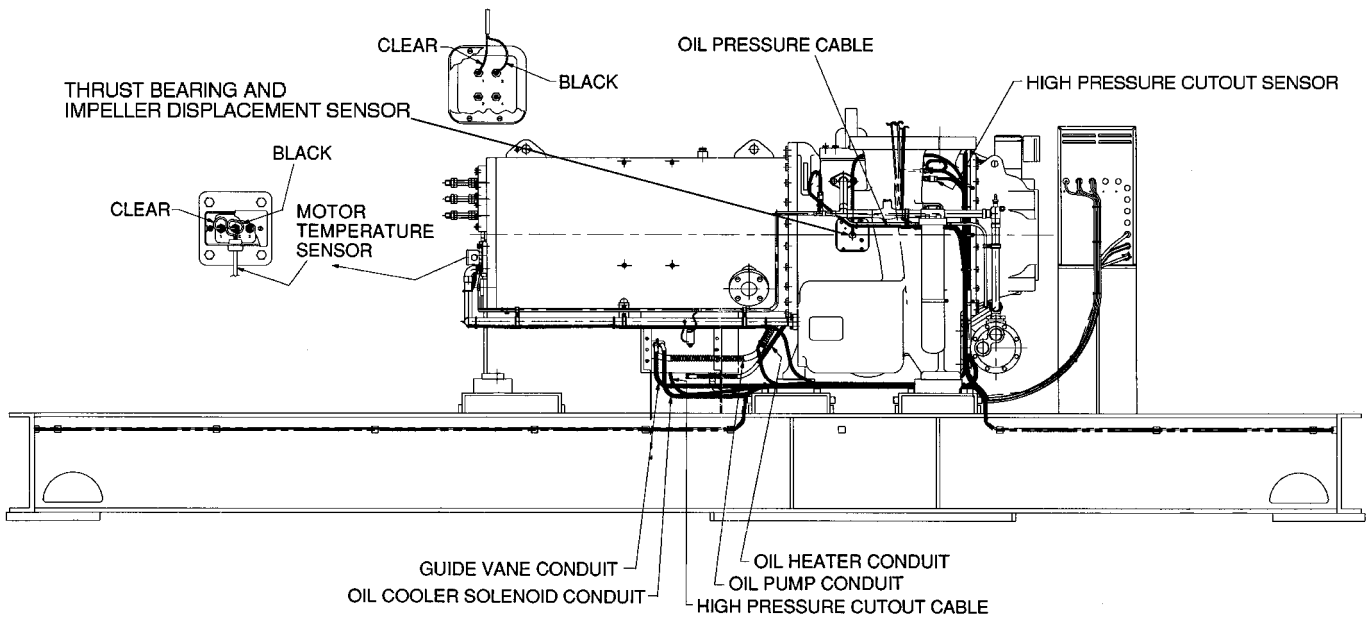


Fig. 5 — 19EF Controls and Sensor Locations



REAR COMPRESSOR SIDE VIEW

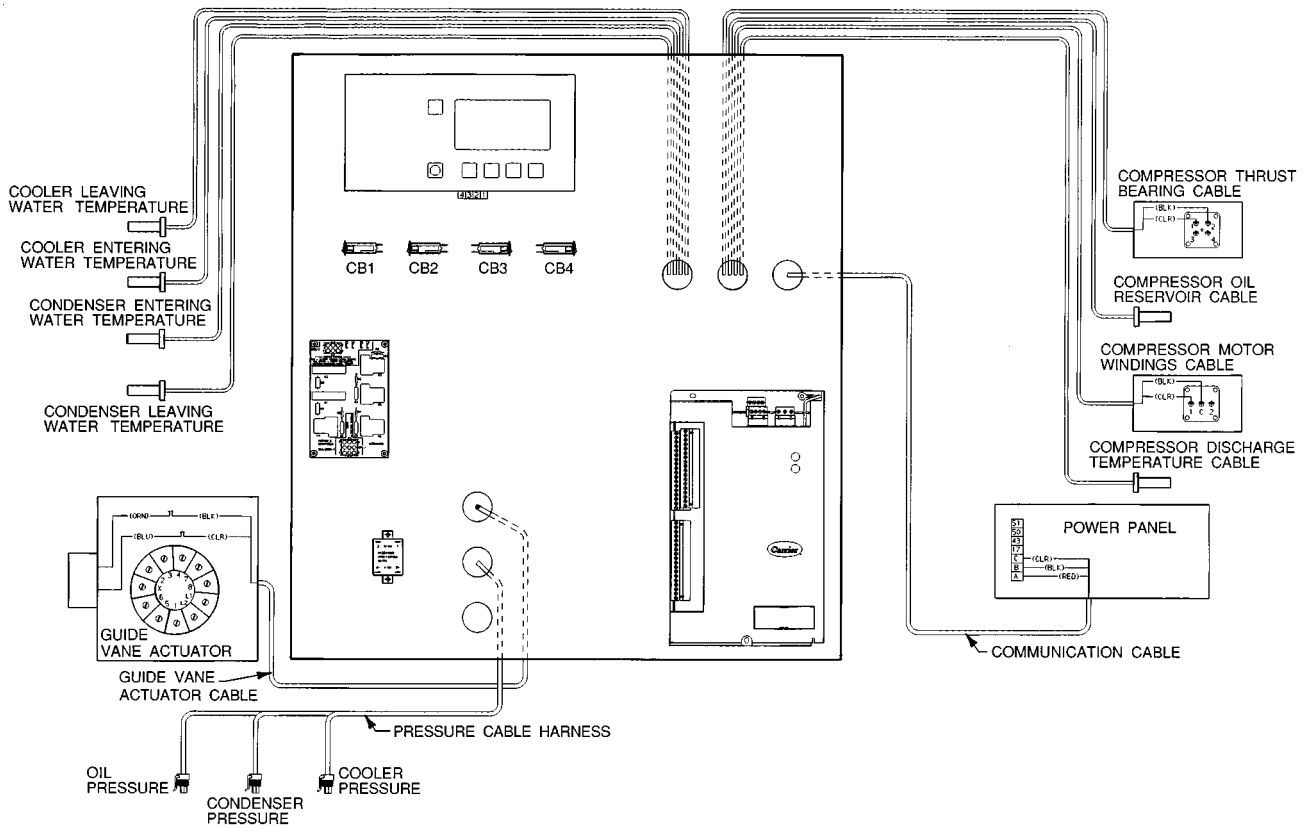


Fig. 5 — 19EF Controls and Sensor Locations (cont)

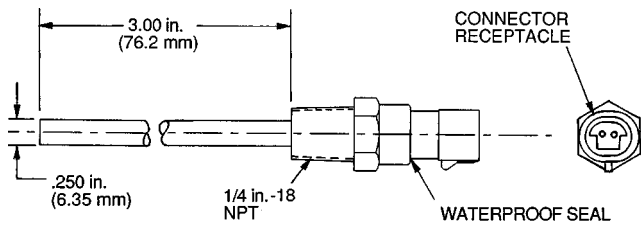


Fig. 6 — Control Sensors (Temperature)

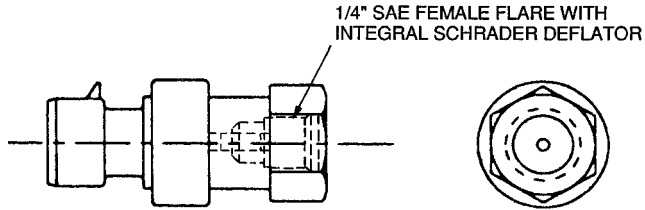
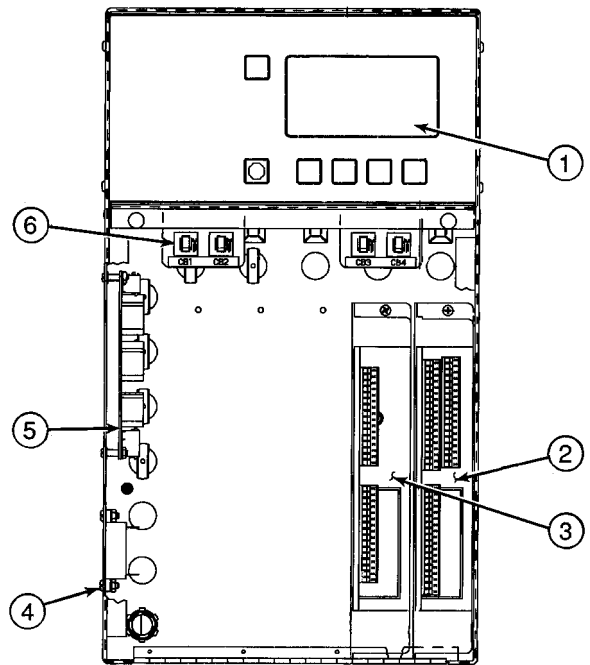


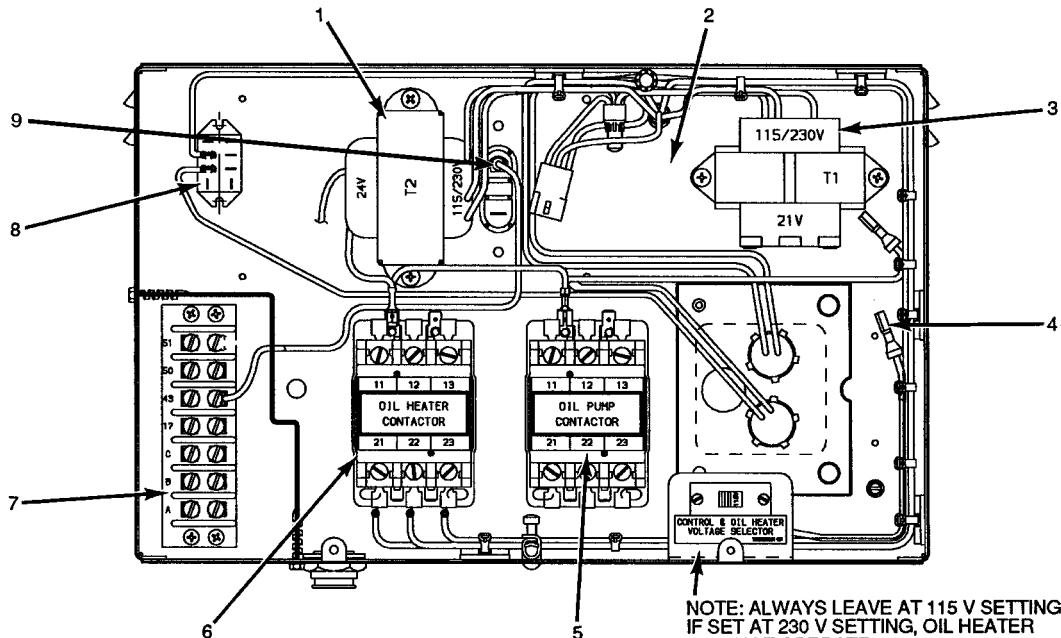
Fig. 7 — Control Sensors (Pressure Transducer, Typical)



LEGEND

- 1 — LID
- 2 — PSIO
- 3 — 8-Input Module (One of 2 Available)
- 4 — 5-Volt Transducer Power Supply
- 5 — 6-Pack Relay Board
- 6 — Circuit Breakers (4)
- 7 — 5-Volt Backlight Power Supply (Not Shown)

Fig. 8 — Control Center (Front View), with Options Module



NOTE: ALWAYS LEAVE AT 115 V SETTING IF SET AT 230 V SETTING, OIL HEATER WILL NOT OPERATE.

- 1 — T2 — Hot Gas Bypass Relay, Oil Pump Relay, and Oil Heater Relay, Power Transformer
- 2 — T4 — 8-Input Module Transformer (Not Shown)
- 3 — T1 — Control Center Transformer
- 4 — 3C Hot Gas Bypass Relay Location
- 5 — Oil Pump Contactor (2C)
- 6 — Oil Heater Contactor (1C)
- 7 — Factory Terminal Connections
- 8 — Oil Cooler Relay
- 9 — Oil Pressure Switch

Fig. 9 — Power Panel with Options

CONTROL TRANSFORMERS (T1-T4) — These transformers convert incoming control voltage to 21 vac power for the PSIO module and options modules, or 24 vac power for 3 power panel contactor relays, and 3 control solenoid valves. They are located in the power panel.

CONTROL AND OIL HEATER VOLTAGE SELECTOR (S1) — It is possible to use 115 v incoming control power in the power panel. The switch is set to the voltage used at the jobsite.

LID Operation and Menus (Fig. 10-16)

GENERAL

- The LID display will automatically revert to the default screen after 15 minutes if no softkey activity takes place and if the machine is not in the Pumpdown mode (Fig. 10).
- When not in the default screen, the upper right-hand corner of the LID always displays the name of the screen that you have entered (Fig. 11).
- The LID may be configured in English or SI units, through the LID configuration screen.
- Local Operation — By pressing the **[LOCAL]** softkey, the PIC is now in the LOCAL operation mode and the control will accept modification to programming from the LID only. The PIC will use the Local Time Schedule to determine machine start and stop times.
- CCN Operation — By pressing the **[CCN]** softkey, the PIC is now in the CCN operation mode, and the control will accept modifications from any CCN interface or module (with the proper authority), as well as the LID. The PIC will use the CCN time schedule to determine start and stop times.

ALARMS AND ALERTS — Alarm (*) and alert (!) status are indicated on the Default screen and the Status tables. An alarm (*) will shut down the compressor. An alert (!) notifies the operator that an unusual condition has occurred. The machine will continue to operate when an alert is shown.

Alarms are indicated when the control center alarm light (!) flashes. The primary alarm message is viewed on the default screen and an additional, secondary, message and troubleshooting information are sent to the Alarm History table.

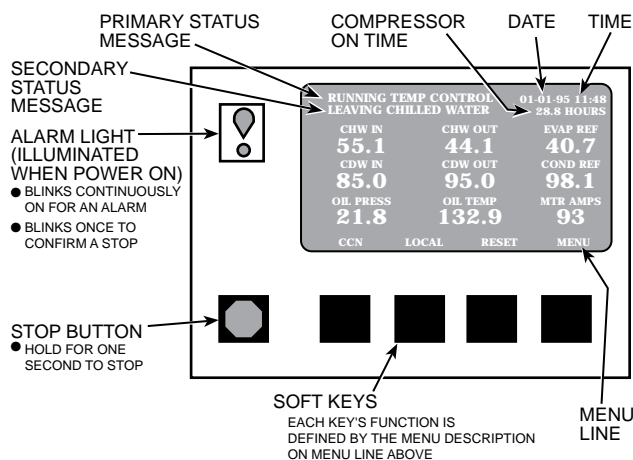


Fig. 10 — LID Default Screen

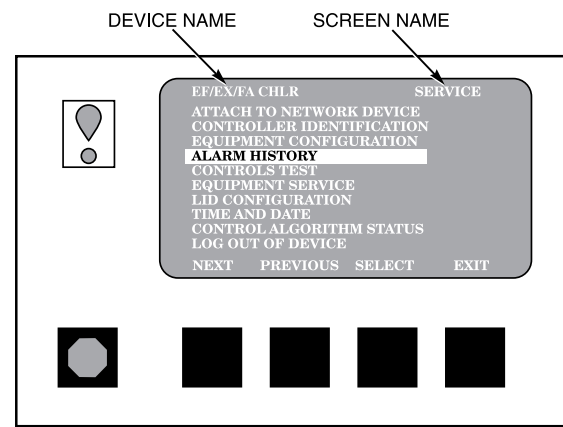


Fig. 11 — LID Service Screen

When an alarm is detected, the LID default screen will freeze (stop updating) at the time of alarm. The freeze enables the operator to view the machine 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 LID screen will return to normal operation.

LID DEFAULT SCREEN MENU ITEMS — To perform any of the operations described below, the PIC must be powered up and have successfully completed its self test.

The Default screen menu selection offers four options (Status, Schedule, Setpoint, and Service). The Status menu allows for viewing and limited calibration/modification of control points and sensors, relays and contacts, and the operations board. The Schedule menu allows for the viewing and modification of the Local Control, CCN Control, and Ice Build time schedules. Numerous set points including Base Demand Limit, LCW, ECW, and Ice Build can be adjusted under the Setpoint menu. The Service menu can be used to revise alarm history, control test, control algorithm status, equipment configuration, equipment service, time and date, attach to network, log out of device, controller identification, and LID configurations. Figures 12 and 13 provide additional information on the menu structure.

Press the **[MENU]** softkey to select from the 4 options. To view or change parameters within any menu structure, use the **[SELECT]** softkey to choose the desired table or item. The softkey modification choices displayed will depend on whether the selected item is a discrete point, analog point, or an override point. At this point, press the softkey that corresponds to your configuration selection or press the **[QUIT]** softkey. If the **[QUIT]** softkey is depressed, the configuration will not be modified. Use the following softkeys to access and select the desired section.

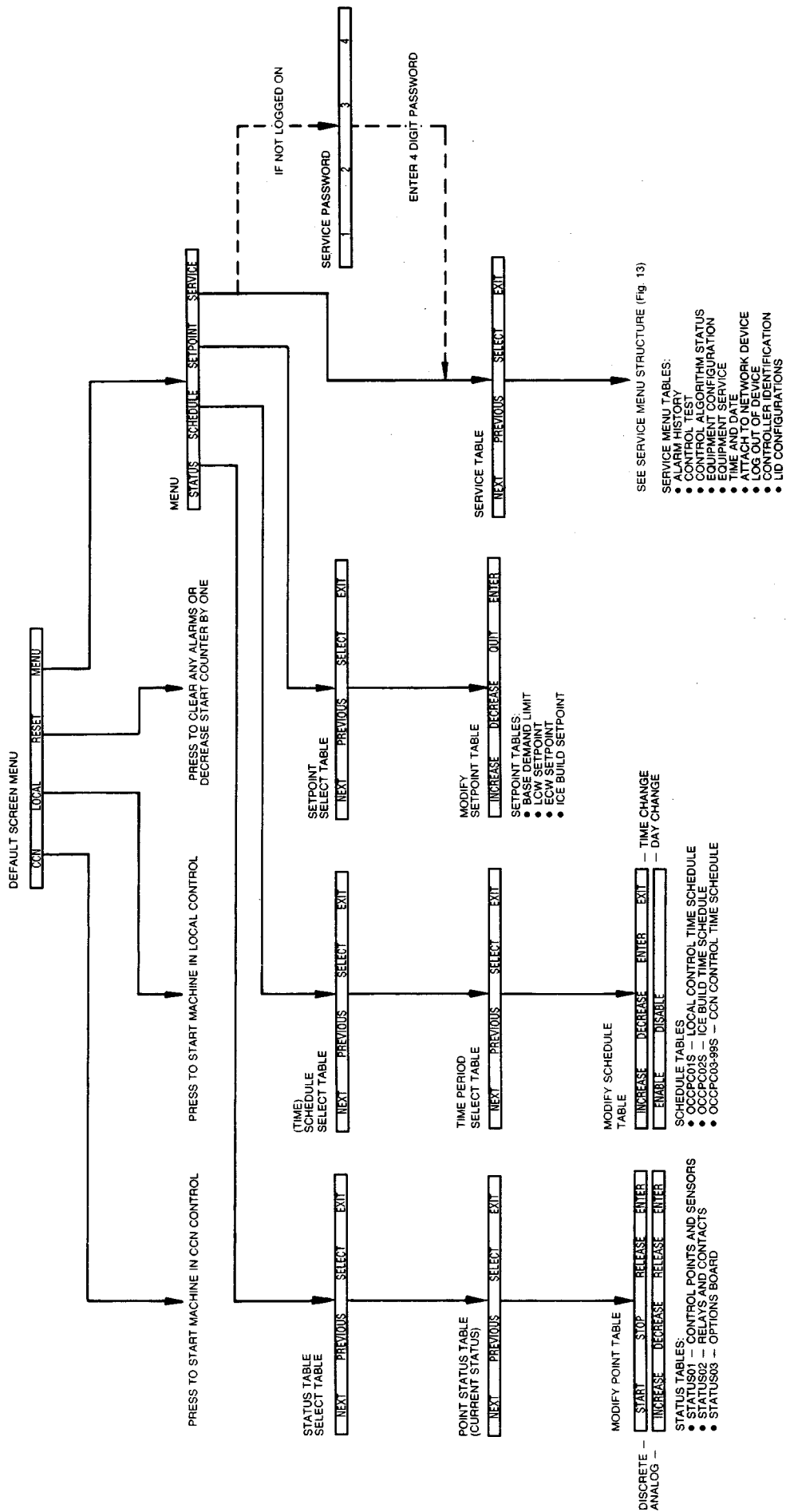


Fig. 12 — 19EF Menu Structure

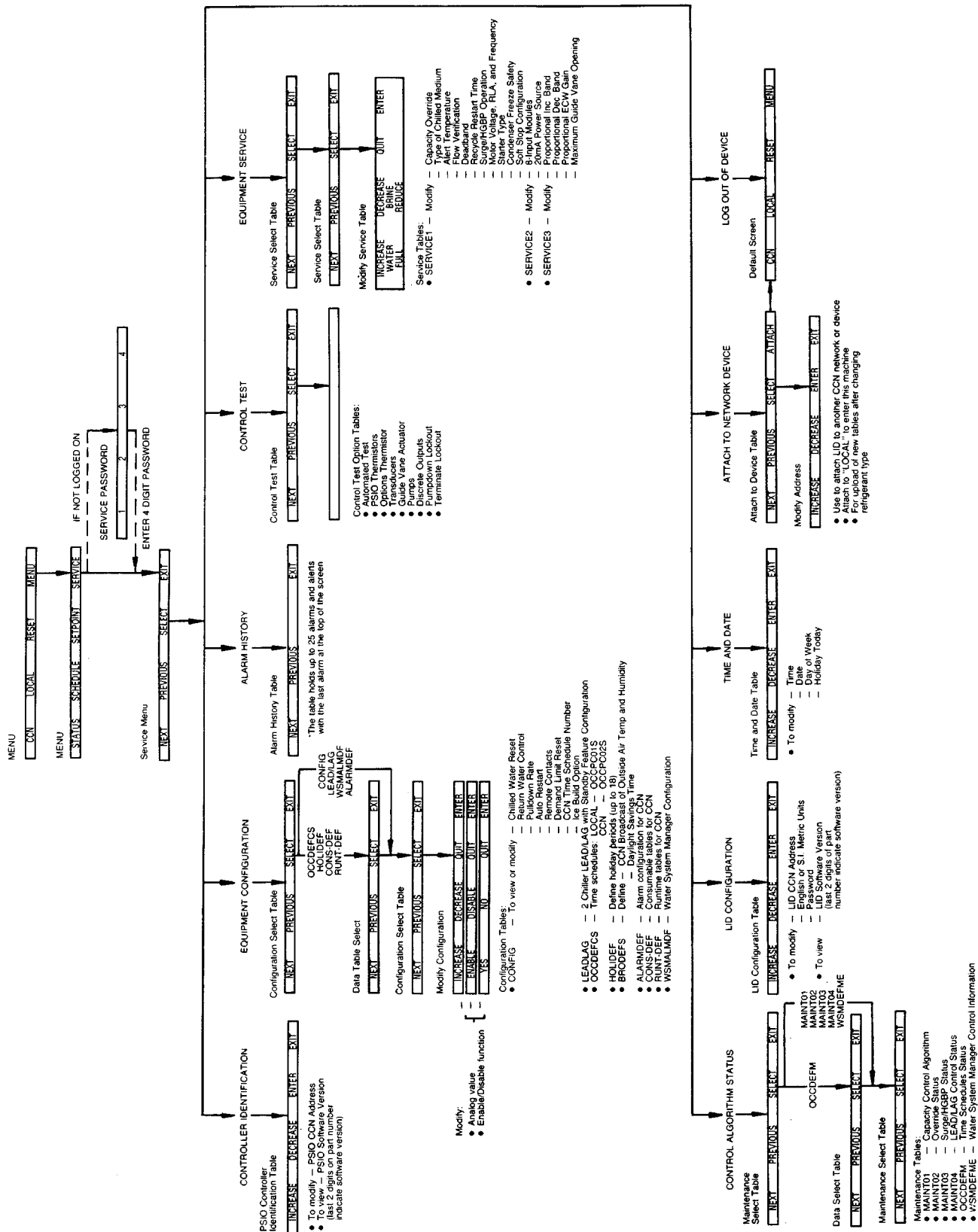
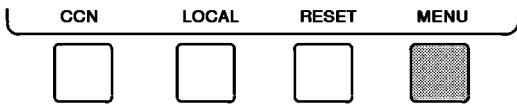


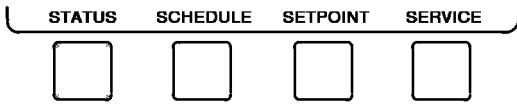
Fig. 13 — 19EF Service Menu Structure

MENU STRUCTURE — To perform any of the operations described below, the PIC must be powered up and have successfully completed its self test.

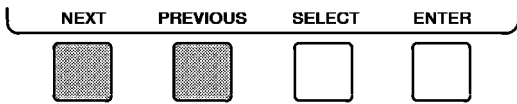
- Press **MENU** to select from the four available options.



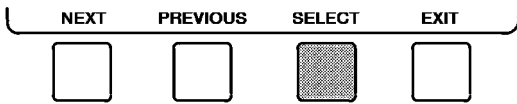
- Press the softkey that corresponds to the desired menu structure.



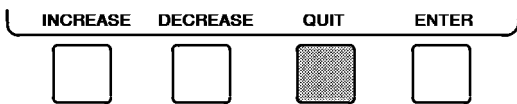
- Press **NEXT** or **PREVIOUS** to highlight the desired entry.



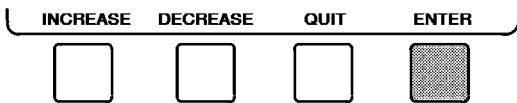
- Press **SELECT** to access the highlighted point.



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



- Or, press **ENTER** to leave the selected decision or field and save changes.



TO VIEW OR CHANGE POINT STATUS (Fig. 14) — Point Status is the actual value of all of the temperatures, pressures, relays, and actuators sensed and controlled by the PIC.

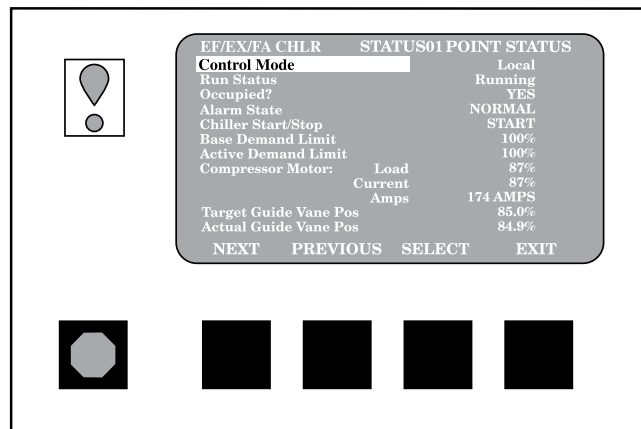
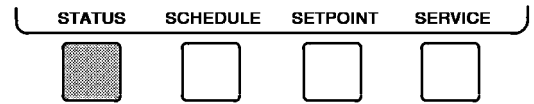


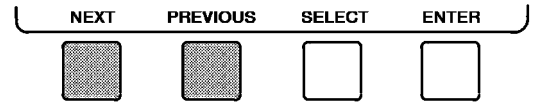
Fig. 14 — Example of Point Status Screen (Status01)

- On the Menu screen, press **STATUS** to view the list of Point Status tables.

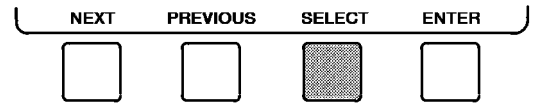


- Press **NEXT** or **PREVIOUS** to highlight the desired status table. The list of tables is:

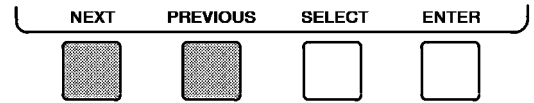
- Status01 — Status of control points and sensors
- Status02 — Status of relays and contacts
- Status03 — Status of both optional 8-input modules and sensors



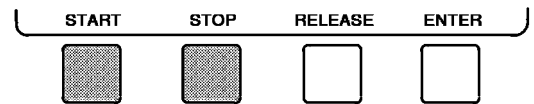
- Press **SELECT** to view the desired Point Status table.



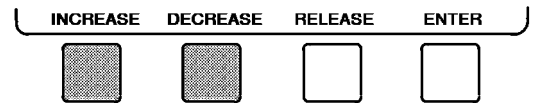
- On the Point Status table press **NEXT** or **PREVIOUS** until desired point is displayed on the screen.



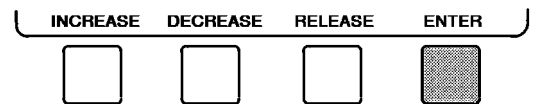
For Discrete Points — Press **START** or **STOP**, **YES** or **NO**, **ON** or **OFF**, etc. to select the desired state.



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



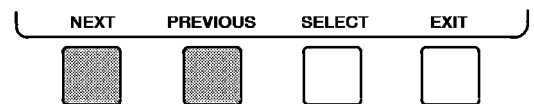
- Press **ENTER** to register new value.



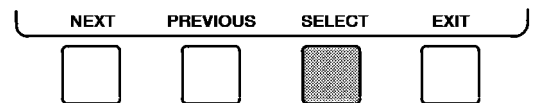
NOTE: When overriding or changing metric values, it is necessary to hold the softkey down for a few seconds in order to see a value change, especially on kilopascal values.

To Remove an Override

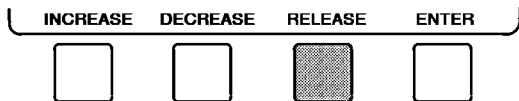
- On the Point Status table press **NEXT** or **PREVIOUS** to highlight the desired point.



- Press **SELECT** to access the highlighted point.



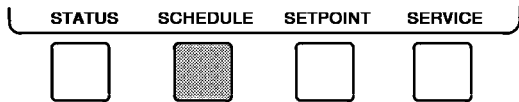
- Press **RELEASE** to remove the override and return the point to the PIC's automatic control.



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

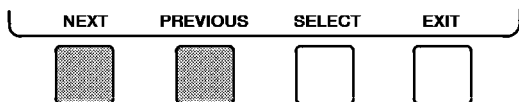
TO VIEW OR CHANGE TIME SCHEDULE OPERATION (Fig. 15)

- On the Menu screen, press **SCHEDULE**.

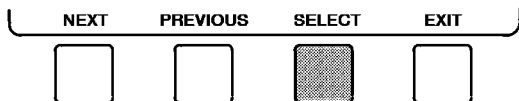


- Press **NEXT** or **PREVIOUS** to highlight one of the following schedules.

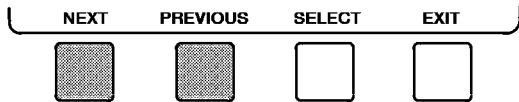
OCCPC01S — LOCAL Time Schedule
 OCCPC02S — ICE BUILD Time Schedule
 OCCPC03-99S — CCN Time Schedule (Actual number is defined in Config table.)



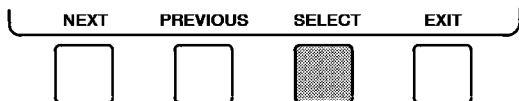
- Press **SELECT** to access and view the time schedule.



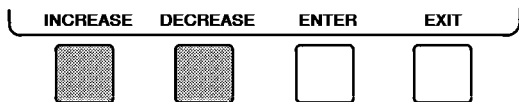
- Press **NEXT** or **PREVIOUS** to highlight the desired period or override that you wish to change.



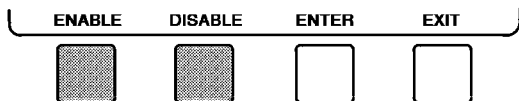
- Press **SELECT** to access the highlighted period or override.



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



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



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

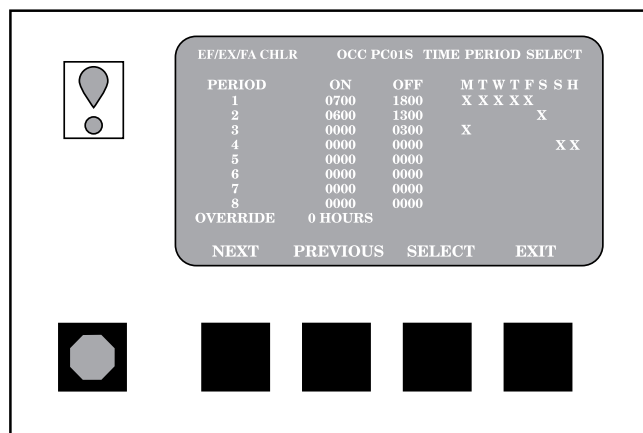
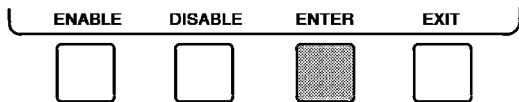
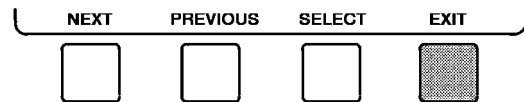
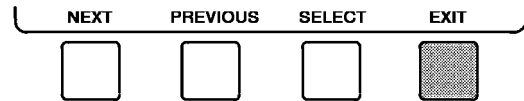


Fig. 15 — Example of Time Schedule Operation Screen

- Press **EXIT** to leave the period or override.



- 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.



- Holiday Designation (HOLIDEF table) may be found in the Service Operation section, page 33. You must assign the month, day, and duration for the holiday. The Broadcast function in the Brodefs table also must be enabled for holiday periods to function.

TO VIEW AND CHANGE SET POINTS (Fig. 16)

- To view the Set Point table, at the Menu screen press **SETPOINT**.

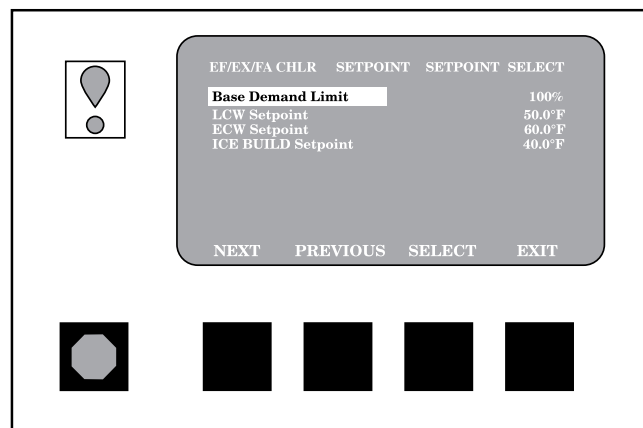
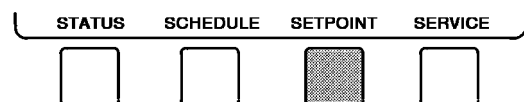
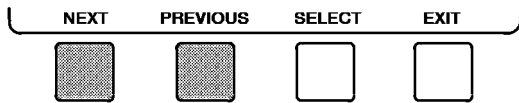


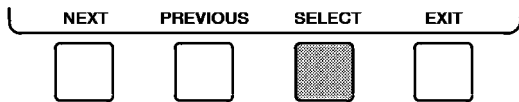
Fig. 16 — Example of Set Point Screen

2. There are 4 set points on this screen: Base Demand Limit; LCW Set Point (leaving chilled water set point); ECW Set Point (entering chilled water set point); and ICE BUILD set point. Only one of the chilled water set points can be active at one time, and the type of set point is activated in the Service menu. ICE BUILD is also activated and configured in the Service menu.

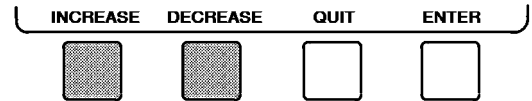
3. Press **NEXT** or **PREVIOUS** to highlight the desired set point entry.



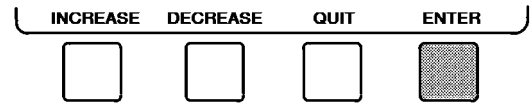
4. Press **SELECT** to modify the highlighted set point.



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 33. For examples of LID display screens, see Table 2.

Table 2 — LID Screens

NOTES:

- Only 12 lines of information appear on the LID screen at any given time. Press **NEXT** or **PREVIOUS** to highlight a point or to view points below or above the current screen.
- The LID may be configured in English or SI units, as required, through the LID configuration screen.
- Data appearing in the Reference Point Names column is used for CCN operations and the identification of points in the alarm history file.
- All table information includes variables available for read operation on a CCN. Descriptions shown with (*) support write operations for BEST programming language, data-transfer, and overriding.

EXAMPLE 1 — STATUS01 DISPLAY SCREEN

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

- Press **MENU**.
- Press **STATUS** (**STATUS01** will be highlighted).
- Press **SELECT**.

DESCRIPTION	RANGE	UNITS	REFERENCE POINT NAME (ALARM HISTORY)
Control Mode	Reset.Off.Local.CCN		MODE
Run Status	Timeout.Recycle.Startup. Ramping.Running.Demand. Override.Shutdown.Abnormal. Pumpdown		STATUS
Occupied ?	No/Yes		OCC
Alarm State	Normal/Alarm		ALM
*Chiller Start/Stop	Stop/Start		CHIL__S__S
Base Demand Limit	40-100	%	DLM
*Active Demand Limit	40-100	%	DEM__LIM
Compressor Motor Load	0-999	%	CA__L
Current	0-9999	%	CA__P
Amps	0-9999	AMPS	CA__A
*Target Guide Vane Pos	0-100	%	GV__TRG
Actual Guide Vane Pos	0-100	%	GV__ACT
Water/Brine: Set Point	10-120 (-12.2-48.9)	DEG F (DEG C)	SP
* Control Point	10-120 (-12.2-48.9)	DEG F (DEG C)	LCW__STPT
Entering Chilled Water	-40-245 (-40-118)	DEG F (DEG C)	ECW
Leaving Chilled Water	-40-245 (-40-118)	DEG F (DEG C)	LCW
Entering Condenser Water	-40-245 (-40-118)	DEG F (DEG C)	ECDW
Leaving Condenser Water	-40-245 (-40-118)	DEG F (DEG C)	LCDW
Evaporator Refrig Temp	-40-245 (-40-118)	DEG F (DEG C)	ERT
Evaporator Pressure	-6.7-420 (-46-2896)	PSI (kPa)	ERP
Condenser Refrig Temp	-40-245 (-40-118)	DEG F (DEG C)	CRT
Condenser Pressure	-6.7-420 (-46-2896)	PSI (kPa)	CRP
Discharge Temperature	-40-245 (-40-118)	DEG F (DEG C)	CMPD
Bearing Temperature	-40-245 (-40-118)	DEG F (DEG C)	MTRB
Motor Winding Temp	-40-245 (-40-118)	DEG F (DEG C)	MTRW
Oil Sump Temperature	-40-245 (-40-118)	DEG F (DEG C)	OILT
Oil Pressure Transducer	-6.7-420 (-46-2896)	PSI (kPa)	OILP
Oil Pressure	-6.7-420 (-46-2896)	PSID (kPad)	OILPD
Line Voltage: Percent	0-999	%	V__P
Actual	0-9999	VOLTS	V__A
*Remote Contacts Input	Off/On		REMCON
Total Compressor Starts	0-65535		c__starts
Starts in 12 Hours	0-8		STARTS
Compressor Ontime	0-500000.0	HOURS	c__hrs
*Service Ontime	0-32767	HOURS	S__HRS
*Compressor Motor kW	0-9999	kW	CKW

Table 2 — LID Screens (cont)

EXAMPLE 2 — STATUS02 DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **STATUS** .
3. Scroll down to highlight **STATUS02**.
4. Press **SELECT** .

DESCRIPTION	POINT TYPE		UNITS	REFERENCE POINT NAME (ALARM HISTORY)
	INPUT	OUTPUT		
Hot Gas Bypass Relay		X	OFF/ON	HGBR
†Chilled Water Pump		X	OFF/ON	CHWP
Chilled Water Flow	X		NO/YES	EVFL
†Condenser Water Pump		X	OFF/ON	CDP
Condenser Water Flow	X		NO/YES	CDFL
Compressor Start Relay		X	OFF/ON	CMPR
Compressor Start Contact	X		OPEN/CLOSED	1CR__AUX
Compressor Run Contact	X		OPEN/CLOSED	RUN__AUX
Starter Fault Contact	X		OPEN/CLOSED	STR__FLT
Pressure Trip Contact	X		OPEN/CLOSED	PRS__TRIP
Single Cycle Dropout	X		NORMAL/ALARM	V1__CYCLE
Oil Pump Relay		X	OFF/ON	OILR
Oil Heater Relay		X	OFF/ON	OILH
Motor Cooling Relay		X	OFF/ON	MTRC
†Tower Fan Relay		X	OFF/ON	TFR
Compr. Shunt Trip Relay		X	OFF/ON	TRIPR
Alarm Relay		X	NORMAL/ALARM	ALM
Spare Prot Limit Input	X		ALARM/NORMAL	SPR__PL

NOTE: All values are variables available for read operation on a CCN. Descriptions shown with (†) support write operations from the LID only.

EXAMPLE 3 — STATUS03 DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **STATUS** .
3. Scroll down to highlight **STATUS03**.
4. Press **SELECT** .

DESCRIPTION	RANGE	UNITS	REFERENCE POINT NAME (ALARM HISTORY)
OPTIONS BOARD 1			
Demand Limit 4-20 mA	4-20	mA	DEM__OPT
Temp Reset 4-20 mA	4-20	mA	RES__OPT
Common CHWS Sensor	-40-245 (-40-118)	DEG F (DEG C)	CHWS
Common CHWR Sensor	-40-245 (-40-118)	DEG F (DEG C)	CHWR
Remote Reset Sensor	-40-245 (-40-118)	DEG F (DEG C)	R__RESET
Temp Sensor — Spare 1	-40-245 (-40-118)	DEG F (DEG C)	SPARE1
Temp Sensor — Spare 2	-40-245 (-40-118)	DEG F (DEG C)	SPARE2
Temp Sensor — Spare 3	-40-245 (-40-118)	DEG F (DEG C)	SPARE3
OPTIONS BOARD 2			
4-20 mA — Spare 1	4-20	mA	SPARE1__M
4-20 mA — Spare 2	4-20	mA	SPARE2__M
Temp Sensor — Spare 4	-40-245 (-40-118)	DEG F (DEG C)	SPARE4
Temp Sensor — Spare 5	-40-245 (-40-118)	DEG F (DEG C)	SPARE5
Temp Sensor — Spare 6	-40-245 (-40-118)	DEG F (DEG C)	SPARE6
Temp Sensor — Spare 7	-40-245 (-40-118)	DEG F (DEG C)	SPARE7
Temp Sensor — Spare 8	-40-245 (-40-118)	DEG F (DEG C)	SPARE8
Temp Sensor — Spare 9	-40-245 (-40-118)	DEG F (DEG C)	SPARE9

EXAMPLE 4 — SETPOINT DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SETPOINT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
Base Demand Limit	40-100	%	DLM	100
LCW Set Point	20-120 (-6.7-48.9)	DEG F (DEG C)	lcw__sp	50.0 (10.0)
ECW Set Point	20-120 (-6.7-48.9)	DEG F (DEG C)	ecw__sp	60.0 (15.6)
ICE BUILD Set Point	20- 60 (-6.7-15.6)	DEG F (DEG C)	ice__sp	40.0 (4.4)

Table 2 — LID Screens (cont)

EXAMPLE 5 — CONFIGURATION (CONFIG) DISPLAY SCREEN

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

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

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
RESET TYPE 1 Degrees Reset at 20 mA	-30-30 (-17-17)	DEG F (DEG C)	deg__20ma	10Δ(6Δ)
RESET TYPE 2 Remote Temp (No Reset)	-40-245 (-40-118)	DEG F (DEG C)	res__rt1	85 (29)
Remote Temp (Full Reset)	-40-245 (-40-118)	DEG F (DEG C)	res__rt2	65 (18)
Degrees Reset	-30-30 (-17-17)	DEG F (DEG C)	res__rt	10Δ(6Δ)
RESET TYPE 3 CHW Delta T (No Reset)	0-15 (0-8)	DEG F (DEG C)	restd__1	10Δ(6Δ)
CHW Delta T (Full Reset)	0-15 (0-8)	DEG F (DEG C)	restd__2	0Δ(0Δ)
Degrees Reset	-30-30 (-17-17)	DEG F (DEG C)	deg__chw	5Δ(3Δ)
Select/Enable Reset Type	0-3		res__sel	0
ECW CONTROL OPTION Demand Limit At 20 mA	DISABLE/ENABLE 40-100	%	ecw__opt dem__20ma	DISABLE 40
20mA Demand Limit Option	DISABLE/ENABLE		dem__sel	DISABLE
Auto Restart Option	DISABLE/ENABLE		astart	DISABLE
Remote Contacts Option	DISABLE/ENABLE		r__contact	DISABLE
Temp Pulldown Deg/Min	2-10		tmp__ramp	3
Load Pulldown %/Min	5-20		kw__ramp	10
Select Ramp Type: Temp = 0, Load = 1	0/1		ramp__opt	1
Loadshed Group Number	0-99		ldsgrp	0
Loadshed Demand Delta	0-60	%	ldsdelta	20
Maximum Loadshed Time	0-120	MIN	maxldstm	60
CCN Occupancy Config: Schedule Number	3-99		ocpcxxe	3
Broadcast Option	DISABLE/ENABLE		ocbcrcst	DISABLE
ICE BUILD Option	DISABLE/ENABLE		ibopt	DISABLE
ICE BUILD TERMINATION 0 =Temp, 1 =Contacts, 2 =Both	0-2		ibterm	0
ICE BUILD Recycle Option	DISABLE/ENABLE		ibrecyc	DISABLE

NOTE: Δ = delta degrees.

EXAMPLE 6 — LEAD/LAG CONFIGURATION DISPLAY SCREEN

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

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

LEAD/LAG CONFIGURATION SCREEN

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
LEAD/LAG SELECT DISABLE =0, LEAD =1, LAG =2, STANDBY =3	0-3		leadlag	0
Load Balance Option	DISABLE/ENABLE		loadbal	DISABLE
Common Sensor Option	DISABLE/ENABLE		commsens	DISABLE
LAG Percent 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	0-30	MIN	prefit	5
STANDBY Chiller Option	DISABLE/ENABLE		stndopt	DISABLE
STANDBY Percent Capacity	25-75	%	stnd__per	50
STANDBY Address	1-236		stnd__add	93

Table 2 — LID Screens (cont)

EXAMPLE 7 — SERVICE1 DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **SERVICE1**.
6. Press **SELECT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
Motor Temp Override	150-200 (66-93)	DEG F (DEG C)	mt__over	200 (93)
Cond Press Override	90-200 (620-1379)	PSI (kPa)	cp__over	125 (862)
Refrig Override Delta T	2-5 (1-3)	DEG F (DEG C)	ref__over	3Δ (1.6Δ)
Chilled Medium	Water/Brine		medium	WATER
Brine Refrig Trippoint	8-40 (-13.3-4)	DEG F (DEG C)	br__trip	33 (1)
Compr Discharge Alert	125-200 (52-93)	DEG F (DEG C)	cd__alert	200 (93)
Bearing Temp Alert	175-185 (79-85)	DEG F (DEG C)	tb__alert	175 (79)
Water Flow Verify Time	0.5-5	MIN	wflow__t	5
Oil Press Verify Time	15-300	SEC	oilpr__t	15
Water/Brine Deadband	0.5-2.0 (0.3-1.1)	DEG F (DEG C)	cw__db	1.0 (0.6)
Recycle Restart Delta T	2.0-10.0 (1.1-5.6)	DEG F (DEG C)	rcyc__dt	5 (2.8)
Surge Limit/HGBP Option	0/1		srg__hgbp	0
Select: Surge=0, HGBP=1				
Surge/HGBP Delta T1	0.5-15 (0.3-8.3)	DEG F (DEG C)	hgb__dt1	1.5 (0.8)
Surge/HGBP Delta P1	30-170 (207-1172)	PSI (kPa)	hgb__dp1	50 (345)
Min. Load Points (T1/P1)				
Surge/HGBP Delta T2	0.5-15 (0.3-8.3)	DEG F (DEG C)	hgb__dt2	10 (5.6)
Surge/HGBP Delta P2	30-170 (207-1172)	PSI (kPa)	hgb__dp2	85 (586)
Full Load Points (T2/P2)				
Surge/HGBP Deadband	1-3 (0.6-1.6)	DEG F (DEG C)	hgb__dp	1 (0.6)
Surge Delta Percent Amps	10-50	%	surge__a	25
Surge Time Period	1-5	MIN	surge__t	2
Demand Limit Source	0/1		dem__src	0
Select: Amps=0, Load=1				
Amps Correction Factor	1-8		corfact	3
Motor Rated Load Amps	1-9999	AMPS	a__fs	200
Motor Rated Line Voltage	1-9999	VOLTS	v__fs	460
Meter Rated Line kW	1-9999	kW	kw__fs	600
Line Frequency	0/1	HZ	freq	0
Select: 0=60 Hz, 1=50 Hz				
Compr Starter Type	REDUCE/FULL		starter	REDUCE
Condenser Freeze Point	-20-35 (-28.9-1.7)	DEG F (DEG C)	cdfreeze	34 (1)
Soft Stop Amps Threshold	40-100	%	softstop	100

NOTE: Δ = delta degrees.

Table 2 — LID Screens (cont)

EXAMPLE 8 — SERVICE2 DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **SERVICE2**.
6. Press **SELECT** .

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
OPTIONS BOARD 1				
20 mA POWER CONFIGURATION External = 0, Internal = 1				
RESET 20 mA Power Source	DISABLE/ENABLE		res__20 ma	DISABLE
DEMAND 20 mA Power Source	DISABLE/ENABLE		dem__20 ma	DISABLE
SPARE ALERT ENABLE Disable = 0, Low = 1, High = 2 Temp = Alert Threshold				
CHWS Temp Enable	0-2		chws__en	0
CHWS Temp Alert	-40-245 (-40-118)	DEG F (DEG C)	chws__al	245 (118)
CHWR Temp Enable	0-2		chwr__en	0
CHWR Temp Alert	-40-245 (-40-118)	DEG F (DEG C)	chwr__al	245 (118)
Reset Temp Enable	0-2		rres__en	0
Reset Temp Alert	-40-245 (-40-118)	DEG F (DEG C)	rres__al	245 (118)
Spare Temp 1 Enable	0-2		spr1__en	0
Spare Temp 1 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr1__al	245 (118)
Spare Temp 2 Enable	0-2		spr2__en	0
Spare Temp 2 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr2__al	245 (118)
Spare Temp 3 Enable	0-2		spr3__en	0
Spare Temp 3 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr3__al	245 (118)
OPTIONS BOARD 2				
20 mA POWER CONFIGURATION External = 0, Internal = 1				
SPARE 1 20 mA Power Source	DISABLE/ENABLE		sp1__20 ma	DISABLE
SPARE 2 20 mA Power Source	DISABLE/ENABLE		sp2__20 ma	DISABLE
SPARE ALERT ENABLE Disable = 0, Low = 1, High = 2 Temp = Alert Threshold				
Spare Temp 4 Enable	0-2		spr4__en	0
Spare Temp 4 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr4__al	245 (118)
Spare Temp 5 Enable	0-2		spr5__en	0
Spare Temp 5 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr5__al	245 (118)
Spare Temp 6 Enable	0-2		spr6__en	0
Spare Temp 6 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr6__al	245 (118)
Spare Temp 7 Enable	0-2		spr7__en	0
Spare Temp 7 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr7__al	245 (118)
Spare Temp 8 Enable	0-2		spr8__en	0
Spare Temp 8 Alert	-40-245 (-0-118)	DEG F (DEG C)	spr8__al	245 (118)
Spare Temp 9 Enable	0-2		spr9__en	0
Spare Temp 9 Alert	-40-245 (-40-118)	DEG F (DEG C)	spr9__al	245 (118)

NOTE: This screen provides the means to generate alert messages based on exceeding the "Temp Alert" threshold for each point listed. If the "Enable" is set to 1, a value above the "Temp Alert" threshold shall generate an alert message. If the "Enable" is set to 2, a value below the "Temp Alert" threshold shall generate an alert message. If the "Enable" is set to 0, alert generation is disabled.

EXAMPLE 9 — SERVICE3 DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **EQUIPMENT SERVICE**.
4. Press **SELECT** .
5. Scroll down to highlight **SERVICE3**.

DESCRIPTION	CONFIGURABLE RANGE	UNITS	REFERENCE POINT NAME	DEFAULT VALUE
Proportional Inc Band	2-10		gv__inc	6.5
Proportional Dec Band	2-10		gv__de	6.0
Proportional ECW Gain	1-3		gv__ecw	2.0
Guide Vane Travel Limit	30-100	%	gv__lim	50

Table 2 — LID Screens (cont)

EXAMPLE 10 — MAINTENANCE (MAINT01) DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT01**.

DESCRIPTION	RANGE/STATUS	UNITS	REFERENCE POINT NAME
CAPACITY CONTROL			
Control Point	10-120 (-12.2-48.9)	DEG F (DEG C)	ctrlpt
Leaving Chilled Water	-40-245 (-40-118)	DEG F (DEG C)	LCW
Entering Chilled Water	-40-245 (-40-118)	DEG F (DEG C)	ECW
Control Point Error	-99-99 (-55-55)	DEG F (DEG C)	cperr
ECW Delta T	-99-99 (-55-55)	DEG F (DEG C)	ecwdt
ECW Reset	-99-99 (-55-55)	DEG F (DEG C)	ecwres
LCW Reset	-99-99 (-55-55)	DEG F (DEG C)	lcwres
Total Error + Resets	-99-99 (-55-55)	DEG F (DEG C)	error
Guide Vane Delta	-2-2	%	gvd
Target Guide Vane Pos	0-100	%	GV__TRG
Actual Guide Vane Pos	0-100	%	GV__ACT
Proportional Inc Band	2-10		gv__inc
Proportional Dec Band	2-10		gv__dec
Proportional ECW Gain	1-3		gv__ecw
Water/Brine Deadband	0.5-2 (0.3-1.1)	DEG F (DEG C)	cwdb

NOTE: Overriding is not supported on this maintenance screen. Active overrides show the associated point in alert (!). Only values with capital letter reference point names are variables available for read operation on a CCN.

EXAMPLE 11 — MAINTENANCE (MAINT02) DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT02**.
6. Press **SELECT** .

DESCRIPTION	RANGE/STATUS	UNITS	REFERENCE POINT NAME
OVERRIDE/ALERT STATUS			
MOTOR WINDING TEMP			
Override Threshold	-40-245 (-40-118)	DEG F (DEG C)	MTRW
CONDENSER PRESSURE	150-200 (66-93)	DEG F (DEG C)	mt__over
Override Threshold	-6.7-420 (-42-2896)	PSI (kPa)	CRP
EVAPORATOR REFRIG TEMP	90-245 (621-1689)	PSI (kPa)	cp__over
Override Threshold	-40-245 (-40-118)	DEG F (DEG C)	ERT
DISCHARGE TEMPERATURE	2-45 (1-7.2)	DEG F (DEG C)	rt__over
Alert Threshold	-40-245 (-40-118)	DEG F (DEG C)	CMPD
BEARING TEMPERATURE	125-200 (52-93)	DEG F (DEG C)	cd__alert
Alert Threshold	-40-245 (-40-118)	DEG F (DEG C)	MTRB
	175-185 (79-85)	DEG F (DEG C)	tb__alert

Table 2 — LID Screens (cont)

EXAMPLE 12 — MAINTENANCE (MAINT03) DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT03**.
6. Press **SELECT** .

DESCRIPTION	RANGE/STATUS	UNITS	REFERENCE POINT NAME
SURGE/HGBP ACTIVE ?	NO/YES		
Active Delta P	0-200 (0-1379)	PSI (kPa)	dp__a
Active Delta T	0-200 (0-111)	DEG F (DEG C)	dt__a
Calculated Delta T	0-200 (0-111)	DEG F (DEG C)	dt__c
Surge Protection Counts	0-12		spc

EXAMPLE 13 — MAINTENANCE (MAINT04) DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **SERVICE** .
3. Scroll down to highlight **CONTROL ALGORITHM STATUS**.
4. Press **SELECT** .
5. Scroll down to highlight **MAINT04**.
6. Press **SELECT** .

DESCRIPTION	RANGE/STATUS	UNITS	REFERENCE POINT NAME
LEAD/LAG: Configuration	DISABLE, LEAD, LAG, STANDBY, INVALID		leadlag
Current Mode	DISABLE, LEAD, LAG, STANDBY, CONFIG		lmode
Load Balance Option	DISABLE/ENABLE		loadbal
LAG Start Time	0-60	MIN	lagstart
LAG Stop Time	0-60	MIN	lagstop
Prestart Fault Time	0-30	MIN	preflt
Pulldown: Delta T/Min	x.xx	Δ DEG F (Δ DEG C)	pull__dt
Satisfied?	No/Yes		pull__sat
LEAD CHILLER in Control	No/Yes		leadctrl
LAG CHILLER: Mode	Reset, Off, Local, CCN		lagmode
Run Status	Timeout, Recycle, Startup, Ramping, Running Demand, Override, Shutdown, Abnormal, Pumpdown		lagstat
Start/Stop	Stop, Start, Retain		lag__s__s
Recovery Start Request	No/Yes		lag__rec
STANDBY CHILLER: Mode	Reset, Off, Local, CCN		stdmode
Run Status	Timeout, Recycle, Startup, Ramping, Running Demand, Override, Shutdown, Abnormal, Pumpdown		stdstat
Start/Stop	Stop, Start, Retain		std__s__s
Recovery Start Request	No/Yes		std__rec

NOTES:

1. Only values with capital letter reference point names are variables available for read operation on a CCN. Forcing is not supported on this maintenance screen.
2. Δ = delta degrees.

PIC System Functions

NOTE: Throughout this manual, words printed in capital letters and italics are values that may be viewed on the LID. See Table 2 for examples of LID screens. Point names are listed in the Description column. An overview of LID operation and menus is given in Fig. 10-16.

CAPACITY CONTROL — The PIC controls the machine capacity by modulating the inlet guide vanes in response to chilled water temperature changes away from the *CONTROL POINT*. The *CONTROL POINT* may be changed by a CCN network device, or is determined by the PIC adding any active chilled water reset to the chilled water *SET POINT*. The PIC 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/overridden on the Status table, Status01 selection.

ENTERING CHILLED WATER CONTROL — If this option is enabled, the PIC uses *ENTERING CHILLED WATER* temperature to modulate the vanes instead of *LEAVING CHILLED WATER* temperature. *ENTERING CHILLED WATER* control option may be viewed/modified on the Equipment Configuration table, Config table.

DEADBAND — This is the tolerance on the chilled water/brine temperature *CONTROL POINT*. If the water temperature goes outside of the *DEADBAND*, the PIC opens or closes the guide vanes in response until it is within tolerance. The PIC may be configured with a 0.5 to 2 F (0.3 to 1.1 C) deadband. *DEADBAND* may be viewed or modified on the Equipment Service1 table.

For example, a 1° F (0.6° C) deadband setting controls the water temperature within $\pm 0.5^\circ$ F (0.3° C) of the control point. This may cause frequent guide vane movement if the chilled water load fluctuates frequently. A value of 1° F (0.6° C) is the default setting.

PROPORTIONAL BANDS AND GAIN — Proportional band is the rate at which the guide vane position is corrected in proportion to how far the chilled water/brine temperature is from the control point. Proportional gain determines how quickly the guide vanes react to how quickly the temperature is moving from *CONTROL POINT*.

The proportional band can be viewed/modified on the LID. There are two response modes, one for temperature response above the control point, the other for response below the control point.

The first type is called *PROPORTIONAL INC BAND*, and it can slow or quicken vane response to chilled water/brine temperature above *DEADBAND*. It can be adjusted from a setting of 2 to 10; the default setting is 6.5. *PROPORTIONAL DEC BAND* can slow or quicken vane response to chilled water temperature below deadband plus control point. It can be adjusted on the LID from a setting of 2 to 10, and the default setting is 6.0. Increasing either of these settings will cause the vanes to respond slower than a lower setting.

The *PROPORTIONAL ECW GAIN* can be adjusted at the LID display from a setting of 1.0 to 3.0, with a default setting of 2.0. Increase this setting to increase guide vane response to a change in entering chilled water temperature. The proportional bands and gain may be viewed/modified on the Equipment Service3 table.

DEMAND LIMITING — The PIC will respond to the *ACTIVE DEMAND LIMIT* set point by limiting the opening of

the guide vanes. It will compare the set point to either *COMPRESSOR MOTOR LOAD* or *COMPRESSOR MOTOR CURRENT* (percentage), depending on how the control is configured for the *DEMAND LIMIT SOURCE* which is accessed on the SERVICE1 table. The default setting is current limiting.

MACHINE TIMERS — The PIC 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 resettable timer that can be used to indicate the hours since the last service visit or any other reason. The time can be changed through the LID 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 machine can be started. See the Start-Up/Shutdown/Recycle Sequence section, page 34, for operational information.

OCCUPANCY SCHEDULE — This schedule determines when the chiller is either occupied or unoccupied.

Each schedule consists of from one to 8 occupied/unoccupied time periods, set by the operator. These time periods can be enabled to be in effect, or not in effect, on each day of the week and for holidays. The day begins with 0000 hours and ends with 2400 hours. The machine is in OCCUPIED mode unless an unoccupied time period is in effect.

The machine will shut down when the schedule goes to UNOCCUPIED. These schedules can be set up to follow the building schedule or to be 100% OCCUPIED if the operator wishes. The schedules also can be bypassed by forcing the Start/Stop command on the PIC Status screen to start. The schedules also can be overridden to keep the unit in OCCUPIED mode for up to 4 hours, on a one-time basis.

Figure 15 shows a schedule for a typical office building time schedule, with a 3-hour, off-peak cool down period from midnight to 3 a.m., following a weekend shutdown. Example: Holiday periods are unoccupied 24 hours per day. The building operates Monday through Friday, 7:00 a.m. to 6:00 p.m., with a Saturday schedule of 6:00 a.m. to 1:00 p.m., and 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.

The Local Time Schedule is still the Occupancy Schedule 01. The Ice Build Time Schedule is Schedule 02 and the CCN Default Time Schedule is Schedule 03. The CCN schedule number is defined on the Config table in the Equipment Configuration table on page 19. The schedule number can change to any value from 03 to 99. If this schedule number is changed on the Config table, the operator must use the Attach to Network Device table to upload the new number into the Schedule screen. See Fig. 14.

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

- high bearing temperature
- high motor winding temperature
- high discharge temperature
- low oil pressure

- low cooler refrigerant temperature/pressure
- condenser high pressure or low pressure
- inadequate water/brine cooler and condenser flow
- high, low, or loss of voltage
- excessive motor acceleration time
- excessive starter transition time
- lack of motor current signal
- excessive motor amps
- excessive compressor surge
- temperature and transducer faults

Starter faults or optional protective devices within the starter can shut down the machine. These devices are dependent on what has been purchased as options.

⚠ CAUTION

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

If the controller initiates a safety shutdown, it displays the fault on the LID with a primary and a secondary message, and energizes an alarm relay in the starter and blinks the alarm light on the control center. The alarm is stored in memory and can be viewed in the PIC Alarm History table along with a message for troubleshooting.

To give a better warning as to the operating condition of the machine, the operator also can define alert limits on various monitored inputs. Safety contact and alert limits are defined in Table 3. Alarm and alert messages are listed in the Troubleshooting Guide section, page 53.

SHUNT TRIP — The optional shunt trip function of the PIC is a safety trip. The shunt trip is wired from an output on the SMM to the motor circuit breaker. If the PIC tries to shut down the compressor through normal shutdown procedure but is unsuccessful for 30 seconds, the shunt trip output is energized and causes the circuit breaker to trip. If ground fault protection has been applied to the starter, the ground fault trip will also energize the shunt trip to trip the circuit breaker.

Table 3 — Protective Safety Limits and Control Settings

MONITORED PARAMETER	LIMIT	APPLICABLE COMMENTS
TEMPERATURE SENSORS OUT OF RANGE	-40 to 245 F (-40 to 118.3 C)	Must be outside range for 2 seconds
PRESSURE TRANSDUCERS OUT OF RANGE	0.08 to 0.98 Voltage Ratio	Must be outside range for 2 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
BEARING TEMPERATURE	>220 F (104.4 C)	Preset, alert setting configurable
EVAPORATOR REFRIGERANT TEMPERATURE	<33 F (for water chilling) (0.6° C)	Preset, configure chilled medium for water (Service1 screen)
	3 F (1.7° C) less than Design Refrigerant Temperature (set point adjustable from 0 to 40 F [-18 to 4 C] for brine chilling)	Configure chilled medium for brine (Service1 screen). Adjust brine refrigerant trippoint for proper cutout
TRANSDUCER VOLTAGE	<4.5 vdc > 5.5 vdc	Preset
CONDENSER PRESSURE — SWITCH — CONTROL	>185 ± 7 psig (1276 ± 48 kPa), reset at 120 ± 10 (827 ± 69 kPa)	Preset
	>200 psig (1379 kPa)	Preset
OIL PRESSURE	<15 psid (103 kPad)	Preset, alert setting preset at 15 psid (103 kPad)
LINE VOLTAGE — HIGH — LOW — SINGLE-CYCLE	>110% for one minute	Preset, based on transformed line voltage input to the Starter Management Module
	<90% for one minute or ≤85% for 3 seconds	
	<50% for one cycle	
COMPRESSOR MOTOR LOAD	>110% for 30 seconds	Preset
	<10% with compressor running	Preset
	>10% with compressor off	Preset
STARTER ACCELERATION TIME (Determined by inrush current going below 100% compressor motor load)	>45 seconds	For machines with reduced voltage mechanical and solid state starters
	>10 seconds	For machines with full voltage starters (Configured on Service1 screen)
STARTER TRANSITION	>75 seconds	Reduced voltage starters only
IMPELLER CLEARANCE	Displacement switch open (bearing sensor -40 F [-40 C])	Thrust movement excessive

Flow Switch (Field Supplied) — Operate water pumps with machine off. Manually reduce water flow and observe switch for proper cutout. Safety shutdown occurs when cut-out time exceeds 3 seconds. Switches are required to be rated electrically at 24 vdc, see Fig. 17.

Ramp Loading Control — 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 machine is started and the chilled water loop has to be brought down to normal design conditions. This helps reduce electrical demand charges by slowly bringing the chilled water to control point. However, the total power draw during this period remains almost unchanged.

There are 2 methods of ramp loading with the PIC. Ramp loading can be based on chilled water temperature or on motor load.

1. **Temperature ramp loading** limits the rate at which either leaving chilled water or entering chilled water temperature decreases by an operator-configured rate.
2. **Motor load ramp loading** limits the rate at which the compressor motor current or compressor motor load increases by an operator-configured rate.

The *TEMP (Temperature) PULLDOWN*, *LOAD PULL DOWN*, and *SELECT RAMP TYPE* may be viewed/modified on the LID Equipment Configuration table, Config table (see Table 2). Motor load is the default type.

Capacity Override (Table 4) — These can prevent some safety shutdowns caused by exceeding 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 vane control.

1. The vanes are held from opening further, and the status line on the LID indicates the reason for the override.
2. The vanes are closed until condition decreases below the first step set point, and then the vanes are released to normal capacity control.

Whenever the motor current demand limit set point is reached, it activates a capacity override, again with a two-step process. Exceeding 110% of the rated load amps for more than 30 seconds will initiate a safety shutdown.

The compressor high lift (surge prevention) set point will cause a capacity override as well. When the surge prevention set point is reached, the controller normally will only hold the guide vanes from opening. If so equipped, the hot gas bypass valve will open instead of holding the vanes.

High Discharge Temperature Control — If the discharge temperature increases above 160 F (71.1 C) the guide vanes are proportionally opened to increase gas flow through the compressor. If the leaving chilled water temperature drops 5° F (2.8° C) below the control point, the machine will enter the recycle mode.

NO ADJUSTMENTS ARE TO BE MADE ON THIS SETSCREW! (FACTORY ADJUSTED ONLY)

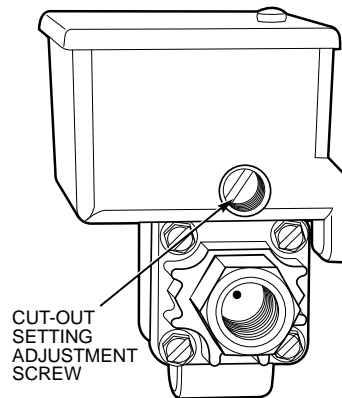
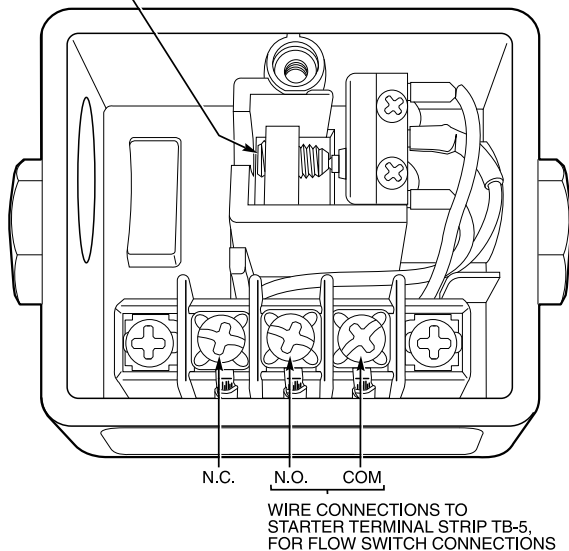


Fig. 17 — 19EF Flow Switch (Field Supplied)

Table 4 — Capacity Overrides

OVERRIDE CAPACITY CONTROL	FIRST STAGE SET POINT			SECOND STAGE SET POINT	OVERRIDE TERMINATION
	View/Modify on LID Screen	Default Value	Configurable Range	Value	Value
HIGH CONDENSER PRESSURE	Equipment Service1	125 psi (862 kPa)	90 to 200 psi (620 to 1379 kPa)	>Override Set Point + 4 psi (28 kPa)	<Override Set Point
HIGH MOTOR TEMPERATURE	Equipment Service1	>200 F (93.3 C)	150 to 200 F (66 to 93 C)	>Override Set Point +10° F (6° C)	<Override Set Point
LOW REFRIGERANT TEMPERATURE (Refrigerant Override Delta Temperature)	Equipment Service1	<3° F (1.7° C) (Above Trippoint)	2° to 5° F (1° to 3° C)	≤Trippoint + Override ΔT -1° F (0.56° C)	>Trippoint + Override ΔT +2° F (1.2° C)
HIGH COMPRESSOR LIFT (Surge Prevention)	Equipment Service1	Min: T1 — 1.5° F (0.8° C) P1 — 50 psi (345 kPa) Max: T2 — 10° F (5.6° C) P2 — 85 psi (586 kPa)	0.5° to 15° F (0.3° to 8.3° C) 30 to 170 psi (207 to 1172 kPa) 0.5° to 15° F (0.3° to 8.3° C) 30 to 170 psi (207 to 1172 kPa)	None	Within Lift Limits
MANUAL GUIDE VANE TARGET	Control Algorithm Maint01	Automatic	0 to 100%	None	Release of Manual Control
MOTOR LOAD — ACTIVE DEMAND LIMIT	Status01	100%	40 to 100%	≥105% of Set Point	2% Lower Than Set Point

LEGEND

- P1 — Minimum Pressure Load
- P2 — Maximum Pressure Load
- T1 — Minimum Temperature Load
- T2 — Maximum Temperature Load

Oil Sump Temperature Control — The oil sump temperature control is regulated by the PIC which uses the oil heater relay when the machine is shut down. The oil heater relay is energized whenever the chiller compressor is off and the oil sump temperature is less than 150 F (65.6 C) or the oil sump temperature is less than the cooler refrigerant temperature plus 70° F (39° C). The oil heater is turned off when the oil sump temperature is either 1) more than 160 F (71.1 C); or 2) the oil sump temperature is more than 155 F (68.3 C) and more than the cooler refrigerant temperature plus 75° F (41.6° C). The oil heater is always off during start-up or when the compressor is running.

As part of the pre-start checks executed by the controls, oil sump temperature is compared against evaporator refrigerant temperature. If the difference between these two temperatures is 50 F (27.8 C) or less, the start-up will be delayed until the oil temperature is 50 F (27.8 C) or more. Once this temperature is confirmed, the start-up continues.

Oil Cooler — The oil must be cooled when the compressor is running. This is accomplished through a small, tube and shell heat exchanger located beneath the compressor suction housing. The heat exchanger uses chilled or condenser water as the cooling liquid. A solenoid and cock valve regulate flow to control oil temperature entering the bearings. The valve is set to maintain 140 F (60 C) oil sump temperature.

Remote Start/Stop Controls — A remote device, such as a timeclock which uses a set of contacts, may be used to start and stop the machine. However, the device should not be programmed to start and stop the machine in excess of 2 or 3 times every 12 hours. If more than 8 starts in 12 hours occur, then an Excessive Starts alert is displayed, preventing the machine from starting. The operator must reset the alert at the LID in order to override the starts counter and start the machine. If Automatic Restart After a Power Failure is not activated when a power failure occurs, and the remote contact is closed, the machine will indicate an alarm because of the loss of voltage.

The contacts for Remote Start are wired into the starter at terminals 8A and 8B. See the certified drawings for further details on contact ratings. The contacts must be dry (no power).

Spare Safety Inputs — Normally closed (NC) digital 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 LID display. Refer to the certified drawings for safety contact ratings.

Analog temperature sensors may also be added to the options modules, if installed. These may be programmed to provide an alert at the PIC or for CCN network, but will not shut the machine down.

SPARE ALARM CONTACTS — Two spare sets of alarm contacts are provided within the starter. The contact ratings are provided in the certified drawings. The contacts are located on terminals 5A and 5B and terminals 5C and 5D.

Condenser Pump Control — The machine will monitor the *CONDENSER PRESSURE* and may turn on this pump if the pressure becomes too high whenever the compressor is shut down. *CONDENSER PRESSURE OVERRIDE* is used to determine this pressure point. This value is found on the Equipment Service1 LID table and has a default value (Table 4). If the *CONDENSER PRESSURE* is greater than or equal to the *CONDENSER PRESSURE OVERRIDE*, and the *ENTERING CONDENSER WATER TEMP (Temperature)* is less than 115 F (46 C), then the condenser pump will energize to try to decrease the pressure. The pump will turn off when the condenser pressure is less than the pressure override less 5 psi (34 kPa), or the *CONDENSER REFRIG (Refrigerant) TEMP* is within 3° F (2° C) of the *ENTERING CONDENSER WATER* temperature.

Condenser Freeze Prevention — This control algorithm helps prevent condenser tube freeze-up by energizing the condenser pump relay. If the pump is controlled by the PIC, starting the pump will help prevent the water in the condenser from freezing. Condenser freeze prevention can occur whenever the machine is not running except when it is either actively in pumpdown or in Pumpdown Lockout with the freeze prevention disabled (refer to Control Test table, Pumpdown/Terminate Lockout tables).

When the CONDENSER REFRIG TEMP is less than or equal to the CONDENSER FREEZE POINT, or the ENTERING CONDENSER WATER temperature is less than or equal to the CONDENSER FREEZE POINT, then the CONDENSER WATER PUMP shall be energized until the CONDENSER REFRIG TEMP is greater than the CONDENSER FREEZE POINT plus 5° F (2.7° C). An alarm will be generated if the machine is in PUMPDOWN mode and CONDENSER FREEZE is active. An alert will be generated if the machine is not in PUMPDOWN mode and CONDENSER FREEZE is active.

Tower-Fan Relay — Low condenser water temperature can cause the chiller to shut down on low refrigerant temperature. The tower fan relay, located in the starter, is controlled by the PIC to energize and deenergize as the pressure differential between cooler and condenser vessels changes in order to prevent low condenser water temperature and to maximize machine 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* 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) or entering condenser water temperature is greater than 85 F (29 C). The *TOWER FAN RELAY* is deenergized when the condenser pump is off, flow is lost, the evaporator refrigerant temperature is less than the override temperature, or the differential pressure is less than 28 psid (193 kPad) and entering condensing water is less than 80 F (27 C).

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 20° F (11° 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 and associated problems.

Auto. Restart After Power Failure — This option may be enabled or disabled, and may be viewed/modified in the Config table of Equipment Configuration. If enabled, the chiller will start up automatically after a single cycle dropout, low, high, or loss of voltage has occurred, and the power is within ±10% of normal. The 15- and 1-minute inhibit timers are ignored during this type of start-up.

When power is restored after the power failure, and if the compressor had been running, the oil pump will be energized for one minute prior to the evaporator pump energizing. Auto restart will then continue like a normal start-up.

Water/Brine Reset — Three types of chilled water or brine reset are available and can be viewed or modified on the Equipment Configuration table Config selection.

The LID default screen status message indicates when the chilled water reset is active. The Control Point temperature on the Status01 table indicates the machine's current reset temperature.

To activate a reset type, input all configuration information for that reset type in the Config table. Then input the reset type number in the SELECT/ENABLE RESET TYPE input line.

1. **Reset Type 1** (Requires optional 8-input module) — Automatic chilled water temperature reset based on a 4 to 20 mA input signal. This type permits up to ±30° F (±16° C) of automatic reset to the chilled water or brine temperature set point, based on the input from a 4 to 20 mA signal. This signal is hardwired into the number one 8-input module.

If the 4-20 mA signal is externally powered from the 8-input module, the signal is wired to terminals J1-5(+) and J1-6(-). If the signal is to be internally powered by the 8-input module (for example, when using variable resistance), the signal is wired to J1-7(+) and J1-6(-). The PIC must now be configured on the Service2 table to ensure that the appropriate power source is identified.

2. **Reset Type 2** (Requires optional 8-input module) — Automatic chilled water temperature reset based on a remote temperature sensor input. This type permits ±30° F (±16° C) of automatic reset to the set point based on a temperature sensor wired to the number one 8-input module (see wiring diagrams or certified drawings).

The temperature sensor must be wired to terminal J1-19 and J1-20.

To configure Reset Type 2, enter the temperature of the remote sensor at the point where no temperature reset will occur. Next, enter the temperature at which the full amount of reset will occur. Then, enter the maximum amount of reset required to operate the machine. Reset Type 2 can now be activated.

3. **Reset Type 3** — Automatic chilled water temperature reset based on cooler temperature difference. This type of reset will add ±30° F (±16° C) based on the temperature difference between entering and leaving chilled water temperature. This is the only type of reset available without the need of the number one 8-input module. No wiring is required for this type as it already uses the cooler water sensors.

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. This chilled water temperature difference is usually the full design load temperature difference. The difference in chilled water temperature at which the full amount of reset will occur is now entered on the next input line. Next, the amount of reset is entered. Reset Type 3 can now be activated.

Demand Limit Control, Option — (Requires Optional 8-Input Module) — The demand limit may be externally controlled with a 4 to 20 mA signal from an energy management system (EMS). The option is set up on the Config table. When enabled, the control is set for 100% demand with 4 mA and an operator configured minimum demand set point at 20 mA.

The Demand Reset input from an energy management system is hardwired into the number one, 8-input module. The signal may be internally powered by the module or externally powered. If the signal is externally powered, the signal is wired to terminals J1-1(+) and J1-2(-). If the signal is internally powered, the signal is wired to terminals J1-3(+) and J1-2(-). When enabled, the control is set for 100% demand with 4 mA and an operator configured minimum demand set point at 20 mA.

Surge Prevention Algorithm — This is an operator configurable feature which can determine if lift conditions are too high for the compressor and then take corrective action. Lift is defined as the difference between the pressure at the impeller eye and the impeller discharge. The maximum lift that a particular impeller wheel can perform varies with the gas flow across the impeller, and the size of the wheel.

The algorithm first determines if corrective action is necessary. This is done by checking 2 sets of operator configured data points, which are the MINIMUM and the MAXIMUM Load Points, (T1/P1;T2/P2). These points have default settings as defined on the Service1 table, or on Table 4. These settings and the algorithm function are graphically displayed in Fig. 18 and 19. The two sets of load points on this graph (default settings are shown) describe a line which the algorithm uses to determine the maximum lift of the compressor. Whenever the actual differential pressure between the cooler and condenser, and the temperature difference between the entering and leaving chilled water are above the line on the graph (as defined by the MINIMUM and MAXIMUM Load Points) the algorithm will go into a corrective action mode. If the actual values are below the line, the algorithm takes no action. Modification of the default set points of the MINIMUM and MAXIMUM load points is described in Before Initial Start-Up, Input Service Configurations section, page 42.

Corrective action can be taken by making one of two choices. If a hot gas bypass line is present, and the hot gas is configured on the Service1 table, then the hot gas bypass valve can be energized. If a hot gas bypass is not present, then the action taken is to hold the guide vanes. See Table 4, Capacity Overrides. Both of these corrective actions will reduce the lift experienced by the compressor and help to prevent a surge condition. Surge is a condition when the lift becomes so high that the gas flow across the impeller reverses. This condition can eventually cause machine damage. The surge prevention algorithm is intended to notify the operator that machine operating conditions are marginal, and to take action, such as lowering entering condenser water temperature, to help prevent machine damage.

Surge Protection — Surging of the compressor can be determined by the PIC through operator configured settings. Surge will cause amperage fluctuations of the compressor motor. The PIC monitors these amperage swings, and if the swing is greater than the configurable setting in one second, then one surge count has occurred. The SURGE DELTA PERCENT AMPS setting is displayed and configured on the Service1 table. It has a default setting of 25% amps, SURGE PROTECTION COUNTS can be monitored on the Maint03 table.

A surge protection shutdown of the machine will occur whenever the surge protection counter reaches 12 counts within an operator specified time, known as the SURGE TIME PERIOD. The SURGE TIME PERIOD is displayed and configured on the Service1 table. It has a default of 2 minutes.

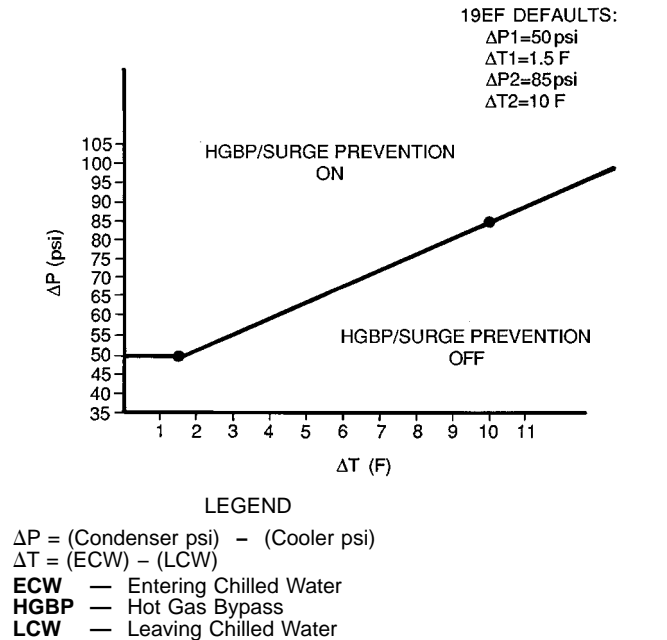


Fig. 18 — 19EF Hot Gas Bypass/Surge Prevention

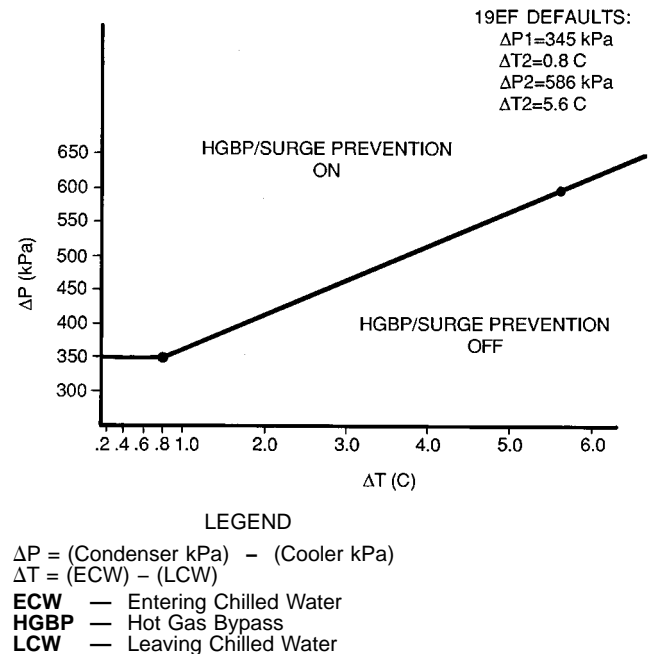


Fig. 19 — 19EF With Default Metric Settings

Lead/Lag Control — Lead/lag is a control system process that automatically starts and stops a lag or second chiller in a 2-chiller water system. Refer to Fig. 13 and 14 for menu, table, and screen selection information. On machines that have PSIO software with Lead/Lag capability, it is possible to utilize the PIC controls to perform the lead/lag function on 2 machines. A third machine 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.

NOTE: Lead/lag configuration is viewed and edited under Lead/Lag in the Equipment Configuration table (located in the Service menu). Lead/lag status during machine operation is viewed in the MAINT04 table in the Control Algorithm Status table. See Table 2.

Lead/Lag System Requirements:

- all machines must have PSIO software capable of performing the lead/lag function
- water pumps **MUST** be energized from the PIC controls
- water flows should be constant
- CCN Time Schedules for all machines 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 can be added to the 8-input option module, if desired. Refer to the certified drawings for termination of sensor leads.

NOTE: If the common point sensor option is chosen on a chilled water system, both machines should have their own 8-input option module and common point sensor installed. Each machine will use its own common point sensor for control, when that machine is designated as the lead chiller. The PIC cannot read the value of common point sensors installed on other machines in the chilled water system.

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 machine.

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 that 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.

MACHINE COMMUNICATION WIRING — Refer to the machine's Installation Instructions, Carrier Comfort Network Interface section on page 40 for information on machine communication wiring.

LEAD/LAG OPERATION — The PIC control provides the ability to operate 2 chillers in the LEAD/LAG mode. It also provides the additional ability to start a designated standby chiller when either the lead or lag chiller is faulted and

capacity requirements are not met. The lead/lag option operates in CCN mode only. If any other chiller configured for lead/lag is set to the LOCAL or OFF modes, it will be unavailable for lead/lag operation.

NOTE: Lead/lag configuration is viewed and edited in Lead/Lag, under the Equipment Configuration table of the Service menu. Lead/lag status during machine operation is viewed in the MAINT04 table in the Control Algorithm Status table.

Lead/Lag Chiller Configuration and Operation — The configured lead chiller is identified when the LEAD/LAG SELECT value for that chiller is configured to the value of "1." The configured lag chiller is identified when the LEAD/LAG SELECT for that chiller is configured to the value of "2." The standby chiller is configured to a value of "3." A value of "0" disables the lead/lag in that chiller.

To configure the LAG ADDRESS value on the LEAD/LAG Configuration table, always use the address of the other chiller on the system for this value. Using this address will make it easier to rotate the lead and lag machines.

If the address assignments placed into the LAG ADDRESS and STANDBY ADDRESS values conflict, the lead/lag will be disabled and an alert (!) message will occur. For example, if the LAG ADDRESS matches the lead machine's address, the lead/lag will be disabled and an alert (!) message will occur. The lead/lag maintenance screen (MAINT04) will display the message 'INVALID CONFIG' in the LEAD/LAG CONFIGURATION and CURRENT MODE fields.

The lead chiller responds to normal start/stop controls such as occupancy schedule, forced start/stop, and remote start contact inputs. After completing start up and ramp loading, the PIC evaluates the need for additional capacity. If additional capacity is needed, the PIC 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, then the chiller at the STANDBY ADDRESS (if configured) is requested to start. After the second chiller is started and is running, the lead chiller shall monitor conditions and evaluate whether the capacity has 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, then the lag and standby chillers are stopped. If the configured lead chiller stops for an alarm condition, then 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 (user configured value) elapses, then the lag chiller shall be started and the lead chiller will shut down. The lead chiller then monitors the start request from the acting lead chiller to start. The PRESTART FAULT TIMER is initiated at the time of a start request. The PRESTART FAULT TIMER's function is to provide a timeout in the event that there is a prestart alert condition preventing the machine from starting in a timely manner. The timer is configured under Lead/Lag, found in the Equipment Configuration table of the Service menu.

If the lag chiller does not achieve start-up before the PRESTART FAULT TIMER elapses, then the lag chiller shall be stopped and the standby chiller will be requested to start, if configured and ready.

Standby Chiller Configuration and Operation — The configured standby chiller is identified as such by having the LEAD/LAG SELECT configured to the value of “3.” The standby chiller can only operate as a replacement for the lag chiller if one of the other two chillers is in an alarm (*) condition (as shown on the LID panel). If both lead and lag chillers are in an alarm (*) condition, the standby chiller shall default to operate in CCN mode based on its configured Occupancy Schedule and remote contacts input.

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

1. Lead chiller ramp loading must be complete.
2. Lead chiller CHILLED WATER temperature must be greater than the CONTROL POINT plus 1/2 the WATER/BRINE DEADBAND.

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 value must be greater than 95% of full load amps.
4. Lead chiller temperature pulldown rate of the CHILLED WATER temperature is less than 0.5° F (0.27° C) per minute.
5. The lag chiller status indicates it is in CCN mode and is not faulted. If the current lag chiller is in an alarm condition, then 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 shall be started when the lead chiller ramp loading is completed. The LAG START TIMER entry is accessed by selecting Lead/Lag from the Equipment Configuration table of the Service menu.

When all of the above requirements have been met, the lag chiller is forced to a START mode. The PIC 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 LOAD value is less than the lead chiller percent capacity plus 15%.

NOTE: Lead chiller percent capacity = 100 – LAG PERCENT CAPACITY

The LAG PERCENT CAPACITY value is configured on the Lead/Lag Configuration screen.

2. The lead chiller chilled water temperature is less than the CONTROL POINT plus 1/2 of the WATER/BRINE DEADBAND.
3. The configured LAG STOP TIMER entry has elapsed. The LAG STOP TIMER is started when the CHILLED WATER TEMPERATURE is less than the CHILLED WATER CONTROL POINT plus 1/2 of the WATER/BRINE DEADBAND and the lead chiller COMPRESSOR MOTOR LOAD is less than the lead chiller percent capacity plus 15%. The timer is ignored if the chilled water temperature reaches 3° F (1.67° C) below the CONTROL POINT and the lead chiller COMPRESSOR MOTOR LOAD value is less than the lead chiller percent capacity plus 15%.

FAULTED CHILLER OPERATION — If the lead chiller shuts down on an alarm (*) condition, it stops communication to the lag and standby chillers. After 30 seconds, the lag chiller will now become the acting lead chiller and will start and stop the standby chiller, if necessary.

If the lag chiller faults when the lead chiller is also faulted, 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 LID panel), the RESET softkey is pressed to clear the alarm, and the chiller is placed in the CCN mode, the lead chiller will now communicate and monitor the RUN STATUS of the lag and standby chillers. If both the lag and standby chillers are running, the lead chiller will not attempt to start and will 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 will wait for a start request from the operating chiller. When the configured lead chiller starts, it assumes its role as lead chiller.

LOAD BALANCING — When the LOAD BALANCE OPTION is enabled, the lead chiller will set the ACTIVE DEMAND LIMIT in the lag chiller to the lead chiller's COMPRESSOR MOTOR LOAD value. This value has limits of 40% to 100%. When setting the lag chiller ACTIVE DEMAND LIMIT, the CONTROL POINT shall be modified to a value of 3° F (1.67° 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 autorestart 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 verification. The PIC controls ensure that the guide vanes are closed. After the guide vane position is confirmed, the delay for lag and standby chiller occurs prior to energizing the oil pump. 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 motors from being energized simultaneously. This will help reduce the inrush demands on the building power system.

Ice Build Control — Ice build control automatically sets the chilled WATER/BRINE CONTROL POINT of the machine to a temperature where an ice building operation for thermal storage can be accomplished.

NOTE: For ice build control to properly operate, the PIC controls must be placed in CCN mode. See Fig. 13 and 14.

The PIC can be configured for ice build operation. Configuration of ice build control is accomplished through entries in the Config table, Ice Build Set Point table, and the Ice Build Time Schedule table. Figures 13 and 14 show how to access each entry.

The Ice Build Time Schedule defines the period during which ice build is active if the ice build option is ENABLED. If the Ice Build Time Schedule overlaps other schedules defining time, then the Ice Build Time Schedule shall take priority. During the ice build period, the WATER/BRINE CONTROL POINT is set to the ICE BUILD SETPOINT for temperature control. The ICE BUILD RECYCLE OPTION and ICE BUILD TERMINATION entries from a screen in the Config (configuration) table provide options for machine recycle and termination of ice build cycle, respectively. Termination of ice build can result from the ENTERING CHILLED WATER/BRINE temperature being less than the ICE BUILD SETPOINT, opening of the REMOTE CONTACT inputs from an ice level indicator, or reaching the end of the Ice Build Time Schedule.

ICE BUILD INITIATION — The Ice Build Time Schedule provides the means for activating ice build. The ice build time table is named OCCPC02S.

If the Ice Build Time Schedule is OCCUPIED and the ICE BUILD OPTION is ENABLED, then ice build is active and the following events automatically take place (unless overridden by a higher authority CCN device):

1. Force CHILLER START/STOP to START.
2. Force WATER/BRINE CONTROL POINT to the ICE BUILD SETPOINT.
3. Remove any force (Auto) on the ACTIVE DEMAND LIMIT.

NOTE: Items 1-3 (shown above) shall not occur if the chiller is configured and operating as a lag or standby chiller for lead/lag and is actively controlled by a lead chiller. The lead chiller communicates the ICE BUILD SETPOINT, desired CHILLER START/STOP state, and 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 machine is not running when ice build activates, then the PIC checks the following parameters, based on the ICE BUILD TERMINATION value, to avoid starting the compressor unnecessarily:

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

The ICE BUILD RECYCLE OPTION determines whether or not the PIC will go into a RECYCLE mode. If the ICE BUILD RECYCLE OPTION is set to DSABLE (disable) when the ice build terminates, the PIC will revert back to normal temperature control duty. If the ICE BUILD RECYCLE OPTION is set to ENABLE, when ice build terminates, the PIC will go into an ICE BUILD RECYCLE mode and the chilled water pump relay will remain energized to keep the chilled water flowing. If the entering CHILLED WATER/BRINE TEMPERATURE increases above the ICE BUILD SETPOINT plus the RECYCLE DELTA T value, the compressor will restart and control the CHILLED WATER/BRINE TEMPERATURE to the ICE BUILD SETPOINT.

TEMPERATURE CONTROL DURING ICE BUILD — During ice build, the capacity control algorithm uses the WATER/BRINE CONTROL POINT minus 5 F (2.7 C) to control the LEAVING CHILLED WATER temperature. The ECW OPTION and any temperature reset option are ignored during ice build. The 20 mA DEMAND LIMIT OPTION is also ignored during ice build.

TERMINATION OF ICE BUILD — Ice build termination occurs under the following conditions:

1. Ice Build Time Schedule — When the Ice Build Time Schedule transitions to UNOCCUPIED, ice build operation shall terminate.
2. ECW TEMPERATURE — Termination of compressor operation, based on temperature, shall occur if the ICE BUILD TERMINATION is set to the ICE BUILD TERMINATION TEMP option and the ENTERING CHILLED WATER temperature is less than the ICE BUILD SET-

POINT. If the ICE BUILD RECYCLE OPTION is set to ENABLE, a recycle shutdown occurs and recycle start-up shall be based on LEAVING CHILLED WATER temperature being greater than the WATER/BRINE CONTROL POINT plus RECYCLE DELTA T.

3. Remote Contacts/Ice Level Input — Termination of compressor operation occurs when ICE BUILD TERMINATION is set to CONTACTS ONLY OPTION and the remote contacts are open. In this case, the contacts are provided for ice level termination control. The remote contacts can still be opened and closed to start and stop the chiller when the Ice Build Time Schedule is UNOCCUPIED. The contacts are used to stop the ICE BUILD mode when the Ice Build Time Schedule is OCCUPIED.
4. ECW TEMPERATURE and Remote Contacts — Termination of compressor operation shall occur when ICE BUILD TERMINATION is set to BOTH (temperature and contacts) option and the previously described conditions for ECW TEMPERATURE and remote contacts have occurred.

NOTE: Overriding the CHILLER START/STOP, WATER/BRINE CONTROL POINT, and ACTIVE DEMAND LIMIT variables by CCN devices (with a priority less than 4) during the ice build period is not possible. However, overriding can be accomplished with CCN during two chiller lead/lag.

RETURN TO NON-ICE BUILD OPERATIONS — Upon termination of ice build, the machine shall return to normal temperature control and start/stop schedule operation. If the CHILLER START/STOP or WATER/BRINE CONTROL POINT has been forced (with a priority less than 4), prior to entering ice build operation, then chiller START/STOP and WATER/BRINE CONTROL POINT forces will be removed.

Attach to Network Device Control — On the Service menu, one of the selections is ATTACH TO NETWORK DEVICE. This table serves the following purposes:

- to upload the Occupancy Schedule Number (if changed) for OCCPC03S, as defined in the Service01 table
- to attach the LID to any CCN device, if the machine has been connected to a CCN Network. This may include other PIC controlled chillers.
- to change to a new PSIO or LID module.

Figure 20 illustrates the ATTACH TO NETWORK DEVICE table. The Local description is always the PSIO module address of the machine the LID is mounted on. Whenever the controller identification of the PSIO is changed, this change is reflected on the bus and address for the LOCAL DEVICE of the ATTACH TO DEVICE screen automatically. See Fig. 14.

Whenever the ATTACH TO NETWORK DEVICE table is entered, the LID erases information on the module to which it was attached in order to make room for another device. Therefore, it is then required to attach to a CCN module when this screen is entered, even if the LID is attached back to the original module. When the ATTACH softkey is pressed, the message “UPLOADING TABLES, PLEASE WAIT” flashes. The LID will then upload the highlighted device or module. If the module address cannot be found, the message “COMMUNICATION FAILURE” will appear. The LID will then revert back to the ATTACH TO DEVICE screen. The upload process time for various CCN modules is different for each module. In general, the uploading process will take 3 to 5 minutes.

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

To view the other devices, move to the ATTACH TO NETWORK DEVICE table. Move the highlight bar to any device number. Press SELECT softkey to change the bus number and address of the module to be viewed. Press EXIT softkey to move back to the ATTACH TO NETWORK DEVICE table. If the module number is not valid, the “COMMUNICATION FAILURE” message will show and a new address number should be entered or the wiring checked. If the model 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 CCN module the LID is currently showing, check the device name descriptor on the upper left hand corner of the LID screen. See Fig. 20.

When the CCN device has been viewed, the ATTACH TO NETWORK DEVICE table should now be used to attach to the PSIO that is on the machine. Move to the ATTACH TO NETWORK DEVICE table and press the ATTACH softkey to upload the LOCAL device. The PSIO for the 19EF will now be uploaded.

NOTE: The LID will not automatically re-attach to the PSIO module on the machine. Press the ATTACH softkey to attach to LOCAL DEVICE and view the machine PSIO.

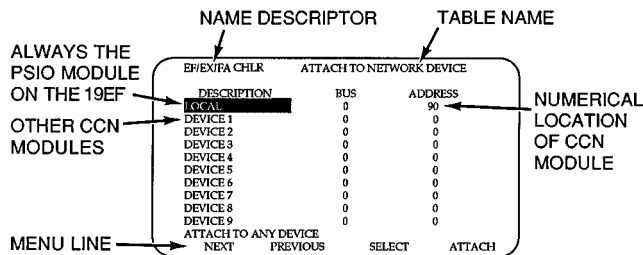
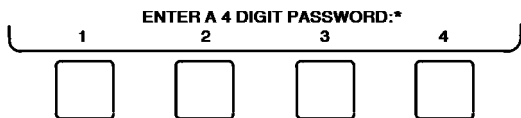


Fig. 20 — Example of Attach to Network Device Screen

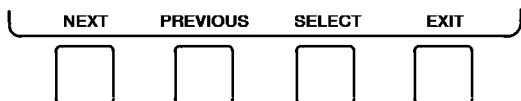
Service Operation — An overview of the menu-driven programs available for Service Operation is shown in Fig. 14.

TO LOG ON

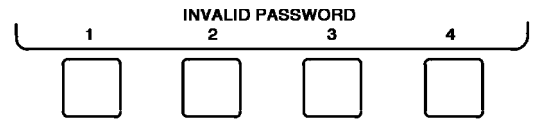
1. On the Menu screen, press **SERVICE**. The keys now correspond to the numerals 1, 2, 3, 4.
2. Press the four digits of your password, one at a time. An asterisk (*) appears as you enter each digit.



The menu bar (Next-Previous-Select-Exit) is displayed to indicate that you have successfully logged on.



If the password is entered incorrectly, an error message is displayed. If this occurs, return to Step 1 and try logging on again.



NOTE: The initial factory set password is 1-1-1-1.

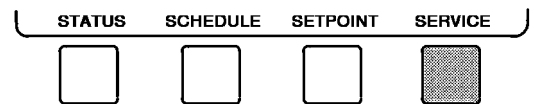
TO LOG OFF — Access the Log Out of Device table of the Service menu in order to password-protect the Service menu. The LID will automatically sign off and password-protect itself if a key is not pressed for 15 minutes. The LID default screen is then displayed.

HOLIDAY SCHEDULING (Fig. 21) — 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. 15.)

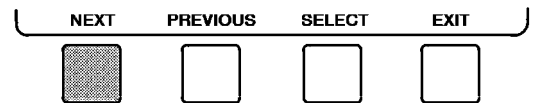
The Broadcast function must be activated for the holidays configured in the Holidef tables to work properly. Access the Brodefns table in the Equipment Configuration table and answer “Yes” to the activated function. However, when the machine is connected to a CCN Network, only one machine or CCN device can be configured to be the broadcast device. The controller that is configured to be the broadcaster is the device responsible for transmitting holiday, time, and daylight-savings dates throughout the network.

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

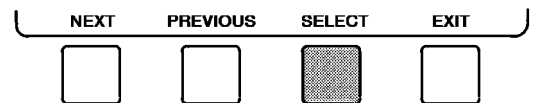
1. At the Menu screen, press **SERVICE** to access the Service menu.



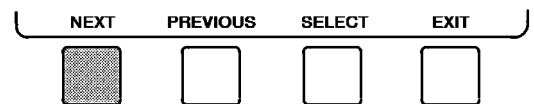
2. If not logged on, follow the instructions for To Log On or To Log Off. Once logged on, press **NEXT** until Equipment Configuration is highlighted.



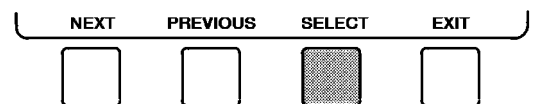
3. Once Equipment Configuration is highlighted, press **SELECT** to access.



4. Press **NEXT** until Holidef is highlighted. This is the Holiday Definition table.



5. Press **SELECT** to enter the Data Table Select screen. This screen lists 18 holiday tables.



START-UP/SHUTDOWN/ RECYCLE SEQUENCE (Fig. 22)

Local Start-Up — Local start-up (or a manual start-up) is initiated by pressing the **LOCAL** menu softkey which is on the default LID screen. Local start-up can proceed when Time Schedule 01 is in OCCUPIED mode, and after the internal 15-minute start-to-start and the 1-minute stop-to-start inhibit timers have expired.

The chiller start/stop status point on the Status01 table may be overridden to start, regardless of the time schedule, in order to locally start the unit. Also, the remote contacts may be enabled through the LID and closed to initiate a start-up.

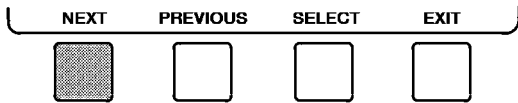
Whenever the chiller is in LOCAL control mode, the PIC will wait for Time Schedule 01 to become occupied and the remote contacts to close, if enabled. The PIC will then perform a series of pre-start checks to verify that all pre-start alerts and safeties are within the limits shown in Table 3. The run status line on the LID now reads "Starting." If the checks are successful, the chilled water/brine pump relay will be energized. Five seconds later, the condenser pump relay is energized. One minute later the PIC monitors the chilled water and condenser water flow switches, and waits until the *WATER FLOW VERIFY TIME* (operator configured, default 5 minutes) to confirm flow. After flow is verified, the chilled water/brine temperature is compared to *CONTROL POINT* plus *DEADBAND*. If the temperature is less than or equal to this, the PIC will turn off the condenser pump relay and go into a RECYCLE mode. If the water/brine temperature is high enough, the start-up sequence continues on to check the guide vane position. If the guide vanes are more than 6% open, the start-up waits until the PIC closes the vanes. If the vanes are closed, and the oil pump pressure is less than 3 psi (21 kPa), the oil pump relay will then be energized. The PIC then waits until the *OIL PRESS (Pressure) VERIFY TIME* (operator configured, default 15 seconds) for oil pressure to reach 15 psi (103 kPa). After oil pressure is verified, the PIC waits 10 seconds, and then the compressor start relay (1CR) is energized to start the compressor.

Failure to verify any of the requirements up to this point will result in the PIC aborting the start and displaying the applicable pre-start mode of failure on the LID 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 the 12 hours counter by one, and displays the applicable shutdown status on the LID display.

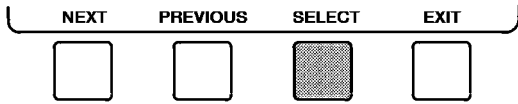
Shutdown Sequence — Shutdown of the machine can occur if any of the following events happen:

- the STOP button is pressed for at least one second (the alarm light will blink once to confirm stop command)
- recycle condition is present (see Chilled Water Recycle Mode section)
- time schedule has gone into UNOCCUPIED mode
- remote contact opens
- the start/stop status is overridden to stop from the CCN network or the LID

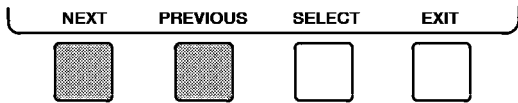
6. Press **NEXT** to highlight the holiday table that you wish to view or change. Each table is one holiday period, starting on a specific date, and lasting up to 99 days.



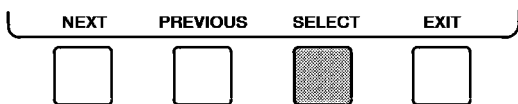
7. Press **SELECT** to access the holiday table. The Configuration Select table now shows the holiday start month and day, and how many days the holiday period will last.



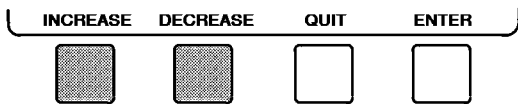
8. Press **NEXT** or **PREVIOUS** to highlight the month, day, or duration.



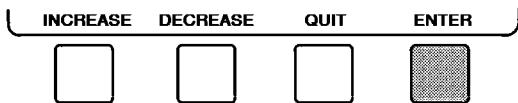
9. Press **SELECT** to modify the month, day, or duration.



10. Press **INCREASE** or **DECREASE** to change the selected value.



11. Press **ENTER** to save the changes.



12. Press **EXIT** to return to the previous menu.

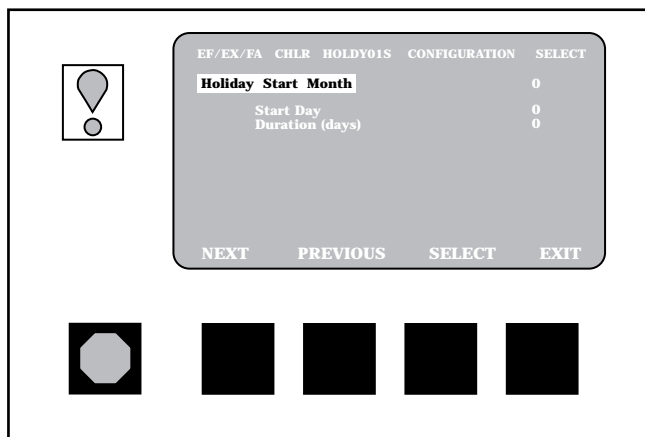
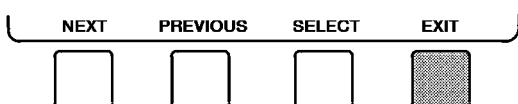
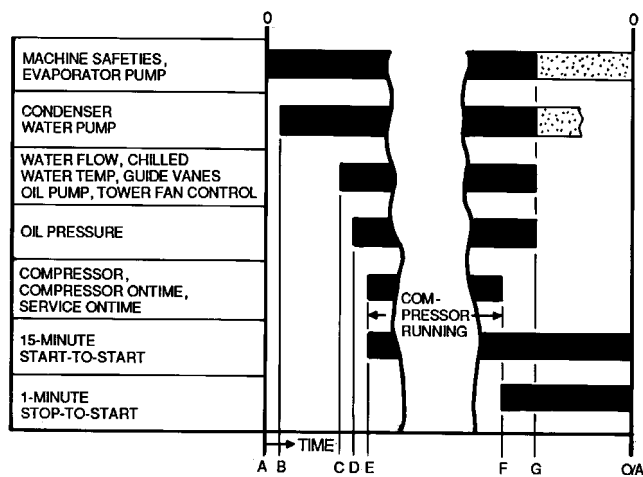


Fig. 21 — Example of Holiday Period Screen



- A — START INITIATED — Prestart checks made; evaporator pump started
- B — Condenser water pump started (5 seconds after A)
- C — Water flows verified (30 seconds to 5 minutes maximum after B). Chilled water temperatures checked against control point. Guide vanes checked for closure. Oil pump started; tower fan control enabled.
- D — Oil pressure verified (15 seconds minimum, 300 seconds maximum after C)
- E — Compressor motor starts, compressor ontime and service ontime start, 15-minute inhibit timer starts (10 seconds after D)
- F — SHUTDOWN INITIATED — Compressor motor stops, compressor ontime and service ontime stops, and 1-minute inhibit timer starts.
- G — Oil pump and evaporator pumps deenergized (60 seconds after F). Condenser pump and tower fan control may continue to operate if condenser pressure is high. Evaporator pump may continue if in RECYCLE mode.
- O/A — Restart permitted (both inhibit timers expired) (minimum of 15 minutes after E; minimum of 1 minute after F).

Fig. 22 — Control Sequence

When a safety shutdown occurs, the shutdown sequence first stops the compressor by deactivating the start relay. A status message of “SHUTDOWN IN PROGRESS, COMPRESSOR DEENERGIZED” is displayed. The guide vanes are then brought to the closed position. The oil pump relay and the chilled water/brine pump relay are shut down 60 seconds after the compressor stops. The condenser water pump will be shut down when the *CONDENSER REFRIGERANT TEMP* is less than the *CONDENSER PRESSURE OVERRIDE* minus 5 psi (34 kPa) or is less than or equal to the *ENTERING CONDENSER WATER TEMP* plus 3° F (2° C). The stop-to-start timer will now begin to count down. If the start-to-start timer is still greater than the value of the start-to-stop timer, then this time is now displayed on the LID.

Certain conditions during shutdown will change this sequence:

- if the *COMPRESSOR MOTOR LOAD* is greater than 10% after shutdown, or the starter contacts remain energized, the oil pump and chilled water pump remain energized and the alarm is displayed
- if the *ENTERING CONDENSER WATER* temperature is greater than 115 F (46 C) at shutdown, the condenser pump will be deenergized after the ICR compressor start relay
- if the machine shuts down due to low refrigerant temperature, the chilled water pump will stay running until the *LEAVING CHILLED WATER* is greater than *CONTROL POINT*, plus 5° F (3° C)

Automatic Soft Stop Amps Threshold — The **SOFT STOP AMPS THRESHOLD** closes the guide vanes of the compressor automatically when a non-recycle, non-alarm stop signal occurs before the compressor motor is deenergized.

If the STOP button is pressed, the guide vanes close to a preset amperage percent or until the guide vane is less than 2% open. The compressor will then shut off.

If the machine enters an alarm state or if the compressor enters a RECYCLE mode, the compressor will be deenergized immediately.

To activate **SOFT STOP AMPS THRESHOLD**, view the bottom of Service1 table. Set the **SOFT STOP AMPS THRESHOLD** value to the percentage amps at which the motor will shut down. The default setting is 100% amps (no Soft Stop).

When the **SOFT STOP AMPS THRESHOLD** is being applied, a status message “SHUTDOWN IN PROGRESS, COMPRESSOR UNLOADING” is shown.

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

- when in LCW control, the *LEAVING CHILLED WATER* temperature is more than 5° F (3° C) below the control point, and the *CONTROL POINT* has not increased in the last 5 minutes
- when *ECW CONTROL OPTION* is enabled, the *ENTERING CHILLED WATER* temperature is more than 5° F (3° C) below the *CONTROL POINT*, and the *CONTROL POINT* has not increased in the last 5 minutes
- when the *LEAVING CHILLED WATER* temperature is within 3° F (2° C) of the *BRINE REFRIG TRIPPOINT*

When the machine is in RECYCLE mode, the chilled water pump relay remains energized so that 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 5° F (3° C). This value is viewed/modified on the Service1 table. The compressor will restart when:

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

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

An alert condition may be generated if 5 or more RECYCLE STARTUPS occur in less than 4 hours. This excessive recycling can reduce machine life. Compressor recycling due to extremely low loads should be reduced. To reduce compressor recycling, use the time schedule to shut the machine down during low load operation or increase the machine 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 Service1 table to lengthen the time between restarts.

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

Safety Shutdown — A safety shutdown is identical to a manual shutdown with the exception that the LID will display the reason for the shutdown, the alarm light will blink continuously, and the spare alarm contacts will be energized. A safety shutdown requires that the **RESET** softkey be pressed in order to clear the alarm. If the alarm is still present, the alarm light will continue to blink. Once the alarm is cleared, the operator must press the **CCN** or **LOCAL** softkeys to restart the machine. Soft stop unload does not occur during safety shutdowns.

⚠ CAUTION

Do not reset starter loads or any other starter safety for 30 seconds after the compressor has stopped. Voltage output to the compressor start signal is maintained for 10 seconds to determine starter fault.

BEFORE INITIAL START-UP

Job Data Required

- list of applicable design temperatures and pressures (product data submittal)
- machine certified drawings
- starting equipment details and wiring diagrams
- diagrams and instructions for special controls or options
- 19EF 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. 23)
- 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

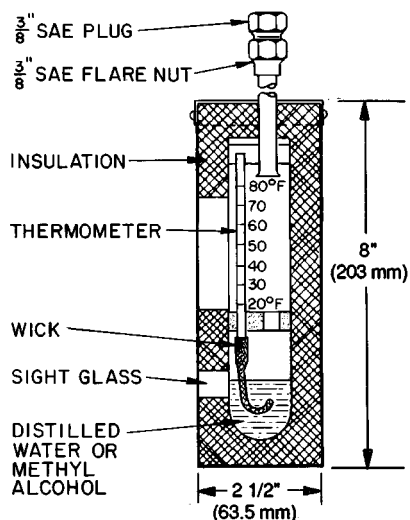


Fig. 23 — Typical Wet-Bulb Type Vacuum Indicator

Remove Shipping Packaging — Remove any packaging material from the control center, power panel, guide vane actuator, motor and bearing temperature sensor covers, and the starter.

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

Torque All Gasketed Joints — Gaskets normally have relaxed by the time the machine arrives at the jobsite. Tighten all gasketed joints to ensure a leak tight machine.

Check Machine Tightness — Figure 24 outlines the proper sequence and procedures for leak testing.

19EF chillers are shipped with the refrigerant contained in the condenser shell and the oil charge shipped in the compressor. The cooler will have a 15 psig (103 kPa) refrigerant charge. Units may be ordered with the refrigerant shipped separately, along with a 15 psig (103 kPa) nitrogen-holding charge in each vessel. To determine if there are any leaks, the machine should be charged with refrigerant. Use an electronic leak detector to check all flanges and solder joints after the machine is pressurized. If any leaks are detected, follow the leak test procedure.

If the machine is spring isolated, keep all springs blocked in both directions in order to prevent possible piping stress and damage during the transfer of refrigerant from vessel to vessel during the leak test process, or any time refrigerant is transferred. Adjust the springs when the refrigerant is in operating condition, and when 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 also can be used if the machine is under pressure.

⚠ WARNING

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

Leak Test Machine — Due to regulations regarding refrigerant emissions and the difficulties associated with separating contaminants from refrigerant, Carrier recommends the following leak test procedures. See Fig. 24 for an outline of the leak test procedures. See Table 5A and 5B for refrigerant pressure/temperature values.

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

⚠ WARNING

Never charge liquid refrigerant into the machine if the pressure in the machine is less than 35 psig (241 kPa). Charge as a gas only, with the cooler and condenser pumps running, until this pressure is reached, using PUMP-DOWN LOCKOUT and TERMINATE LOCKOUT mode on the PIC. Flashing of liquid refrigerant at low pressures can cause tube freezeup and considerable damage.

- c. Leak test machine as outlined in Steps 3 - 9.

2. If the pressure readings are abnormal for machine condition:
 - a. Prepare to leak test machines shipped with refrigerant (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 the 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 Machine Dehydration section, this page.
 - h. Slowly raise the system pressure to maximum 210 psig (1448 kPa) but no less than 35 psig (241 kPa) by adding refrigerant. Proceed with the test for small leaks (Steps 3-9).
 3. Check the machine carefully with an electronic leak detector, halide torch, or soap bubble solution.
 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 machine. Leakage at rates greater than 1 lb/year (0.45 kg/year) for the entire machine must be repaired. Note total machine 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 machine (see Refrigerant Transfer Procedure). Retest.
 6. If no leak is found after a retest:
 - a. Transfer the refrigerant and perform a standing vacuum test as outlined in the Standing Vacuum Test section, this page.
 - b. If the machine fails this test, check for large leaks (Step 2b).
 - c. Dehydrate the machine if it passes the standing vacuum test. Follow the procedure in the Machine Dehydration section. Charge machine with refrigerant (see Refrigerant Transfer Procedure).
 7. If a leak is found, transfer the refrigerant out of the machine (see Refrigerant Transfer Procedure section on page 48).
 8. Transfer the refrigerant until machine pressure is at 18 in. Hg (41 kPa absolute).
 9. Repair the leak and repeat the procedure, beginning from Step 2h to ensure a leaktight repair. (If machine is opened to the atmosphere for an extended period, evacuate it before repeating leak test.)
4. a. If the leakage rate is less than 0.05 in. Hg (.17 kPa) in 24 hours, the machine is sufficiently tight.
 - b. If the leakage rate exceeds 0.05 in. Hg (.17 kPa) in 24 hours, repressurize the vessel and test for leaks. Refer the leak test procedures in Fig. 24. Raise the vessel pressure in increments until the leak is detected. If refrigerant is used, the maximum gas pressure is approximately 70 psig (483 kPa) at normal ambient temperature. If nitrogen is used, limit the leak test pressure to 230 psig (1585 kPa) maximum.
5. Repair leak, retest, and proceed with dehydration.

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

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

Dehydration is readily accomplished at room temperatures. Use of a cold trap (Fig. 25) 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 for boiling 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 m³/s] or larger is recommended) to the refrigerant charging valve (Fig. 5). Tubing from the pump to the machine should be as short and as large a 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 machine vacuum.
3. Open all isolation valves (if present), if the entire machine is to be dehydrated.
4. With the machine 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 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/pressure, isolated pockets of moisture can turn into ice. The slow rate of evaporation (sublimation) of ice at these low temperatures/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 170 psig (1172 kPa) pressure. Locate and repair the leak, and repeat dehydration.

Standing Vacuum Test — When performing the standing vacuum test, or machine dehydration, use a manometer or a wet bulb indicator. Dial gages cannot indicate the small amount of acceptable leakage during a short period of time.

1. Attach an absolute pressure manometer or wet bulb indicator to the machine.
2. Evacuate the vessel (using the same procedure shown in Refrigerant Transfer Procedure section, page 48) to at least 18 in. Hg vac, ref 30-in. bar (41 kPa absolute), using a vacuum pump or the pumpout unit.
3. Valve off the pump to hold the vacuum and record the manometer or indicator reading.

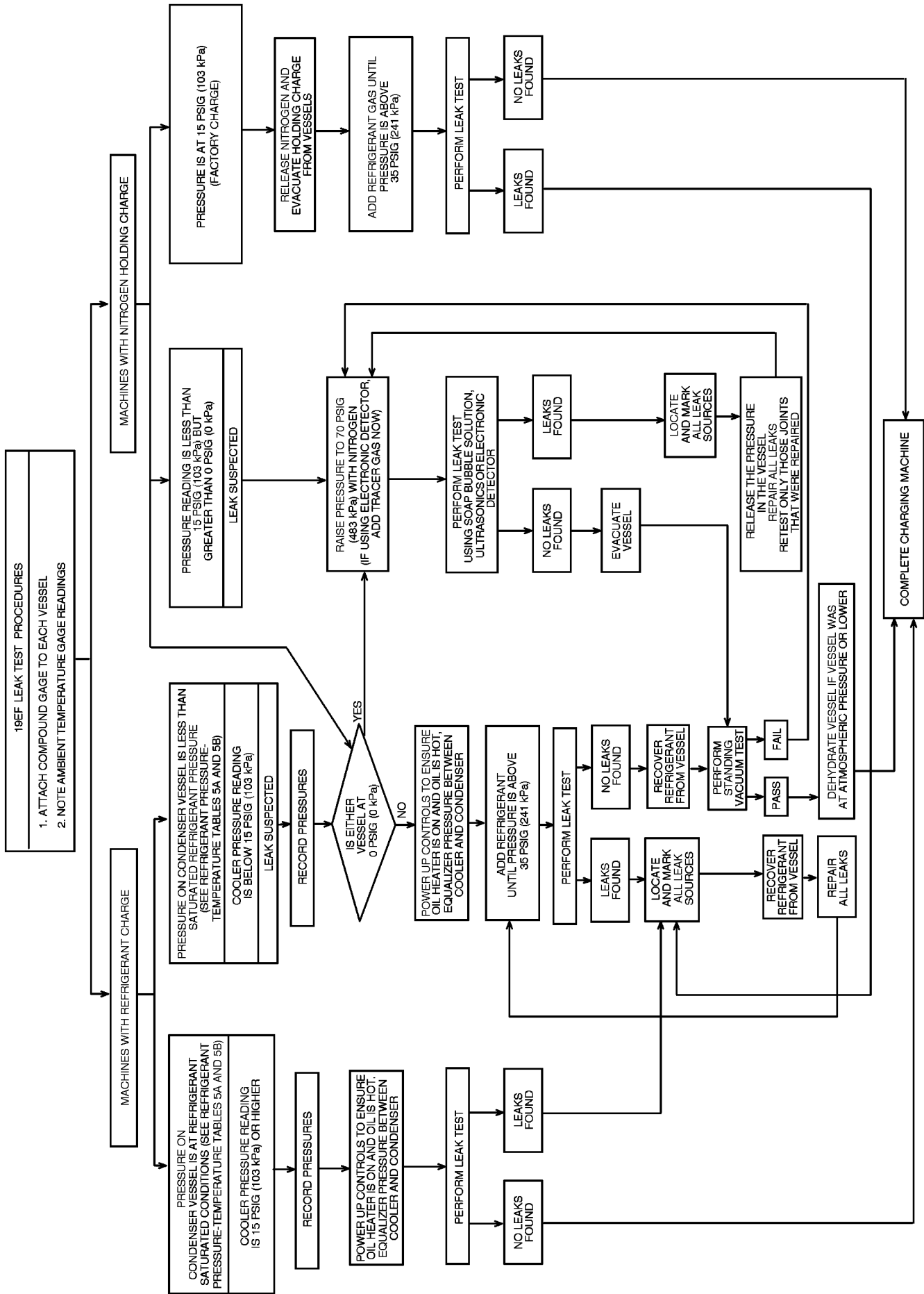


Fig. 24 — 19EF Leak Test Procedures

Table 5A — HFC-134a Pressure — Temperature (F)

TEMPERATURE (F)	PRESSURE (psi)
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 5B — 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

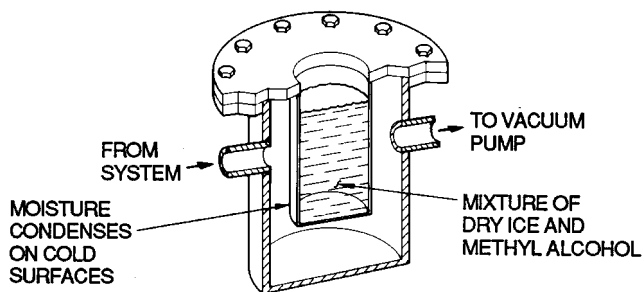


Fig. 25 — Dehydration Cold Trap

Inspect Water Piping — Refer to piping diagrams provided in the certified drawings, and the piping instructions in the 19EF Installation Instructions manual. Inspect the piping to the cooler and condenser. Be sure that 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 cooler and across condenser.

⚠ CAUTION

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

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

19EF relief valves are set to relieve at the 18 psig (124 kPa) machine design pressure.

Inspect Wiring

⚠ WARNING

Do not check 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 machine is under a dehydration vacuum. Insulation breakdown and serious damage may result.

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

5. Check the voltage at the following components and compare to the nameplate values: oil pump contact, and power panel.
6. Be sure that fused disconnects or circuit breakers have been supplied for the oil pump, and power panel.
7. Check that all electrical equipment and controls are properly grounded in accordance with job drawings, certified drawings, and all applicable electrical codes.
8. Make sure that the customer's contractor has verified proper operation of the pumps, cooling tower fans, and associated auxiliary equipment. This includes ensuring that motors are properly lubricated and have proper electrical supply and proper rotation.
9. Test the machine 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.)
 - 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 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.
10. Tighten up all wiring connections to the plugs on the SMM, 8-input, and PSIO modules.
11. Ensure that the voltage selector switch inside the power panel is switched to the 115-v setting.
12. 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 signal ground pins.

To attach the CCN communication bus wiring, refer to the certified drawings and wiring diagrams. The wire is inserted into the CCN communications plug (COMM1) on the PSIO module. This plug also is referred to as J5.

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 -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	PSIO MODULE COMM 1 PLUG (J5) PIN NO.
+ Ground	RED	1
-	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 machine or pump.

Use the instruction and service manual supplied by the starter manufacturer to verify that the starter has been installed correctly.

⚠ 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.

Whenever a starter safety trip device activates, wait at least 30 seconds before resetting the safety. The microprocessor maintains its output to the 1CR relay for 10 seconds after starter safety shutdown to determine the fault mode of failure.

MECHANICAL-TYPE STARTERS

1. Check all field wiring connections for tightness, clearance from moving parts, and correct connection.
2. Check the contactor(s) to be sure 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, e.g., relays, timers, 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 job site. If the starter is equipped with devices of this type, remove the fluid cups from these magnetic overload relays. Add dashpot oil to cups per instructions supplied with the starter. The oil is usually shipped in a small container attached to the starter frame near the relays. Use only dashpot oil supplied with the starter. Do not substitute.

Factory-filled dashpot overload relays need no oil at start-up and solid-state overload relays do not have oil.

4. Reapply starter control power (*not main chiller power*) to check electrical functions. When using a reduced-voltage starter (such as a wye-delta type) check the transition timer for proper setting. The factory setting is 30 seconds (± 5 seconds), timed closing. The timer is adjustable in a range between 0 and 60 seconds and settings other than the nominal 30 seconds may be chosen as needed (typically 20 to 30 seconds are used).

When the timer has been set, check that the starter (with relay 1CR closed) goes through a complete and proper start cycle.

SOLID-STATE STARTER

⚠ WARNING

This equipment is at line voltage when AC power is connected. Pressing the Stop button does not remove voltage. Use caution when adjusting the potentiometers on the equipment.

1. Check that all wiring connections are properly terminated to the starter.
2. Verify that the ground wire to the starter is installed properly and is of sufficient size.
3. Verify that the motors are properly grounded to the starter.
4. Check that all of the relays are properly seated in their sockets.
5. Verify that the proper ac input voltage is brought into the starter per the certified drawings.
6. Verify the initial factory settings (i.e., starting torque, ramp potentiometers, etc. are set per the manufacturer's instructions).

Oil Charge — If oil is added, it must meet Carrier’s specification for centrifugal compressor usage as described in the Oil Specification section on page 51. Charge the oil through the oil charging valve, located near the bottom of the transmission housing (Fig. 2). 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 150 psig (0 to 1034 kPa) or above unit pressure. Oil should only be charged or removed when the machine is shut down.

Power Up the Controls and Check the Oil Heater

— Ensure that an oil level is visible in the compressor before energizing controls. A circuit breaker in the starter energizes the oil heater and the control circuit. When first powered, the LID 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 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 set up allows the heater to energize when the main motor circuit breaker is off for service work or extended shutdowns. The oil heater relay status can be viewed on the Status02 table on the LID. Oil sump temperature can be viewed on the LID default screen.

SOFTWARE VERSION — The software version will always be labeled on the PSIO module, and on the back side of the LID module. On both the Controller ID and LID ID display screens, the software version number will also appear.

Set Up Machine Control Configuration

⚠ WARNING

Do not operate the machine 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 configuration of the 19EF unit is performed, write down all configuration settings. 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 LID 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 can control a set point to either the leaving or entering chilled water. This control method is set in the Equipment Configuration table, Config table.

Input the Local Occupied Schedule (OCCPC01S)

— Access the schedule OCCPC01S screen on the LID to set up the occupied time schedule. 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 8.

The CCN Occupied Schedule (OCCPC03S) should be configured if a CCN system is being installed or if a secondary time schedule is required. It is normally input through the CCN Building Supervisor, but it can be configured at the LID.

The Ice Build Schedule (OCCPC02S) should be configured for ice build applications.

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

- password
- input time and date
- LID configuration
- controller identification
- service parameters
- equipment configuration
- automated control test

PASSWORD — When accessing the Service tables, a password must be entered. All LIDs are initially set for a password of 1-1-1-1. This password may be changed in the LID configuration screen, if desired.

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. “Holiday Today” should only be configured to “Yes” if the present day is a holiday.

CHANGE LID CONFIGURATION IF NECESSARY — The LID Configuration screen is used to view or modify the LID address, change to English or SI units, and to change the password. If there is more than one machine at the jobsite, change the LID address on each machine so that each machine has its own address. Note and record the new address. Change the screen to SI units as required, and change the password if desired. A copy of the password should be obtained for future reference.

MODIFY CONTROLLER IDENTIFICATION IF NECESSARY — The controller identification screen is used to change the PSIO module address. Change this address for each machine if there is more than one machine at the jobsite. Write the new address on the PSIO module for future reference.

INPUT EQUIPMENT SERVICE PARAMETERS IF NECESSARY — The Equipment Service table has three service tables: Service1, Service2, and Service3.

Configure SERVICE1 Table — Access Service1 table to modify/view the following to jobsite parameters:

Chilled Medium Brine Refrigerant Trippoint	Water or Brine? Usually 3° F (1.7° C) below design refrigerant temperature
Surge Limiting or Hot Gas Bypass Option Minimum Load Points (T1/P1)	Is HGBP installed? Per job data — See Modify Min/Max Load Points section (shown below)
Maximum Load Points (T2/P2)	Per job data — See Modify Min/Max Load Points section (shown below)
Motor Rated Load Amps	Per job data
Motor Rated Line Voltage	Per job data
Motor Rated Line kW	Per job data (if kW meter installed)
Line Frequency	50 or 60 Hz
Compressor Starter Type	Reduced voltage or full?

NOTE: Other values are left at the default values. These may be changed by the operator as required. Service2 and Service3 tables can be modified by the owner/operator as required.

Modify Minimum and Maximum Load Points (ΔT1/P1; ΔT2/P2) If Necessary — These pairs of machine load points, located on the Service1 table, determine when to limit guide vane travel or to open the hot gas bypass valve when surge prevention is needed. These points should be set based on individual machine operating conditions.

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

Example of configuration: Machine operating parameters

Refrigerant used: HFC-134a

Estimated Minimum Load Conditions:

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

Estimated Maximum Load Conditions:

- 44 F (6.7 C) LCW
- 54 F (12.2 C) ECW
- 42 F (5.6 C) Suction Temperature
- 98 F (36.7 C) Condensing Temperature

Calculate Maximum Load — To calculate maximum load points, use design load condition data. If the machine full load cooler temperature difference is more than 10° F (5.6 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:

$$42 \text{ F (5.6 C)} = 37.1 \text{ psig (256 kPa) saturated refrigerant pressure (HFC-134a)}$$

Condensing Temperature:

$$98 \text{ F (36.7 C)} = 120.1 \text{ psig (828 kPa) saturated refrigerant pressure (HFC-134a)}$$

Maximum Load ΔT_2 :

$$54 - 44 = 10^\circ \text{ F (12.2} - 6.7 = 5.5^\circ \text{ C)}$$

Maximum Load ΔP_2 :

$$120.1 - 37.1 = 83 \text{ psi (828} - 256 = 572 \text{ kPa)}$$

To avoid unnecessary surge prevention, add about 5 psi (34 kPa) to ΔP_2 from these conditions:

$$\Delta T_2 = 10^\circ \text{ F (5.5}^\circ \text{ C)}$$

$$\Delta P_2 = 88 \text{ psi (606 kPa)}$$

Calculate Minimum Load — To calculate minimum load conditions, estimate the temperature difference that 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:

$$43 \text{ F (6.1 C)} = 38.1 \text{ psig (263 kPa) saturated refrigerant pressure (HFC-134a)}$$

Condensing Temperature:

$$70 \text{ F (21.1 C)} = 71.1 \text{ psig (490 kPa) saturated refrigerant pressure (HFC-134a)}$$

Minimum Load ΔT_1 :

$$45.5 - 44 = 1.5^\circ \text{ F (7.5} - 6.7 = 0.8^\circ \text{ C)}$$

Minimum Load ΔP_1 :

$$71.1 - 38.1 = 33 \text{ psig (490} - 263 = 227 \text{ kPa)}$$

Again, to avoid unnecessary surge prevention, add 5 psi (34 kPa) at ΔP_1 from these conditions:

$$\Delta T_1 = 1.5^\circ \text{ F (0.8}^\circ \text{ C)}$$

$$\Delta P_1 = 38 \text{ psi (261 kPa)}$$

If surge prevention occurs too soon or too late:

LOAD	SURGE PREVENTION OCCURS TOO SOON	SURGE PREVENTION OCCURS TOO LATE
At low loads (<50%)	Increase P1 by 5 psi (34 kPa)	Decrease P1 by 5 psi (34 kPa)
At high loads (>50%)	Increase P2 by 5 psi (34 kPa)	Decrease P2 by 5 psi (34 kPa)

Modify Amp Correction Factors — To modify the amp correction factor, use the values listed in Table 6. Enter the appropriate amp correction factor in the Service1 table of Equipment Service.

MODIFY EQUIPMENT CONFIGURATION IF NECESSARY — The Equipment Configuration table has tables to select and view or modify. Carrier's certified drawings will have the configuration values required for the jobsite. Modify these tables only if requested.

Config Table Modifications — Change the values in this table per job data. See certified drawings for values. Modifications include:

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

Owner-Modified CCN Tables — The following tables are described for reference only.

Occdef Table Modifications — The Occdef tables contain the Local and CCN time schedules, which can be modified here, or in the Schedule screen as described previously.

Holiddef Table Modifications — The Holiddef tables configure the days of the year that holidays are in effect. See the holiday paragraphs in the Controls section for more details.

Brodef Table Modifications — The Brodef screen defines the outside-air temperature sensor and humidity sensor if one is to be installed. It will define the start and end of daylight savings time. Enter the dates for the start and end of daylight savings if required for the location. Brodef also will activate the Broadcast function which enables the holiday periods that are defined on the LID.

Other Tables — The Alarmdef, Cons-def, and Runt-def contain tables for use with a CCN system. See the applicable CCN manual for more information on these tables. These tables can only be defined through a CCN Building Supervisor.

CHECK VOLTAGE SUPPLY — Access the Status 01 table and read the actual line voltage. This reading should be equal to the incoming power to the starter. Use a voltmeter to check incoming power at the starter power leads. If the readings are not equal, an adjustment can be made to the 24-v input to the SMM at the potentiometer located in the low-voltage section of the starter to equalize the two readings.

PERFORM AN AUTOMATED CONTROL TEST — Check the safety controls status by performing an automated controls test. Access the Control Test table and select the Automated Tests function (Table 7).

The automated control test will check all outputs and inputs for function. It will also set the refrigerant type. The compressor must be in the OFF mode in order to operate the control test and the 24-v input to the SMM must be in range (per line voltage percent on Status01 table). The OFF mode is caused by pressing the STOP pushbutton on the LID. Each test will ask the operator to confirm that the operation is occurring, and whether or not to continue. If an error occurs, the operator has the choice to try to address the problem as the test is being done, or to note the problem and proceed to the next test.

Table 6 — Amps Correction Factors for 19EF Motors

VOLT/ HZ	MOTOR CODE												
	DB	DC	DD	DE	DF	DG	DH	DJ	DK	DL	DM	DN	DP
200/60	2	4	3	3	2	—	—	—	—	—	—	—	—
208/60	2	5	4	4	3	—	—	—	—	—	—	—	—
360/60	2	2	1	1	2	1	1	1	1	1	1	1	1
380/60	3	3	2	2	3	1	2	2	2	2	2	2	1
400/60	5	4	3	3	4	2	2	2	2	2	2	2	2
440/60	2	1	1	3	2	1	1	1	2	2	2	1	1
460/60	3	2	2	4	3	2	1	1	3	2	3	1	1
480/60	4	3	3	5	4	3	2	2	3	3	3	2	2
550/60	3	2	1	1	2	1	5	1	1	2	1	1	1
575/60	4	3	2	2	3	2	2	1	1	2	1	1	1
600/60	5	4	3	3	4	3	3	2	2	3	2	2	2
2400/60	2	3	2	2	2	3	4	3	1	1	2	2	1
3300/60	3	2	2	2	2	2	3	2	1	1	1	2	1
4160/60	2	3	2	2	2	3	4	3	1	1	2	2	1
6600/60	—	—	3	2	2	2	2	2	1	2	2	1	1
6900/60	—	—	4	3	3	3	3	3	2	3	2	2	2
7200/60	—	—	5	4	4	4	4	4	3	4	3	3	3
220/50	3	3	1	1	1	2	1	—	—	—	—	—	—
230/50	4	4	1	2	1	3	1	—	—	—	—	—	—
240/50	6	5	3	3	2	3	2	—	—	—	—	—	—
320/50	3	3	1	1	1	1	1	1	1	1	1	1	1
346/50	5	4	2	2	1	1	1	1	1	2	1	2	1
360/50	7	6	3	3	2	1	2	2	2	2	2	2	2
380/50	3	3	2	1	1	1	1	1	1	2	1	1	1
400/50	4	4	3	2	2	1	1	2	1	3	2	2	1
415/50	6	5	4	3	2	2	2	3	2	3	3	2	2
3000/50	2	3	3	2	2	1	1	1	1	2	2	2	1
3300/50	2	3	3	3	3	2	1	2	2	2	2	3	2
6000/50	4	3	2	2	2	2	2	2	1	2	1	1	1
6300/50	5	3	3	3	3	2	3	3	3	2	2	2	2
6600/50	6	5	4	4	5	3	4	4	4	3	3	3	3

NOTE: The oil pump test will not energize the oil pump if cooler pressure is below -5 psig (-35 kPa).

When the test is finished, or the **EXIT** softkey is pressed, the test will be stopped and the Control Test menu will be displayed. 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 as follows:

Automated Tests	As described above, a complete control test.
PSIO Thermistors	Check of all PSIO thermistors only.
Options Thermistors	Check of all options boards thermistors.
Transducers	Check of all transducers.
Guide Vane Actuator	Check of the guide vane operation.
Pumps	Check operation of pump outputs, either all pumps can be activated, or individual pumps. The test will also test the associated input such as flow or pressure.
Discrete Outputs	Activation of all on/off outputs or individually.
Pumpdown/Lockout	Pumpdown prevents the low refrigerant alarm during evacuation so refrigerant can be removed from the unit; locks the compressor off; and starts the water pumps.
Terminate Lockout	To charge refrigerant and enable the chiller to run after pumpdown lockout.

High Altitude Locations — Recalibration of the pressure transducers will be necessary as the machine was initially calibrated at sea level. Refer to the calibration procedure in the Troubleshooting Guide section.

Charge Refrigerant into Machine

⚠ CAUTION

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

The 19EF machine will have the refrigerant shipped separately, and a nitrogen holding charge of 15 psig (103 kPa) in the machine. Evacuate the entire machine, and charge machine from refrigerant cylinders.

Table 7 — Control Test Menu Functions

TESTS TO BE PERFORMED	DEVICES TESTED
1. Automated Tests*	Operates the second through seventh tests
2. PSIO Thermistors	Entering chilled water Leaving chilled water Entering condenser water Leaving condenser water Discharge temperature Bearing temperature Motor winding temperature Oil sump temperature
3. Options Thermistors	Common chilled water supply sensor Common chilled water return sensor Remote reset sensor Temperature sensor — Spare 1 Spare 2 Spare 3 Spare 4 Spare 5 Spare 6 Spare 7 Spare 8 Spare 9
4. Transducers	Evaporator pressure Condenser pressure Oil pressure differential Oil pump pressure
5. Guide Vane Actuator	Open Close
6. Pumps	All pumps or individual pumps may be activated: Oil pump — Confirm pressure Chilled water pump — Confirm flow Condenser water pump — Confirm flow
7. Discrete Outputs	All outputs or individual outputs may be energized: Hot gas bypass relay Oil heater relay Motor cooling relay Tower fan relay Alarm relay
8. Pumpdown/Lockout	When using pumpdown/lockout, observe freeze up precautions when removing charge: Instructs operator as to 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
9. Terminate Lockout	Starts pumps and monitors flows Instructs operator as to which valves to open and when Monitors — Evaporator pressure Condenser pressure Evaporator temperature during charging process Terminates compressor lockout

During any of the tests that are not automated, an out-of-range reading will have an asterisk () next to the reading and a message will be displayed.

The full refrigerant charge on the 19EF will vary with machine components and design conditions, indicated on the job data specifications. An approximate charge may be found in Table 8.

Always operate the condenser and chilled water pumps during charging operations to prevent freeze-ups. Use the Control Test, Terminate Lockout table to monitor conditions and start the pumps.

The refrigerant will be added through the refrigerant charging valve (Fig. 5) or to the pumpout charging connection. First evacuate the nitrogen holding charge from the vessels. Charge the refrigerant as a gas until the system pressure exceeds 35 psig (141 kPa) After the machine is beyond this pressure the refrigerant should be charged as a liquid until all of the recommended refrigerant charge has been added.

TRIMMING REFRIGERANT CHARGE — Trimming the charge can be best accomplished when design load is available. To trim, check the temperature difference between 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.

Table 8 — Refrigerant Charges

COOLER SIZE	19EF TOTAL REFRIGERANT CHARGE	
	lb	kg
26	2630	1195
56	3140	1427

NOTE: The size of the cooler determines refrigerant charge for the entire machine.

INITIAL START-UP

Preparation — Before starting the machine, check that the:

1. Power is on to the main starter, oil pump relay, tower fan starter, oil heater relay, and the machine control center.
2. Cooling tower water is at proper level, and at or below design entering temperature.
3. Machine is charged with refrigerant and all refrigerant and oil valves are in their proper operating position.
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 50° F (28° C).
6. Valves in the evaporator and condenser water circuits are open.

NOTE: If pumps are not automatic, make sure 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 devices and result in the loss of refrigerant charge.

7. Press **RELEASE** to automate the chiller start/stop value on the Status01 table to enable the chiller to start. The initial factory setting of this value is overridden to stop in order to prevent accidental start-up.

Manual Operation of the Guide Vanes — Manual operation of the guide vanes is helpful to establish a steady motor current for calibration of the motor amps value.

In order to manually operate the guide vanes, it is necessary to override the *TARGET GUIDE VANE POSITION* value which is accessed on the Status01 table. Manual control is indicated by the word “SUPVSR!” flashing after the target value position. Manual control is also indicated on the default screen on the run status line.

1. Access the Status01 table and look at the target guide vane position (Fig. 13). If the compressor is off, the value will read zero.
2. Move the highlight bar to the *TARGET GUIDE VANE POSITION* line and press the **SELECT** softkey.
3. Press **ENTER** to override the automatic target. The screen will now read a value of zero, and the word “SUPVSR!” will flash.
4. Press the **SELECT** softkey, and then press **RELEASE** softkey to release the vanes to AUTOMATIC mode. After a few seconds the “SUPVSR!” will disappear.

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. Look at the default screen on the LID: the Status message in the upper left-hand corner will show a “Manually Stopped” message. Press **CCN** or **LOCAL** softkeys to start. If not, 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. Check that chilled water and condenser water pumps energize.
4. Check that the oil pump starts and pressurizes the lubrication system. After the oil pump has run about 11 seconds, the starter will be energized and go through its start-up sequence.
5. Check the main contactor for proper operation.
6. The PIC will eventually show an alarm for motor amps not sensed. Reset this alarm and continue with the initial start-up.

Check Rotation

1. Engage the main motor disconnect on the front of the starter panel. The motor is now ready for rotation check.
2. After the default screen Status message states “Ready for Start” press the **LOCAL** softkey; start-up checks will be made by the control.
3. When the starter is energized and the motor begins to turn. Check for clockwise rotation (Fig. 26).

NOTE: Starter may have phase protection and will not allow a start if the phase is not correct. Instead, a Starter Fault message will occur if this happens.

IF ROTATION IS PROPER, allow the compressor to come up to speed.

IF THE MOTOR ROTATION IS NOT CLOCKWISE (as viewed through the sight glass), reverse any 2 of the 3 incoming power leads to the starter and recheck rotation. Make sure that oil pump rotation does not change.

⚠ CAUTION

Do not check motor rotation during coastdown. Rotation may have reversed during equalization of vessel pressures.



CORRECT MOTOR ROTATION IS CLOCKWISE WHEN VIEWED THROUGH MOTOR SIGHT GLASS

TO CHECK ROTATION, ENERGIZE COMPRESSOR MOTOR MOMENTARILY.
DO NOT LET MACHINE DEVELOP CONDENSER PRESSURE.
CHECK ROTATION IMMEDIATELY.

ALLOWING CONDENSER PRESSURE TO BUILD OR CHECKING
ROTATION WHILE MACHINE COASTS DOWN MAY GIVE A FALSE
INDICATION DUE TO GAS PRESSURE EQUALIZING THROUGH COMPRESSOR.

Fig. 26 — Correct Motor Rotation

Check Oil Pressure and Compressor Stop

1. When the motor is up to full speed, note the differential oil pressure reading on the LID default screen. It should be between 18 and 30 psid (124 to 206 kPad).
2. Press the Stop button and listen for any unusual sounds from the compressor as it coasts to a stop.

Calibrate Motor Current Demand Setting

1. Make sure that the compressor motor rated load amps in the Service1 table has been configured. Place an ammeter on the line that passes through the motor load current transfer on the motor side of the power factor correction capacitors (if provided).
2. Start the compressor and establish a steady motor current value between 70% and 100% (RLA) rated load amps by manually overriding the guide vane target value on the LID and setting the chilled water set point to a low value. Do not exceed 105% of the nameplate RLA.
3. When a steady motor current value in the desired range is met, compare the compressor motor amps value on the Status01 table to the actual amps shown on the ammeter on the starter. Adjust the amps value on the LID to the actual value seen at the starter if there is a difference. Highlight the amps value then press **[SELECT]**. Press **[INCREASE]** or **[DECREASE]** to bring the value to that indicated on the ammeter. Press **[ENTER]** when equal.
4. Make sure that the target guide vane position is released into AUTOMATIC mode.

To Prevent Accidental Start-Up — The PIC can be set up so that start-up of the unit is more difficult than just pressing the **[LOCAL]** or **[CCN]** softkeys during machine service or when necessary. By accessing the Status01 table, and highlighting the chiller Start/Stop line, the value can be overridden to stop by pressing **[SELECT]** and then the **[STOP]** and **[ENTER]** softkeys. “SUPVSR” will appear after the value. When attempting to restart, remember to release the override. The default machine message line will also state that the Start/Stop has been set to “Start” or “Stop” when the value is overridden.

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

Instruct the Customer Operator — Check to be sure that the operator(s) understand all operating and maintenance procedures. Point out the various machine parts and explain their function as part of the complete system.

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

ECONOMIZER — Float chambers.

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, LID 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 MACHINE 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 machine.

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 refrigeration machine and related equipment before operating the machine.
2. Prepare the system for start-up, start and stop the machine, 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 Machine for Start-Up — Follow the steps described in the Initial Start-Up section, page 45.

To Start the Machine

1. Start the water pumps, if they are not automatic.
2. On the LID default screen, press the **LOCAL** or **CCN** softkey to start the system. If the machine is in the OCCUPIED mode, and the 1- and 15-minute start timers have expired, the start sequence will start. Follow the procedure described in the Start-Up/Shutdown/Recycle section, page 34.

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

1. The oil reservoir temperature should be above 140 F (60 C) or refrigerant temperature plus 50° F (27° C) during shutdown, and above 110 F (43 C) during compressor operation.
2. The bearing oil temperature accessed on the Status01 table should be 140 to 165 F (60 to 74 C). If the bearing temperature reads more than 180 F (83 C) with the oil pump running, stop the machine and determine the cause of the high temperature. *Do not restart* the machine until corrected.
3. The oil level should be visible anywhere in one of the two sight glasses when the compressor is running.
At shutdown, oil level should be halfway in the lower sight glass.
4. The oil pressure should be between 15 and 30 psi (103 to 207 kPa) differential, as seen on the LID default screen. Typically the reading will be 18 to 25 psi (124 to 172 kPa) at initial start-up.
5. The moisture indicating sight glass on the refrigerant motor cooling line should indicate refrigerant flow and a dry condition.
6. The condenser pressure and temperature varies with the machine design conditions. Typically the pressure will range between 100 and 210 psig (690 to 1450 kPa) with a corresponding temperature range of 60 to 105 F (15 to 41 C). The condenser entering water temperature should be controlled below the specified design entering water temperature to save on compressor kilowatt requirements.

7. 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), with temperature ranging between 34 and 45 F (1 and 8 C).
8. 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 kW, 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 kW rate or temperature rate. It is accessed on the Equipment Configuration menu Config table (Table 2, Example 5).

To Stop the Machine

1. The occupancy schedule will start and stop the machine automatically once the time schedule is set up.
2. By pressing the STOP button for one second, the alarm light will blink once to confirm that the button has been pressed, then the compressor will follow the normal shutdown sequence as described in the Controls section. The machine will not restart until the **CCN** or **LOCAL** softkey is pressed. The machine is now in the OFF mode.

If the machine fails to stop, in addition to action that the PIC will initiate, the operator should close the guide vanes by overriding the guide vane target to zero to reduce machine load; then by opening the main disconnect. Do not attempt to stop the machine by opening an isolating knife switch. High intensity arcing may occur. *Do not restart* the machine until the problem is diagnosed and corrected.

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

Extended Shutdown — The refrigerant should be transferred into a storage vessel in order to reduce machine pressure and possibility of leaks. Maintain a holding charge of 5 to 10 lbs (2.27 to 4.5 kg) of refrigerant within the cooler/condenser/compressor sections, to prevent air from leaking into the machine.

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

Leave the oil charge in the machine with the oil heater and controls energized to maintain the oil reservoir temperature. Open compressor motor disconnect.

After Extended Shutdown — Be sure that 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 if necessary.

Check the cooler pressure on the LID default screen, and compare to the original holding charge that was left in the machine. If (after adjusting for ambient temperature changes) any loss in pressure is indicated, check for refrigerant leaks. See Check Machine Tightness section, page 36.

Recharge the machine by transferring refrigerant from the storage vessel. Follow the Refrigerant Transfer Procedure 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 compressor oil level appears abnormally high, the oil may have absorbed refrigerant. Make sure that the oil temperature is above 140 F (60 C) or cooler refrigerant temperature plus 50° F (27° C).

Cold Weather Operation — When the entering condenser water drops very low (55 F [13 C] minimum), the PIC can automatically cycle the cooling tower fans off to keep the temperature up. Piping may also have to be arranged to bypass the cooling tower.

Manual Guide Vane Operation — Manual operation of the guide vanes in order to check control operation or control of the guide vanes in an emergency operation is possible by overriding the target guide vane position. Access the Status01 table on the LID and highlight TARGET GUIDE VANE POSITION. To control the position, enter a percentage of guide vane opening that is desired. Zero percent is fully closed, 100% is fully open. To release the guide vanes to AUTOMATIC mode, press the **RELEASE** softkey.

NOTE: Manual control will increase the guide vanes and override the pulldown rate during start-up. Motor current above the electrical demand setting, capacity overrides, and chilled water below control point will override the manual target and close the guide vanes. For descriptions of capacity overrides and set points, see the Controls section.

Refrigeration Log — A refrigeration log, such as the one shown in Fig. 27, provides a convenient checklist for routine inspection and maintenance and provides a continuous record of machine performance. It is an aid in scheduling routine maintenance and in diagnosing machine problems.

Keep a record of the machine pressures, temperatures, and liquid levels on a sheet similar to that shown. Automatic recording of PIC 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.

REFRIGERANT TRANSFER PROCEDURE

Preparation — The refrigerant can be pumped into a storage tank for service work. Follow the manufacturer's pumpout and storage instructions and the pumpout instructions provided on the LID when transferring refrigerant.

To read refrigerant pressures during pumpout or leak testing:

The LID display on the machine control center is suitable for determining refrigerant-side pressures and low (soft) vacuum. For evacuation or dehydration measurement, use a quality vacuum indicator or manometer to ensure the desired range and accuracy. This can be placed on the Schrader connections on each vessel (Fig. 5) by removing the pressure transducer.

⚠ CAUTION

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

GENERAL MAINTENANCE

Refrigerant Properties — HFC-134a is the standard refrigerant in the 19EF. At normal atmospheric pressure, HFC-134a will boil at -41 F (-25 C) and therefore must be kept in pressurized containers or storage tanks. The refrigerants are practically odorless when mixed with air. This refrigerant 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 this refrigerant.

▲ DANGER

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 Charge Refrigerant Into Machine section, page 44.

▲ WARNING

Always use the compressor pumpdown function in the Control Test table 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 machine pressure is below 30 psig (207 kPa) for HFC-134a.

Removing Refrigerant — The 19EF refrigerant charge must be transferred to a storage vessel. Follow the appropriate procedures when removing refrigerant.

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

→ **Refrigerant Leak Testing** — Because HFC-134a is above atmospheric pressure at room temperature, leak testing can be performed with refrigerant in the machine. Use an electronic detector, soap bubble solution, or ultrasonic 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 liquid and gas from the leaking vessel.

Refrigerant Leak Rate — ASHRAE recommends that machines should be immediately taken off line and repaired if the refrigerant leakage rate for the entire machine 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 machine has been opened for service, the machine or the affected vessels must be pressurized and leak tested. Refer to the Leak Test Machine section to perform a leak test.

▲ WARNING

HFC-134a should not be mixed with air or oxygen and pressurized for leak testing. In general, this refrigerant should not be allowed to be present with high concentrations of air or oxygen above atmospheric pressures, as the mixture can undergo combustion.

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 pressurize with nitrogen only and use a 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 machine 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 machine. Remove the copper tube if no longer required.

Repair the Leak, Retest, and Apply Standing Vacuum Test

— After pressurizing the machine, test for leaks with an electronic leak detector, soap bubble solution, or an ultrasonic leak detector. Bring the machine back to atmospheric pressure, repair any leaks found, and retest.

After retesting and finding no leaks, apply a standing vacuum test, and then dehydrate the machine. Refer to the Standing Vacuum Test and Machine Dehydration in the Before Initial Start-Up section, page 37.

Checking Guide Vane Linkage — When the machine is off, the guide vanes are closed and the actuator mechanism is in the position shown in Fig. 28. If slack develops in the drive chain, backlash can be eliminated as follows:

1. With the machine shut down and the actuator fully closed, remove the chain guard and loosen the actuator bracket holddown bolts.
2. Loosen guide vane sprocket adjusting bolts.
3. Pry bracket upwards to remove slack, then retighten the bracket holddown bolts.
4. Retighten the guide vane sprocket adjusting bolts. Make sure that the guide vane shaft is rotated fully in the clockwise direction in order for it to be fully closed.

Trim Refrigerant Charge — If it becomes necessary to adjust the refrigerant charge to obtain optional machine performance, operate the machine 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 or becomes a minimum. *Do not overcharge.*

WEEKLY MAINTENANCE

Check the Lubrication System — Mark the oil level on the reservoir sight glass, and observe the level each week while the machine is shut down.

If the level goes below the lower sight glass, the oil reclaim system will need to be checked for proper operation. If additional oil is required, add it through the oil drain charging valve (Fig. 2). A pump is required for adding oil against refrigerant pressure. The oil charge is approximately 15 gallons (57 L) for compressors. The added oil *must* meet Carrier specifications for the 19EF. Refer to Change Oil and Oil Filter and Oil Changes sections. Any additional oil that is added should be logged by noting the amount and date. Any oil that is added due to oil loss that is not related to service will eventually return to the sump. It must be removed when the level is high.

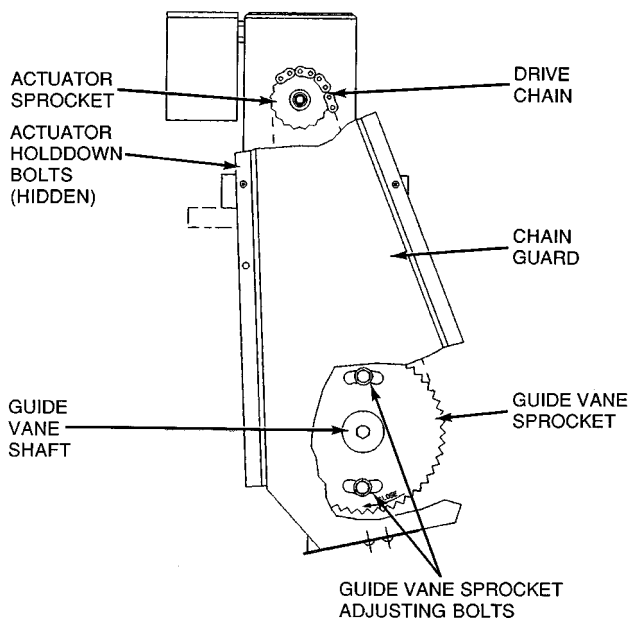


Fig. 28 — Guide Vane Actuator Linkage

An oil heater is controlled by the PIC to maintain oil temperature above 140 F (60 C) or refrigerant temperature plus 60° F (15.6° C) (see the Controls section) when the compressor is off. The LID Status02 table displays whether the heater is energized or not. If the PIC 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 will not permit compressor start-up if the oil temperature is too low. 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 machine requirements such as machine load, run hours, and water quality. The time intervals listed in this section are offered as guides to service only.

Service Ontime — The LID will display a *SERVICE ONTIME* value on the Status01 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 viewed.

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

⚠ CAUTION

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

Check Safety and Operating Controls Monthly

— To ensure machine protection, the Control Test Automated Test should be done at least once per month. See Table 3 for safety control settings. See Table 7 for Control Test functions.

Change Oil and Oil Filters

1. Transfer refrigerant into storage tanks.
 2. Turn off oil heater.
 3. When machine pressure is 5 psig (35 kPa) or less, drain the oil reservoir by opening the drain valve (Fig. 2). Open valve slowly against refrigerant pressure.
 4. Close the line valve (Fig. 29, Item 1) to isolate the oil filter(s).
 5. Loosen the filter holding clamp (Item 2).
 6. Rotate filter nut (Item 3) counterclockwise to remove filter housing. Keep the filter housing upright to avoid oil spill.
 7. Drain the oil; remove and replace filter cartridges. Do not use any of the extra felt washers supplied with the filters.
 8. Bench assemble Items A-D upside down. Then slide filter housing over the stack to ensure that spring (Item D) is centered in the bottom of the filter housing as indicated.
 9. Charge machine with oil. Approximately 15 gal. (57 L) for 19EF4 size compressor should bring level into compressor sight glass.
 10. Turn on oil heater and warm the oil to 140 to 150 F (60 to 66 C). Operate the oil pump for 2 minutes. Add oil if required to keep level up to lower sight glass.
- Oil should be visible in the reservoir sight glass during all operating and shutdown conditions.

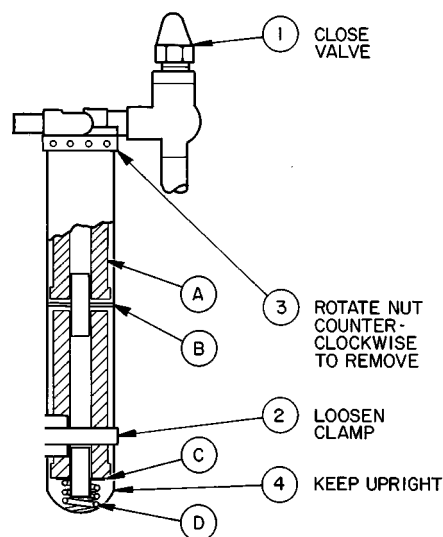


Fig. 29 — Removing the Oil Filter

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

- Oil Type for units using HFC-134a Inhibited polyolester-based synthetic compressor oil formatted for use with HFC, gear-driven, hermetic compressors.
- ISO Viscosity Grade 68

The polyolester-based oil may be ordered from your local Carrier representative.

Oil Changes — Carrier recommends changing the oil and filter after the first year of operation and every three years thereafter as a minimum along with a yearly oil analysis. However, if a continuous oil monitoring system is functioning and a yearly oil analysis is performed, time between oil changes can be extended.

Refrigerant Filter — A replaceable core refrigerant filter/drier, located on the refrigerant cooling line to the motor, (Fig. 2) should have the core changed once a year, or more often if filter condition indicates a need for more frequent replacement. Change the filter with the machine pressure at 0 psig (0 kPa) by transferring the refrigerant to the utility vessel. A moisture indicating sight glass is located beyond this filter to indicate the volume and moisture in the refrigerant. If the moisture indicator (dry-eye) indicates moisture, locate the source of water immediately by performing a thorough leak check.

Change Refrigerant Filter or Strainer — With machine refrigerant evacuated and the pressure at 0 psig (0 kPa), change refrigerant filter or strainer yearly, or more often if filter or strainer condition indicates a need for more frequent replacement.

Inspect Refrigerant Float System — The refrigerant float system must be inspected every 5 years or when machine is opened for service.

Transfer refrigerant into storage tanks. Remove float chamber access covers on economizer. Clean each chamber and valve assembly thoroughly. Be sure that float valves move freely. See that orifices, vent, drain, and control connections are free from obstructions. Examine cover gaskets and replace if necessary.

Inspect Relief Valves and Piping — The relief valves on this machine 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.

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 machine 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 and Gear Maintenance — The key to good bearing and gear maintenance is proper lubrication. Use the proper grade of oil, maintained at recommended level, temperature, and pressure. Inspect the lubrication system regularly and thoroughly.

Only a trained service technician should remove and examine the bearings. The bearings and gears should be examined on a scheduled basis for signs of wear. The frequency of examination is determined by the hours of machine operation, load conditions during operation, and the condition of the oil and the lubrication system. Excessive bearing wear can sometimes be detected through increased vibration or increased bearing temperature. If either symptom appears, contact an experienced and responsible service organization for assistance.

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 machine. 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 HFC-134a is a high-pressure refrigerant, air usually does not enter the machine.

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 machine operation by the refrigerant moisture indicator (dry-eye) (Fig. 2) on the refrigerant motor cooling line. Water leaks should be repaired immediately.

⚠ CAUTION

Machine must be dehydrated after repair of water leaks. See Machine Dehydration section, page 37.

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 machine performance and 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 machine, and open all disconnects supplying power to the starter.

⚠ WARNING

The disconnect on the starter front panel does not de-energize 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 silver-plated 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 three transducers: oil pressure, condenser pressure, cooler pressure.

Note the evaporator and condenser pressure readings on the Status01 table on the LID. 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.

Ordering Replacement Chiller Parts — When ordering Carrier specified parts, the following information must accompany an order:

- machine 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 has many features to aid the operator and the technician in troubleshooting a 19EF machine.

- By using the LID display, the chiller actual operating conditions can be viewed while the unit is running.
- When an alarm occurs, the default LID screen will freeze at the time of alarm. The freeze enables the operator to view the machine conditions at the time of alarm. The Status tables will still show the current information. Once all alarms have been cleared, the default LID screens will return to normal operation.
- The Control Test feature allows proper operation and testing 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 display will show the required temperatures and pressures during these operations.
- Other Service menu tables 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 LID default screen. A more detailed message — along with a diagnostic message — also is stored into the Alarm History table.

Checking the Display Messages — The first area to check when troubleshooting the 19EF is the LID display. If the alarm light is flashing, check the primary and secondary message lines on the LID default screen (Fig. 10). These messages will indicate where the fault is occurring. The Alarm History table on the LID Service menu will also carry an alarm message to further expand on this alarm. For a complete listing of messages, see Table 9. If the alarm light starts to flash while accessing a menu screen, depress **EXIT** to return to the Default screen to read the failure message. The compressor will not run with an alarm condition existing, unless the alarm type is an unauthorized start or a failure to shut down.

Checking Temperature Sensors — All temperature sensors are of the thermistor type. This means that the resistance of the sensor varies with temperature. All sensors have the same resistance characteristics. Determine sensor temperature by measuring voltage drop if the controls are powered, or resistance if the controls are powered off. Compare the readings to the values listed in Table 10A or 10B.

RESISTANCE CHECK — Turn off the control power and disconnect the terminal plug of the sensor in question from the module. Measure sensor resistance between receptacles designated by the wiring diagram with a digital ohmmeter. The resistance and corresponding temperature is listed in Table 10A or 10B. Check the resistance of both wires to ground. This resistance should be infinite.

VOLTAGE DROP — Using a digital voltmeter, the voltage drop across any energized sensor can be measured 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. Sensor wire should also be checked at the sensor plug connection. Check the sensor wire by removing the condenser at the sensor and measure for 5 vdc back to the module if the control is powered.

▲ CAUTION

Relieve all refrigerant pressure or drain the water prior to replacing the temperature sensors.

CHECK SENSOR ACCURACY — Place the sensor in a medium of a 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 0.5° F (.25° C) graduations. The sensor in question should be accurate to within 2° F (1.2° C).

See Fig. 5 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 — There are 2 sensing elements on each of the bearing and motor temperature sensors for servicing convenience. In case one of the dual sensors is damaged, the other one can be used by moving a wire.

The number 1 terminal in the sensor terminal box is the common line. To use the second sensor, move the wire from the number 2 position to the number 3 position.

Checking Pressure Transducers — There are 3 pressure transducers on the 19EF. These determine cooler, condenser, and oil pressure. The cooler and condenser transducers also are used by the PIC to determine the refrigerant temperatures. All 3 can be calibrated if necessary. It is not usually necessary to calibrate at initial start-up. However, at high altitude locations, calibration of the transducer will be necessary to ensure the proper refrigerant temperature/pressure relationship. Each transducer is supplied with 5 vdc power from a power supply. If the power supply fails, a transducer voltage reference alarm will occur. If the transducer reading is suspected of being faulty, check the supply voltage. It should be 5 vdc ± .5 v. If the supply voltage is correct, the transducer should be recalibrated or replaced.

IMPORTANT: Whenever the oil pressure or the cooler pressure transducer is calibrated, the other sensor should be calibrated to prevent problems with oil differential pressure readings.

Calibration can be checked by comparing the pressure readings from the transducer against an accurate refrigeration gage. These readings are all viewed or calibrated from the Status01 table on the LID. The transducer can be checked and calibrated at 2 pressure points. These calibration points are 0 psig (0 kPa) and between 225 and 275 psig (1551 and 1896 kPa). To calibrate these transducers:

1. Shut down the compressor.
2. Disconnect the transducer in question from its Schrader fitting.

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 Status01 table, and view the particular transducer reading; 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 zeroed by pressing the **[SELECT]** softkey while the highlight bar is located on the transducer, and then by pressing the **[ENTER]**. The value will now go to zero.

If the transducer value is not within the calibration range, the transducer will return to the original reading. If the LID pressure value 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, measured at the PSIO terminals J7-J34 and J7-J35. For example, the condenser transducer voltage input is measured at PSIO terminals J7-1 and J7-2. The voltage ratio must be between 0.80 vdc and 0.11 vdc 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 225 and 275 psig (1551 and 1896 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 transducer on the Status01 table, highlighting the transducer, pressing the **[SELECT]** softkey, and then increasing or decreasing the value to the exact pressure on the refrigerant gage. Press **[ENTER]** to finish. High altitude locations must compensate the pressure so that the temperature/pressure relationship is correct.

If the transducer reading returns to the previous value and the pressure is within the allowed range, check the voltage ratio of the transducer. Refer to Step 3 above. The voltage ratio for this high pressure calibration must be between 0.585 and 0.634 vdc to allow calibration. Change the pressure at the transducer until the ratio is within the acceptable range. Then attempt calibrate to the new pressure input.

The PIC will not allow calibration if the transducer is too far out of calibration. 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. 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

Make sure to use a backup wrench on the Schrader fitting whenever removing any transducer. The Schrader fitting can be removed when the transducer is removed. Serious injury can result.

Control Algorithms Checkout Procedure — In the LID Service menu, one of the tables is Control Algorithm Status. This table contains 6 maintenance tables which may be viewed in order to see how the particular control algorithm is operating. The 6 tables are:

MAINT01	Capacity Control	This table shows all values that are used to calculate the chilled water/brine control point.
MAINT02	Override Status	Details of all chilled water control override values are viewed here.
MAINT03	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.
MAINT04	LEAD/LAG Status	This screen indicates LEAD/LAG operation status.
OCCDEFM	Time Schedules Status	The Local and CCN occupied schedules are displayed here in a manner that the operator can 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 which can turn on the chiller and change the chilled water control point. This screen indicates the status of this system.

These maintenance tables are very useful in determining how the control temperature is calculated, guide vane position, reaction from load changes, control point overrides, hot gas bypass reaction, surge prevention, etc.

Control Test — The Control Test feature can check all of the thermistor temperature sensors, including those on the Options modules, pressure transducers, pumps and their associated flow switches, the guide vane actuator, 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, among other useful troubleshooting tests. During pumpdown operations, the pumps are energized to prevent freeze-up and the vessel pressures and temperatures are displayed. The lockout feature will prevent start-up of the compressor when no refrigerant is present in the machine, or if the vessels are isolated. The lockout is then terminated by the operator by using the Terminate Lockout table after the pumpdown procedure is reversed and refrigerant is added.

LEGEND FOR TABLE 9, A - N

1CR__AUX	— Compressor Start Contact
CA__P	— Compressor Current
CDFL	— Condenser Water Flow
CHIL__S__S	— Chiller Start/Stop
CMPD	— Discharge Temperature
CRP	— Condenser Pressure
ERT	— Evaporator Refrigerant Temperature
EVFL	— Chilled Water Flow
GV__TRG	— Target Guide Vane Position
LID	— Local Interface Device
MTRB	— Bearing Temperature
MTRW	— Motor Winding Temperature
OILPD	— Oil Pressure
OILT	— Oil Sump Temperature
PIC	— Product Integrated Control
PRS__TRIP	— Pressure Trip Contact
PSIO	— Processor Sensor Input/Output Module
RLA	— Rated Load Amps
RUN__AUX	— Compressor Run Contact
SPR__PL	— Spare Protective Limit Input
SMM	— Starter Management Module
STR__FLT	— Starter Fault
TXV	— Thermostatic Expansion Valve
V__P	— Line Voltage: Percent
V__REF	— Voltage Reference

Table 9 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides

A. SHUTDOWN WITH ON/OFF/RESET-OFF

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
MANUALLY STOPPED — PRESS	CCN OR LOCAL TO START	PIC in OFF mode, press the 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	Machine unloading before shutdown due to Soft Stop feature.
SHUTDOWN IN PROGRESS	COMPRESSOR DEENERGIZED	Machine compressor is being commanded to stop. Water pumps are deenergized within one minute.
ICE BUILD	OPERATION COMPLETE	Machine shutdown from Ice Build operation.

B. TIMING OUT OR TIMED OUT

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
READY TO START IN XX MIN	UNOCCUPIED MODE	Time schedule for PIC is unoccupied. Machines will start only when occupied.
READY TO START IN XX MIN	REMOTE CONTACTS OPEN	Remote contacts have stopped machine. Close contacts to start.
READY TO START IN XX MIN	STOP COMMAND IN EFFECT	Chiller START/STOP on Status01 manually forced to stop. Release value to start.
READY TO START IN XX MIN	RECYCLE RESTART PENDING	Machine in recycle mode.
READY TO START	UNOCCUPIED MODE	Time schedule for PIC is UNOCCUPIED. Machine will start when occupied. Make sure the time and date have been set on the Service menu.
READY TO START	REMOTE CONTACTS OPEN	Remote contacts have stopped machine. Close contacts to start.
READY TO START	STOP COMMAND IN EFFECT	Chiller START/STOP on Status01 manually forced to stop. Release value to start.
READY TO START IN XX MIN	REMOTE CONTACTS CLOSED	Machine timer counting down unit. Ready for start.
READY TO START IN XX MIN	OCCUPIED MODE	Machine timer counting down unit. Ready for start.
READY TO START	REMOTE CONTACTS CLOSED	Machine timers complete, unit start will commence.
READY TO START	OCCUPIED MODE	Machine timers complete, unit start will commence.
STARTUP INHIBITED	LOADSHED IN EFFECT	CCN loadshed module commanding chiller to stop.
READY TO START IN XX MIN	START COMMAND IN EFFECT	Chiller START/STOP on Status01 has been manually forced to start. Machine will start regardless of time schedule or remote contact status.

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 high enough to start.
RECYCLE RESTART PENDING	REMOTE CONTACT CLOSED	Unit in recycle mode, chilled water temperature is not high enough to start.
RECYCLE RESTART PENDING	START COMMAND IN EFFECT	Chiller START/STOP on Status01 manually forced to start, chill water temperature is not high enough to start.
RECYCLE RESTART PENDING	ICE BUILD MODE	Machine in ICE BUILD mode. Chilled Water/Brine Temperature is satisfied for Ice Build Setpoint temperature.

D. PRE-START ALERTS: These alerts only delay start-up. When alert is corrected, the start-up will continue. No reset is necessary.

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
PRESTART ALERT	STARTS LIMIT EXCEEDED	STARTS EXCESSIVE Compressor Starts (8 in 12 hours)	Depress the RESET softkey if additional start is required. Reassess start-up requirements.
PRESTART ALERT	HIGH MOTOR TEMPERATURE	MTRW VALUE exceeded limit of [LIMIT]*. Check motor temperature.	Check motor cooling line for proper operation. Check for excessive starts within a short time span. Check refrigerant filter.
PRESTART ALERT	HIGH BEARING TEMPERATURE	MTRB VALUE exceeded limit of [LIMIT]*. Check thrust bearing temperature.	Check oil heater for proper operation, check for low oil level, partially closed oil supply valves, etc. Check sensor accuracy. Check oil cooler and valve.
PRESTART ALERT	HIGH DISCHARGE TEMP	CMPD VALUE exceeded limit of [LIMIT]*. Check discharge temperature.	Check sensor accuracy. Allow discharge temperature to cool. Check for excessive starts. Avoid extended low load operation.
PRESTART ALERT	LOW REFRIGERANT TEMP	ERT VALUE exceeded limit of [LIMIT]*. Check refrigerant temperature.	Check transducer accuracy. Check for low chilled water/brine supply temperature.
PRESTART ALERT	LOW OIL TEMPERATURE	OILT VALUE exceeded limit of [LIMIT]*. Check oil temperature.	Check oil heater power, oil heater relay. Check oil level. Check oil cooler solenoid.
PRESTART ALERT	LOW LINE VOLTAGE	V__ P VALUE exceeded limit of [LIMIT]*. Check voltage supply.	Check voltage supply. Check voltage transformers. Consult power utility if voltage is low. Adjust voltage potentiometer in starter for SMM voltage input.
PRESTART ALERT	HIGH LINE VOLTAGE	V__ P VALUE exceeded limit of [LIMIT]*. Check voltage supply.	Check voltage supply. Check voltage transformers. Consult power utility if voltage is low. Adjust voltage potentiometer in starter for SMM voltage input.
PRESTART ALERT	HIGH CONDENSER PRESSURE	CRP VALUE exceeded limit of [LIMIT]*. Check condenser water and transducer.	Check for high condenser water temperature. Check transducer accuracy.

*[LIMIT] is shown on the LID as temperature, pressure, voltage, etc., predefined or selected by the operator as an override or an alert.

Table 9 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

E. NORMAL OR AUTO.-RESTART

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
STARTUP IN PROGRESS	OCCUPIED MODE	Machine starting. Time schedule is occupied.
STARTUP IN PROGRESS	REMOTE CONTACT CLOSED	Machine starting. Remote contacts are closed.
STARTUP IN PROGRESS	START COMMAND IN EFFECT	Machine starting. Chiller START/STOP on Status01 manually forced to start.
AUTORESTART IN PROGRESS	OCCUPIED MODE	Machine starting. Time schedule is occupied.
AUTORESTART IN PROGRESS	REMOTE CONTACT CLOSED	Machine starting. Remote contacts are closed.
AUTORESTART IN PROGRESS	START COMMAND IN EFFECT	Machine starting. Chiller START/STOP on Status01 manually forced to start.

F. START-UP FAILURES: This is an alarm condition. A manual reset is required to clear.

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
FAILURE TO START	LOW OIL PRESSURE	OILPD [VALUE] exceeded limit of [LIMIT]*. Check oil pump system.	Check for closed oil supply valves. Check oil filter. Check for low oil temperature. Check transducer accuracy.
FAILURE TO START	OIL PRESS SENSOR FAULT	OILPD [VALUE] exceeded limit of [LIMIT]*. Check oil pressure sensor.	Check for excessive refrigerant in oil sump. Run oil pump manually for 5 minutes. Check transducer calibration. Check cooler pressure transducer calibration. Check wiring. Replace transducer if necessary.
FAILURE TO START	LOW CHILLED WATER FLOW	EVFL Evap Flow Fault: Check water pump/flow switch.	Check wiring to flow switch. Check through Control Test for proper switch operation.
FAILURE TO START	LOW CONDENSER WATER FLOW	CDFL Cond. Flow Fault: Check water pump/flow switch.	Check wiring to flow switch. Check through Control Test for proper switch operation.
FAILURE TO START	STARTER FAULT	STR__FLT Starter Fault: Check Starter for Fault Source.	A starter protective device has faulted. Check starter for ground fault, voltage trip, temperature trip, etc.
FAILURE TO START	STARTER OVERLOAD TRIP	STR__FLT Starter Overload Trip: Check amps calibration/reset overload.	Reset overloads before restart.
FAILURE TO START	LINE VOLTAGE DROPOUT	V__P Single-Cycle Dropout Detected: Check voltage supply.	Check voltage supply. Check transformers for supply. Check with utility if voltage supply is erratic. Monitor must be installed to confirm consistent, single-cycle dropouts. Check low oil pressure switch. Check under/over voltage fault relay.
FAILURE TO START	HIGH CONDENSER PRESSURE	High Condenser Pressure [LIMIT]: Check switch 2C aux, and water temperature/flow.	Check for proper design condenser flow and temperature. Check condenser approach. Check 2C auxiliary contacts on oil sump starter. Check high pressure switch.
FAILURE TO START	EXCESS ACCELERATION TIME	CA__P Excess Acceleration: Check guide vane closure at start-up.	Check that guide vanes are closed at start-up. Check starter for proper operation. Reduce unit pressure if possible.
FAILURE TO START	STARTER TRANSITION FAULT	RUN__AUX Starter Transition Fault: Check 1CR/1M/Interlock mechanism.	Check starter for proper operation. Run contact failed to close.
FAILURE TO START	1CR AUX CONTACT FAULT	1CR__AUX Starter Contact Fault: Check 1CR/1M aux. contacts.	Check starter for proper operation. Start contact failed to close.
FAILURE TO START	MOTOR AMPS NOT SENSED	CA__P Motor Amps Not Sensed: Check motor load signal.	Check for proper motor amps signal to SMM. Check wiring from SMM to current transformer. Check main motor circuit breaker for trip.
FAILURE TO START	LOW OIL PRESSURE	Low Oil Pressure [LIMIT]: Check oil pressure switch/pump and 2C aux.	The oil pressure differential switch is open when the compressor tried to START. Check the switch for proper operation. Also, check the oil pump interlock (2C aux) in the power panel and the high condenser pressure switch.

*[LIMIT] is shown on the LID 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.

G. COMPRESSOR JUMPSTART AND REFRIGERANT PROTECTION

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
UNAUTHORIZED OPERATION	UNIT SHOULD BE STOPPED	CA__P Emergency: Compressor running without control authorization.	Compressor is running with more than 10% RLA and control is trying to shut it down. Turn power off to compressor if unable to stop. Determine cause before repowering.
POTENTIAL FREEZE-UP	EVAP PRESS/TEMP TOO LOW	ERT Emergency: Freeze-up prevention.	Determine cause. If pumping refrigerant out of machine, stop operation and go over pumpout procedures.
FAILURE TO STOP	DISCONNECT POWER	RUN__AUX Emergency: DISCONNECT POWER.	Starter run or start contacts are closed while control tried to shut down. Disconnect power to starter.
LOSS OF COMMUNICATION	WITH STARTER	Loss of Communication with Starter: Check machine.	Check wiring from PSIO to SMM. Check SMM module troubleshooting procedures.
STARTER CONTACT FAULT	ABNORMAL 1CR OR RUN AUX	1CR__AUX Starter Contact Fault: Check 1CR/1M aux. contacts.	Starter run and start contacts energized while machine was off. Disconnect power.
POTENTIAL FREEZE UP	COND PRESS/TEMP TOO LOW	CRT [VALUE] exceeded limit of [LIMIT]* Emergency: Freeze-up prevention.	The condenser pressure transducer is reading a pressure that could freeze the water in the condenser tubes. Check for condenser refrigerant leaks, bad transducers, or transferred refrigerant. Place the unit in Pumpdown mode to eliminate ALARM if vessel is evacuated.

*[LIMIT] is shown on the LID 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 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

H. NORMAL RUN WITH RESET, TEMPERATURE, OR DEMAND

PRIMARY MESSAGE	SECONDARY MESSAGE	PROBABLE CAUSE/REMEDY
RUNNING — RESET ACTIVE	4-20MA SIGNAL	Reset program active based upon Config table setup.
RUNNING — RESET ACTIVE	REMOTE SENSOR CONTROL	
RUNNING — RESET ACTIVE	CHW TEMP DIFFERENCE	
RUNNING — TEMP CONTROL	LEAVING CHILLED WATER	Default method of temperature control.
RUNNING — TEMP CONTROL	ENTERING CHILLED WATER	ECW control activated on Config table.
RUNNING — TEMP CONTROL	TEMPERATURE RAMP LOADING	Ramp loading in effect. Use Service1 table to modify.
RUNNING — DEMAND LIMITED	BY DEMAND RAMP LOADING	Ramp loading in effect. Use Service1 table to modify.
RUNNING — DEMAND LIMITED	BY LOCAL DEMAND SETPOINT	Demand limit setpoint is < actual demand.
RUNNING — DEMAND LIMITED	BY 4-20MA SIGNAL	Demand limit is active based on Config table setup.
RUNNING — DEMAND LIMITED	BY CCN SIGNAL	
RUNNING — DEMAND LIMITED	BY LOADSHED/REDLINE	
RUNNING — TEMP CONTROL	HOT GAS BYPASS	Hot Gas Bypass is energized. See surge prevention in the control section.
RUNNING — DEMAND LIMITED	BY LOCAL SIGNAL	Active demand limit manually overridden or Status01 table.
RUNNING — TEMP CONTROL	ICE BUILD MODE	Machine is running under Ice Build temperature control.

I. NORMAL RUN OVERRIDES ACTIVE (ALERTS)

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
RUN CAPACITY LIMITED	HIGH CONDENSER PRESSURE	CRP [VALUE]* exceeded limit of [LIMIT]*. Condenser pressure override.	See Capacity Overrides, Table 4. Correct operating condition, modify setpoint, or release override.
RUN CAPACITY LIMITED	HIGH MOTOR TEMPERATURE	MTRW [VALUE]* exceeded limit of [LIMIT]*. Motor temperature override.	
RUN CAPACITY LIMITED	LOW EVAP REFRIG TEMP	ERT [VALUE]* exceeded limit of [LIMIT]*. Check refrigerant charge level.	
RUN CAPACITY LIMITED	HIGH COMPRESSOR LIFT	Surge Prevention Override; lift too high for compressor.	
RUN CAPACITY LIMITED	MANUAL GUIDE VANE TARGET	GV__TRG Run Capacity Limited: Manual guide vane target.	

*[LIMIT] is shown on the LID 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 temperature, pressure, voltage, etc., at which the control tripped.

J. OUT-OF-RANGE SENSOR FAILURES

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
SENSOR FAULT	LEAVING CHW TEMPERATURE	Sensor Fault: Check leaving CHW sensor.	See sensor test procedure and check sensors for proper operation and wiring.
SENSOR FAULT	ENTERING CHW TEMPERATURE	Sensor Fault: Check entering CHW sensor.	
SENSOR FAULT	CONDENSER PRESSURE	Sensor Fault: Check condenser pressure transducer.	
SENSOR FAULT	EVAPORATOR PRESSURE	Sensor Fault: Check evaporator pressure transducer.	
SENSOR FAULT	BEARING TEMPERATURE	Sensor Fault: Check bearing temp/impeller displacement switch.	
SENSOR FAULT	MOTOR WINDING TEMP	Sensor Fault: Check motor temperature sensor.	
SENSOR FAULT	DISCHARGE TEMPERATURE	Sensor Fault: Check discharge temperature sensor.	
SENSOR FAULT	OIL SUMP TEMPERATURE	Sensor Fault: Check oil sump temperature sensor.	
SENSOR FAULT	OIL PRESSURE TRANSDUCER	Sensor Fault: Check oil pressure transducer.	

Table 9 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

K. MACHINE PROTECT LIMIT FAULTS

⚠ CAUTION

Excessive numbers of the same fault can lead to severe machine damage. Contact your service contractor.

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
PROTECTIVE LIMIT	HIGH DISCHARGE TEMP	CMPD [VALUE] exceeded limit of [LIMIT]*. Check discharge temperature.	Check discharge temperature immediately. Check sensor for accuracy; check for proper condenser flow and temperature; check oil reservoir temperature. Check condenser for fouled tubes or air in machine. Check for proper guide vane actuator operation.
PROTECTIVE LIMIT	LOW REFRIGERANT TEMP	ERT [VALUE] exceeded limit of [LIMIT]*. Check evap pump and flow switch.	Check for proper amount of refrigerant charge; check for proper water flow and temperatures. Check for proper guide vane actuator operation.
PROTECTIVE LIMIT	HIGH MOTOR TEMPERATURE	MTRW [VALUE] exceeded limit of [LIMIT]*. Check motor cooling and solenoid.	Check motor temperature immediately. Check sensor for accuracy. Check for proper condenser flow and temperature. Check motor cooling system for restrictions. Check refrigerant filter.
PROTECTIVE LIMIT	HIGH BEARING TEMPERATURE	MTRB [VALUE] exceeded limit of [LIMIT]*. Check oil cooling control.	Check for throttled oil supply isolation valves. Valves should be wide open. Check oil cooler solenoid cock valve. Check sensor accuracy. Check journal and thrust bearings. Check refrigerant filter. Check for excessive oil sump level.
PROTECTIVE LIMIT	LOW OIL PRESSURE	OILPD [VALUE] exceeded limit of [LIMIT]*. Check oil pump and transducer.	Check power to oil pump and oil level. Check for dirty filters or oil foaming at start-up. Check for thermal overload cutout. Reduce ramp load rate if foaming noted. NOTE: This alarm is not related to pressure switch problems.
PROTECTIVE LIMIT	NO MOTOR CURRENT	CA_P Loss of Motor Current: Check sensor.	Check wiring: Check torque setting on solid state starter. Check for main circuit breaker trip. Check power supply to PSIO module.
PROTECTIVE LIMIT	POWER LOSS	V_P Power Loss: Check voltage supply.	Check 21-vac power to PSIO.
PROTECTIVE LIMIT	LOW LINE VOLTAGE	V_P [VALUE] exceeded limit of [LIMIT]*. Check voltage supply.	Check 24-vac input sensor on the SMM; adjust potentiometer if necessary. Check transformers to SMM. Check power to PSIO module. Check distribution bus. Consult power company. Check trip indication on under/over voltage device.
PROTECTIVE LIMIT	HIGH LINE VOLTAGE	V_P [VALUE] exceeded limit of [LIMIT]*. Check voltage supply.	Check 24-vac input sensor on the SMM; adjust potentiometer if necessary. Check transformers to SMM. Check power to PSIO module. Check distribution bus. Consult power company. Check trip indication on under/over voltage device.
PROTECTIVE LIMIT	LOW CHILLED WATER FLOW	EVFL Flow Fault: Check evap pump/flow switch.	Perform pumps Control Test and verify proper switch operation. Check all water valves and pump operation.
PROTECTIVE LIMIT	LOW CONDENSER WATER FLOW	CDFL Flow Fault: Check cond pump/flow switch.	Perform pumps Control Test and verify proper switch operation. Check all water valves and pump operation.
PROTECTIVE LIMIT	HIGH CONDENSER PRESSURE	High Cond Pressure [OPEN]: Check switch, 2C aux., and water temp/flow.	Check the high-pressure switch. Check for proper condenser pressures and condenser waterflow. Check for fouled tubes. Check the 2C aux. contact and the oil pressure switch in the power panel. This alarm is not caused by the transducer.
PROTECTIVE LIMIT	HIGH CONDENSER PRESSURE	High Cond Pressure [VALUE]: Check switch, water flow, and transducer.	Check water flow in condenser. Check for fouled tubes. Transducer should be checked for accuracy. This alarm is not caused by the high pressure switch.
PROTECTIVE LIMIT	1CR AUX CONTACT FAULT	CR_AUX Starter Contact Fault: Check 1CR/1M aux contacts.	1CR auxiliary contact opened while machine was running. Check starter for proper operation.
PROTECTIVE LIMIT	RUN AUX CONTACT FAULT	RUN_AUX Starter Contact Fault: Check 1CR/1M aux contacts.	Run auxiliary contact opened while machine was running. Check starter for proper operation.
PROTECTIVE LIMIT	CCN OVERRIDE STOP	CHIL_S_S CCN Override Stop while in LOCAL run mode.	CCN has signaled machine to stop. Reset and restart when ready. If the signal was sent by the LID, release the Stop signal on STATUS01 table.
PROTECTIVE LIMIT	SPARE SAFTY DEVICE	SRP_PL Spare Safety Fault: Check contacts.	Spare safety input has tripped or factory-installed jumper not present.
PROTECTIVE LIMIT	EXCESSIVE MOTOR AMPS	CA_P [VALUE] exceeded limit of [LIMIT]*. High Amps; Check guide vane drive.	Check motor current for proper calibration. Check guide vane drive and actuator for proper operation.
PROTECTIVE LIMIT	EXCESSIVE COMPR SURGE	Compressor Surge: Check condenser water temp and flow.	Check condenser flow and temperatures. Check configuration of surge protection. Check for low refrigerant temperature.
PROTECTIVE LIMIT	STARTER FAULT	STR_FLT Starter Fault: Check starter for fault source.	Check starter for possible ground fault, reverse rotation, voltage trip, etc.
PROTECTIVE LIMIT	STARTER OVERLOAD TRIP	STR_FLT Starter Overload Trip: Check amps calibration/reset overload.	Reset overloads and reset alarm. Check motor current calibration or overload calibration (do not field-calibrate overloads).
PROTECTIVE LIMIT	TRANSDUCER VOLTAGE FAULT	V_REF [VALUE] exceeded limit of [LIMIT]*. Check transducer power supply.	Check transformer power (5 vdc) supply to transducers. Power must be 4.5 to 5.5 vdc.
PROTECTIVE LIMIT	LOW OIL PRESSURE	Low Oil Pressure [OPEN]: Check oil pressure switch/pump and 2C aux.	Check the oil pressure switch for proper operation. Check oil pump for proper pressure. Check for excessive refrigerant in oil system.

*[LIMIT] is shown on the LID 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 temperature, pressure, voltage, etc., at which the control tripped.

Table 9 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

L. MACHINE ALERTS

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
RECYCLE ALERT	HIGH AMPS AT SHUTDOWN	High Amps at Recycle: Check guide vane drive.	Check that guide vanes are closing. Check motor amps correction calibration is correct. Check actuator for proper operation.
SENSOR FAULT ALERT	LEAVING COND WATER TEMP	Sensor Fault: Check leaving condenser water sensor.	Check sensor. See sensor test procedure.
SENSOR FAULT ALERT	ENTERING COND WATER TEMP	Sensor Fault: Check entering condenser water sensor.	
LOW OIL PRESSURE ALERT	CHECK OIL FILTER	Low Oil Pressure Alert: Check oil pressure.	Check oil filter. Check for improper oil level or temperature.
AUTORESTART PENDING	POWER LOSS	V__P Power Loss: Check voltage supply.	Check power supply if there are excessive compressor starts occurring.
AUTORESTART PENDING	LOW LINE VOLTAGE	V__P [VALUE] exceeded limit of [LIMIT*]. Check voltage supply.	
AUTORESTART PENDING	HIGH LINE VOLTAGE	V__P [VALUE] exceeded limit of [LIMIT*]. Check voltage supply.	
SENSOR ALERT	HIGH DISCHARGE TEMP	CMPD [VALUE] exceeded limit of [LIMIT*]. Check discharge temperature.	Discharge temperature exceeded the alert threshold. Check entering condenser water temperature, reduce entering condenser water temperature, if possible.
SENSOR ALERT	HIGH BEARING TEMPERATURE	MTRB [VALUE] exceeded limit of [LIMIT*]. Check thrust bearing temperature.	Thrust bearing temperature exceeded the alert threshold. Check for closed valves, improper oil level or temperatures.
CONDENSER PRESSURE ALERT	PUMP RELAY ENERGIZED	CRP High Condenser Pressure [LIMIT*]. Pump energized to reduce pressure.	Check ambient conditions. Check condenser pressure for accuracy. Check pump operation in Control Test table.
RECYCLE ALERT	EXCESSIVE RECYCLE STARTS	Excessive recycle starts.	The machine load is too small to keep the machine on line and there have been more than 5 restarts in 4 hours. Increase machine load, adjust hot gas bypass, increase RECYCLE RESTART DELTA T.

*[LIMIT] is shown on the LID 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 temperature, pressure, voltage, etc., at which the control tripped.

M. SPARE SENSOR ALERT MESSAGES

PRIMARY MESSAGE	SECONDARY MESSAGE	ALARM MESSAGE/PRIMARY CAUSE	ADDITIONAL CAUSE/REMEDY
SPARE SENSOR ALERT	COMMON CHWS SENSOR	Sensor Fault: Check common CHWS sensor.	Check alert temperature set points on Equipment Service, SERVICE2 LID table. Check sensor for accuracy if reading is not accurate.
SPARE SENSOR ALERT	COMMON CHWR SENSOR	Sensor Fault: Check common CHWR sensor.	
SPARE SENSOR ALERT	REMOTE RESET SENSOR	Sensor Fault: Check remote reset temperature sensor.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 1	Sensor Fault: Check temperature sensor — Spare 1.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 2	Sensor Fault: Check temperature sensor — Spare 2.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 3	Sensor Fault: Check temperature sensor — Spare 3.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 4	Sensor Fault: Check temperature sensor — Spare 4.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 5	Sensor Fault: Check temperature sensor — Spare 5.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 6	Sensor Fault: Check temperature sensor — Spare 6.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 7	Sensor Fault: Check temperature sensor — Spare 7.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 8	Sensor Fault: Check temperature sensor — Spare 8.	
SPARE SENSOR ALERT	TEMP SENSOR — SPARE 9	Sensor Fault: Check temperature sensor — Spare 9.	

Table 9 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

N. OTHER PROBLEMS/MALFUNCTIONS

DESCRIPTION/MALFUNCTION	PROBABLE CAUSE/REMEDY
Chilled Water/Brine Temperature Too High (Machine Running)	<p>Chilled water set point set too high. Access set point on LID and verify.</p> <p>Capacity override or excessive cooling load (machine at design capacity). Check LID status messages. Check for outside air infiltration into conditioned space.</p> <p>Condenser temperature too high. Check for proper flow, examine cooling tower operation, check for air or water leaks, check for fouled tubes.</p> <p>Refrigerant level low. Check for leaks, add refrigerant, and trim charge.</p> <p>Liquid bypass in waterbox. Examine division plates and gaskets for leaks.</p> <p>Guide vanes fail to open. Use Control Test to check operation.</p> <p>Chilled water control point too high. Access control algorithm status and check chilled water control operation.</p> <p>Guide vanes fail to open fully. Be sure that the guide vane target is released. Check guide vane linkage. Check limit switch in actuator. Check that sensor is in the proper terminals.</p>
Chilled Water/Brine Temperature Too Low (Machine Running)	<p>Chilled water set point set too low. Access set point on LID and verify.</p> <p>Chilled water control point too low. Access control algorithm status and check chilled water control for proper resets.</p> <p>High discharge temperature keeps guide vanes open.</p> <p>Guide vanes fail to close. Be sure that guide vane target is released. Check chilled water sensor accuracy. Check guide vane linkage. Check actuator operation.</p>
Chilled Water Temperature Fluctuates. Vanes Hunt	<p>Deadband too narrow. Configure LID for a larger deadband.</p> <p>Proportional bands too narrow. Either INC or DEC proportional bands should be increased.</p> <p>Loose guide vane drive. Adjust chain drive.</p> <p>Defective vane actuator. Check through Control Test.</p> <p>Defective temperature sensor. Check sensor accuracy.</p>
Low Oil Sump Temperature While Running (Less than 100 F [38 C])	<p>Check for proper oil level (not enough oil). Check for proper refrigerant level (too much refrigerant). See protective limit low oil temperature.</p>
At Power Up, Default Screen Does Not Appear, "Tables Loading" Message Continually Appears	<p>Check for proper communications wiring on PSIO module. Check that the COMM1 communications wires from the LID are terminated to the COMM1 PSIO connection.</p>
SMM Communications Failure	<p>Check that PSIO communication plugs are connected correctly. Check SMM communication plug. Check for proper SMM power supply. See Control Modules section on page 63.</p>
High Oil Temperature While Running	<p>Check for proper oil level (too much oil). Check that TXV valve is operating properly.</p>
Blank LID Screen	<p>Adjust contrast potentiometer. Check red LED on LID for proper operation, (power supply). If LED is blinking, but green LED's are not, replace LID module, (memory failure)</p>
"Communications Failure" Highlighted Message At Bottom of LID Screen	<p>LID is not properly addressed to the PSIO. Make sure that "Attach to Network Device," "Local Device" is set to read the PSIO address. Check LED's on PSIO. Is red LED operating properly? Are green LED's blinking? See control module troubleshooting section.</p>
Control Test Disabled	<p>Press the "Stop" pushbutton. The PIC must be in the OFF mode for the controls test to operate. Clear all alarms. Check line voltage percent on Status01 screen. The percent must be within 90% to 110%. Check voltage input to SMM, calibrate starter voltage potentiometer for accuracy. Make sure starter communication is established.</p>
Vanes Will Not Open In Control Test	<p>Low pressure alarm is active. Put machine into pumpdown mode or equalize pressure. Check guide vane actuator wiring. Make sure starter communication is established.</p>
Oil Pump Does Not Run	<p>Check oil pump voltage supply. Cooler vessel pressure under vacuum. Pressurize vessel. Check temperature overload cutout switch.</p>

Table 10A — Thermistor Temperature (F) vs Resistance/Voltage Drop

TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)	TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)	TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)
-25.0	4.821	98,010	71	3.093	5,781	167	0.838	719
-24.0	4.818	94,707	72	3.064	5,637	168	0.824	705
-23.0	4.814	91,522	73	3.034	5,497	169	0.810	690
-22.0	4.806	88,449	74	3.005	5,361	170	0.797	677
-21.0	4.800	85,486	75	2.977	5,229	171	0.783	663
-20.0	4.793	82,627	76	2.947	5,101	172	0.770	650
-19.0	4.786	79,871	77	2.917	4,976	173	0.758	638
-18.0	4.779	77,212	78	2.884	4,855	174	0.745	626
-17.0	4.772	74,648	79	2.857	4,737	175	0.734	614
-16.0	4.764	72,175	80	2.827	4,622	176	0.722	602
-15.0	4.757	69,790	81	2.797	4,511	177	0.710	591
-14.0	4.749	67,490	82	2.766	4,403	178	0.700	581
-13.0	4.740	65,272	83	2.738	4,298	179	0.689	570
-12.0	4.734	63,133	84	2.708	4,196	180	0.678	561
-11.0	4.724	61,070	85	2.679	4,096	181	0.668	551
-10.0	4.715	59,081	86	2.650	4,000	182	0.659	542
-9.0	4.705	57,162	87	2.622	3,906	183	0.649	533
-8.0	4.696	55,311	88	2.593	3,814	184	0.640	524
-7.0	4.688	53,526	89	2.563	3,726	185	0.632	516
-6.0	4.676	51,804	90	2.533	3,640	186	0.623	508
-5.0	4.666	50,143	91	2.505	3,556	187	0.615	501
-4.0	4.657	48,541	92	2.476	3,474	188	0.607	494
-3.0	4.648	46,996	93	2.447	3,395	189	0.600	487
-2.0	4.636	45,505	94	2.417	3,318	190	0.592	480
-1.0	4.624	44,066	95	2.388	3,243	191	0.585	473
0.0	4.613	42,679	96	2.360	3,170	192	0.579	467
1.0	4.602	41,339	97	2.332	3,099	193	0.572	461
2.0	4.592	40,047	98	2.305	3,031	194	0.566	456
3.0	4.579	38,800	99	2.277	2,964	195	0.560	450
4.0	4.567	37,596	100	2.251	2,898	196	0.554	445
5.0	4.554	36,435	101	2.217	2,835	197	0.548	439
6.0	4.540	35,313	102	2.189	2,773	198	0.542	434
7.0	4.527	34,231	103	2.162	2,713	199	0.537	429
8.0	4.514	33,185	104	2.136	2,655	200	0.531	424
9.0	4.501	32,176	105	2.107	2,597	201	0.526	419
10.0	4.487	31,202	106	2.080	2,542	202	0.520	415
11.0	4.472	30,260	107	2.053	2,488	203	0.515	410
12.0	4.457	29,351	108	2.028	2,436	204	0.510	405
13.0	4.442	28,473	109	2.001	2,385	205	0.505	401
14.0	4.427	27,624	110	1.973	2,335	206	0.499	396
15.0	4.413	26,804	111	1.946	2,286	207	0.494	391
16.0	4.397	26,011	112	1.919	2,239	208	0.488	386
17.0	4.381	25,245	113	1.897	2,192	209	0.483	382
18.0	4.366	24,505	114	1.870	2,147	210	0.477	377
19.0	4.348	23,789	115	1.846	2,103	211	0.471	372
20.0	4.330	23,096	116	1.822	2,060	212	0.465	367
21.0	4.313	22,427	117	1.792	2,018	213	0.459	361
22.0	4.295	21,779	118	1.771	1,977	214	0.453	356
23.0	4.278	21,153	119	1.748	1,937	215	0.446	350
24.0	4.258	20,547	120	1.724	1,898	216	0.439	344
25.0	4.241	19,960	121	1.702	1,860	217	0.432	338
26.0	4.223	19,393	122	1.676	1,822	218	0.425	332
27.0	4.202	18,843	123	1.653	1,786	219	0.417	325
28.0	4.184	18,311	124	1.630	1,750	220	0.409	318
29.0	4.165	17,796	125	1.607	1,715	221	0.401	311
30.0	4.145	17,297	126	1.585	1,680	222	0.393	304
31.0	4.125	16,814	127	1.562	1,647	223	0.384	297
32.0	4.103	16,346	128	1.538	1,614	224	0.375	289
33.0	4.082	15,892	129	1.517	1,582	225	0.366	282
34.0	4.059	15,453	130	1.496	1,550			
35.0	4.037	15,027	131	1.474	1,519			
36.0	4.017	14,614	132	1.453	1,489			
37.0	3.994	14,214	133	1.431	1,459			
38.0	3.968	13,826	134	1.408	1,430			
39.0	3.948	13,449	135	1.389	1,401			
40.0	3.927	13,084	136	1.369	1,373			
41.0	3.902	12,730	137	1.348	1,345			
42.0	3.878	12,387	138	1.327	1,318			
43.0	3.854	12,053	139	1.308	1,291			
44.0	3.828	11,730	140	1.291	1,265			
45.0	3.805	11,416	141	1.289	1,240			
46.0	3.781	11,112	142	1.269	1,214			
47.0	3.757	10,816	143	1.250	1,190			
48.0	3.729	10,529	144	1.230	1,165			
49.0	3.705	10,250	145	1.211	1,141			
50.0	3.679	9,979	146	1.192	1,118			
51.0	3.653	9,717	147	1.173	1,095			
52.0	3.627	9,461	148	1.155	1,072			
53.0	3.600	9,213	149	1.136	1,050			
54.0	3.575	8,973	150	1.118	1,029			
55.0	3.547	8,739	151	1.100	1,007			
56.0	3.520	8,511	152	1.082	986			
57.0	3.493	8,291	153	1.064	965			
58.0	3.464	8,076	154	1.047	945			
59.0	3.437	7,868	155	1.029	925			
60.0	3.409	7,665	156	1.012	906			
61.0	3.382	7,468	157	0.995	887			
62.0	3.353	7,277	158	0.978	868			
63.0	3.323	7,091	159	0.962	850			
64.0	3.295	6,911	160	0.945	832			
65.0	3.267	6,735	161	0.929	815			
66.0	3.238	6,564	162	0.914	798			
67.0	3.210	6,399	163	0.898	782			
68.0	3.181	6,238	164	0.883	765			
69.0	3.152	6,081	165	0.868	750			
70.0	3.123	5,929	166	0.853	734			

Table 10B — Thermistor Temperature (C) vs Resistance/Voltage Drop

TEMPERATURE (C)	VOLTAGE DROP (V)	RESISTANCE (Ohms)	TEMPERATURE (C)	VOLTAGE DROP (V)	RESISTANCE (Ohms)
-40	4.896	168 230	45	1.898	2 184
-39	4.889	157 440	46	1.852	2 101
-38	4.882	147 410	47	1.807	2 021
-37	4.874	138 090	48	1.763	1 944
-36	4.866	129 410	49	1.719	1 871
-35	4.857	121 330	50	1.677	1 801
-34	4.848	113 810	51	1.635	1 734
-33	4.838	106 880	52	1.594	1 670
-32	4.828	100 260	53	1.553	1 609
-31	4.817	94 165	54	1.513	1 550
-30	4.806	88 480	55	1.474	1 493
-29	4.794	83 170	56	1.436	1 439
-28	4.782	78 125	57	1.399	1 387
-27	4.769	73 580	58	1.363	1 337
-26	4.755	69 250	59	1.327	1 290
-25	4.740	65 205	60	1.291	1 244
-24	4.725	61 420	61	1.258	1 200
-23	4.710	57 875	62	1.225	1 158
-22	4.693	54 555	63	1.192	1 118
-21	4.676	51 450	64	1.160	1 079
-20	4.657	48 536	65	1.129	1 041
-19	4.639	45 807	66	1.099	1 006
-18	4.619	43 247	67	1.069	971
-17	4.598	40 845	68	1.040	938
-16	4.577	38 592	69	1.012	906
-15	4.554	38 476	70	0.984	876
-14	4.531	34 489	71	0.949	836
-13	4.507	32 621	72	0.920	805
-12	4.482	30 866	73	0.892	775
-11	4.456	29 216	74	0.865	747
-10	4.428	27 633	75	0.838	719
-9	4.400	26 202	76	0.813	693
-8	4.371	24 827	77	0.789	669
-7	4.341	23 532	78	0.765	645
-6	4.310	22 313	79	0.743	623
-5	4.278	21 163	80	0.722	602
-4	4.245	20 079	81	0.702	583
-3	4.211	19 058	82	0.683	564
-2	4.176	18 094	83	0.665	547
-1	4.140	17 184	84	0.648	531
0	4.103	16 325	85	0.632	516
1	4.065	15 515	86	0.617	502
2	4.026	14 749	87	0.603	489
3	3.986	14 026	88	0.590	477
4	3.945	13 342	89	0.577	466
5	3.903	12 696	90	0.566	456
6	3.860	12 085	91	0.555	446
7	3.816	11 506	92	0.545	436
8	3.771	10 959	93	0.535	427
9	3.726	10 441	94	0.525	419
10	3.680	9 949	95	0.515	410
11	3.633	9 485	96	0.506	402
12	3.585	9 044	97	0.496	393
13	3.537	8 627	98	0.486	385
14	3.487	8 231	99	0.476	376
15	3.438	7 855	100	0.466	367
16	3.387	7 499	101	0.454	357
17	3.337	7 161	102	0.442	346
18	3.285	6 840	103	0.429	335
19	3.234	6 536	104	0.416	324
20	3.181	6 246	105	0.401	312
21	3.129	5 971	106	0.386	299
22	3.076	5 710	107	0.370	285
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			

Control Modules

⚠ CAUTION

Turn controller power off before servicing controls. This ensures safety and prevents damage to controller.

The Processor module (PSIO), 8-input (Options) modules, Starter Management Module (SMM), and the Local Interface Device (LID) module 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 side of the LID, and on the top horizontal surface of the PSIO, SMM, and 8-input modules.

RED LED — If the LED is blinking continuously at a 2-second rate, it is indicating proper operation. If it is lit continuously or if the LED blinks at a rate of 3 times per second, it indicates a problem requiring replacement of the module. Off continuously indicates that the power should be checked. If the red LED blinks 3 times, a software error has been discovered and the module must be replaced. If there is no input power, check fuses and the circuit breaker. If fuse is good, check for shorted secondary of transformer, or if power is present to the module, replace the module.

GREEN LEDs — There are one or 2 green LEDs on each type of module. These LEDs indicate communication status between different parts of the controller and the network modules as follows:

LID Module

Upper LED — Communication with CCN network, if present; blinks when communication occurs.

Lower LED — Communication with PSIO module; must blink every 3 to 5 seconds.

PSIO Module

Green LED closest to communications connection — Communication with SMM and 8-input module; must blink continuously.

Other Green LED — Communication with LID; must blink every 3 to 5 seconds.

8-Input Modules and SMM

Green LED — Communication with PSIO module; will blink continuously.

Notes on Module Operation (see Fig. 30-34).

1. The machine operator monitors and modifies configurations in the microprocessor through the 4 softkeys and the LID. Communication with the LID and the PSIO is accomplished through the CCN (Level II) bus. The communication between the PSIO, SMM, and both 8-input modules is accomplished through the sensor bus, which is a 3-wire cable. This sensor bus runs in parallel between modules.

On sensor bus terminal strips, Terminal 1 of PSIO module is connected to Terminal 1 of each of the other modules. Terminals 2 and 3 are connected in the same manner. If a Terminal 2 wire is connected to Terminal 1, the system does not work.

2. If a green LED is solid on, check communication wiring. If a green LED is off, check the red LED. If the red LED is normal, check the module address switches (Fig. 30-34). Proper addresses are:

MODULE	ADDRESS	
	SW1	SW2
SMM (Starter Management Module)	3	2
8-input Options Module 1	6	4
8-input Options Module 2	7	2

If all modules indicate communications failure, check communications plug on the PSIO module for proper seating. Also check the wiring terminations (Level II — 1:red, 2:wht, 3:blk; Sensor bus — 1:red, 2:blk, 3:clr/wht) and the plug is connected to the proper socket. If a good connection is assured and the condition persists, perform an Attach to Network Device upload of the PSIO module. The correct address of the PSIO module must be known in order to perform this function. If the Attach to Network Device function does not work, replace the module.

If only one 8-input module or SMM indicates communication failure, check the communications plug on that module. Make sure the wiring is correct, and the plug is connected to the correct socket. If a good connection is assured and the condition persists, replace the module.

All system operating intelligence rests in the PSIO module. Some safety shutdown logic resides in the SMM in case communications are lost between the 2 modules. The PSIO monitors conditions using input ports on the PSIO, the SMM, and the 8-input modules. Outputs are controlled by the PSIO and SMM as well.

3. Power is supplied to modules within the control panel via 21-vac power sources.

The transformers are located within the power panel, with the exception of the SMM, which operates from a 24-vac power source and has its own 24-vac transformer located within the starter.

Within the power panel, T1 supplies power to the LID, the PSIO, and the 5-vac power supply for the transducers. The other 21-vac transformer is T4, which supplies power to both 8-input modules (if present). T4 is capable of supplying power to two modules; if additional modules are added, another power supply will be required.

Power is connected to Terminals 1 and 2 of the power input connection on each module.

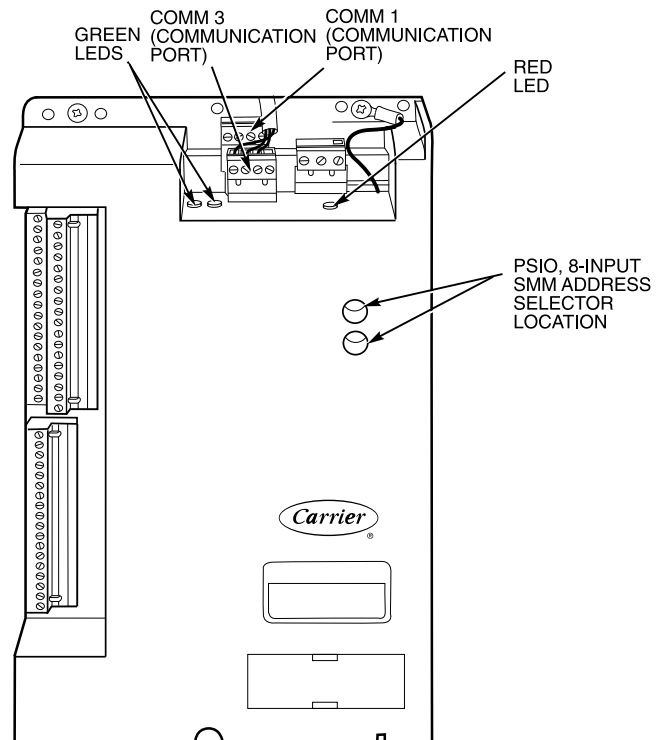
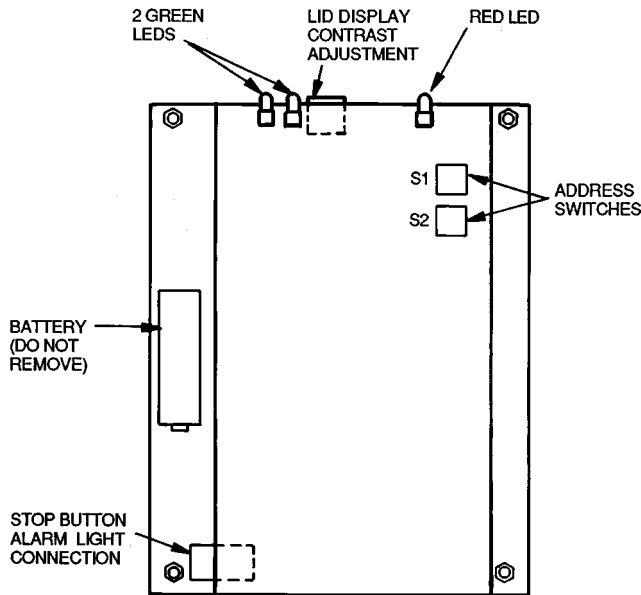


Fig. 30 — Address Selector Switch and LED Locations

Processor Module (PSIO) (Fig. 32)

INPUTS — Each input channel has 3 terminals; only 2 of the terminals are used. Application of machine determines which terminals are normally used. Always refer to individual unit wiring for terminal numbers.

OUTPUTS — Output is 20 vdc. There are 3 terminals per output, only 2 of which are used, depending on the application. Refer to the unit wiring diagram.



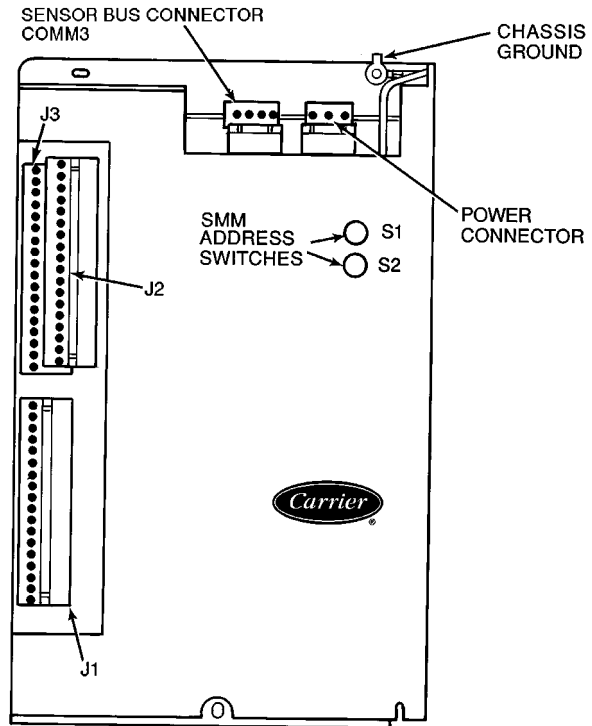
NOTE: LID address switches are factory set as follows:
S1 is set at E;
S2 is set at 6.

Fig. 31 — LID Module Address Selector Switch (Rear View) and LED Locations

Starter Management Module (SMM) (Fig. 33)

INPUTS — Inputs on strips J2 and J3 are a mix of analog and discrete (on/off) inputs. Application of the machine determines which terminals are used. Always refer to the individual unit wiring diagram for terminal numbers.

OUTPUTS — Outputs are 24 vdc and wired to strip J1. There are 2 terminals used per output.

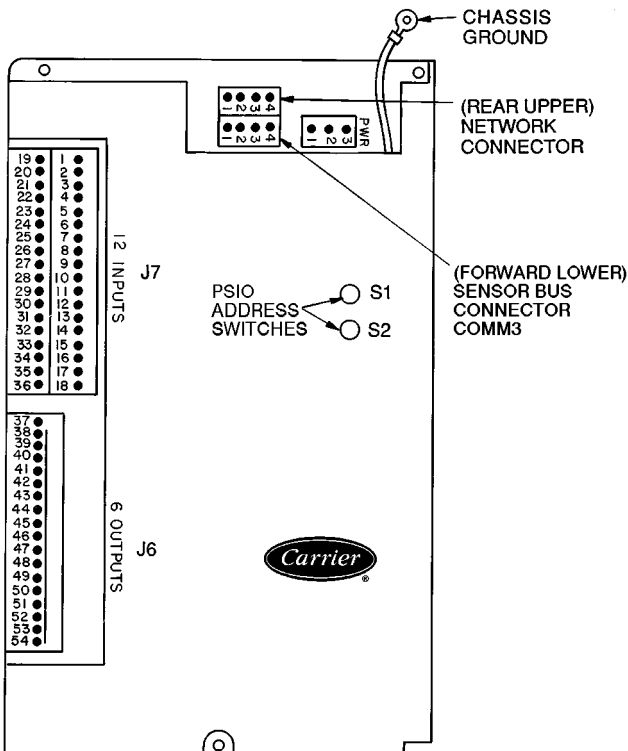


NOTE: SSM address switches should be set as follows:
S1 set at 3;
S2 set at 2.

Fig. 33 — Starter Management Module (SSM)

Options Modules (8-Input) — The options modules are optional additions to the PIC, and are used to add temperature reset inputs, spare sensor inputs, and demand limit inputs. Each option module contains 8 inputs, each input meant for a specific duty. See the wiring diagram for exact module wire terminations. Inputs for each of the options modules available include the following:

OPTION MODULE 1
4 to 20 mA Auto. Demand Reset
4 to 20 mA Auto. Chilled Water Reset
Common Chilled Water Supply Temperature
Common Chilled Water Return Temperature
Remote Temperature Reset Sensor
Spare Temperature 1
Spare Temperature 2
Spare Temperature 3
OPTION MODULE 2
4 to 20 mA Spare 1
4 to 20 mA Spare 2
Spare Temperature 4
Spare Temperature 5
Spare Temperature 6
Spare Temperature 7
Spare Temperature 8
Spare Temperature 9



NOTE: PSIO address switches are factory set as follows:
S1 is set at 5;
S2 is set at A.

Fig. 32 — Processor (PSIO) Module

Terminal block connections are provided on the options modules. All sensor inputs are field wired and installed. Options module 1 can be factory or field-installed. Options module 2 is shipped separately and must be field installed. For installation, refer to the unit or field wiring diagrams. Be sure to address the module for the proper module number (Fig. 34) and to configure the chiller for each feature being used.

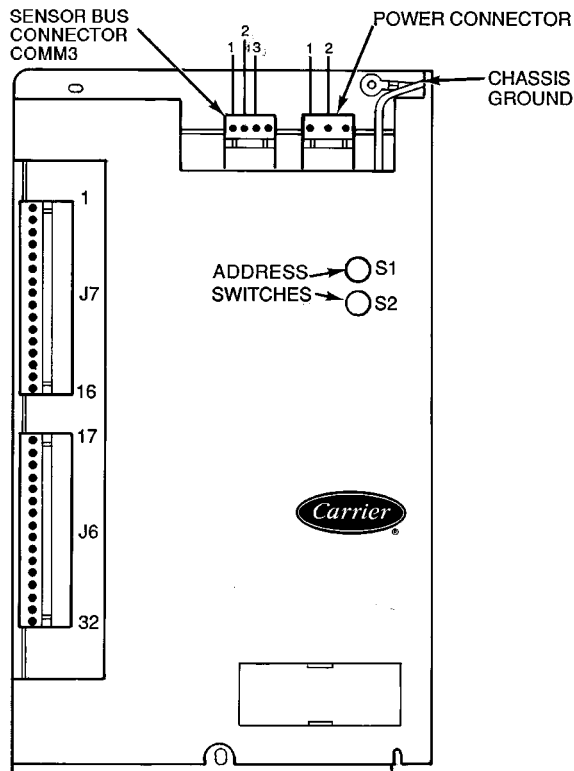


Fig. 34 — Options Module

Replacing Defective Processor Modules — The replacement part number is printed in a small label on front of the PSIO module. The model and serial numbers are printed on the unit nameplate located on an exterior corner post. The proper software is factory-installed by Carrier in the replacement module. When ordering a replacement processor module (PSIO), specify complete replacement part number, full unit model number, and serial number. This new unit requires reconfiguration to the original machine data by the installer.

⚠ CAUTION

Electrical shock can cause personal injury. Disconnect all electrical power before servicing.

INSTALLATION

1. Verify if the existing PSIO module is defective, by using the procedure described in the Troubleshooting Guide section, page 53, and Control Modules section, page 63. Do not select the Attach to Network Device table if the LID displays communication failure.

2. Data regarding the PSIO configuration should have been recorded and saved. This data will have to be reconfigured into the new PSIO through the LID. If this data is not available, follow the procedures described in the Set Up Machine Control Configuration section, page 42.

If a CCN Building Supervisor or Service Tool is present, the module configuration should have already been uploaded into memory; then, when the new module is installed, the configuration can be downloaded from the computer.

Any communication wires from other machines or CCN modules should be disconnected to prevent the new PSIO module from uploading incorrect run hours into memory.

3. Check that all power to the unit is off. Carefully disconnect all wires from the defective module by unplugging the 6 connectors. It is not necessary to remove any of the individual wires from the connectors.
4. Remove defective PSIO by removing its mounting screw with a long-shaft Phillips screwdriver, and removing the module from the control center. Save the screw for later use. The green ground wire is held in place with the module mounting screw.
5. Package the defective module in the carton of the new module for return to Carrier.
6. Mount the new module in the unit control box using a long-shaft Phillips screwdriver and the screw saved in Step 4 above. Make sure that the green grounding wire is reinstalled along with the mounting screw.
7. Connect the LID communication wires (Level II bus) and the power wires only. If CCN wiring or wiring to other machines has been attached to the Level II bus, disconnect the wires.
8. Carefully check all wiring connections before restoring power.
9. Restore control power and verify that the red and green LEDs on the PSIO are functioning properly.
10. Access the Attach to Network Device table on the LID Service menu. Set the local device address to Bus 0, Address 90. Press the **ATTACH** softkey to upload the PSIO software tables into the LID.
11. Change the address of the PSIO in the Config table of the Equipment Configuration table back to the previous value. Write the address on the PSIO.
12. Use the configuration sheets to input set point, configuration, and schedule information into the PSIO. The Time and Date table also must be set. A Building Supervisor can be used to download the old configuration into the PSIO.
13. Perform a Control Test and verify all tests.
If the software version has been updated, a CCN download of the configuration will not be allowed. Configure the PSIO by hand, and upload the PSIO into the network by using the Attach to Network Device table.
14. Restore chiller to normal operation, calibrate motor amps.

Physical Data — Tables 11-15 and Fig. 35-37 provide additional information regarding compressor fits and

clearances, physical and electrical data and wiring schematics for operator convenience during troubleshooting.

Table 11 — Heat Exchanger Data*

VESSEL	HEAT EXCHANGER CODE	NUMBER OF TUBES	RIGGING WEIGHTS		MACHINE CHARGE			
			Dry Weight		Refrigerant		Volume of Water	
			Lb	Kg	Lb	Kg	Gal	L
COOLER	26	832	14,000	6,350	1,310	594	186	704
	56	832	17,100	7,757	1,819	825	238	900
CONDENSER AND SUBCOOLER	26	892	11,200	5,080	1,320	599	203	768

*Based on 2-pass marine waterboxes, 300 psig (2068 kPa) covers, maximum compressor, HFC-134a, and maximum motor and voltage.

Table 12 — Waterbox Cover Weights

VESSEL	HEAT EXCHANGER CODE	WATERBOX TYPE	DESIGN WATER PRESSURE		COVER WEIGHT	
			psi	kPa	lb	kg
Cooler	26, 56	NIH	150	1034	640	290
			250	1723	860	390
		Marine	150	1034	—	—
			250	1723	760	345
Condenser	26	NIH	150	1034	850	386
			250	1723	1075	488
		Marine	150	1034	—	—
			250	1723	1015	460

NIH — Nozzle-In-Head

Table 13 — Auxilliary Systems, Electrical Data

POWER SOURCE	ITEM	SUPPLY V-PH-HZ	MAXIMUM RLA	LRA
1	Control Center and Actuator	115-1-60	2.20	—
		115-1-50		
	Oil Sump Heater	115-1-60	8.70	—
		115-1-50		
2	Oil Pump	200/240-3-60	4.32	24.5
		380/480-3-60	2.00	12.2
		507/619-3-60	2.09	24.5
		200/240-3-50	4.83	28.0
		380/440-3-50	2.49	11.7

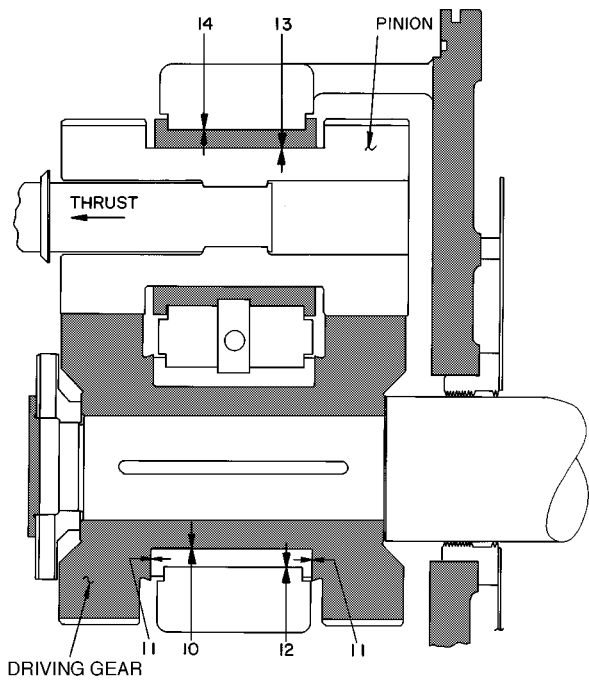
LEGEND

LRA — Locked Rotor Amps

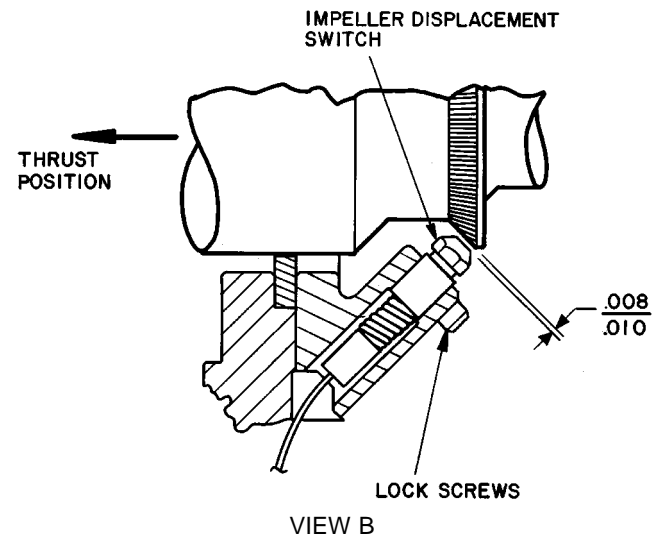
RLA — Rated Load Amps

NOTES:

1. The oil pump is powered through a field wiring terminal into the power panel.
2. Power to the controls and oil heater via the power panel must be on circuits that can provide continuous service when the compressor starter is disconnected.



VIEW A



VIEW B

(Refer to Table 14 for dimensions)

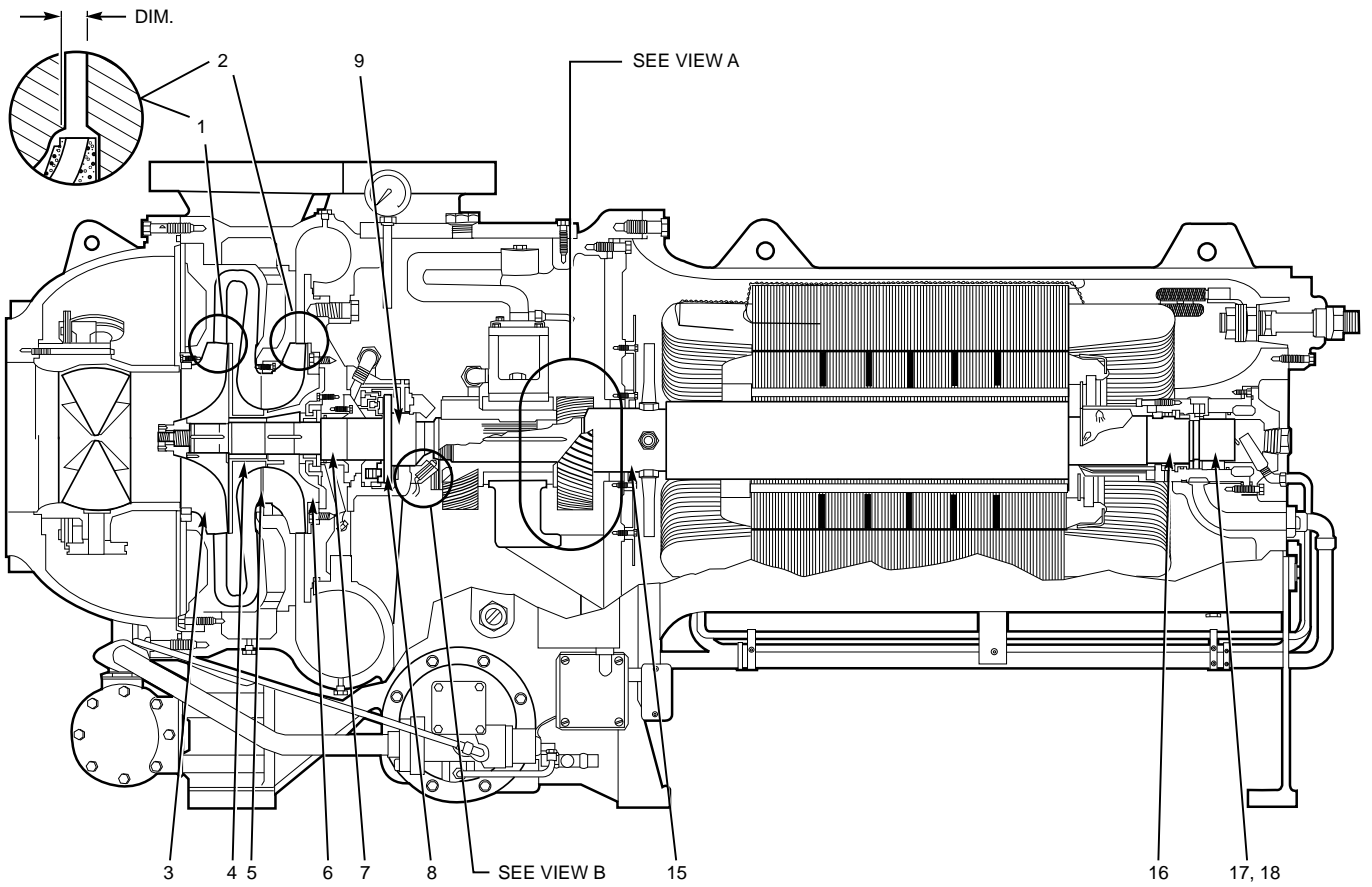


Fig. 35 — Compressor Fits and Clearances

Table 14 — Compressor Fits and Clearances

ITEM*	DESCRIPTION	CLEARANCE†				TYPE OF MEASURE
		in.		mm		
		Minimum	Maximum	Minimum	Maximum	
1	1st Stage Impeller to Diaphragm	See Table 15				Axial
2	2nd Stage Impeller to Discharge Wall	See Table 15				Axial
3	1st Stage Labyrinth	.0160	.0200	.4060	.5080	Diametral
4	Interstage Labyrinth	.0120	.0160	.3050	.4060	Diametral
5	2nd Stage Labyrinth	.0080	.0120	.2030	.3050	Diametral
6	Balancing Piston Labyrinth	.0080	.0120	.2030	.3050	Diametral
7	Impeller Shaft Journal Bearing	.0030	.0045	.0762	.1143	Diametral
8	Thrust-end Float	.0100	.0150	.2540	.3810	Axial
9	Counterthrust Bearing Seal Ring	.0020	.0040	.0510	.1020	Diametral
10	Gear Bearing to Gear	.0050	.0065	.1270	.1651	Diametral
11	Gear Bearing to Gear	.0100	.0185	.2540	.4699	Axial
12	Gear Bearing to Bearing Housing	.0005	.0025	.0127	.0635	Diametral
13	Pinion Bearing to Pinion	.0040	.0055	.1016	.1397	Diametral
14	Pinion Bearing to Bearing Housing	.0005	.0025	.1270	.0635	Diametral
15	Transmission Labyrinth	.0060	.0100	.1520	.2540	Diametral
16	Motor-End Labyrinth	.0050	.0080	.1270	.0635	Diametral
17	Motor-End Bearing to Shaft	.0040	.0054	.1016	.1372	Diametral
18	Motor-End Bearing to Bearing Housing	.0005	.0020	.0127	.0508	Diametral

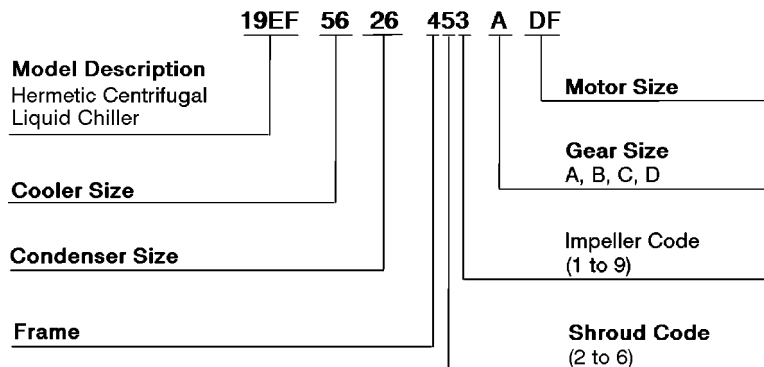
*See Fig. 35 for item. callouts.

†Clearances represent factory tolerances for new components.

Table 15 — Impeller Clearances

FRAME CODE	SHROUD CODE	IMPELLER CODE	IMPELLER DIAMETER		DIMENSION*			
			in.	mm	Item 1		Item 2	
					in.	mm	in.	mm
4	2	1	9.10	304.8	0.631	16.03	0.498	12.65
		3	9.40	314.5	0.596	15.14	0.473	12.01
		5	9.70	323.8	0.561	14.25	0.448	11.38
		7	10.00	336.6	0.531	13.49	0.423	10.74
		9	10.40	349.2	0.511	12.98	0.418	10.62
4	3	1	9.10	304.8	0.837	21.26	0.638	16.21
		3	9.40	314.5	0.797	20.24	0.609	15.47
		5	9.70	323.8	0.757	19.23	0.579	14.71
		7	10.00	336.6	0.717	18.21	0.541	13.74
		9	10.40	349.2	0.690	17.53	0.541	13.74
4	4	1	9.10	304.8	0.977	24.82	0.760	19.30
		3	9.40	314.5	0.937	23.80	0.726	18.44
		5	9.70	323.8	0.897	22.78	0.688	17.48
		7	10.00	336.6	0.837	23.62	0.639	16.23
		9	10.40	349.2	0.810	20.57	0.632	16.05
4	5	1	9.10	304.8	1.177	29.90	0.895	25.02
		3	9.40	314.5	1.137	28.88	0.852	21.64
		5	9.70	323.8	1.077	27.36	0.809	20.55
		7	10.00	336.6	1.017	25.83	0.750	19.05
		9	10.40	349.2	0.970	24.64	0.731	18.57
4	6	1	9.10	304.8	1.297	32.94	0.972	24.69
		3	9.40	314.5	1.237	31.42	0.928	23.57
		5	9.70	323.8	1.177	29.90	0.880	22.35
		7	10.00	336.6	1.007	27.86	0.817	20.75
		9	10.40	349.2	1.050	26.67	0.796	20.22

**MODEL NUMBER NOMENCLATURE FOR COMPRESSOR SIZE
(SEE FIG. 1 ALSO)**



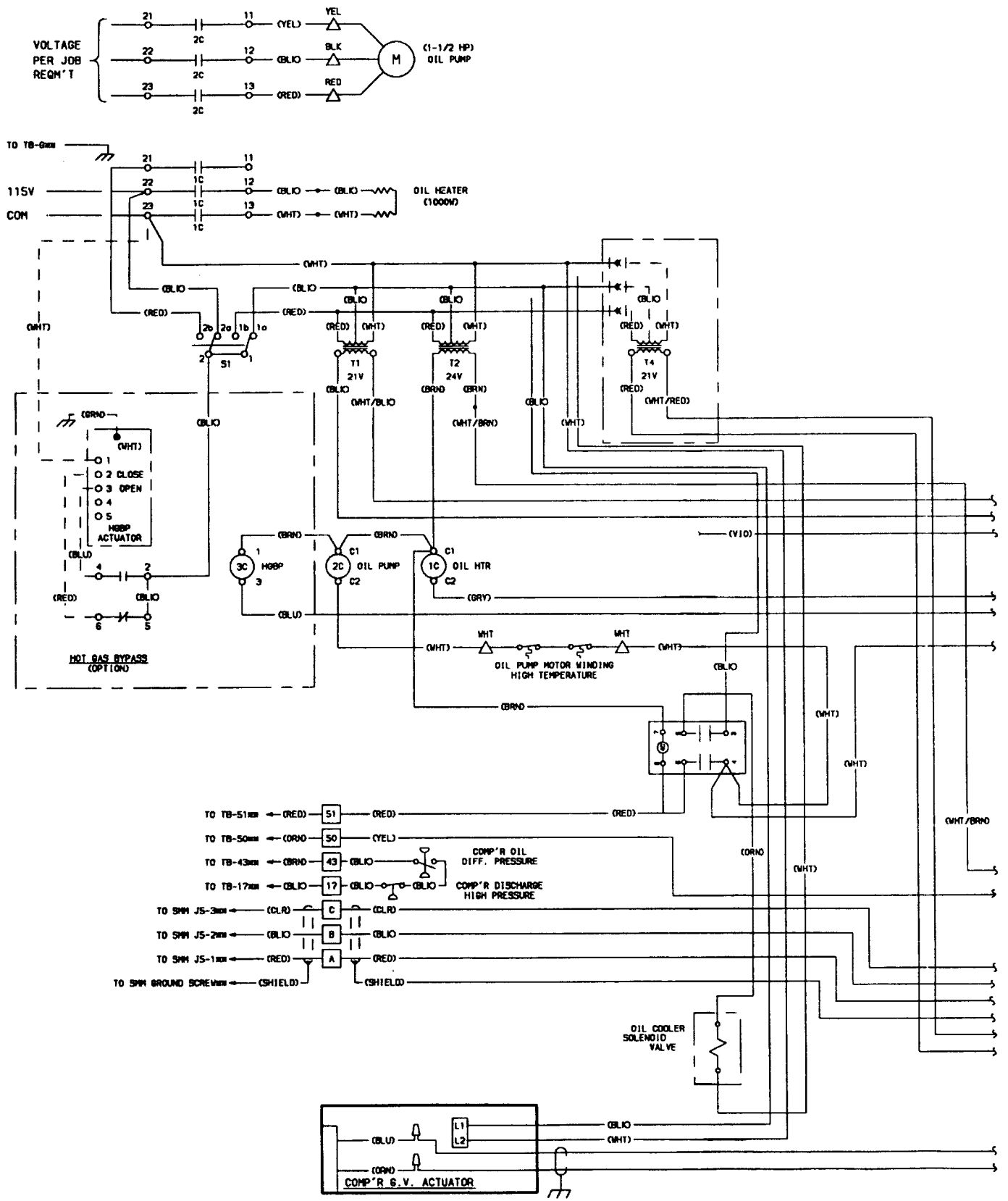


Fig. 36 — Electronic PIC Controls Wiring Schematic

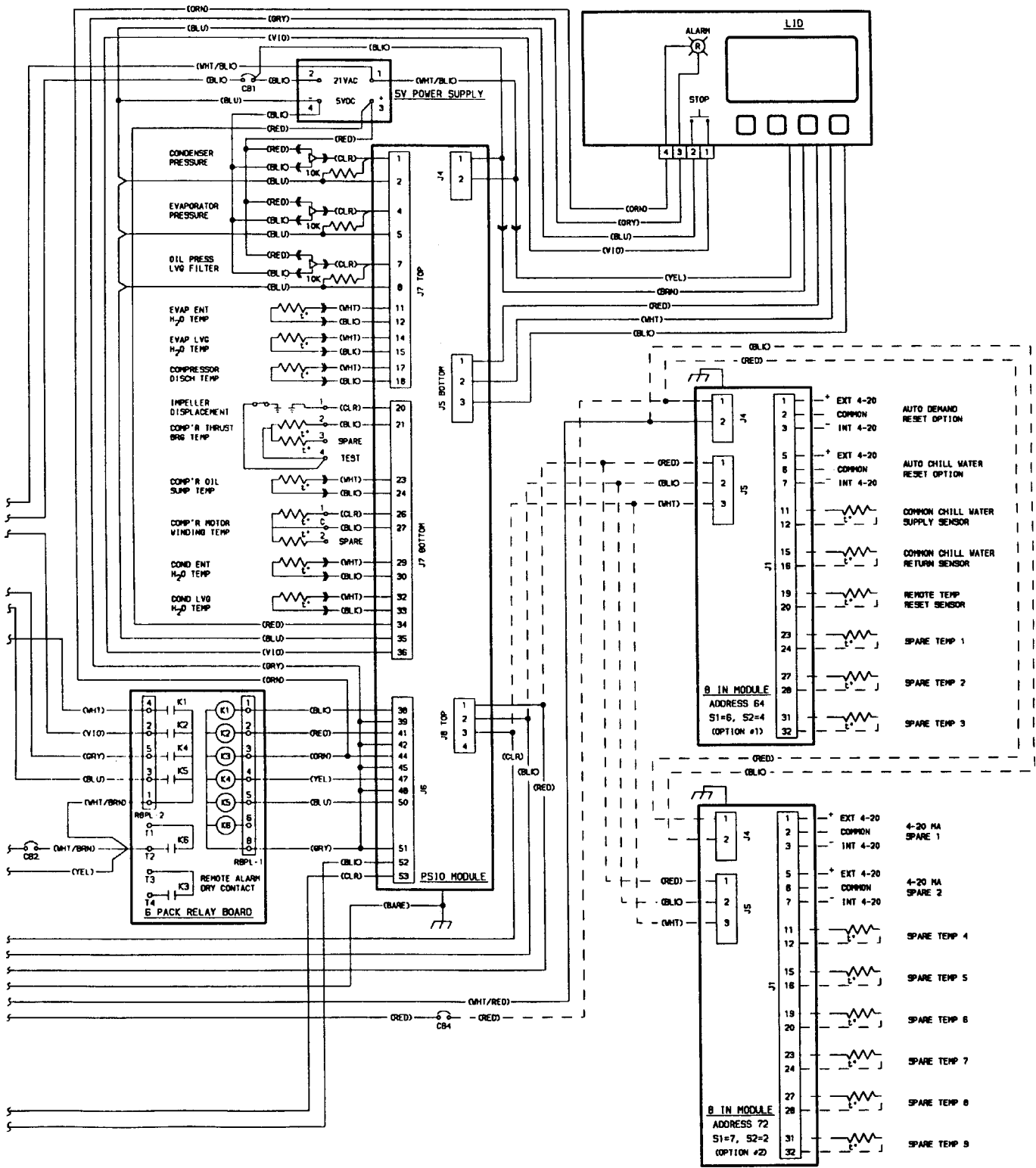


Fig. 36 — Electronic PIC Controls Wiring Schematic (cont)

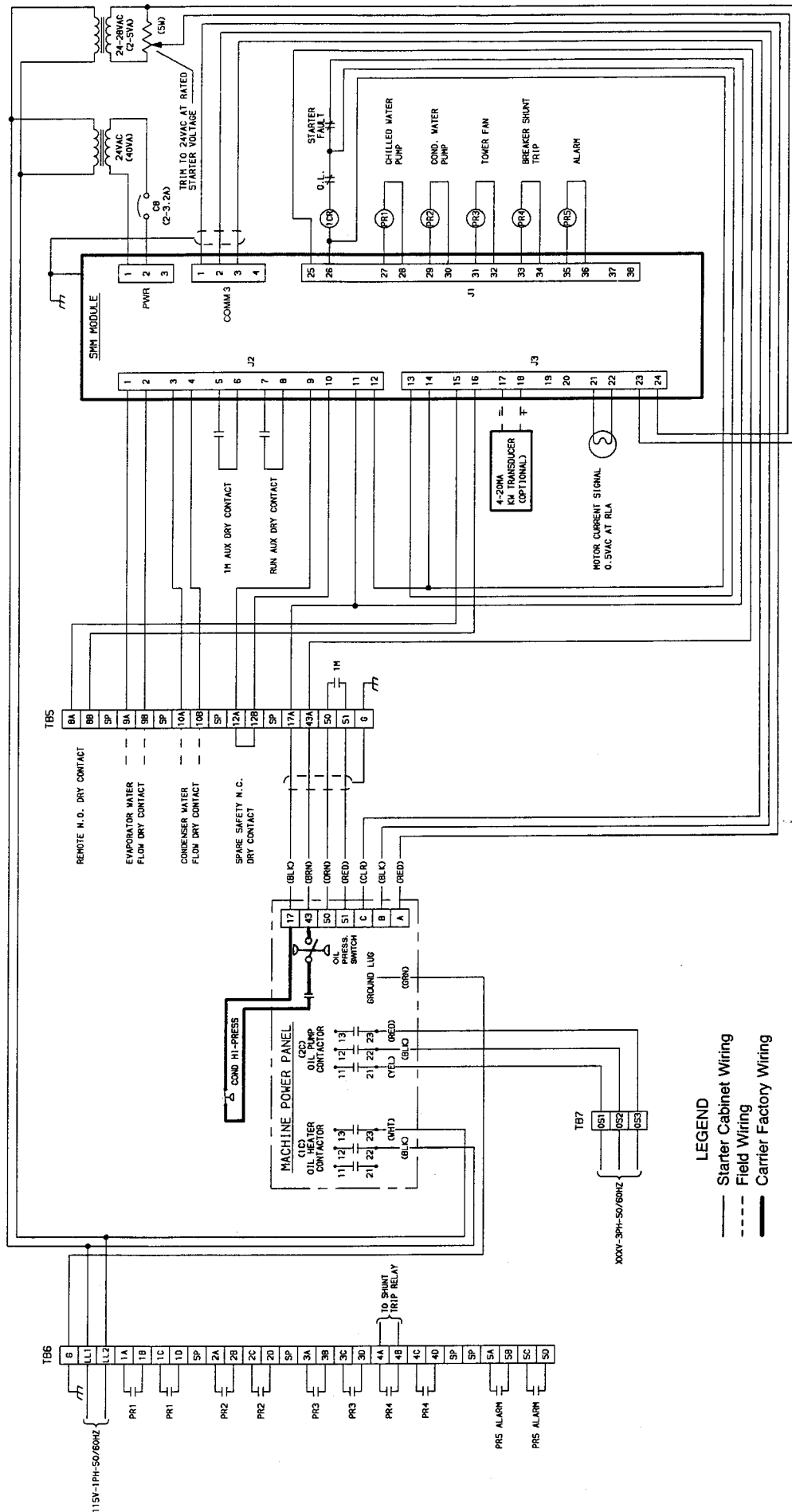


Fig. 37 — Machine Power Panel, Starter Assembly, and Motor Wiring Schematic

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