17/19EX Centrifugal Liquid Chillers 50/60 Hz With HFC-134a

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

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

DO NOT USE OXYGEN to purge lines or to pressurize a 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.

→ RISK OF INJURY OR DEATH by electrocution. High voltage is present on motor leads even though the motor is not running when a solid-state or inside-delta mechanical starter is used. Open the power supply disconnect before touching motor leads or terminals.

⚠ 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.

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 any 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 overpressure can result. When 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 cause 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 such equipment when there is a risk of slipping or losing your balance.

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 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 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.

Book 2 2 | Tab 5a 5d | PC 211 | Catalog No. 531-750 | Printed in U.S.A. | Form 17/19EX-2SS | Pg 1 | 1197 | 3-96 | Replaces: 17/19EX-1SS

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INTRODUCTION

Prior to initial start-up of the 17/19EX 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
CHW	—	Chilled Water
CHWR	—	Chilled Water Return
CHWS	—	Chilled Water Supply
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
TXV	—	Thermostatic Expansion Valve

17/19EX MACHINE FAMILIARIZATION (Fig. 1 - 3)

Machine Identification Label — The identification label is located on the right side of the machine control center panel. The label contains information on model number, refrigerant charge, rated voltage, etc.

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

19EX 43 43 -85 6 DP 62 1 –

Model Description
17EX — Open Drive Centrifugal Liquid Chiller
19EX — Hermetic Centrifugal Liquid Chiller

Cooler Size
31-33 (Frame 3)
41-44 (Frame 4)
45-48 (Frame 4 Stretched)

Condenser Size
31-33 (Frame 3)
41-43 (Frame 4)
45-47 (Frame 4 Stretched)
51-53 (Frame 5)
55-57 (Frame 5 Stretched)

Compressor Size
-51 through -89
421 through 469
531 through 599

Gear Code

2-Digit Compressor Sizes:	3-Digit Compressor Sizes:
5	A
6	B
	C
	D

Special Order Code
– — Standard
S — Special Order

Waterbox Code
1 — Marine Waterbox Cooler/ Marine Waterbox Condenser
2 — Marine Waterbox Cooler/ NIH Waterbox Condenser
3 — NIH Waterbox Cooler/ Marine Waterbox Condenser
4 — NIH Waterbox Cooler/ NIH Waterbox Condenser

Motor Voltage

06 — 200-3-60	67 — 6900-3-60
60 — 230-3-60	50 — 230-3-50
61 — 380-3-60	51 — 346-3-50
62 — 460-3-60	52 — 400-3-50
63 — 575-3-60	53 — 3000-3-50
64 — 2400-3-60	54 — 3300-3-50
65 — 3300-3-60	55 — 6300-3-50
66 — 4160-3-60	

Motor Size*

Hermetic Drive:				Open Drive:†			
DB	DG	DM	EA	FA	GA	HA	JA
DC	DH	DN	EB	FB	GB	HB	JB
DD	DJ	DP	EC	FC	GC	HC	JC
DE	DK	DQ	ED	FD	GD	HD	JD
DF	DL		EE				

NIH — Nozzle-In-Head

*Motors beginning with “E” and open drive motors (FA-JD) cannot be used with size 51-89 or 421-469 compressors.
†Open-drive motor codes:

F A

Open Drive Motor Type
F — ODP (Open Drip Proof)
G — WPI (Weather Protected, Type I)
H — WPII (Weather Protected, Type II)
J — TEWAC (Totally Enclosed Water-to-Air Cooled)

Motor Horsepower (kW)

	hp	(kW)
A —	1250	(932)
B —	1500	(1119)
C —	1750	(1305)
D —	2000	(1492)

UNDERWRITERS’ LABORATORIES CANADA

ASME ‘U’ STAMP

UNDERWRITERS’ LABORATORIES

ARI (Air Conditioning and Refrigeration Institute) PERFORMANCE CERTIFIED (60 Hz Only)

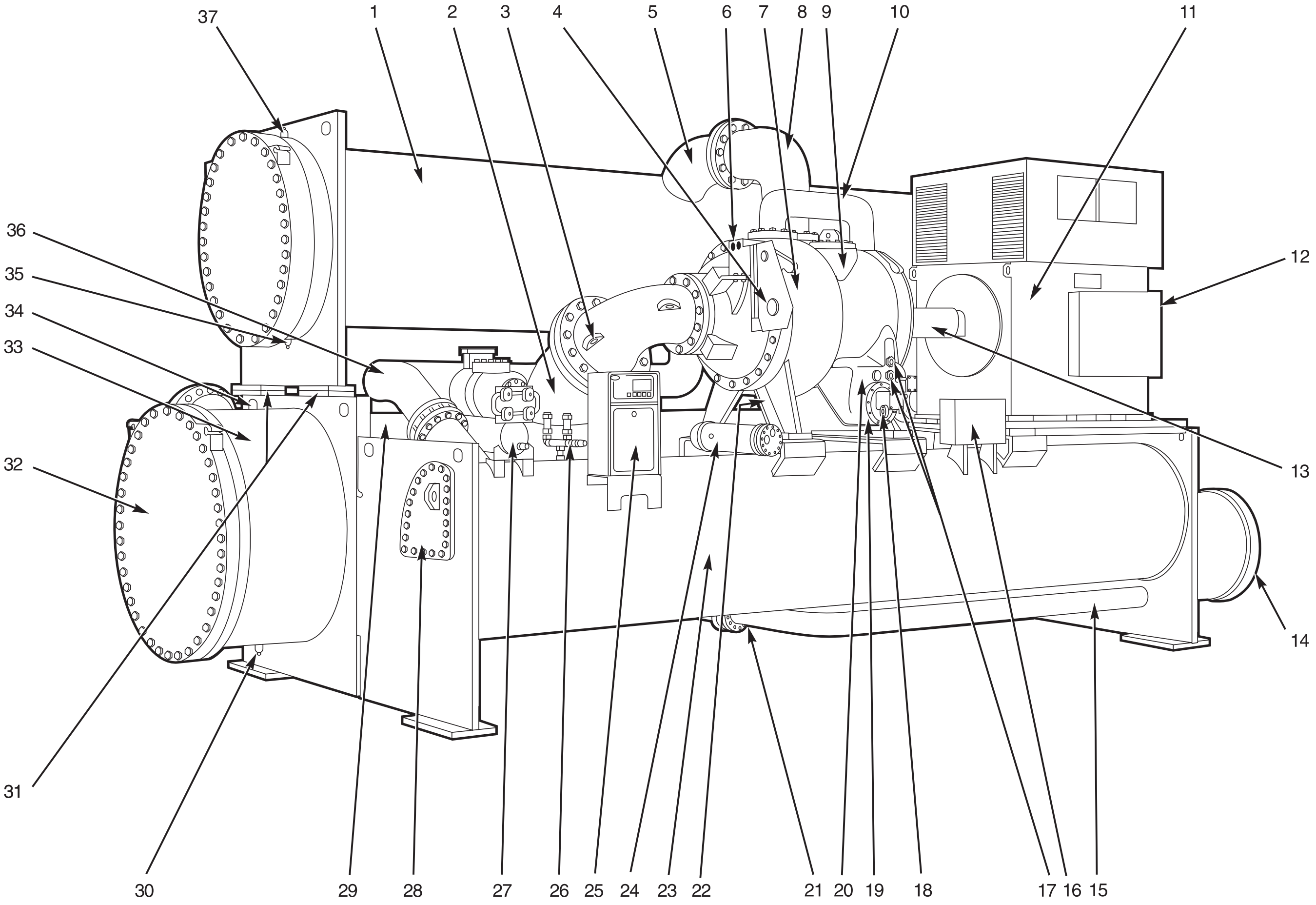
MODEL NUMBER NOMENCLATURE

20 95 J 51295

- 20 — **Week of Year**
- 95 — **Year of Manufacture**
- J — **Place of Manufacture**
- 51295 — **Unique Number**

SERIAL NUMBER BREAKDOWN

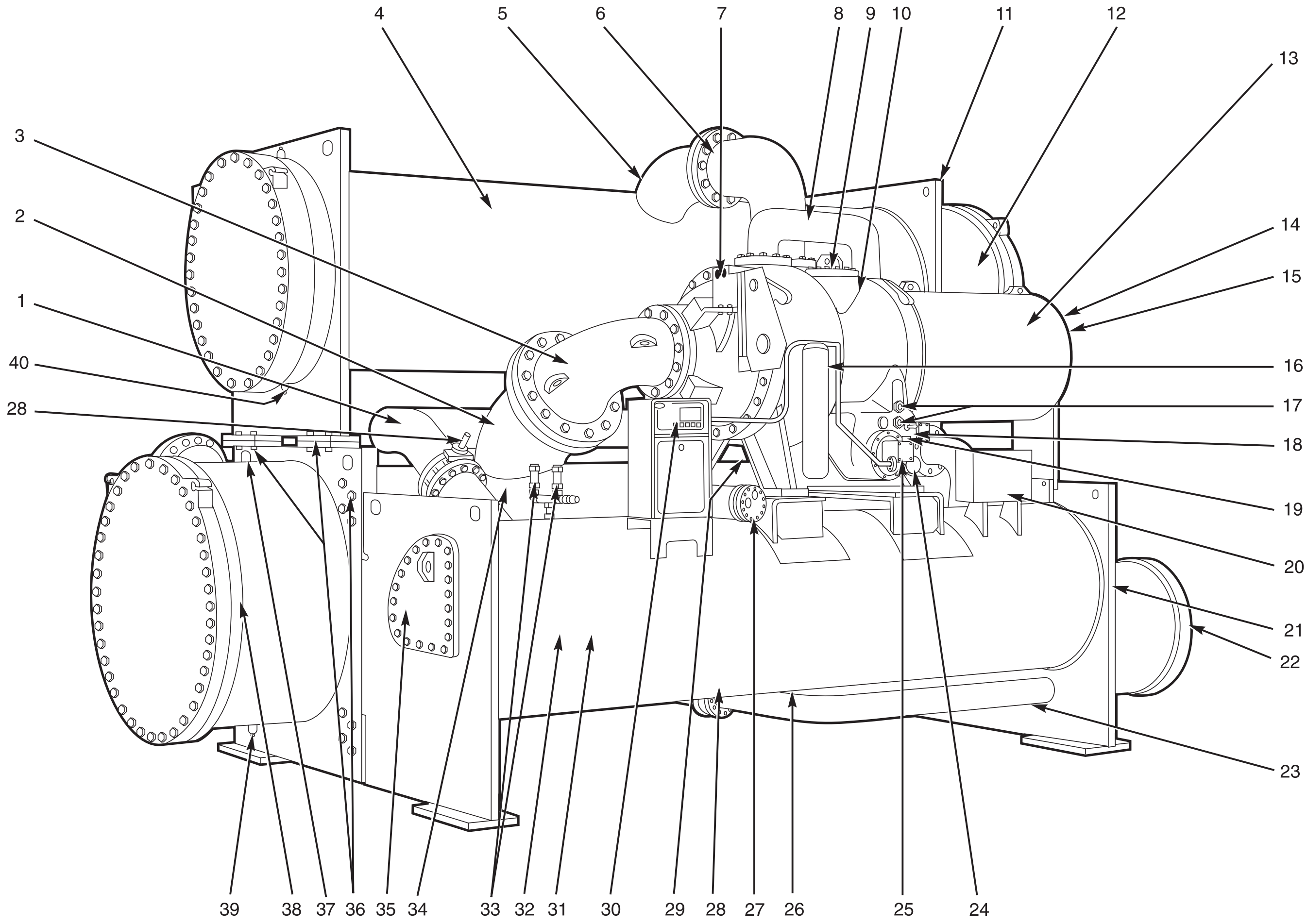
Fig. 1 — 17/19EX Identification



LEGEND

1 — Condenser
2 — Cooler Suction Pipe
3 — Compressor Suction Elbow
4 — Guide Vane Actuator
5 — Condenser Discharge Pipe
6 — Oil Filter (Hidden)
7 — Two-Stage Compressor
8 — Compressor Discharge Elbow
9 — Gear Inspection Cover
10 — Economizer Gas Line to Compressor
11 — Open Drive Compressor Motor
12 — Compressor Motor Terminal Box
13 — Coupling Guard
14 — Low-Side Float Box Cover
15 — Refrigerant Liquid Line to Cooler
16 — Power Panel (Field Wiring Terminals)
17 — Oil Level Sight Glasses
18 — Oil Drain and Charging Valve
19 — Oil Heater (Hidden)
20 — Oil Pump
21 — Refrigerant Charging/Service Valve 10 (Not Shown)
22 — Cooler Relief Valves (Not Shown)
23 — Economizer/Storage Vessel
24 — Oil Cooler
25 — Control Center
26 — Economizer/Storage Vessel Relief Valves
27 — Pumpout Unit
28 — High Side Float Box Cover
29 — Cooler
30 — Cooler Waterbox Drain
31 — Take-Apart Connections (Typical)
32 — Cooler Marine Waterbox Cover
33 — Cooler Waterbox
34 — Cooler Waterbox Vent
35 — Condenser Waterbox Drain
36 — Refrigerant Liquid Line to Economizer/Storage Vessel
37 — Condenser Waterbox Vent

Fig. 2 — Typical 17EX Installation



LEGEND

1 — Refrigerant Liquid Line to Economizer/Storage Vessel
2 — Cooler Suction Pipe
3 — Compressor Suction Elbow
4 — Condenser
5 — Condenser Discharge Pipe
6 — Compressor Discharge Elbow
7 — Guide Vane Actuator
8 — Economizer Gas Line to Compressor
9 — Gear Inspection Cover
10 — 2-Stage Hermetic Compressor
11 — Condenser Waterbox Vent (Not Shown)
12 — Condenser Marine Waterbox
13 — Hermetic Compressor Motor
14 — Compressor Motor Terminal Box (Not Shown)
15 — Motor Sight Glass (Not Shown)
16 — Oil Filter
17 — Oil Level Sight Glasses (2)
18 — Cooler Relief Valves (Not Shown)
19 — Oil Heater (Not Shown)
20 — Auxiliary Power Panel (Field Wiring Terminals)
21 — Pumpdown Unit (Not Shown)
22 — Low-Side Float Box Cover
23 — Refrigerant Liquid Line to Cooler
24 — Oil Drain and Charging Valve
25 — Oil Pump
26 — Refrigerant Charging/Service Valve 10 (Not Shown)
27 — Oil Cooler
28 — Isolation Valves (Not Shown)
29 — Refrigerant Filter Drier
30 — Local Interface Display Control Panel
31 — Economizer/Storage Vessel
32 — Rigging Guide (Not Shown)
33 — Economizer/Storage Vessel Relief Valves
34 — Cooler
35 — High-Side Float Box Cover
36 — Take-Apart Connections
37 — Cooler Waterbox Vent
38 — Cooler Marine Waterbox
39 — Cooler Waterbox Drain
40 — Condenser Waterbox Drain

Fig. 3 — Typical 19EX Installation

Cooler — This vessel (also known as the evaporator) is located underneath the condenser, next to the utility vessel. 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.

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 and regulates the machine capacity as required to maintain proper leaving chilled water temperature. The control center:

- registers cooler, condenser, and lubricating system pressures
- shows machine operating condition 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 (Purchased Separately) — The starter allows for the proper starting and disconnecting of the electrical energy for the compressor-motor, oil pump, oil heater, and control panels.

Utility Vessel — 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 refrigeration cycle. During periods of shutdown and service, the utility vessel can serve as a storage tank for the refrigerant.

REFRIGERATION CYCLE (Fig. 4)

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

The liquid refrigerant obtains the energy needed to vaporize by removing heat from the water or brine in the cooler tubes. The cold water or brine can then be used in air conditioning and/or other processes.

After removing heat from the water or brine, the refrigerant vapor enters the first stage of the compressor, is compressed and flows 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 98 to 102 F [37 to 40 C]) refrigerant vapor comes into contact with the condenser tubes, the relatively cool condensing water (typically 85 to 95 F [29 to 35 C]) removes some of the heat and the vapor condenses into a liquid.

The liquid refrigerant passes through an orifice into the FLASC chamber. Because the coolest condenser water is flowing through the FLASC, it is at a lower pressure and part of the entering liquid refrigerant will flash to vapor, thereby cooling the remaining liquid. The vapor is then recondensed by the condenser water flowing through the FLASC chamber.

The subcooled liquid refrigerant drains into a high-side valve chamber which meters the refrigerant liquid into a flash economizer chamber. Pressure in this chamber is intermediate between condenser and cooler pressures. At this lower pressure, some of the liquid refrigerant flashes to gas, further cooling the remaining liquid. The flash gas, having absorbed heat, is returned directly to the compressor second stage. Here it is mixed with discharge gas that is already compressed by the first-stage impeller. Since the flash gas has to pass through only half the compression cycle, to reach condenser pressure, there is a savings in power.

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

MOTOR/OIL REFRIGERATION COOLING CYCLE (19EX CHILLERS)

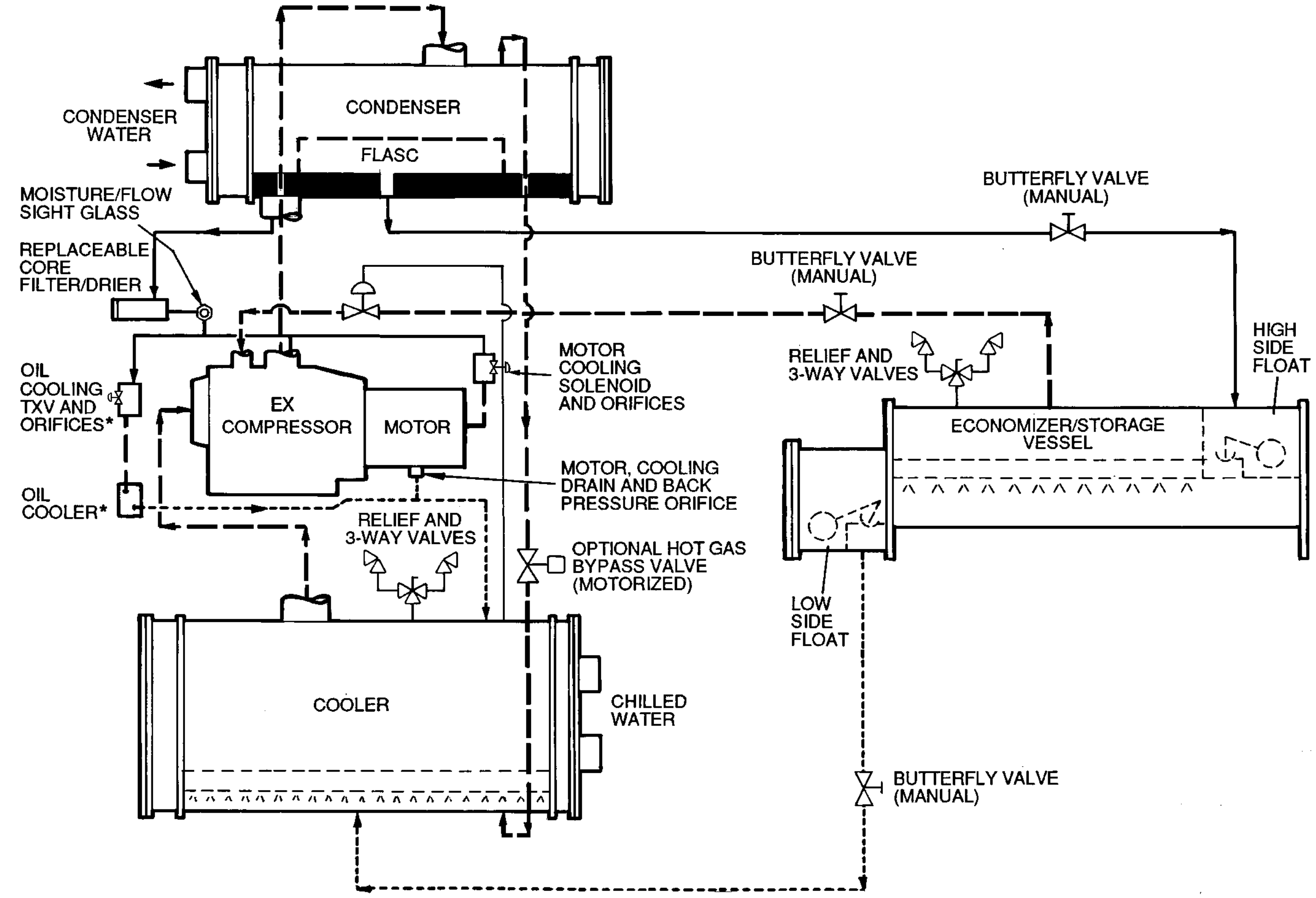
The motor is cooled by liquid refrigerant taken from the bottom of the condenser vessel (Fig. 4). Flow of refrigerant is maintained by the pressure differential that exists due to compressor operation. After the refrigerant flows past an isolation valve, an in-line filter, and a sight glass/moisture indicator, the flow is split between motor cooling and oil cooling systems.

Flow to the motor moves through an orifice and into the motor. On models with a solenoid valve, the valve will open if additional motor cooling is required. Once past the orifice, the refrigerant is directed over the motor by a spray nozzle.

The refrigerant collects in the bottom of the motor casing and then is drained back into the cooler through the motor refrigerant drain line. An orifice in this line maintains a higher pressure in the motor shell than in the cooler/oil sump. The motor is protected by a temperature sensor imbedded in the stator windings. On models with a solenoid valve, higher motor temperatures (above 125 F [51 C]) energize the solenoid to provide additional motor cooling. On all models, a further increase in temperature past the motor override set point will override the temperature capacity control to hold, and if the motor temperature rises 10° F (5.5° C) above this set point, will close the inlet guide vanes. If the temperature rises above the safety limit, the compressor will shut down.

On machines with EX compressors and 41-48 cooler sizes, the oil is also cooled by liquid refrigerant. Refrigerant that flows to the oil cooling system is regulated by a thermostatic expansion valve. There is always a minimum flow bypassing the TXV, which flows through an orifice. The TXV valve regulates flow into the oil/refrigerant plate and frame-type heat exchanger. The bulb for the expansion valve controls oil temperature to the bearings. The refrigerant leaving the heat exchanger then returns to the cooler.

On machines with FA compressors, the oil is water cooled. Water flow through the oil cooler is manually adjusted by a plug valve to maintain an operating temperature at the reservoir of approximately 145 F (63 C).



LEGEND

TXV — Thermostatic Expansion Valve
——— Liquid
– – – – Liquid/Vapor
▬ ▬ ▬ ▬ Vapor

*The FA compressor has a water cooled oil cooler.

Fig. 4 — Refrigerant, Motor Cooling, and Oil Cooling Cycles (19EX Shown)

HERMETIC MACHINES (19 SERIES) 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 any 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. 5).

Details — Oil is charged into the reservoir (Item 1) through a hand valve (Item 4) which also functions as an oil drain. If there is refrigerant in the machine, a pump is required for charging. Sight glasses (Item 10) on the reservoir wall permit observation of the oil level. The normal operating oil level is from the middle of the lower sight glass to the top of the lower sight glass.

The motor-driven oil pump (Item 8) discharges oil to an oil cooler (Item 12) at a rate and pressure controlled by an oil regulator (Item 7). The differential pressure (supply versus return) is registered at the control center. Oil differential pressure is maintained between 18 to 30 psi (124 to 207 kPa).

The oil pump discharges to the oil cooler and filter. On EX compressors, the filter is located ahead of the oil cooler. On FA compressors the oil cooler is located ahead of the filter. The filter is capable of being valved closed to permit removal of the filter without draining the entire oil system (see Scheduled Maintenance, Changing Oil Filter section, page 76 for details).

The oil cooler on the EX compressor is a plate-and-frame type, refrigerant cooled, heat exchanger. The EX compressor oil cooler heat exchanger uses refrigerant from the condenser as a coolant. The refrigerant cools the oil to a temperature between 110 and 120 F (43 and 49 C) supply oil temperature to the bearings.

The FA compressor oil cooler heat exchanger is water cooled. The water flow through the cooler is manually controlled by a plug valve. The valve should be adjusted to maintain approximately 145 F (63 C) in the oil sump during running conditions.

As the oil leaves the oil cooler, it passes the oil pressure transducer (Item 14) and then the thermostatic expansion valve bulb (Item 13). The oil flow is then divided, and a portion flows to the motor-end bearing (Item 19) and seal. The remainder lubricates the compressor transmission (Item 2) and the thrust and journal bearings (Item 3). Thrust bearing temperature is indicated at the Local Interface Device (LID). Oil from each circuit returns by gravity to the reservoir.

A demister (Items 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 features are part of the lubrication system:

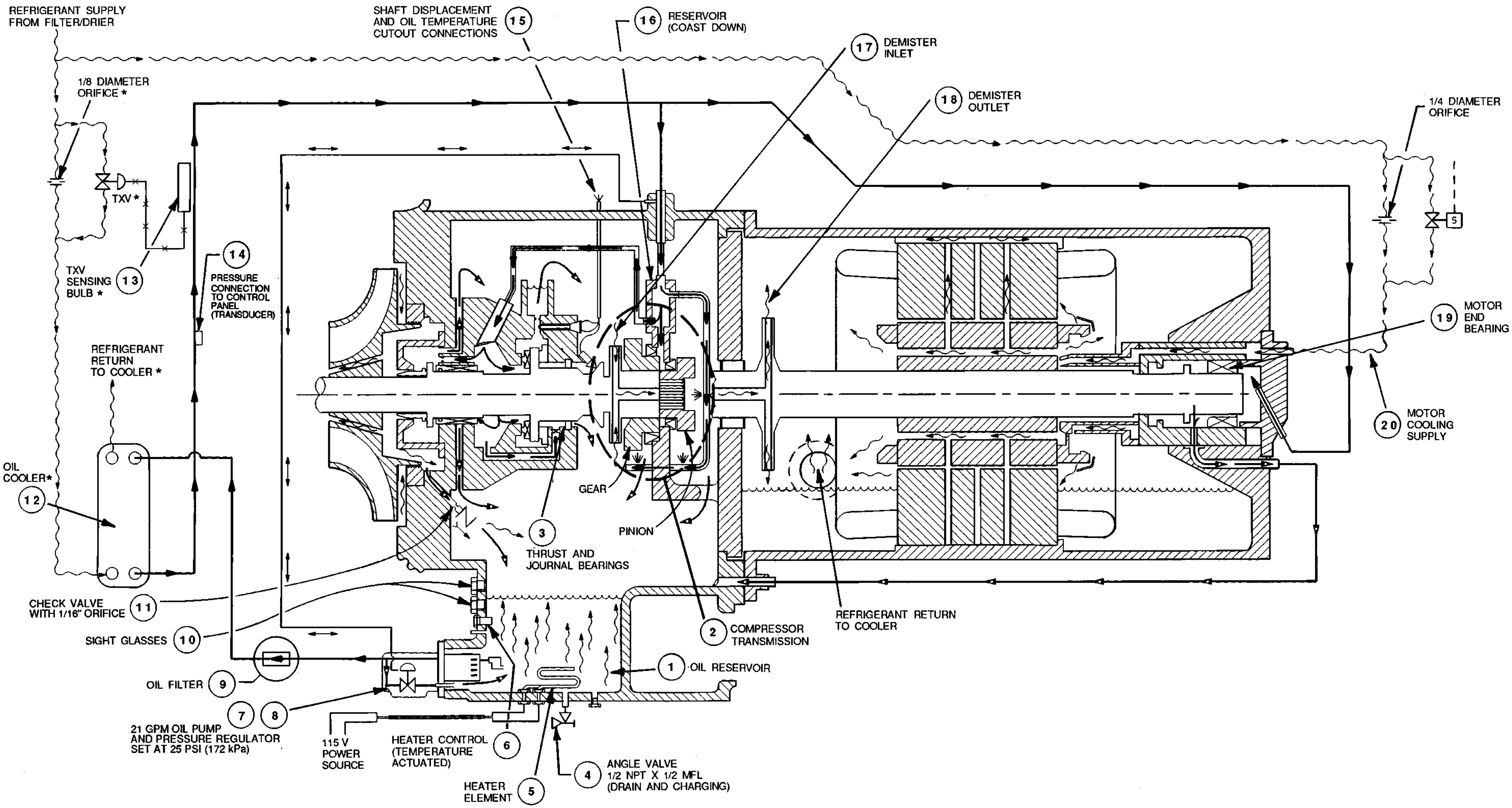
In the event of power failure, a small oil reservoir (Item 16) supplies sufficient oil reserve to ensure continued lubrication until all compressor parts have come to a complete stop. The bearing temperature sensor (Item 15) monitors thrust bearing temperatures and shuts off the machine if the temperature rises above a selected point. Low-oil pressure will shut down the machine or prevent a 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 38). 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 the oil pressure is verified and before the controls start 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 controls 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 15 psi (90 kPa) differential, the PIC will shut down the compressor.

Oil reclaim is accomplished by returning the system oil through the check valve/orifice (Item 11). As oil builds up behind the second stage impeller, it is drained by the check valve/orifice back into the oil reservoir. An oil/refrigerant mixture is drawn up from the operating level of the cooler into the guide vane housing. This assists the oil return system at low load operating conditions.



LEGEND

TXV — Thermostatic Expansion Valve

Oil Supply Flow

Oil Return Flow

Pressure Control Lines

Refrigerant

Capillary Tubing (Filled System)

*The FA compressor has a water-cooled oil cooler. Oil temperature is manually controlled.

Fig. 5 — Hermetic Compressor Lubrication System (EX Compressor Shown)

OPEN-DRIVE MACHINES (17 SERIES) LUBRICATION CYCLE

Summary — The main oil pump and oil reservoir are contained in the compressor base. Oil is pumped through an oil cooler and a filter to remove heat and any foreign particles. A portion of the oil is then directed to shaft-end bearing and the shaft seal. The balance of the oil lubricates the compressor transmission and the thrust and journal bearings. The bearing and transmission oil returns directly to the reservoir to complete the cycle. Contact-seal oil leakage, however, is collected in an atmospheric float chamber to be pumped back to the main reservoir as the oil accumulates.

Details (See Fig. 6) — Oil may be charged into the reservoir (1) through a hand valve (2) which also functions as an oil drain. If there is refrigerant in the machine, however, a hand pump will be required for charging at this connection.

An oil-charging elbow (Item 20) on the seal-oil return chamber allows oil to be added without pumping. The seal-oil return pump (Item 21) automatically transfers the oil to the main reservoir. Sight glasses (Item 6) on the reservoir wall permit observation of the oil level.

A motor-driven oil pump (Item 5) discharges oil to an oil cooler (Item 7) at a rate and pressure controlled by an oil regulator (Item 4). The differential oil pressure (bearing supply versus oil reservoir) is registered on the control panel.

Water flow through the oil cooler is manually adjusted by a plug valve (Item 8) to maintain the oil at an operating temperature of approximately 145 F (63 C). During shutdown, the oil temperature is also maintained at 150 to 160 F (65 to 71 C) by an immersion heater (Item 3) in order to minimize absorption of refrigerant by the oil.

Upon leaving the oil cooler, the oil is filtered (11) and a portion is directed to the seal-end bearing (17) and the shaft seal (18). The remainder lubricates the compressor transmission (15) and the thrust and journal bearings (10). Thrust bearing temperature is indicated by the PIC controls. Oil from both circuits returns by gravity to the reservoir.

A demister (13 and 16), by centrifugal action, draws refrigerant gas from the transmission area to a housing that is vented to the cooler (Item 19). The resulting pressure difference prevents oil from the transmission cavity from passing through the transmission shaft labyrinth into the demister outlet chamber.

The open compressor drive requires that the shaft seal (18) be kept full of lubrication oil, even when the machine is not operating, to prevent loss of refrigerant.

If the machine is not operating and the oil pump has not operated during the last 12 hours, the control system will automatically run the oil pump for one minute in order to keep the contact seal filled with oil.

IMPORTANT: If the control power is to be deenergized for more than one day, the machine refrigerant should be pumped over to the utility vessel.

STARTERS

All starters, whether supplied by Carrier or the customer, must meet Carrier Starter Specification Z-375. This specification can be obtained from the Carrier Sales Representative. The purpose of this specification is to ensure the compatibility of the starter and the machine. Many styles of compatible starters are available, including solid-state starters, autotransformer, wye-delta closed transition starters, and full voltage starters.

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 module is volatile. If the battery in a module is removed or damaged, all programming will be lost.

General — The 17/19EX 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 shutdowns, if required.

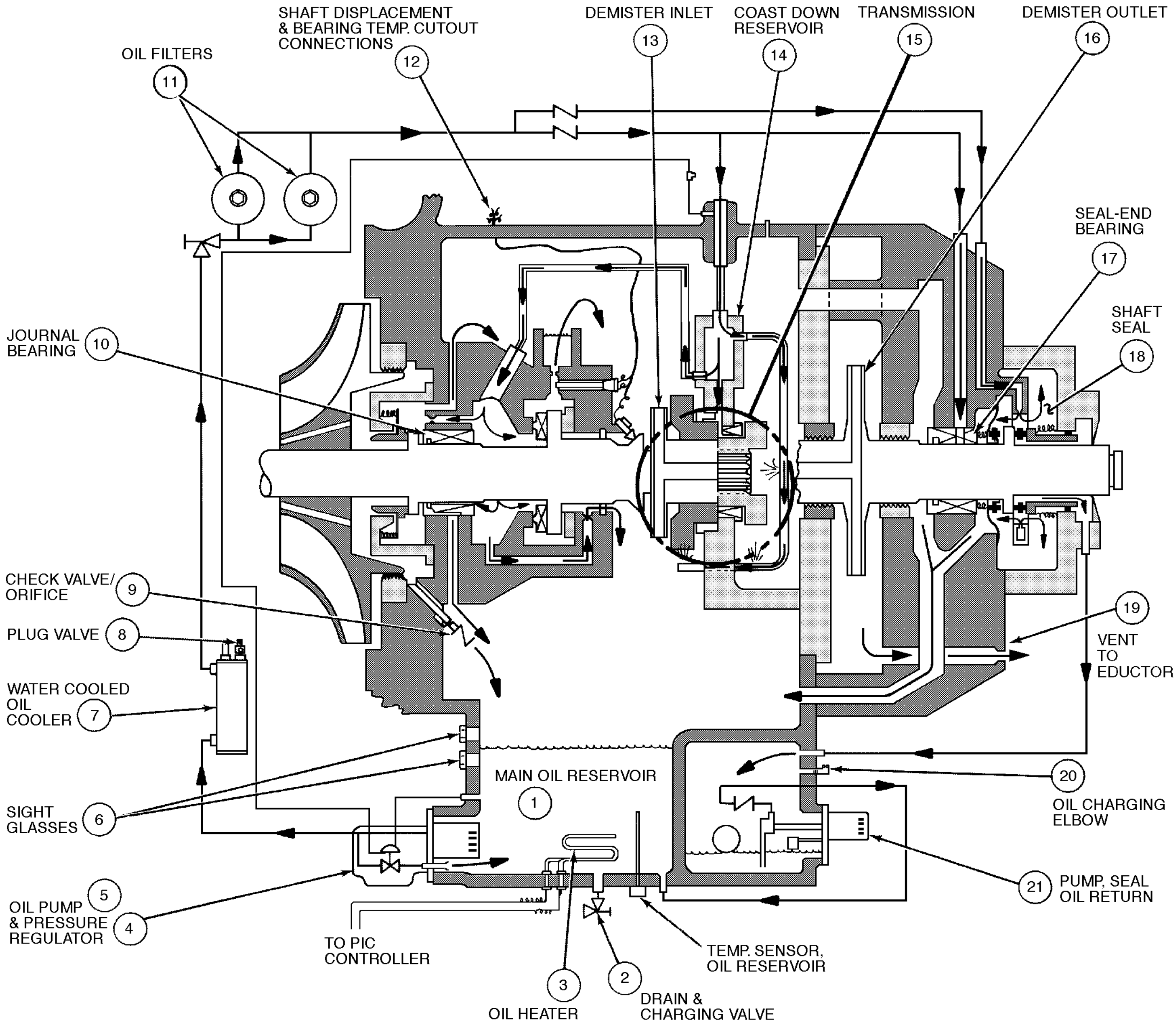


Fig. 6 — Open-Drive (17 Series) Lubrication Cycle

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 Differential Pressure/Power Supply Module	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. 10
Pressure Transducers	See Fig. 11

*See Fig. 7-13.

PROCESSOR MODULE (PSIO) — This module contains all of the operating software needed to control the machine. The open-drive machines use a different software package within the PSIO than the hermetic machines. There are also control hardware differences between the two types of machines. The 19EX uses 3 pressure transducers and 8 thermistors to sense pressures and temperatures. The 17EX uses 4 pressure transducers and 7 thermistors to sense pressures and temperatures.

These inputs are connected to the PSIO module. The PSIO also provides outputs to the: guide vane actuator; oil pump; oil heater; hot gas bypass (optional); motor cooling solenoid; and alarm contact. The PSIO communicates with the LID, the SMM, and the optional 8-input modules for user interface and starter management.

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, optional hot gas bypass relay, and motor cooling solenoid (19EX machines) on auxiliary oil pump (17EX machines).

8-INPUT MODULES — One optional module is factory installed in the control center panel 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 rated 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.

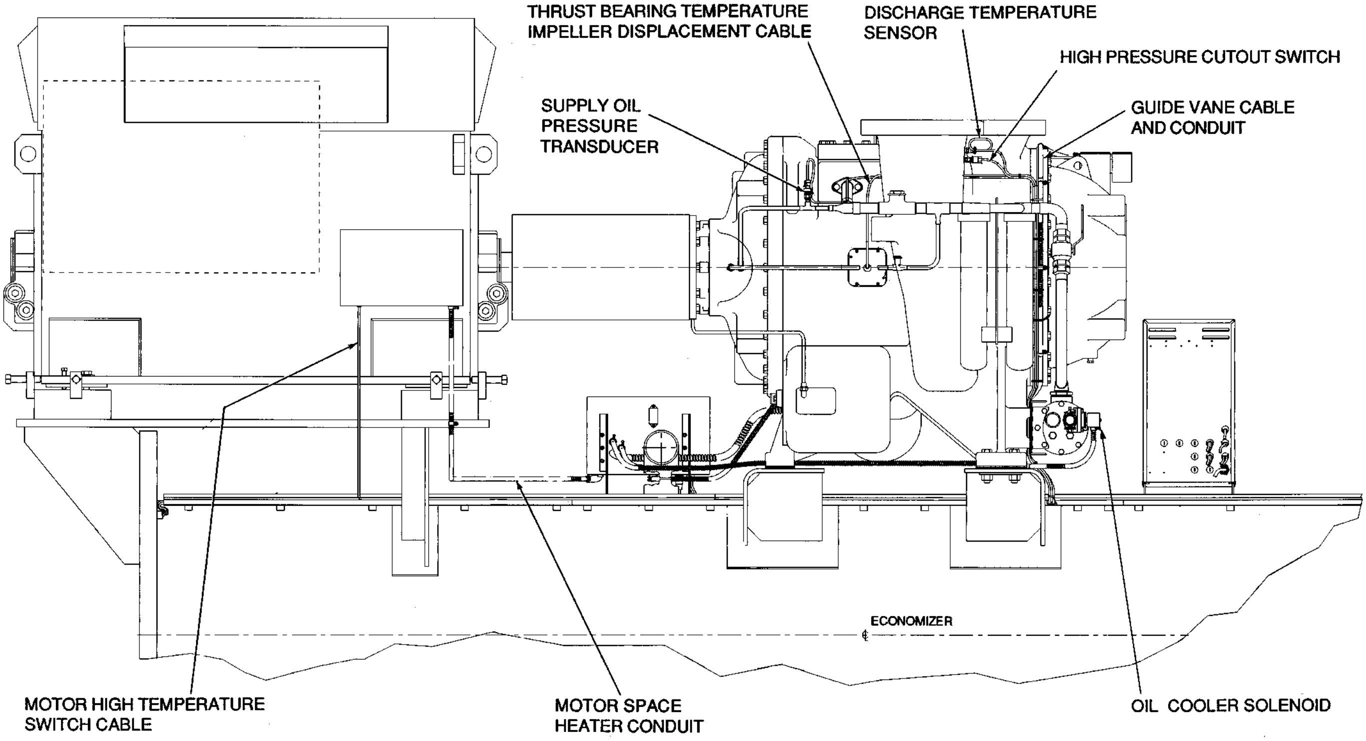
OIL AUXILIARY RELAY (4C) — This relay, supplied only with open-drive machines, opens the oil cooler solenoid valve and interlocks the oil pump with the compressor.

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

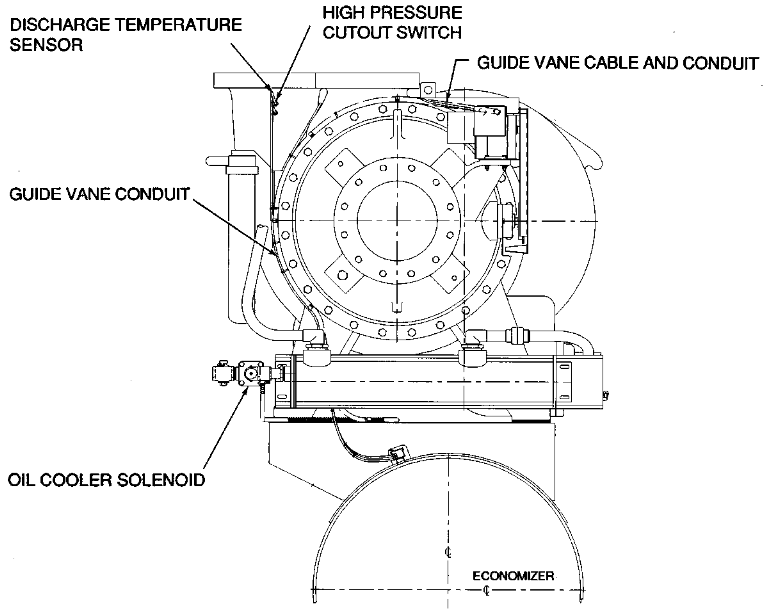
CONTROL AND OIL HEATER VOLTAGE SELECTOR (S1) — It is necessary to use 115 v incoming control power in the power panel. The switch must be set to the 115-v position.

OIL DIFFERENTIAL PRESSURE/POWER SUPPLY MODULE — This module, which is located in the control center, provides 5 vdc power for the transducers and LID backlight.

On open-drive machines, this module outputs the difference between two pressure transducer input signals. The module subtracts oil supply pressure from transmission sump pressure and outputs the difference as an oil differential pressure signal to the PSIO. The PSIO converts this signal to differential oil pressure. To calibrate this reading, refer to the Troubleshooting, Checking Pressure Transducers.

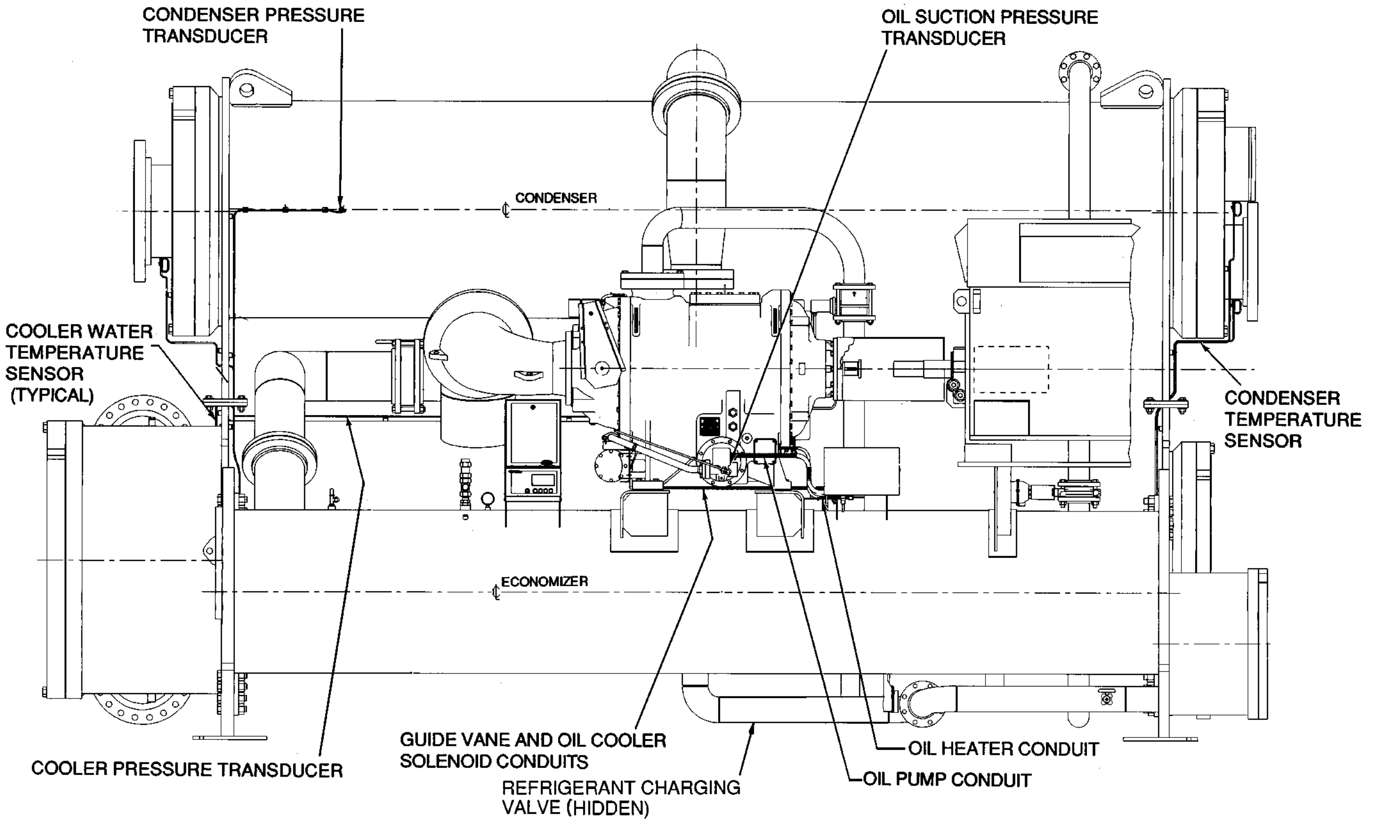


MACHINE REAR; COMPRESSOR SIDE VIEW

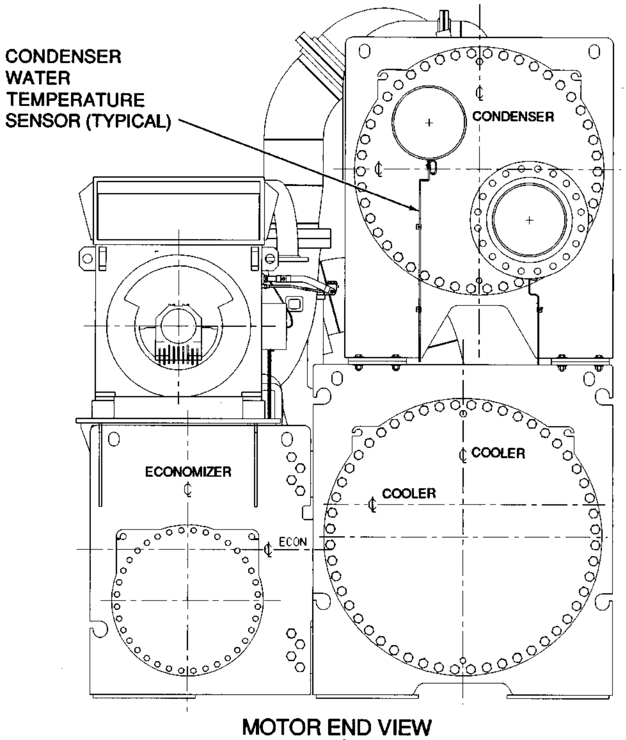


COMPRESSOR END VIEW

Fig. 7 — 17EX Controls and Sensor Locations



MACHINE FRONT VIEW



MOTOR END VIEW

Fig. 7 — 17EX Controls and Sensor Locations (cont)

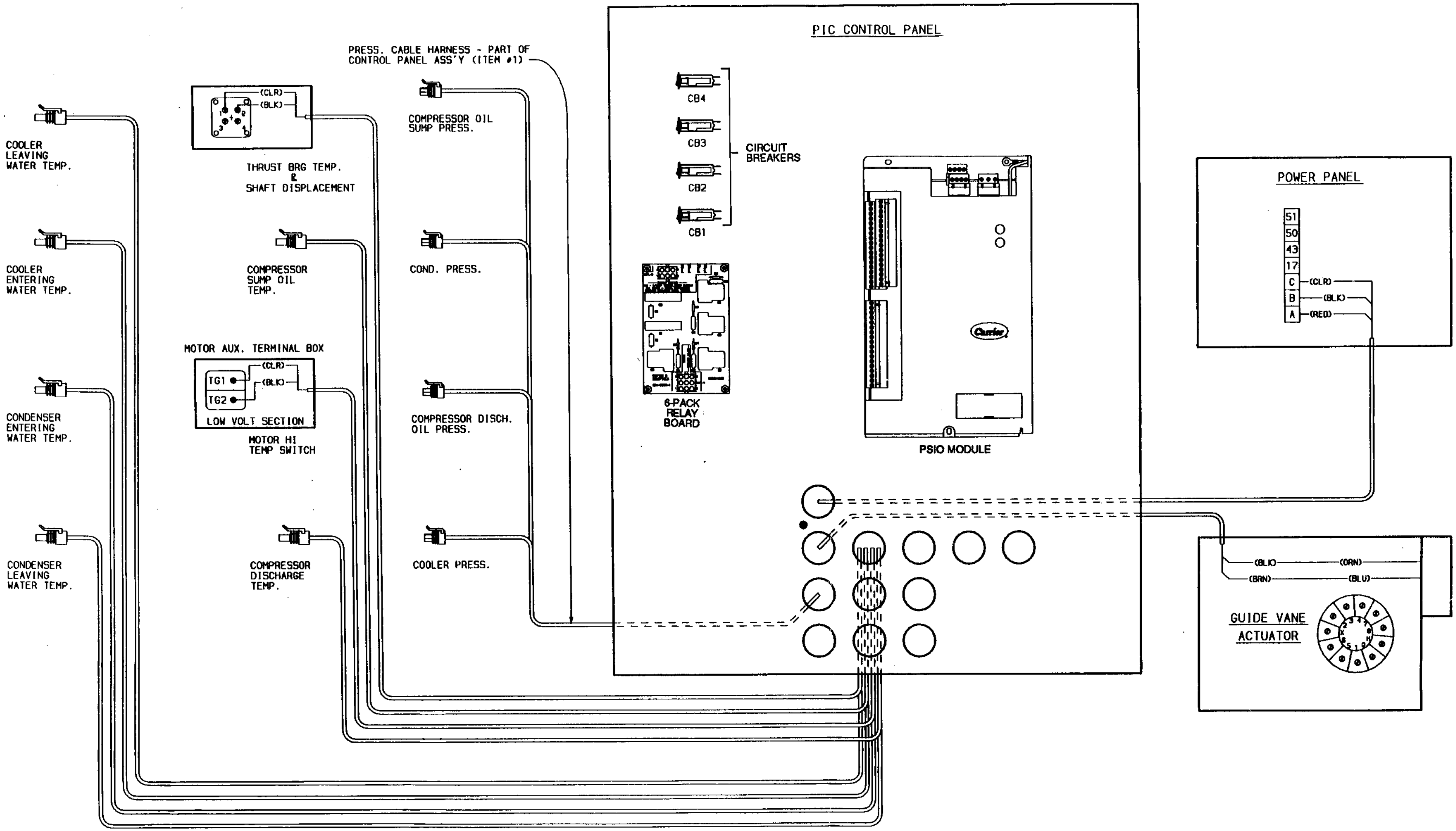


Fig. 7 — 17EX Controls and Sensor Locations (cont)

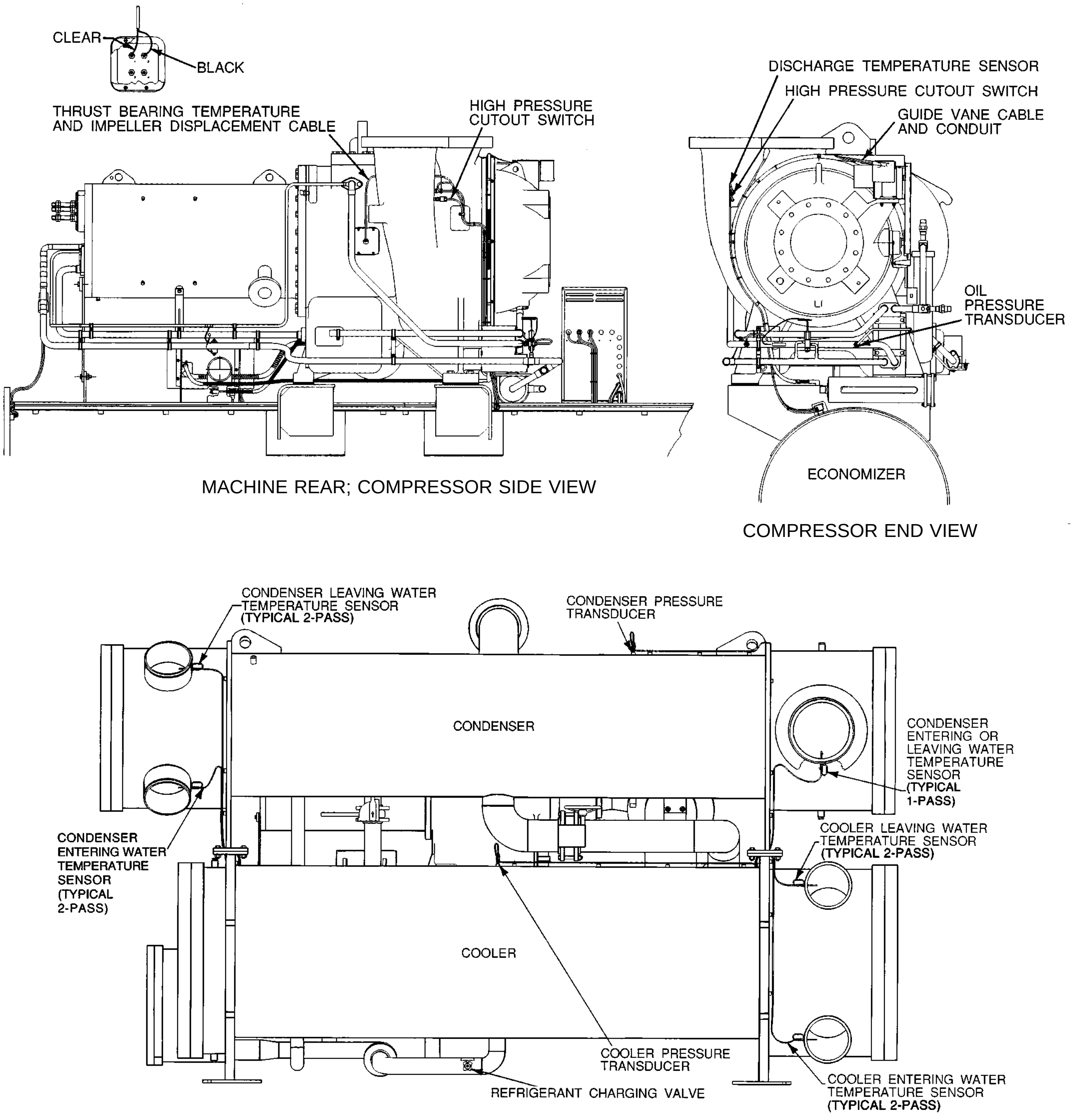
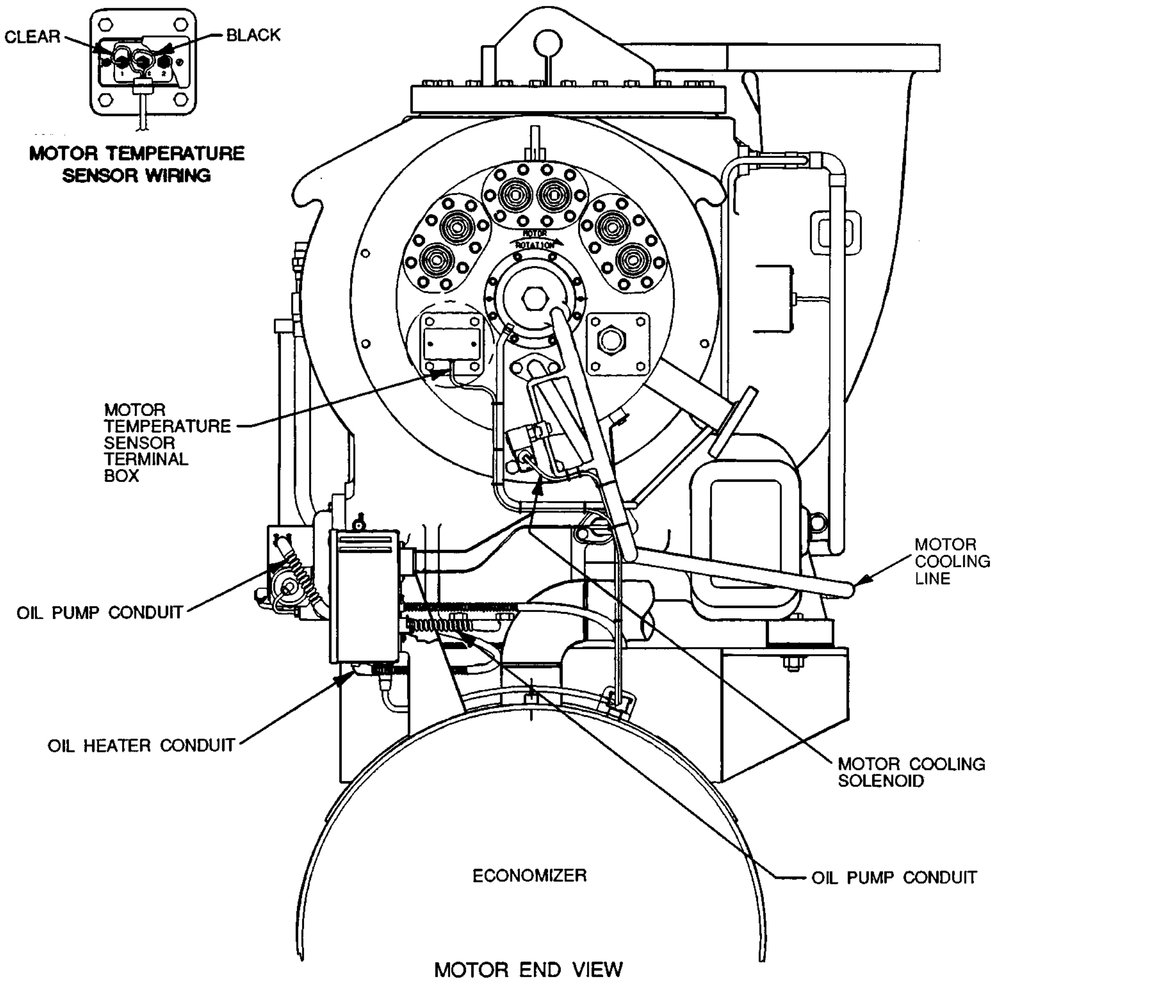


Fig. 8 — 19EX Controls and Sensor Locations



MOTOR END VIEW

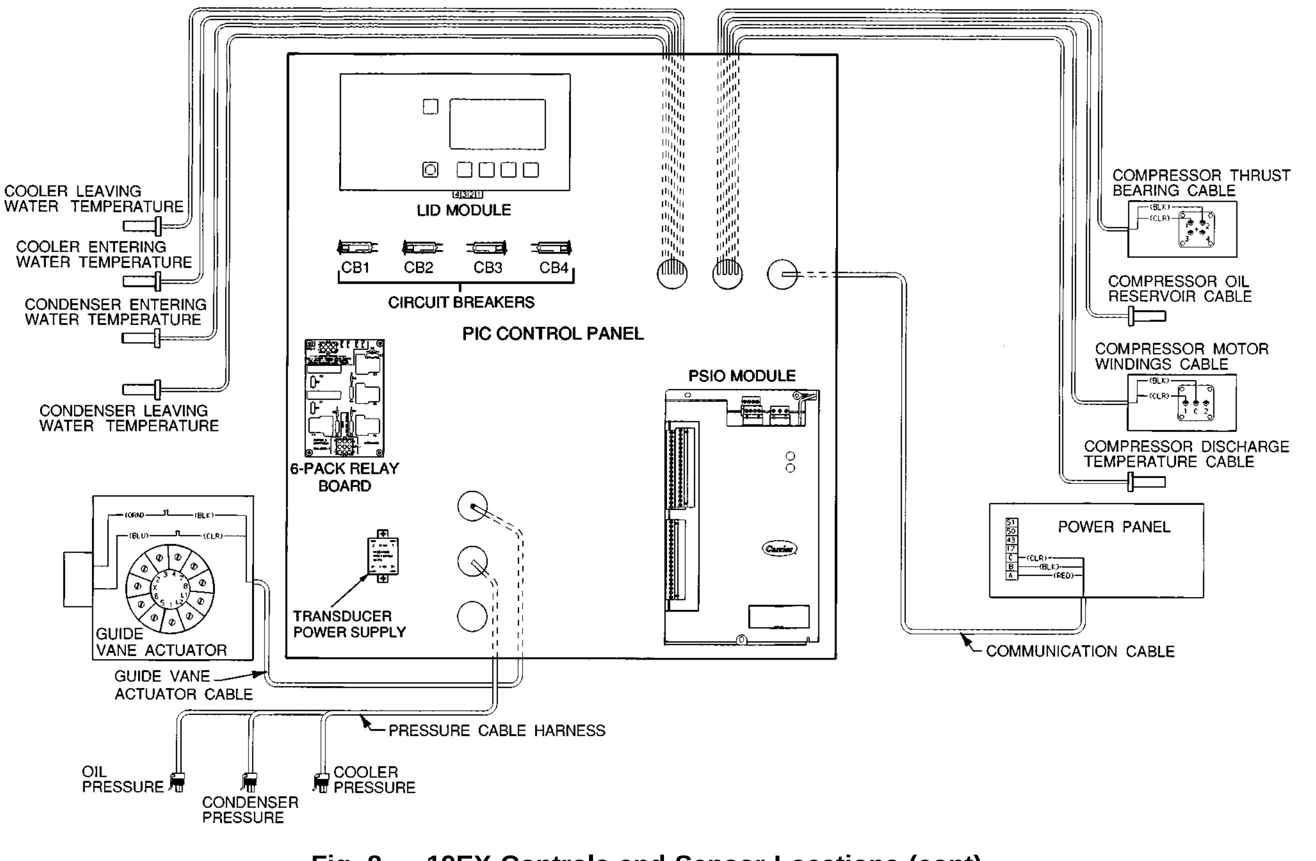
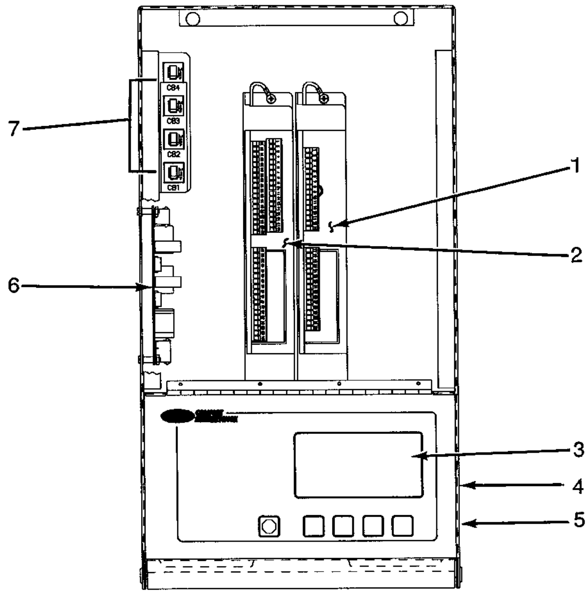


Fig. 8 — 19EX Controls and Sensor Locations (cont)



LEGEND

LID — Local Interface Device
PIC — Product Integrated Controls
PSIO — Processor Sensor Input/Output Module

1 — Optional 8-Input Module for Spare Inputs to Control Interface (One of Two Available)
2 — PSIO
3 — LID Input/Output Interface Panel Display
4 — Oil Differential Pressure/Power Supply Module (Hidden)
5 — LID Light (Hidden)
6 — 6-Pack Relay Board
7 — Circuit Breakers (4)

Fig. 9 — Control Center (Front View); Shown with Options Module

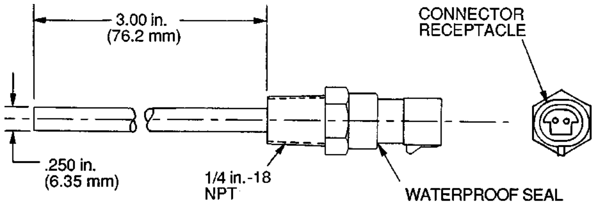


Fig. 10 — Control Sensors (Temperature)

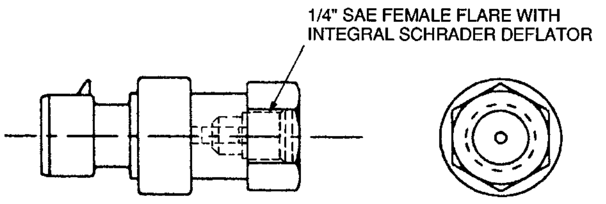
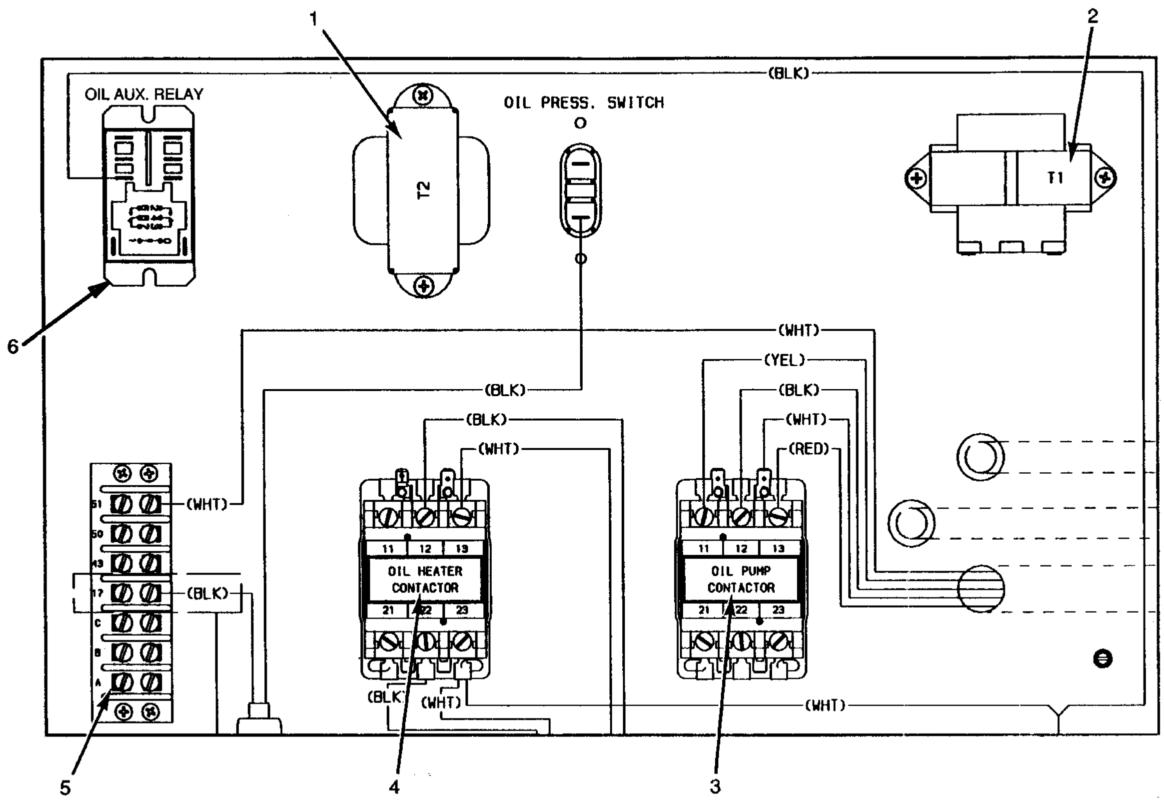


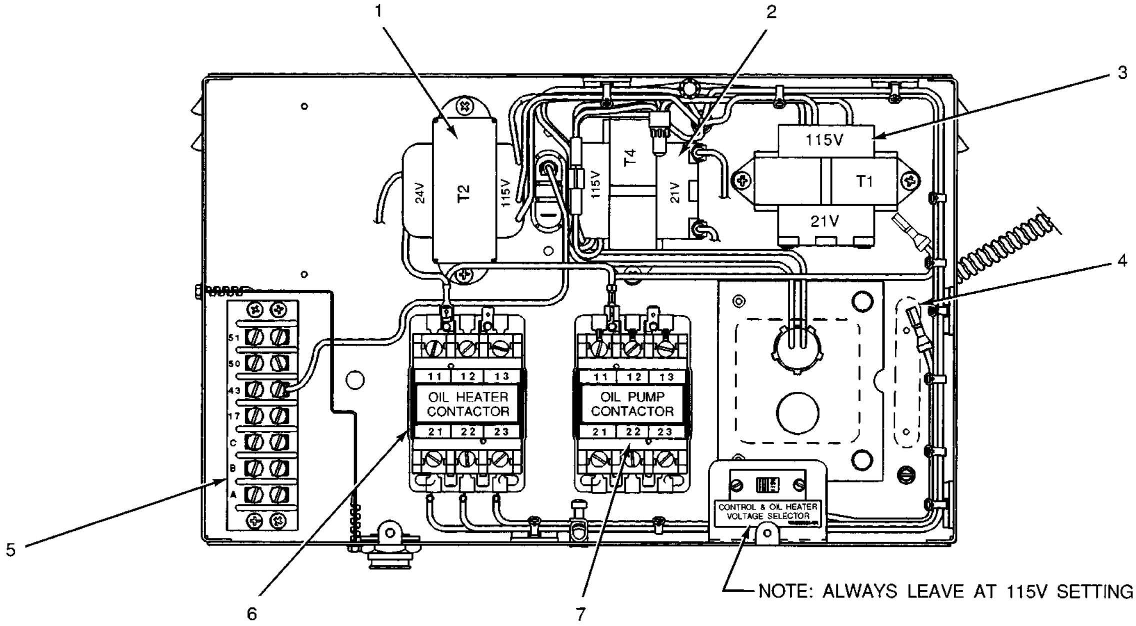
Fig. 11 — Control Sensors (Pressure Transducer, Typical)



LEGEND

1 — T2 — Power Transformer (Hot Gas Bypass Relay, Oil Pump Relay and Oil Heater Relay)
2 — T1 — Control Center Transformer
3 — Oil Heater Contactor (1C)
4 — Oil Pump Contactor (2C)
5 — Factory Terminal Connections
6 — Oil Auxiliary Relay (4C)

Fig. 12 — Power Panel Without Options (Open-Drive Machine Shown)



LEGEND

1 — T2 — Power Transformer (Hot Gas Bypass Relay, Oil Pump Relay and Oil Heater Relay)
2 — T4 — Transformer (8-Input Modules)
3 — T1 — Control Center Transformer
4 — 3C Hot Gas Bypass Relay Location
5 — Factory Terminal Connections
6 — Oil Heater Contactor (1C)
7 — Oil Pump Contactor (2C)

Fig. 13 — Power Panel with Options (Hermetic Machine Shown)

LID Operation and Menus (Fig. 14-20)

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. 14).
- 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. 15).
- 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.

NOTE: 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.

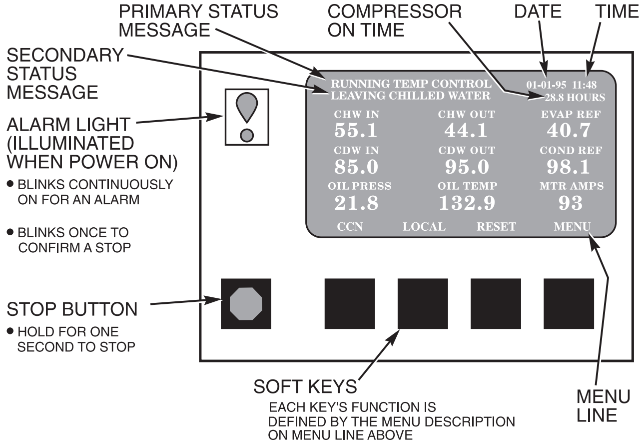


Fig. 14 — LID Default Screen

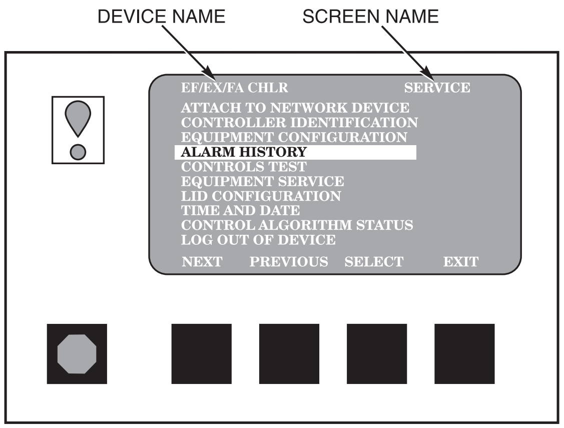


Fig. 15 — LID Service Screen

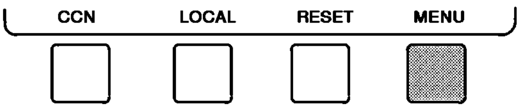
LID DEFAULT SCREEN MENU ITEMS — To perform any of the operations described below, the PIC must be powered up and have successfully completed its self test.

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 options 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 16 and 17 provide additional information on the menu structure.

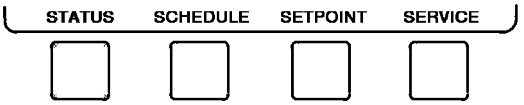
Press the MENU softkey to select from the 4 options. To view or change parameters within any menu structure, use the SELECT softkey to choose the desired table or item. The softkey modification choices displayed will depend on whether the selected item is a discrete point, analog point, or an override 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.

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

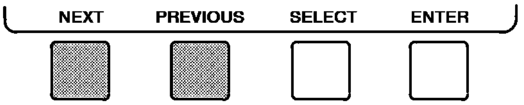
- Press MENU to select from the four available options.



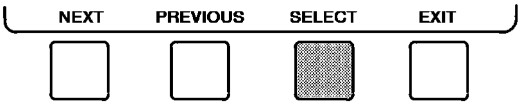
- Press the softkey that corresponds to the desired menu structure.



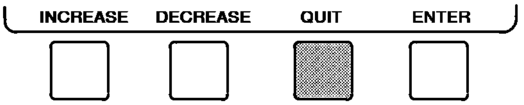
- Press NEXT or PREVIOUS to highlight the desired entry.



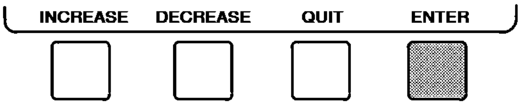
- Press SELECT to access the highlighted point.



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

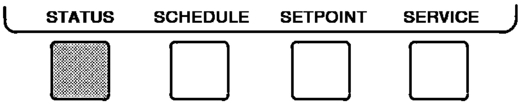


- Or, press ENTER to leave the selected decision or field and save changes.

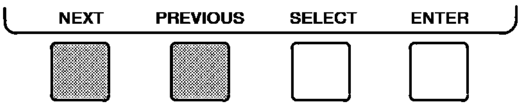


TO VIEW OR CHANGE POINT STATUS (Fig. 18) — Point Status is the actual value of all of the temperatures, pressures, relays, and actuators sensed and controlled by the PIC.

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



2. Press NEXT or PREVIOUS to highlight the desired status table. The list of tables is:
   - Status01 — Status of control points and sensors
   - Status02 — Status of relays and contacts
   - Status03 — Status of both optional 8-input modules and sensors



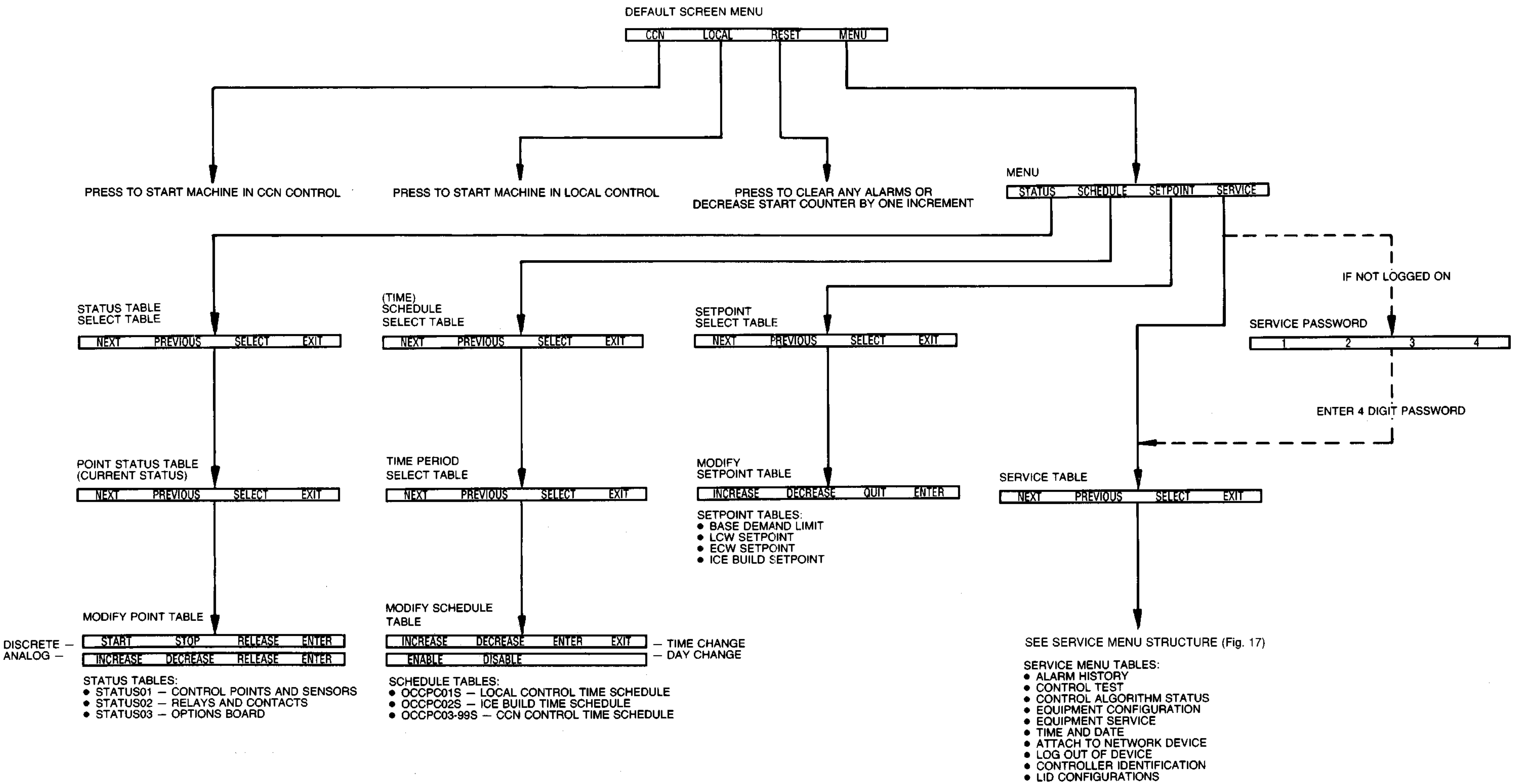


Fig. 16 — 17/19EX LID Menu Structure

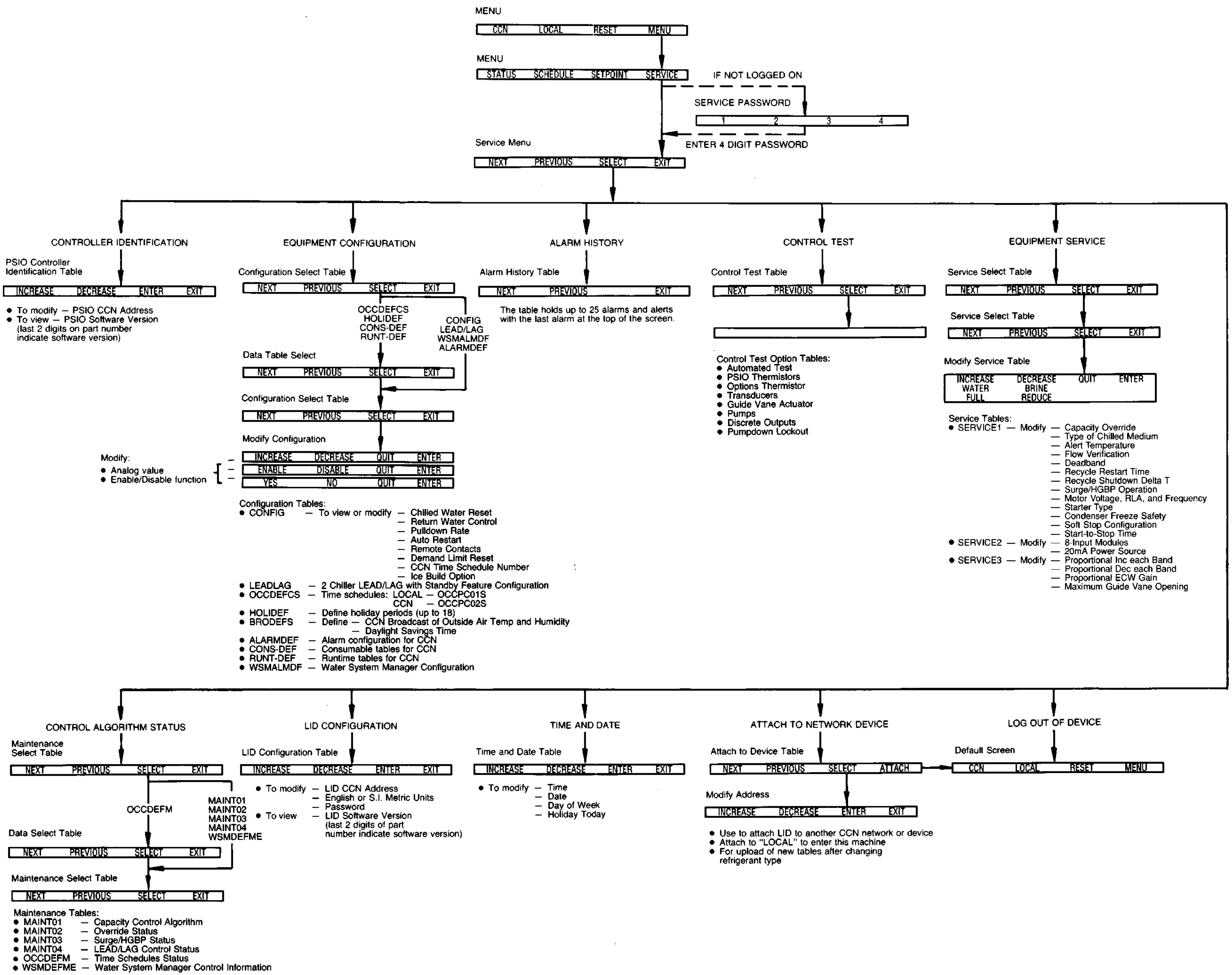
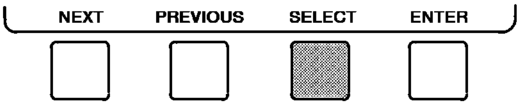
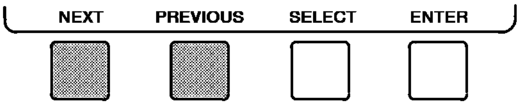


Fig. 17 — 17/19EX Service Menu Structure

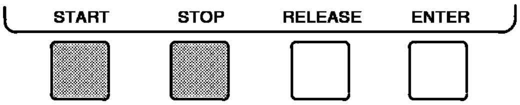
3. Press SELECT to view the desired Point Status table.



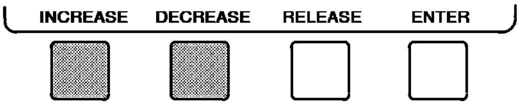
4. On the Point Status table press NEXT or PREVIOUS until desired point is displayed on the screen.



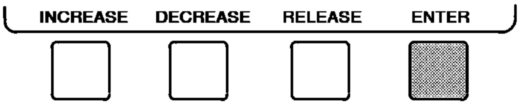
For Discrete Points — Press START or STOP, YES or NO, ON or OFF, etc. to select the desired state.



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



5. Press ENTER to register new value.



OVERRIDE OPERATIONS

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.

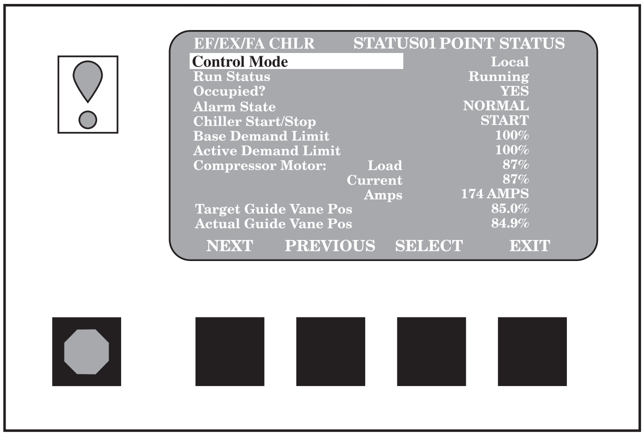
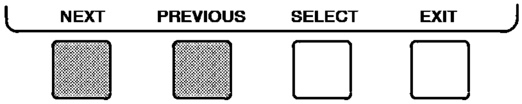


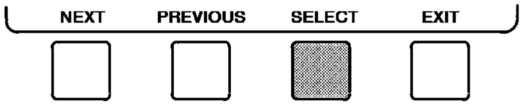
Fig. 18 — Example of Point Status Screen (Status01)

To Remove an Override

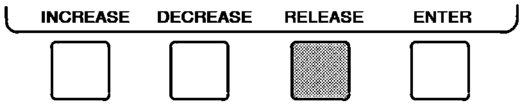
1. On the Point Status table press NEXT or PREVIOUS to highlight the desired point.



2. Press SELECT to access the highlighted point.



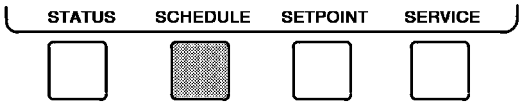
3. Press RELEASE to remove the override and return the point to the PIC's automatic control.



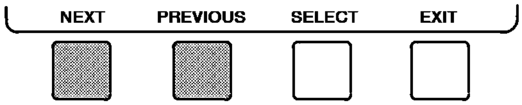
Override Indication — An override value is indicated by ''SUPVSR,'' ''SERVC,'' or ''BEST'' flashing next to the point value on the Status table.

TO VIEW OR CHANGE TIME SCHEDULE OPERATION (Fig. 19)

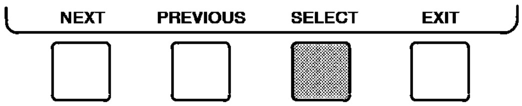
1. On the Menu screen, press SCHEDULE.



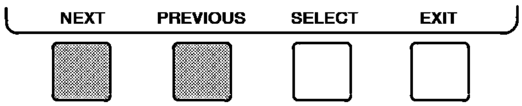
2. Press NEXT or PREVIOUS to highlight one of the following schedules.
   OCCPC01S — LOCAL Time Schedule
   OCCPC02S — ICE BUILD Time Schedule
   OCCPC03-99S — CCN Time Schedule (Actual number is defined in Config table.)



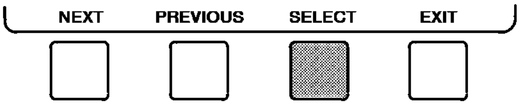
3. Press SELECT to access and view the time schedule.



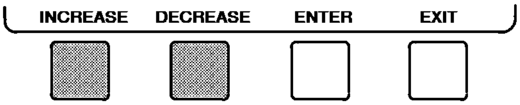
4. Press NEXT or PREVIOUS to highlight the desired period or override that you wish to change.



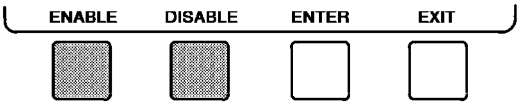
5. Press [SELECT] to access the highlighted period or override.



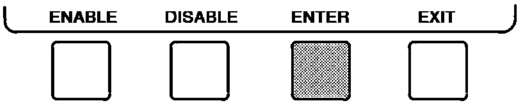
6. a. Press [INCREASE] or [DECREASE] to change the time values. Override values are in one-hour increments, up to 4 hours.



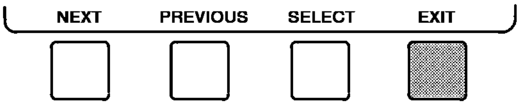
   b. Press [ENABLE] to select days in the day-of-week fields. Press [DISABLE] to eliminate days from the period.



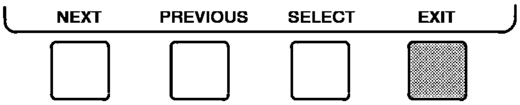
7. Press [ENTER] to register the values and to move horizontally (left to right) within a period.



8. Press [EXIT] to leave the period or override.



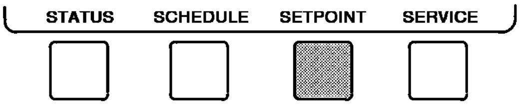
9. Either return to Step 4 to select another period or override, or press [EXIT] again to leave the current time schedule screen and save the changes.



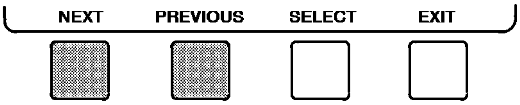
10. Holiday Designation (HOLIDEF table) may be found in the Service Operation section, page 44. You must assign the month, day, and duration for the holiday. The Broadcast function in the Brodefs table also must be enabled for holiday periods to function.

TO VIEW AND CHANGE SET POINTS (Fig. 20)

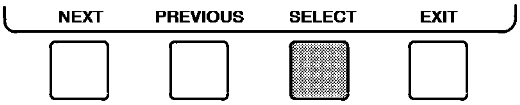
1. To view the Set Point table, at the Menu screen press [SETPOINT] .



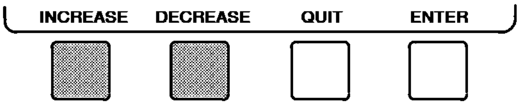
2. There are 4 set points on this screen: Base Demand Limit; LCW Set Point (leaving chilled water set point); ECW Set Point (entering chilled water set point); and ICE BUILD set point. Only one of the chilled water set points can be active at one time, and the type of set point is activated in the Service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



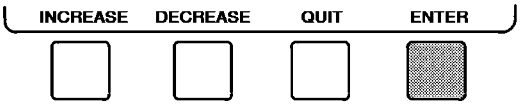
4. Press [SELECT] to modify the highlighted set point.



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

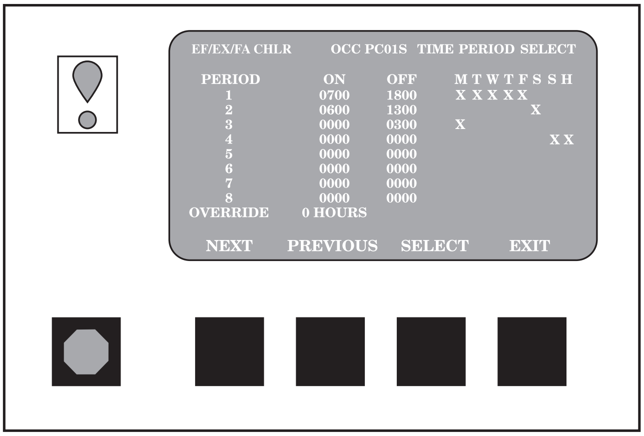


Fig. 19 — Example of Time Schedule Operation Screen

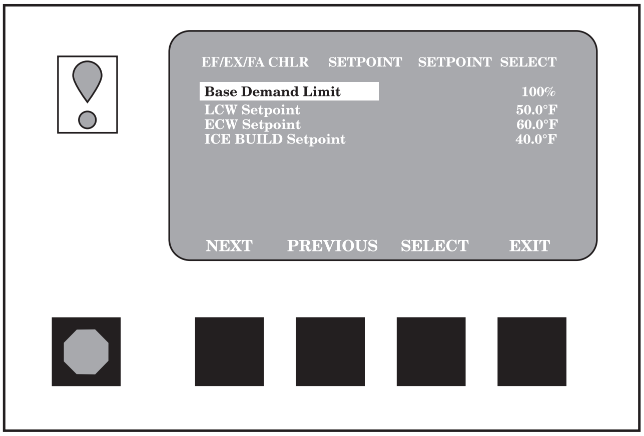


Fig. 20 — Example of Set Point Screen

Table 2 — LID Screens

NOTES:
1. 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.
2. The LID may be configured in English or SI units, as required, through the LID configuration screen.
3. Data appearing in the Reference Point Names column is used for CCN operations only.

EXAMPLE 1 — STATUS01 DISPLAY SCREEN

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

1. Press **MENU** .
2. Press **STATUS** (**STATUS01** will be highlighted).
3. 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	0-999	%	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: Setpoint	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
Motor Winding Hi Temp Cutout**	Normal/Alarm		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

NOTE: All values are variables available for read operation to a CCN. Descriptions shown with (*) support write operations for BEST programming language, data-transfer, and overriding.

†Information is applicable to hermetic machines only.
**Information is applicable to open-drive machines only.
††Oil pressure is read directly from a differential pressure module on 17EX machines.

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
Auxiliary Oil Pump Relay**		X	OFF/ON	AUXOILR
***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 to a CCN. Descriptions shown with (*) support write operations from the LID only.

†Information is applicable to hermetic machines only.
**Information is applicable to open-drive machines 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

NOTE: All values shall be variables available for read operation to a CCN network. Descriptions shown with (*) support write operations for BEST programming language, data-transfer, and overriding.

Table 2 — LID Screens (cont)

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 Setpoint	20-120 (–6.7-48.9)	DEG F (DEG C)	lcw_sp	50.0 (10.0)
ECW Setpoint	20-120 (–6.7-48.9)	DEG F (DEG C)	ecw_sp	60.0 (15.6)
ICE BUILD Setpoint	20- 60 (–6.7-15.6)	DEG F (DEG C)	ice_sp	40.0 (4.4)

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	DISABLE/ENABLE		ecw_opt	DISABLE
Demand Limit At 20 mA	40-100	%	dem_20ma	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		occpcxxe	3
Broadcast Option	DISABLE/ENABLE		occbrcst	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.

Table 2 — LID Screens (cont)

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	preflt	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**	165-210 (74-99)	DEG F (DEG C)	tb_alert	210 (99)
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)	rcycrdt	5 (2.8)
Recycle Shutdown Delta†	0.5-4.0 (.27-2.2)		rcycsdt	1.0 (0.6)
Surge Limit/HGBP Option Select: Surge=0, HGBP=1	0/1		srg_hgbp	0
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 Min. Load Points (T1/P1)	30-170 (207-1172)	PSI (kPa)	hgb_dp1	50 (345)
Surge/HGBP Delta T2	0.5-15 (0.3-8.3)	DEG F (DEG C)	hgb_dt2	10 (5.6)
Surge/HGBP Delta P2 Full Load Points (T2/P2)	30-170 (207-1172)	PSI (kPa)	hgb_dp2	85 (586)
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 Select: Amps=0, Load=1	0/1		dem_src	0
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 Select: 0=60 Hz, 1=50 Hz	0/1	HZ	freq	0
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
Stop to Start Timer†	3-50	MIN	stopmtr	20

NOTE: Δ = delta degrees.

*Information is applicable to hermetic machines only.
†Information is applicable to open-drive machines only.

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	0,1		res_20 ma	0
DEMAND 20 mA Power Source	0,1		dem_20 ma	0
SPARE ALERT ENABLE Disable = 0, 1 = High Alert, 2 = Low Alert, 3 = High Alarm, 4 = Low Alarm Temp = Alert Threshold				
CHWS Temp Enable	0-4		chws_en	0
CHWS Temp Alert	–40-245 (–40-118)	DEG F (DEG C)	chws_al	245 (118)
CHWR Temp Enable	0-4		chwr_en	0
CHWR Temp Alert	–40-245 (–40-118)	DEG F (DEG C)	chwr_al	245 (118)
Reset Temp Enable	0-4		rres_en	0
Reset Temp Alert	–40-245 (–40-118)	DEG F (DEG C)	rres_al	245 (118)
Spare Temp 1 Enable	0-4		spr1_en	0
Spare Temp 1 Alert	–40-245 (–40-118)	DEG F (DEG C)	spr1_al	245 (118)
Spare Temp 2 Enable	0-4		spr2_en	0
Spare Temp 2 Alert	–40-245 (–40-118)	DEG F (DEG C)	spr2_al	245 (118)
Spare Temp 3 Enable	0-4		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	0,1		sp1_20 ma	0
SPARE 2 20 mA Power Source	0,1		sp2_20 ma	0
SPARE ALERT ENABLE Disable = 0, 1 = High Alert, 2 = Low Alert, 3 = High Alarm, 4 = Low Alarm Temp = Alert Threshold				
Spare Temp 4 Enable	0-4		spr4_en	0
Spare Temp 4 Alert	–40-245 (–40-118)	DEG F (DEG C)	spr4_al	245 (118)
Spare Temp 5 Enable	0-4		spr5_en	0
Spare Temp 5 Alert	–40-245 (–40-118)	DEG F (DEG C)	spr5_al	245 (118)
Spare Temp 6 Enable	0-4		spr6_en	0
Spare Temp 6 Alert	–40-245 (–40-118)	DEG F (DEG C)	spr6_al	245 (118)
Spare Temp 7 Enable	0-4		spr7_en	0
Spare Temp 7 Alert	–40-245 (–40-118)	DEG F (DEG C)	spr7_al	245 (118)
Spare Temp 8 Enable	0-4		spr8_en	0
Spare Temp 8 Alert	–40-245 (–0-118)	DEG F (DEG C)	spr8_al	245 (118)
Spare Temp 9 Enable	0-4		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'' threshold for each point listed. If the ''Enable'' is set to 1, a value above the ''Temp'' 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. If the ''Enable'' is set to 3, a value above the ''Temp'' threshold will generate an alarm. If the ''Enable'' is set to 4, a value below the ''Temp'' threshold will generate an alarm.

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 **CONTROL 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.

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†	–40-245 (–40-118)	DEG F (DEG C)	MTRW
Override Threshold	150-200 (66-93)	DEG F (DEG C)	mt_over
CONDENSER PRESSURE	–6.7-420 (–42-2896)	PSI (kPa)	CRP
Override Threshold	90-245 (621-1689)	PSI (kPa)	cp_over
EVAPORATOR REFRIG TEMP	–40-245 (–40-118)	DEG F (DEG C)	ERT
Override Threshold	2-45 (1-7.2)	DEG F (DEG C)	rt_over
DISCHARGE TEMPERATURE	–40-245 (–40-118)	DEG F (DEG C)	CMPD
Alert Threshold	125-200 (52-93)	DEG F (DEG C)	cd_alert
BEARING TEMPERATURE	–40-245 (–40-118)	DEG F (DEG C)	MTRB
Alert Threshold	175-185 (79-85)	DEG F (DEG C)	tb_alert

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.

†Information is applicable to hermetic machines only.

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

NOTE: Override is not supported on this maintenance screen. Only values with capital letter reference point names are variables available for read operation.

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		llmode
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. 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. 14-20.

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 ±0.5° 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 45, 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 an OCCUPIED mode for up to 4 hours, on a one-time basis.

Figure 19 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.

Whenever the chiller is in the LOCAL mode, the machine uses Occupancy Schedule 01.

The Ice Build Time Schedule is Schedule 02. When in the CCN mode, Occupancy Schedule 03 is used.

The CCN schedule number is defined on the Config table in the Equipment Configuration table on page 29. 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. 17.

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 83.

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 off. 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.

Default Screen Freeze — Whenever an alarm occurs, the LID default screen will freeze displaying the condition of the machine at the time of alarm. Knowledge of the operating state of the chiller at the time an alarm occurs is useful when troubleshooting. Current machine information can be viewed on the Status tables. Once all existing alarms are cleared (by pressing the RESET softkey), the default LID will return to normal operation.

Motor Cooling Control (Hermetic Motors Only) — Motor temperature is reduced by refrigerant entering the motor shell and evaporating. The refrigerant is regulated by the motor cooling relay. This relay will energize when the compressor is running and motor temperature is above 125 F (51.7 C). The relay will close when motor temperature is below 100 F (37.8 C). Note that there is always a minimum flow of refrigerant when the compressor is operating for motor cooling; the relay only controls additional refrigerant to the motor.

NOTE: An additional motor cooling relay is not required for Hermetic FA style compressors.

Auxiliary Oil Pump Control (Open Drive Machines Only) — The auxiliary oil pump (optional) is controlled by the PIC. During start-up, if the main oil pump cannot raise pressure to 18 psid (124 kPa), the auxiliary oil pump will be energized. During compressor operation, the auxiliary oil pump will be energized if the oil pressure falls below the alert threshold (18 psid [124 kPa]). Once running, the auxiliary oil pump will remain on until the compressor is turned off and will deenergize with the main oil pump after the post-lube time period.

Shaft Seal Oil Control (Open Drive Machines Only) — All open drive machines require that the shaft seal be bathed in oil at all times, especially when the machine is not running. This ensures that refrigerant does not leak past the seal. The PIC control will energize the oil pump for one minute if the oil pump has not operated during the past 12 hours.

It is important to note that if control power is to be turned off for longer than this period, the refrigerant charge must be pumped over into the utility vessel. Because the oil heater will also be off during this time, storing the refrigerant will also prevent refrigerant migration into the oil.

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. The lowest temperature ramp table will be used the first time the machine is started (at commissioning). The lowest temperature ramp rate will also be used if machine power has been off for 3 hours or more (even if the motor ramp load is selected).
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 (See 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 2-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.

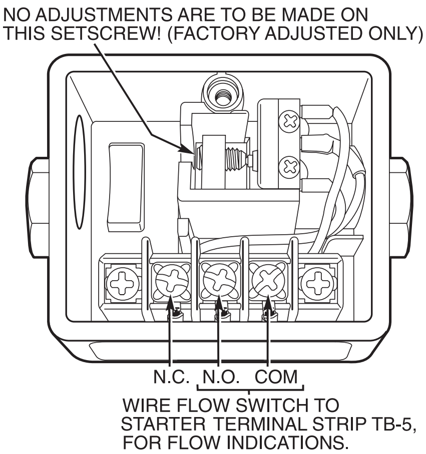
High Discharge Temperature Control — If the discharge temperature increases above 200 F (93 C), the guide vanes are proportionally opened to increase gas flow through the compressor. If the leaving chilled water temperature drops 5° F (2.8° C) below the control point temperature, machine will enter the recycle mode.

Table 3 — Protective Safety Limits and Control Settings

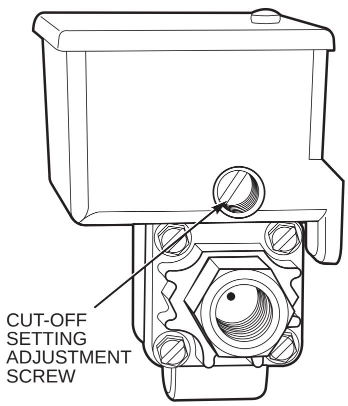
MONITORED PARAMETER	LIMIT	APPLICABLE COMMENTS
TEMPERATURE SENSORS OUT OF RANGE	–40 to 245 F (–40 to 118.3 C)	Must be outside range for 2 seconds
PRESSURE TRANSDUCERS OUT OF RANGE	0.08 to 0.98 Voltage Ratio	Must be outside range for 2 seconds. Ratio = Input Voltage ÷ Voltage Reference
COMPRESSOR DISCHARGE 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 (Temp converted from Pressure Reading)	<33 F (for water chilling) (0.6° C)	Preset, configure chilled medium for water (Service1 table)
	<Brine Refrigerant Trippoint (set point adjustable from 0 to 40 F [–18 to 4 C] for brine chilling)	Configure chilled medium for brine (Service1 table). Adjust brine refrigerant trippoint for proper cutout
TRANSDUCER VOLTAGE	<4.5 vdc > 5.5 vdc	Preset (Read voltage at terminals 34 and 35 on PSIO module)
CONDENSER PRESSURE — SWITCH	>218 ± 7 psig (1503 ± 48 kPa), reset at 120 ± 10 (827 ± 69 kPa)	Preset
— CONTROL	215 psig (1482 kPa)	Preset
OIL PRESSURE — SWITCH	Cutout <11 psid (76 kPad) ± 1.5 psid (10.3 kPad) Cut-in >16.5 psid (114 kPad) ± 4 psid (27.5 kPad)	Preset, no calibration needed
— CONTROL	Cutout <15 psid (103 kPad) Alert <18 psid (124 kPad)	Preset
LINE VOLTAGE — HIGH	>110% for one minute	Preset, based on transformed line voltage to 24 vac rated-input to the Starter Management Module. Also monitored at PSIO power input.
— LOW	<90% for one minute or ≤85% for 3 seconds	
— SINGLE-CYCLE	<50% for one cycle	
COMPRESSOR MOTOR LOAD (% Compressor Amps)	>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 table)
STARTER TRANSITION	>75 seconds	Reduced voltage starters only
CONDENSER FREEZE PROTECTION	Energizes condenser pump relay if condenser refrigerant temperature or condenser entering water temperature is below the configured condenser freeze point temperature. Deenergizes when the temperature is 5 F (3 C) above condenser freeze point temperature.	CONDENSER FREEZE POINT configured in Service01 table with a default setting of 34 F (1 C).
IMPELLER CLEARANCE	Displacement switch open	Thrust movement excessive
MOTOR LEAK DETECTOR*	Water from motor cooling is leaking	Water sensors are installed only on open-drive motors that use water cooling. (Totally enclosed, water-to-air cooled [TEWAC] motors)

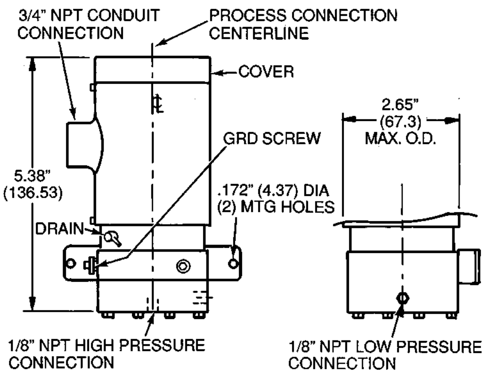
Flow Switches (Field Supplied)

Operate water pumps with machine off. Manually reduce water flow and observe switch for proper cutout. Safety shutdown occurs when cutout time exceeds 3 seconds.



Carrier Part No. HK06ZC033





Carrier Part No. HK06ZC001

NOTE: Dimensions in parentheses are in millimeters.

*Applicable to open-drive machines only.

Table 4 — Capacity Overrides

OVERRIDE CAPACITY CONTROL	FIRST STAGE SETPOINT			SECOND STAGE SETPOINT	OVERRIDE TERMINATION
	View/Modify on LID Screen	Default Value	Configurable Range	Value	Value
HIGH CONDENSER PRESSURE	Equipment Service1	125 psig (862 kPa)	90 to 200 psig (620 to 1379 kPa)	>Override Set Point + 4 psid (28 kPad)	<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 (1.6° 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 psid (345 kPad) Max: T2 — 10° F (5.6° C) P2 — 85 psid (586 kPad)	0.5° to 15° F (0.3° to 8.3° C) 30 to 170 psid (207 to1172 kPad) 0.5° to 15° F (0.3° to 8.3° C) 30 to 170 psid (207 to 1172 kPad)	None	Within Lift Limits Plus Surge/ HGBP Deadband Setting
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%	≥5% 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

*Not available on open drive machines.

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.

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 2 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.

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.

When a power failure to the PSIO module has occurred for more than 3 hours (i.e., initial start-up), the compressor guide vane opening will be slowed down to prevent excessive oil foaming that may result from refrigerant migration into the oil sump during the power failure. The vane opening will be slowed to a value of 2° F (1.1° C) per minute with temperature ramp loading.

Oil Cooler — The oil must be cooled when the compressor is running.

EX Compressors: This is accomplished through a small, plate-type heat exchanger. The heat exchanger uses liquid condenser refrigerant as the cooling liquid. A refrigerant thermostatic expansion valve (TXV) regulates refrigerant flow to control oil temperature entering the bearings. There is always a flow of refrigerant bypassing the TXV. The bulb for the expansion valve is strapped to the oil supply line leaving the heat exchanger and the valve is set to maintain 110 F (43 C).

NOTE: The expansion valve is not adjustable. Oil sump temperature may be at a lower temperature.

FA Compressors: The oil cooler is a water cooled, tube-in-shell type heat exchanger. A plug valve is manually set to maintain proper temperatures. Set the valve to maintain 145 F (63 C) oil sump temperatures while the compressor is running.

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 alarm is displayed, preventing the machine from starting. The operator must reset the alarm 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 terminal strip TB5, 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 cause an alert on the 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 terminal strip TB6, 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 Table 7).

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 the pump is energized. An alert will be generated if the machine is not in PUMPDOWN mode and the pump is energized. If in recycle shutdown, the mode shall transition to a non-recycle shutdown.

Tower-Fan Relay — This control can be used to assist the condenser water temperature control system (field supplied). 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-min start-to-start timer and the stop-to-start timer 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 (±17° 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 to 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.

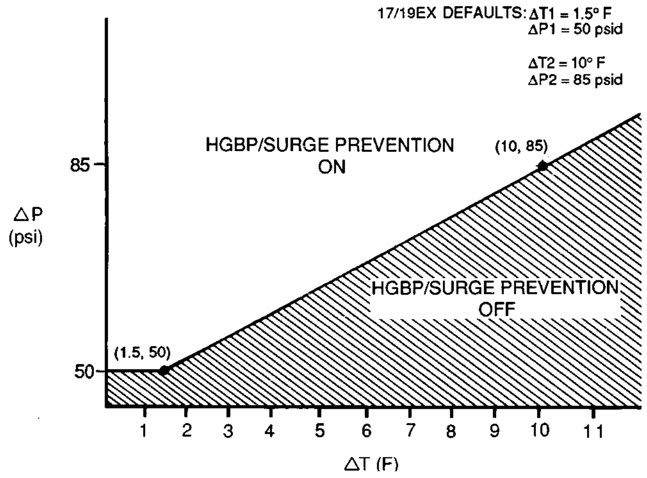
Surge Prevention Algorithm — This is an operator configurable feature which can determine if lift conditions are too high for the compressor and then take corrective action. Lift is defined as the difference between the pressure at the impeller eye and the impeller discharge. The maximum lift that a 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. 21 and 22. The 2 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 the Input Service configurations section on page 55.

Corrective action can be taken by making one of 2 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 if 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 screen. 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 screen. It has a default of 2 minutes.



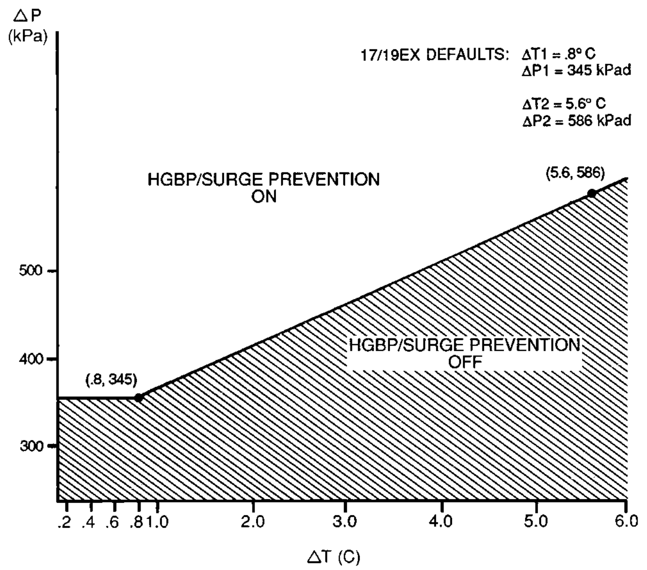
LEGEND

ΔP = (Condenser psi) − (Cooler psi)

ΔT = (ECW) − (LCW)

ECW — Entering Chilled Water
HGBP — Hot Gas Bypass
LCW — Leaving Chilled Water

Fig. 21 — 17/19EX Hot Gas Bypass/Surge Prevention (English)



LEGEND

ΔP = (Condenser kPa) − (Cooler kPa)

ΔT = (ECW) − (LCW)

ECW — Entering Chilled Water
HGBP — Hot Gas Bypass
LCW — Leaving Chilled Water

→ **Fig. 22 — 17/19EX Hot Gas Bypass/Surge Prevention (SI)**

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. 16 and 17 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 and Carrier Comfort Network Interface section on page 53 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.

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

<u>Standby Chiller Configuration and Operation</u> — 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 *LEAVING 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 from normal operation set point temperature 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. 16 and 17.

The PIC can be configured for ice build operation. Configuration of ice build control is accomplished through entries in the Config table, Ice Build Setpoint table, and the Ice Build Time Schedule table. Figures 16 and 17 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 the *REMOTE CONTACTS INPUT* 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 RESTART 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 CONTROL 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 SETPOINT*. 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 RESTART 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 *ENTERING CHILLED WATER* 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 or upgrade software.

Figure 23 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. 17.

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. 23.

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 19XT 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.

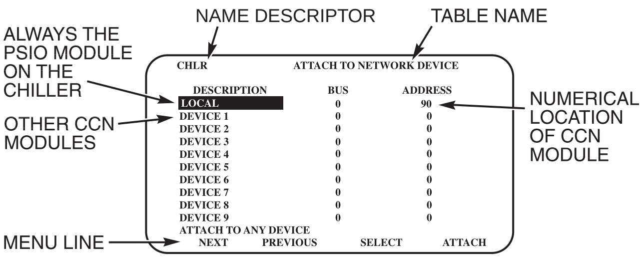
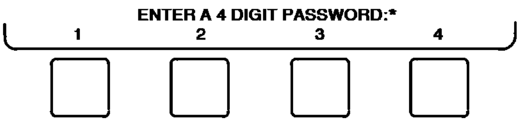


Fig. 23 — Example of Attach to Network Device Screen

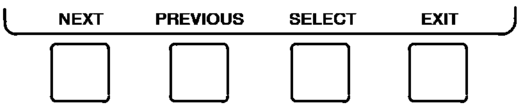
Service Operation — An overview of the menu-driven programs available for Service Operation is shown in Fig. 17.

TO LOG ON

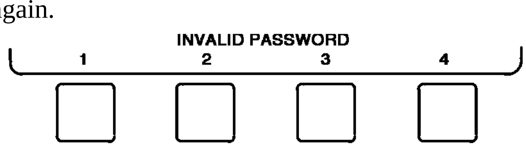
1. On the Menu screen, press SERVICE . The keys now correspond to the numerals 1, 2, 3, 4.
2. Press the four digits of your password, one at a time. An asterisk (*) appears as you enter each digit.



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.

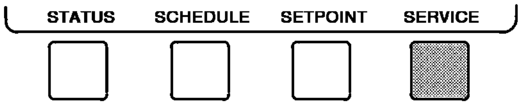
TO LOG OFF — Access the Log Out of Device table of the Service menu in order to password-protect the Service menu. The LID will automatically sign off and password-protect itself if a key is not pressed for 15 minutes. The LID default screen is then displayed.

HOLIDAY SCHEDULING (Fig. 24) — 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. 24.)

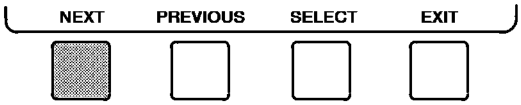
The Broadcast function must be activated for the holidays configured in the Holidef tables to work properly. Access the Brodefs table in the Equipment Configuration table and answer ‘‘Yes’’ to the activated function. However, when the machine is connected to a CCN Network, only one machine or CCN device 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:

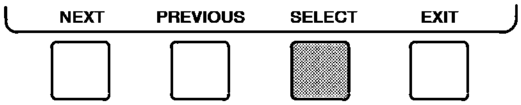
1. At the Menu screen, press SERVICE to access the Service menu.



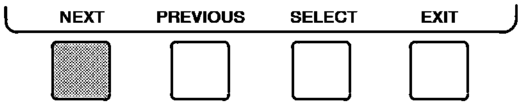
2. If not logged on, follow the instructions for To Log On or To Log Off. Once logged on, press NEXT until Equipment Configuration is highlighted.



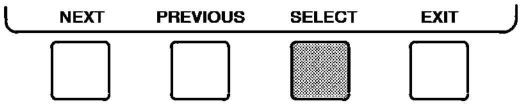
3. Once Equipment Configuration is highlighted, press SELECT to access.



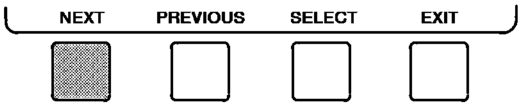
4. Press NEXT until Holidef is highlighted. This is the Holiday Definition table.



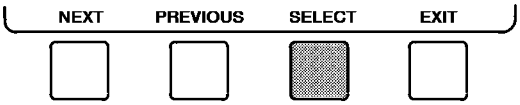
5. Press SELECT to enter the Data Table Select screen. This screen lists 18 holiday tables.



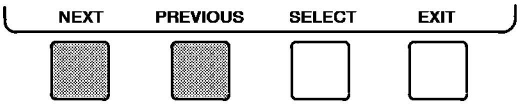
6. Press NEXT to highlight the holiday table that you wish to view or change. Each table is one holiday period, starting on a specific date, and lasting up to 99 days.



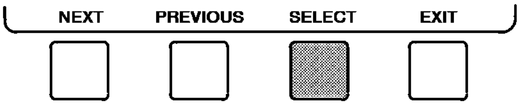
7. Press [SELECT] to access the holiday table. The Configuration Select table now shows the holiday start month and day, and how many days the holiday period will last.



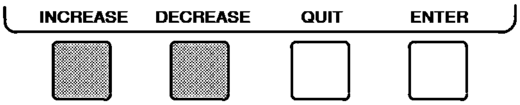
8. Press [NEXT] or [PREVIOUS] to highlight the month, day, or duration.



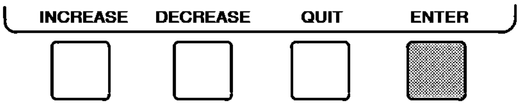
9. Press [SELECT] to modify the month, day, or duration.



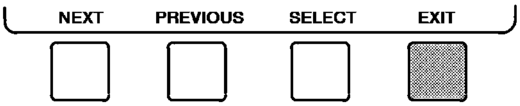
10. Press [INCREASE] or [DECREASE] to change the selected value.



11. Press [ENTER] to save the changes.



12. Press [EXIT] to return to the previous menu.



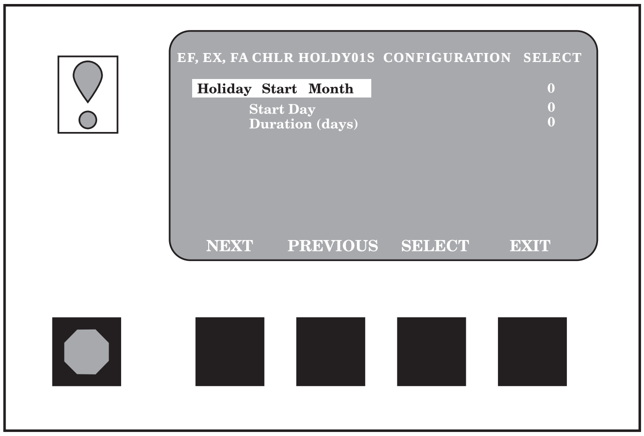


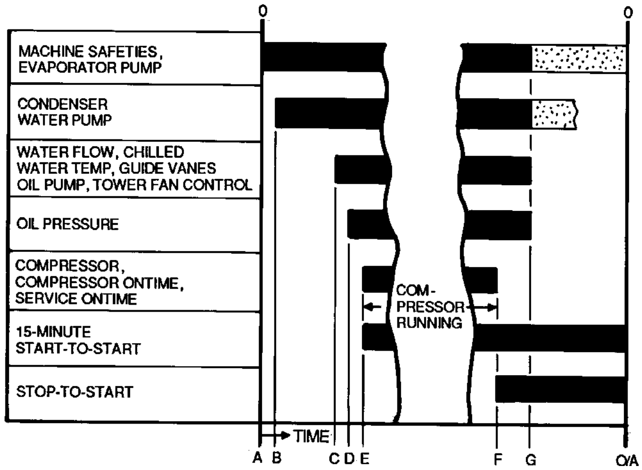
Fig. 24 — Example of Holiday Period Screen

START-UP/SHUTDOWN/ RECYCLE SEQUENCE (Fig. 25)

→ **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 timer and the stop-to-start inhibit timer 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. Thirty seconds 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 value, 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 4 psid (28 kPad), 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 18 psid (124 kPad). After oil pressure is verified, the PIC waits 15 seconds, and then the compressor start relay (1CR) is energized to start the compressor. Compressor ontime and service ontime timers start. Compressor starts counter and number of starts over a 12-hour period counter advance by one.



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 (30 seconds minimum, 300 seconds maximum after C) total compressor starts counter advances by one, number of starts over a 12-hour period advances by one.
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, stop-to-start 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 3 minutes after F).

→ **Fig. 25 — Control Sequence**

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, energizes the alarm light, 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

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

- when in LCW control, the difference between the *LEAVING CHILLED WATER* temperature and *ENTERING CHILLED WATER* temperature is less than the *RECYCLE SHUTDOWN DELTA T* (found in the Service1 table) and the *LEAVING CHILLED WATER TEMP* is below the *CONTROL POINT*, and the *CONTROL POINT* has not increased in the last 5 minutes
- when *ECW CONTROL OPTION* is enabled, the difference between the *ENTERING CHILLED WATER* temperature and the *LEAVING CHILLED WATER* temperature is less than the *RECYCLE SHUTDOWN DELTA T* (found in the Service1 table) and the *ENTERING CHILLED WATER TEMPERATURE* is 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.

⚠ 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
- 17/19EX 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. 26)
- 500 v insulation tester (megohmmeter) for compressor motors with nameplate voltage of 600 v or less, or a 5000-v insulation tester for compressor motor rated above 600 v

Using the Utility Vessel and Pumpout System — Refer to Pumpout and Refrigerant Transfer Procedures section, page 64 for: pumpout system preparation, refrigerant transfer, and machine evacuation.

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

OPEN DRIVE MOTOR

⚠ CAUTION

The motor may be provided with a shipping brace or shipping bolt (normally painted yellow) to prevent shaft movement during transit. It must be removed prior to operation. See Fig. 27.

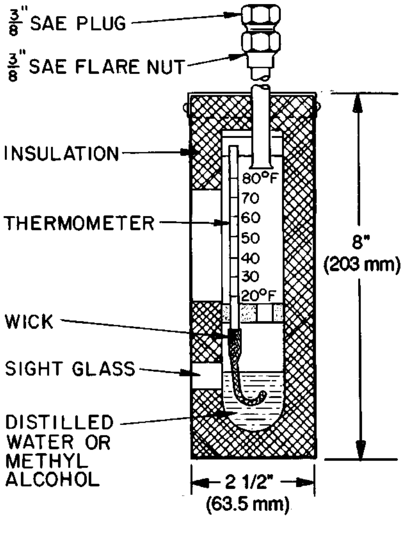


Fig. 26 — Typical Wet-Bulb Type Vacuum Indicator

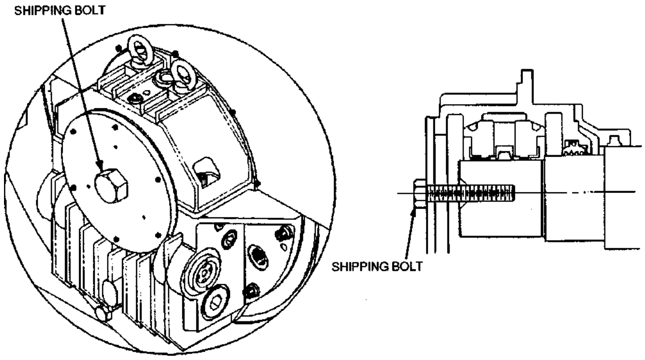


Fig. 27 — Shipping Bolt on Open Drive Motor

The motor should be inspected for any temporary, yellow caution tags whose legends convey information concerning actions necessary before the motor can be safely operated. Any slushing compound on the shaft or other parts must be removed using a petroleum type solvent and observing proper safety precautions.

NOTE: If the motor utilized a shipping bolt for restraining the rotor, the Westinghouse logo must be installed over the hole in the endcover. The logo, the gasket, and hardware can be found with the parts that have been shipped loose. (Usually these are packed inside of the main power lead box.)

Open-Drive Motor Electrical Connection — All interconnecting wiring for controls and grounding should be in strict accordance with both the National Electrical Code and any local requirements.

The main lead box furnished with the motor has been sized to provide adequate space for the make-up of the connections between the motor lead cables and the incoming power cables. The bolted joints between the motor lead and the power cables must be made and insulated in a workman-like manner following the best trade practices.

Fabricated motors are provided with 2 stainless steel grounding pads drilled and tapped with the NEMA 2-hole pattern (two ½-13 tapped holes on 1¾ in. centers). Fan cooled cast frames are provided with a special grounding bolt. The motor should be grounded by a proper connection to the electrical system ground.

The rotation direction of the motor will be as shown by either a nameplate on the motor or the certified drawing. The required phase rotation of the incoming power for this motor rotation may also be stated. If either is unknown, the correct sequence can be determined in the following manner: While the motor is uncoupled from the load, start the motor and observe the direction of rotation. Allow the motor to achieve full speed before disconnecting it from the power source. Refer to Open-Drive Motor Pre-Start Checks (page 53) for information concerning initial start-up. If resulting rotation is incorrect, it can be reversed by interchanging any 2 incoming cables.

Open-Drive Motor Auxiliary Devices — Auxiliary devices such as resistance temperature detectors, thermocouples, thermoguards, etc., will generally terminate on terminal blocks located in the auxiliary terminal box on the motor. Other devices may terminate on their own enclosures elsewhere on the motor. Such information can be obtained by referring to the certified drawing. Information regarding terminal designation and the connection of auxiliary devices can be obtained from auxiliary drawings referenced by the outline drawing.

If the motor is provided with internal space heaters, the incoming voltage supplied to them must be exactly as shown by either a nameplate on the motor or the outline drawing for proper heater operation. Caution must be exercised anytime contact is made with the incoming space heater circuit as space heater voltage is often automatically applied when the motor is shut down.

Open Oil Circuit Valves — Check that the oil filter isolation valves are open by removing the valve cap and checking the valve stem. (See Scheduled Maintenance, Changing Oil Filter, page 76.)

Tighten All Gasketed Joints and Guide Vane Shaft Packing — Gaskets and packings normally relax by the time the machine arrives at the jobsite. Tighten all gasketed joints and the guide vane shaft packing to ensure a leak-tight machine.

NOTE: On open-drive machines, check the machine cold alignment. Refer to Machine Alignment in the Maintenance section.

Check Machine Tightness — Figure 28 outlines the proper sequence and procedures for leak testing.

17/19EX chillers may be shipped with the refrigerant contained in the utility vessel and the oil charge shipped in the compressor. The cooler/condenser vessels will have a 15 psig (103 kPa) refrigerant charge. Units may also 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. 28 for an outline of the leak test procedures. Refer to Tables 5A and 5B for refrigerant pressure/temperature values and to Pumpout and Refrigerant Transfer Procedures section, page 64.

1. If the pressure readings are normal for machine condition:
   a. Evacuate the nitrogen 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. Follow the pumpout procedures in the Pumpout and Refrigerant Transfer Procedures section, page 64.

> **⚠ 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 PUMPDOWN 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, page 51.
   h. Slowly raise the system pressure to the equivalent saturated pressure for the surrounding temperature but no less than 35 psig (241 kPa) by adding HFC-134a 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. This leak rate repair is only for new start-ups. See page 67 for operating machine leak rate/repair recommendations.

5. If no leak is found during initial start-up procedures, complete the transfer of refrigerant gas (see Pumpout and Refrigerant Transfer Procedures section, page 64.)
6. If no leak is found after a retest:
   a. Transfer the refrigerant to the utility vessel or other storage tank 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 Pumpout and Refrigerant Transfer Procedures section, page 64.)
7. If a leak is found, pump the refrigerant back into the utility vessel or other storage tank.
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 2g to ensure a leaktight repair. (If machine is opened to the atmosphere for an extended period, evacuate it before repeating leak test.)

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 (see Pumpout and Refrigerant Transfer Procedures section, page 64) to at least 18 in. Hg vac, ref 30-in. bar (41 kPa), using a vacuum pump or the pumpout unit.
3. Valve off the pump to hold the vacuum and record the manometer or indicator reading.
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. If refrigerant is available in the other vessel, pressurize by following Steps 2-10 of Return Refrigerant To Normal Operating Conditions section, page 66. If not, use nitrogen and a refrigerant tracer. 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.
5. Repair leak, retest, and proceed with dehydration.

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

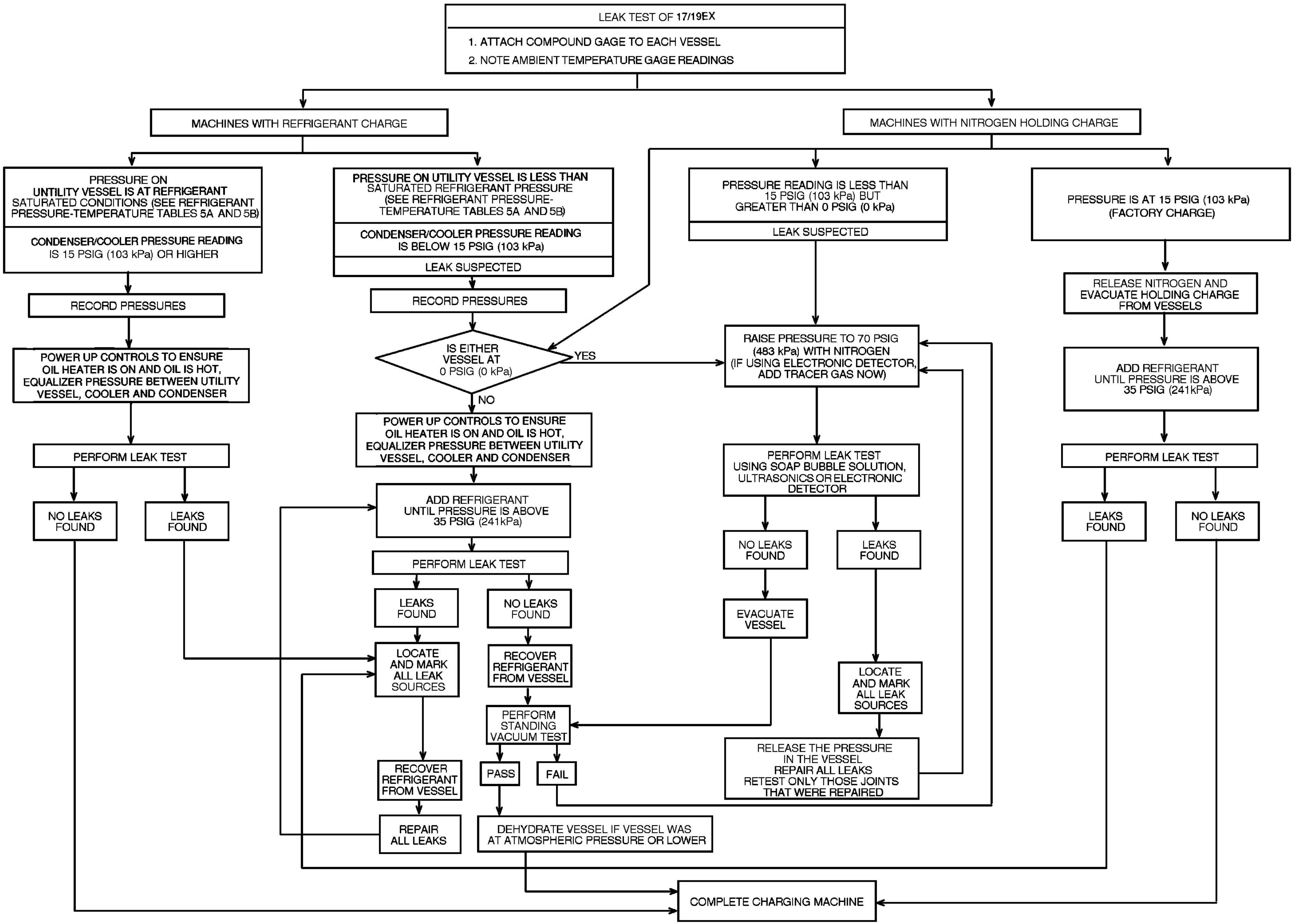


Fig. 28 — 17/19EX Leak Test Procedures

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

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. 29) 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 m^3/s] or larger is recommended) to the refrigerant charging valve (Fig. 7 and 8). 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 (sublimination) 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 180 psig (1241 kPa) pressure. Locate and repair the leak, and repeat dehydration.

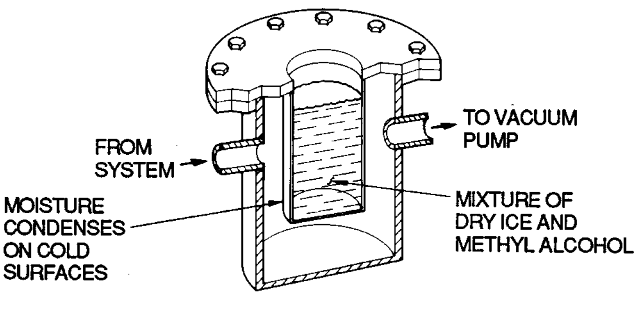


Fig. 29 — Dehydration Cold Trap

Inspect Water Piping — Refer to piping diagrams provided in the certified drawings, and the piping instructions in the 17/19EX 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 Optional Pumpout Compressor Water Piping — If the optional storage tank and/or pumpout system are installed, check to ensure the pumpout condenser water has been piped in. Check for field-supplied shutoff valves and controls as specified in the job data. Check for refrigerant leaks on field-installed piping.

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 and applicable local safety codes. Piping connections must allow for access to the valve mechanism for periodic inspection and leak testing.

Relief valves are set to relieve at the 225 psig (1551 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 to the following components and compare to the nameplate values: oil pump contact, pumpout compressor starter, and power panel.
6. Be sure that fused disconnects or circuit breakers have been supplied for the oil pump, power panel, and pumpout unit.
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. Tighten up all wiring connections to the plugs on the SMM, 8-input, and PSIO modules.
10. Ensure that the voltage selector switch inside the power panel is switched to the incoming voltage rating.
11. On machines with free-standing starters, inspect the power panel to ensure that the contractor has fed the wires into the bottom of the panel. Wiring into the top of the panel can cause debris to fall into the contactors. Clean and inspect the contactors if this has occurred.

⚠ WARNING

Voltage to terminals LL1 and LL2 comes from a control transformer in a starter built to Carrier specifications. Do not connect an outside source of control power to the compressor motor starter (terminals LL1 and LL2). An outside power source will produce dangerous voltage at the line side of the starter, because supplying voltage at the transformer secondary terminals produces input level voltage at the transformer primary terminals.

CHECK INSULATION RESISTANCE (HERMETIC MOTOR) — 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.) Factory-mounted starters do not require a megohm test.

1. 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.

2. With the tester connected to the motor leads, take 10-second and 60-second megohm readings as follows:
   <u>6-Lead Motor</u> — 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.
   <u>3-Lead Motor</u> — Tie terminals 1, 2, and 3 together and test between the group and ground.
3. Divide the 60-second resistance reading by the 10-second reading. The ratio, or polarization index, must be one or higher. Both the 10- and 60-second readings must be at least 50 megohms.

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

   NOTE: Unit-mounted starters do not have to be megohm tested.

CHECK INSULATION RESISTANCE (OPEN-DRIVE MOTOR) — Before operating voltages is applied to the motor, whether for checking rotation direction or for actual operation, the resistance of the stator winding insulation should be measured.

The test voltage, based on the motor operating voltage, is as follows:

Operating Voltage	DC Test Voltage
0- 900	500
901- 7000	1000
7001-14500	2500

This is particularly important if the motor may have been exposed to excessive dampness either during transit or while in storage. A ‘‘megger’’ type instrument can be used to measure the insulation resistance. The test voltage should be applied between the entire winding (all winding leads connected together) and ground for approximately one minute with the winding at ambient temperature. The recommended minimum insulation resistance is determined as follows:

RM = KV + 1

Where

RM = Recommended minimum insulation resistance in megohms at 104° F (40° C) of the entire winding.

KV = Rated motor terminal to terminal voltage in kilovolts (1000 volts = 1 KV).

On a new winding, where the contaminant causing low insulation resistance is generally moisture, drying the winding through the proper application of heat will normally increase the insulation resistance to an acceptable level. The following are several accepted methods for applying heat to a winding:

1. If the motor is equipped with space heaters, they can be energized to heat the winding.
2. Direct current (as from a welder) can be passed through the winding. The total current should not exceed approximately 50% of rated full load current. If the motor has only 3 leads, 2 must be connected together to form one circuit through the winding. In this case, one phase will carry the full applied current and each of the others, one-half each. If the motor has 6 leads (3 mains and 3 neutrals), the 3 phases should be connected into one series circuit.
3. Heated air can be either blown directly into the motor or into a temporary enclosure surrounding the motor. The source of heated air should preferably be electrical as opposed to fueled (such as kerosene) where a malfunction of the fuel burner could result in carbon entering the motor. Caution must be exercised, when heating the motor with any source of heat other than self contained space heaters, to raise the winding temperature at a gradual rate to allow any entrapped moisture to vaporize and escape without rupturing the insulation. The entire heating cycle should extend over 15 to 20 hours.

Insulation resistance measurements can be made while the winding is being heated. However, they must be corrected to 104 F (40 C) for evaluation since the actual insulation resistance will decrease with increasing temperature. As an approximation for a new winding, the insulation resistance will approximately halve for each 18° F (10° C) increase in insulation temperature above the dew point temperature.

Open-Drive Motor Pre-Start Checks — To prevent damage to the motor, the following steps must be taken prior to initial start-up:

1. Remove the shaft shipping brace (if supplied).
2. For sleeve bearing motors, the oil reservoir must be filled with oil to the correct level. The proper oil is a rust and oxidation inhibited, turbine grade oil. The viscosity of the oil must be 32 ISO (150 SSU) at 100 F (37.7 C). Oil capacity in each of the two bearings is 0.6 gal. (2.3 L) per bearing. Use of Carrier Oil Specification PP16-0 is approved (Mobil DTE Light or Sun Oil SUNVIS 916).
3. If possible, the shaft should be turned over by hand to ensure that there is free rotation. On sleeve bearing motors, the shaft should be moved to both extremes of its end play while it is being rotated, and the oil rings should be viewed through the viewing ports in the top of the bearing housing to verify free ring rotation.
4. On fan-cooled motors, the area around he external fan inlet should be checked for loose debris that could be drawn into the fan during operation.
5. All external, factory-made, bolted joints should be checked for any looseness that may have occurred in transit. Refer to Table 6 for recommended bolt torques.

Table 6 — Recommended Torque

	Bolt size	¼″	5⁄16″	3⁄8″	½″	5⁄8″	¾″	7⁄8″	1″	1⅓″	1½″
	Grade	SAE GR 5									
Torque*	Ft-lbs	3.5	7	12	31	63	115	180	275	550	960
	N·m	4.7	9.5	16	42	85	156	244	373	746	1302

	Bolt size	M4	M6	M8	M10	M12	M10	M12	M16
	Grade	DIN 8.8					DIN 12.9		
Torque*	Ft-lbs	2	8	15	35	65	45	92	225
	N·m	2.7	11	20	47	88	61	125	305

*Torque values based upon dry friction.

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.
+	RED	1
Ground	WHITE	2
–	BLACK	3

Check Starter

⚠ CAUTION

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

⚠ 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 Scheduled Maintenance, Oil Specification section (page 77).

On hermetic machines, add oil through the oil drain charging valve (Fig. 3, Item 26). A pump is required for adding oil against refrigerant pressure. The pumping device must be able to lift from 0 to 150 psig (0 to 1034 kPa) or above unit pressure. On open-drive machines, oil may be added through the oil drain and charging valve (Fig. 2, Item 18) using a pump. However, an oil charging elbow on the seal-oil return chamber (Fig. 6) allows oil to be added without pumping. The seal oil return pump automatically transfers the oil to the main oil reservoir.

Oil should only be charged or removed when the machine is shut down. Maximum oil level is the middle of the upper sight glass.

Power Up the Controls and Check the Oil Heater — Ensure that an oil level is visible in the compressor before energizing controls. A separate disconnect 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 screen 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 17/19EX 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 and set up the occupied time schedule per the customer's requirements. If no schedule is available, the default is factory set for 24 hours occupied 7 days per week including holidays.

For more information about how to set up a time schedule, see the Controls section, page 12.

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

The Ice Build Occupied 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 CCN 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 retained 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 3 service tables: Service1, Service2, and Service3.

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

Chilled Medium	Water or Brine?
Brine Refrigerant Trippoint	Usually 3° F (1.7° C) below design refrigerant temperature
Surge Limiting or Hot Gas Bypass Option	Is HGBP installed?
Minimum Load Points (T1/P1)	Per job data — See Modify Load Points section
Maximum Load Points (T2/P2)	Per job data — See Modify Load Points section
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?
Stop-to-Start Time*	Follow motor vendor recommendation for time between starts. See certified prints for correct value.

*Open-drive machines only.

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; Δ T2/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 15° F (8.3° C), estimate the refrigerant suction and condensing temperatures at this difference. Use the proper saturated pressure and temperature for the particular refrigerant used.

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

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

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

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

To avoid unnecessary surge prevention, add about 10 psid (70 kPad) to ΔP2 from these conditions:

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

Calculate Minimum Load — To calculate minimum load conditions, estimate the temperature difference that the cooler will have at 20% load, then estimate what the suction and condensing temperatures will be at this point. Use the proper saturated pressure and temperature for the particular refrigerant used.

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

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

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

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

Again, to avoid unnecessary surge prevention, add 20 psid (140 kPad) at ΔP1 from these conditions:

ΔT1 = 2° F (1.1° C)
ΔP1 = 53 psid (368 kPad)

If surge prevention occurs too soon or too late:

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

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.

Holidef Table Modifications — The Holidef tables configure the days of the year that holidays are in effect. See Holiday Scheduling in the Controls section for more details.

Brodefs Table Modifications — The Brodefs table 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. Brodefs 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 screen and read the *LINE VOLTAGE: ACTUAL* value. 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 by selecting the *LINE VOLTAGE: ACTUAL* point and then increasing or decreasing the value so that the value appearing on the LID is calibrated to the incoming power voltage reading. Voltage can be calibrated only to between 90 and 100 percent of rated line voltage.

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 controls 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.

NOTE: If during the Control Test the guide vanes do not open, check to see that the low pressure alarm is not active. (This will cause the guide vanes to close.)

NOTE: The oil pump test will not energize 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.

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 Auxiliary oil pump — confirm pressure†
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 Shunt trip 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 values 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.
†On open-drive machines, differential pressure is the only oil pressure displayed.
**Displayed only on hermetic machines.

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

See Pumpout and Refrigerant Transfer Procedures (page 64) and Pumpout System Maintenance sections (page 82) for details on transfer of refrigerant, oil specifications, etc.

High Altitude Locations — Recalibration of the pressure transducers will be necessary as the machine was initially calibrated at sea level. Please see 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 17/19EX machine may have the refrigerant already charged in the utility vessels. If machine is not shipped fully charged, refrigerant is shipped separately to conform with transportation regulations. The 17/19EX may be ordered with a nitrogen holding charge of 15 psig (103 kPa). Evacuate the entire machine, and charge machine from refrigerant cylinders.

The full refrigerant charge on the 17/19EX will vary with machine components and design conditions, indicated on the job data specifications. An approximate charge may be found in 17/19EX Physical Data section, page 97. The full machine charge is printed on the machine identification label.

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

If the machine has been shipped with a holding charge, the refrigerant will be added through the refrigerant charging valve (Fig. 8) 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 — The 17/19EX is shipped with the correct charge for the design duty of the machine. 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 a minimum differential.

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.
7. Check the starter to ensure it is ready to start and that all safety circuits have been reset. Be sure to keep the starter door closed.

> **⚠ 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.

8. Press [RELEASE] to automate the chiller start/stop value on the Status01 screen 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 screen. 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 screen and look at the target guide vane position (Fig. 18). 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 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 15 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 (Open-Drive Motor)

OPEN DRIVE MOTOR INITIAL START-UP

Initial Uncoupled Start-Up — The initial start-up of the motor should be made with the motor uncoupled. Verify that oil has been added to each bearing housing to the correct level.

1. If the motor is equipped with unidirectional fans (refer to the certified drawing) and verification of rotation direction is required, the following procedure should be followed:
   a. Start the motor and observe the rotation direction.
   b. Allow the motor to achieve full speed before disconnecting it from the power source.
   c. If the rotation direction must be changed, refer to the Before Initial Start-Up, Open Drive Motor Electrical Connection section, page 47. Otherwise, the motor can be restarted immediately after it has coasted to a stop.
2. Following the initial start-up, the bearing temperatures should be closely monitored. On sleeve bearings, the free rotation of the oil rings should be verified by observing them through the viewing port in the top of the housing. The rate of rise in bearing temperature is more indicative of impending trouble than the actual temperature. If the rate of rise in temperature is excessive or if the motor exhibits excessive vibration or noise, it should be shut down immediately and a thorough investigation made as to the cause before it is operated again.

   If the bearing temperature rise and motor operation appear to be normal, operation should continue until the bearing temperatures stabilize. Recommended limits on bearing temperature rises over ambient temperature are as follows:

Sleeve Bearings	Temperature Rise Over Ambient Temperature
By permanently installed detector	72° F (40° C)
By temporary detector on top of the bearing sleeve near the oil ring	63° F (35° C)

NOTE: When operating flood-lubricated sleeve bearings, the bearing temperature must not be allowed to exceed 185 F (85 C) total temperature.

⚠ CAUTION

Under normal conditions, for the self-lube bearing, the rate of temperature rise should be from 20° to 25° F (11° to 14° C) for the first 10 minutes after starting up and approximately 40° F (22° C) at 30 minutes. The rate of bearing temperature rise is a function of the natural ventilation and operating conditions.

⚠ CAUTION

When the rate of bearing temperature rise is less than 2° F (1.1° C) per half-hour, the bearing temperature is considered to be stabilized.

⚠ CAUTION

If the total bearing temperature exceeds 195 F (91 C), the motor should be shut down immediately.

3. Any abnormal noise or vibration should be immediately investigated and corrected. Increased vibration (with the motor uncoupled from its load) can be indicative of a change in balance due to a mechanical failure or the loosening of a rotor part, a stator winding problem, foundation problem, or a change in motor alignment.
4. Verify that the magnetic center indicator aligns with the shaft.

Initial Coupled Start-Up — After initial uncoupled start-up, the following steps should be taken to ensure safe coupled operation:

1. Follow the procedure stated in General Maintenance, Machine Alignment section to align the motor to the driven machine.
2. Prepare the coupling for operation in accordance with the coupling manufacturer's instructions. Note any match marks on the couplings and assemble accordingly. For sleeve bearing motors, verify that the correct limited endfloat coupling has been installed. The endfloat limits can be found on the certified drawing.
3. Ensure that all personnel are at a safe distance from rotating parts. Start the motor in accordance with instructions supplied with the motor control.
4. If the motor rotor fails to start turning in a second or two, shut off the power supply immediately. This can result from:
   a. Too low a voltage at the motor terminals.
   b. The load is too much for the rotor to accelerate.
   c. The load is frozen up mechanically.
   d. All electrical connections are not made.
   e. Single phase power has been applied.
   f. Any combination of the above.

   Investigate thoroughly and take corrective action before attempting a restart.
5. Carefully observe the vibration of the bearing housing and any abnormal noise generator.

   Note that motor vibration may not be identical to the uncoupled values. If coupled vibration is excessive, recheck the mounting and alignment.
6. Carefully observe the bearing temperature rise and the movement of the oil ring.

   If the bearing temperature rise and motor operation appear normal, operation should continue until the bearing temperatures stabilize.
7. If possible, check the motor line currents for balance.

It should be recognized that each start of an induction motor subjects the motor to full inrush current with resulting heating of the stator and rotor windings. Each acceleration and repeated starts can produce more heat than is produced and dissipated by the motor under full load. The starting duty for which the motor is designed is shown by a nameplate mounted on the motor and must not be exceeded, if long motor life is expected. Abnormally low terminal voltage, excessive load torque and/or excessive load inertia during motor start-up can cause lengthened acceleration times during which rotor ventilation is reduced. This can cause rotor damage or can lead to shortened rotor life.

The temperature rating of the motor is shown on the main nameplate as a temperature rise above an ambient temperature. If there is a service factor, it is also shown. If the motor temperature switch opens, an investigation should be made before further operation is attempted.

If the motor is of TEWAC (Totally Enclosed Water-to-Air Cooled) design, the maximum inlet water temperature and the water flow rate (GPM) at the air cooler must be as shown by the certified drawing. Otherwise, the discharge air temperature from the cooler (actually the ambient air for the motor as shown by the main nameplate) could be too high for the motor to properly cool.

Check Rotation (Hermetic Motor)

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 over, check for clockwise rotation (Fig. 30).

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.

NOTE: Starters may also 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.

⚠ CAUTION

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

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.

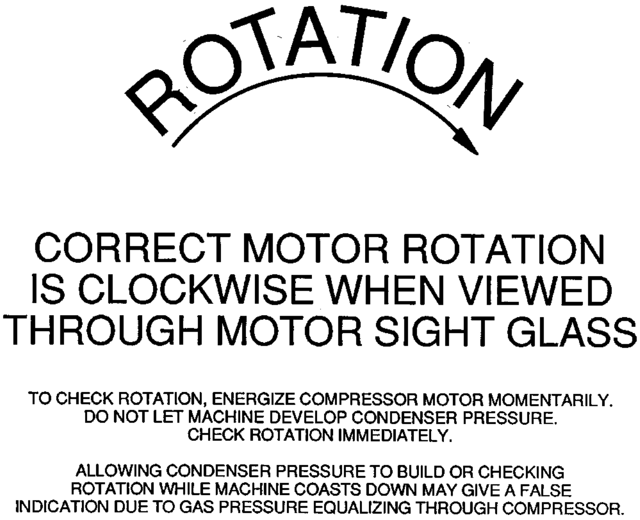


Fig. 30 — Correct Motor Rotation

Calibrate Motor Current Demand Setting

1. Make sure that the compressor motor rated load amps in the Service1 screen 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 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 screen 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 screen, 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.

Hot Alignment Check for Open-Drive Machines — Alignment of compressor with heat exchangers, gear, and driver may be affected by the operating temperatures of the various components. When all machine components have reached operating temperature (after running near full load for 4 to 8 hours), make a hot alignment check.

With the proper equipment and procedure, hot check can be made with either assembled or disassembled couplings. The procedures are detailed in the Maintenance section.

A clamping tool, Part No. TS-170, is available for checking alignment without disassembling the couplings. Check with your local Carrier representative.

⚠ WARNING

Never operate compressor or drive with coupling guards removed. Serious injury can result from contact with rotating equipment.

Doweling for Open-Drive Machines — The size, quantity, and location of dowels vary considerably with type and arrangement of gear and drive. Check your job data for specific doweling instructions. Typical doweling practices are described in the Maintenance section.

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) understands all operating and maintenance procedures. Point out the various machine parts and explain their function as part of the complete system.

COOLER-CONDENSER — Relief devices, temperature sensor locations, pressure transducer locations, Schrader fittings, waterboxes and tubes, and vents and drains.

UTILITY VESSEL — Float chambers, relief valves, charging valve.

PUMPOUT SYSTEM — Transfer valves and pumpout system, refrigerant charging and pumpdown procedure, lubrication, and relief devices.

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

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

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 58.

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 3- and 15-minute start timers have expired, the start sequence will start. Follow the procedure described in the Start-Up/Shutdown/Recycle section, page 45.

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 150 F (66 C) or refrigerant temperature plus 70° F (38° C) during shutdown, and above 125 F (52 C) during compressor operation.
2. The bearing oil temperature accessed on the Status01 LID screen should be 150 to 200 F (65 to 93 C). If the bearing temperature reads more than 210 F (99 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 in the lower sight glass when the compressor is running.

   At shutdown, oil level should be halfway in the lower sight glass.
4. The oil pressure should be between 18 and 30 psi (124 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 (Fig. 8) 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. The leaving condenser water temperature should be at least 20° F (11° C) above leaving chilled water temperature.
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 IkW, or the pulldown rate can be decreased to avoid a high demand charge for the short period of high demand operation. Pulldown rate can be based on kW rate or temperature rate. It is accessed on the Equipment Configuration menu Config screen (Table 2, Example 5).
9. On open-drive machines, the oil pump will be energized once every 12 hours during shutdown periods to ensure that the shaft seal is filled with oil.

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.

NOTE: 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. Control Power must be maintained in order to keep oil temperature hot and all control safeties operational. The oil pump on open-drive machines will operate occasionally to keep the contact seal filled with oil to prevent refrigerant loss.

Extended Shutdown — The refrigerant should be transferred into the utility vessel (see Pumpout and Refrigerant Transfer Procedures) 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 pumpout 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 minimum oil reservoir temperature.

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 48.

Recharge the machine by transferring refrigerant from the utility vessel. Follow the Pumpout and Refrigerant Transfer Procedures section, page 64. Observe freeze-up precautions.

Carefully make all regular preliminary and running system checks. Perform a controls 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 150 F (66 C) or cooler refrigerant temperature plus 70° F (39° C).

Cold Weather Operation — When the entering condenser water drops very low, 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 as well as a tower temperature control system.

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 screen 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. 31, 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.

REFRIGERATION LOG CARRIER 17/19EX CENTRIFUGAL REFRIGERATION MACHINE

Plant___________ **MACHINE MODEL NO.**____________ **MACHINE SERIAL NO.**____________ **REFRIGERANT TYPE**___________

DATE	COOLER							CONDENSER							COMPRESSOR					OPER-ATOR INITIALS	REMARKS
TIME	Refrigerant		Water					Refrigerant		Water					BEAR-ING TEMP	Oil			Motor		
			Pressure			Temp				Pressure			Temp						FLA ____		
	Press.	Temp	In	Out	GPM	In	Out	Press.	Temp	In	Out	GPM	In	Out		Press. Diff.	Temp (reser-voir)	Level	Amperage (or vane position)		

REMARKS: Indicate shutdowns on safety controls, repairs made, oil or refrigerant added or removed, air exhausted and water drained from dehydrator. Include amounts.

Fig. 31 — Refrigeration Log

PUMPOUT AND REFRIGERANT TRANSFER PROCEDURES

Preparation — The 17/19EX may come equipped with an optional pumpout compressor. The refrigerant can be pumped for service work to either the cooler/condenser/compressor sections or the utility vessel by using the pumpout system. The following procedures are used to describe how to transfer refrigerant from vessel to vessel and perform machine evacuations.

Operating the Optional Pumpout Compressor

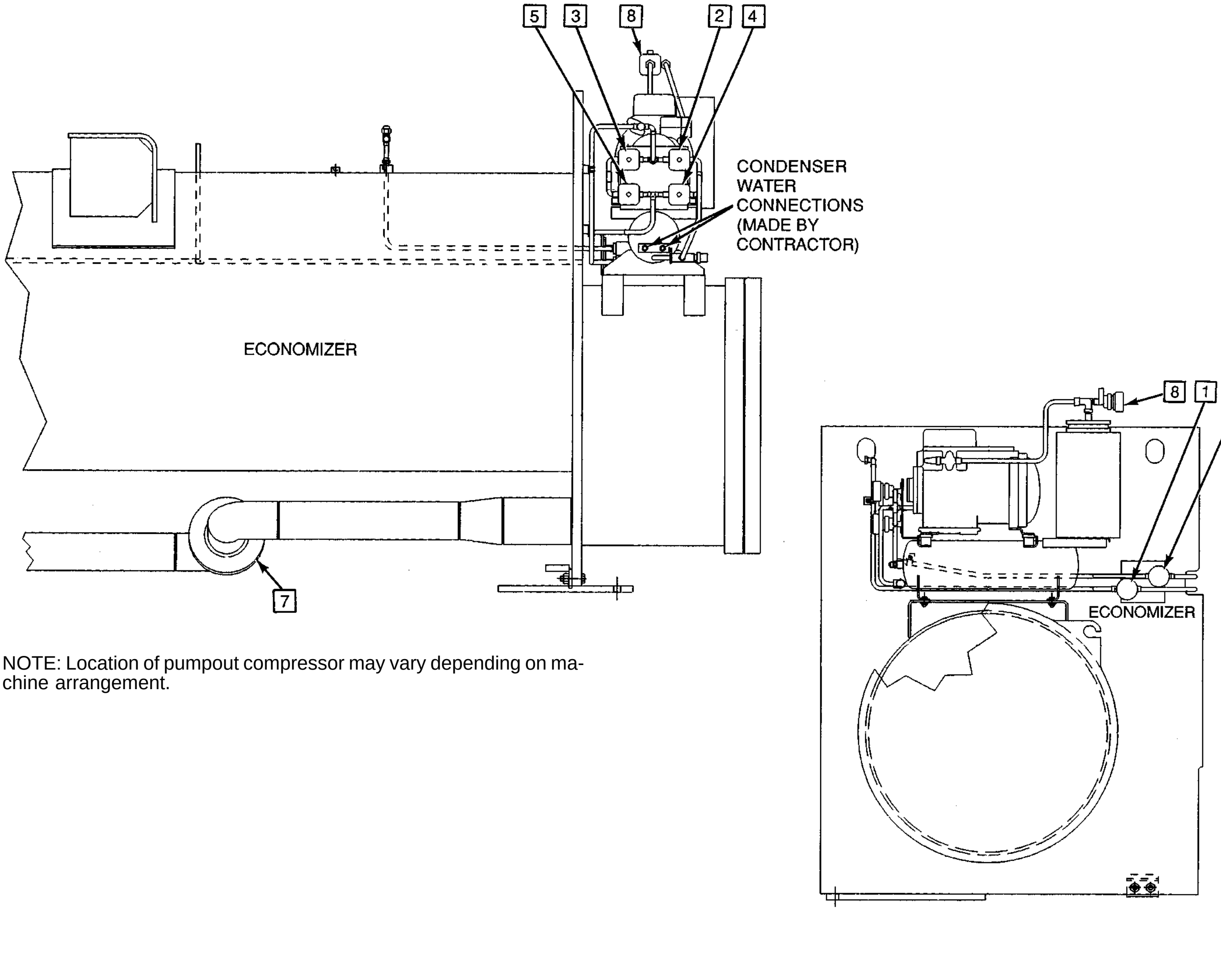
1. Be sure that the suction and the discharge service valves on the optional pumpout compressor are open (back seated) during operation. Figure 32 shows the location of these valves. Rotate the valve stem fully counterclockwise to open. Front seating the valve closes the refrigerant line and opens the gage port to compressor pressure.
2. Make sure that the compressor holddown bolts have been loosened to allow free spring travel.
3. Open the refrigerant inlet valve on the pumpout compressor.
4. Oil should be visible in the compressor sight glass under all operating conditions and during shutdown. If oil is low, add oil as described under Pumpout System Maintenance section, page 82. The pumpout unit control wiring schematic is detailed in Fig. 33. The Optional Pumpout System is detailed in Fig. 34.

TO READ REFRIGERANT PRESSURES during pumpout or leak testing:

1. 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. 7 and 8) by removing the pressure transducer.
2. To determine utility vessel pressure, a 30 in.-0-400 psi (-101-0-2760 kPa) gage is attached to the vessel.
3. Refer to Fig. 32 for valve locations and numbers.

⚠ 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.



NOTE: Location of pumpout compressor may vary depending on machine arrangement.

Fig. 32 — Pumpout Arrangement and Valve Number Locations (12-ft Vessel Shown)

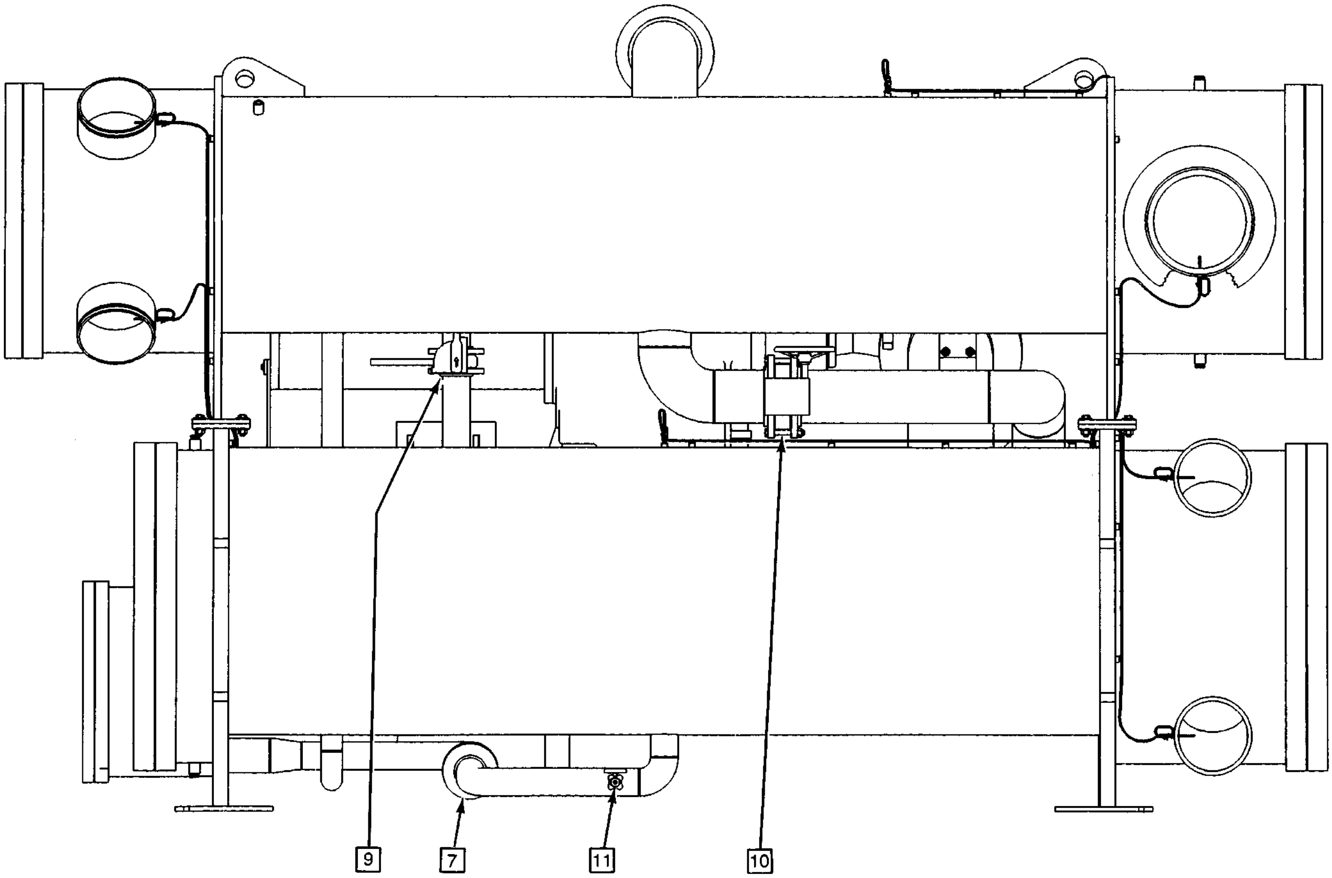
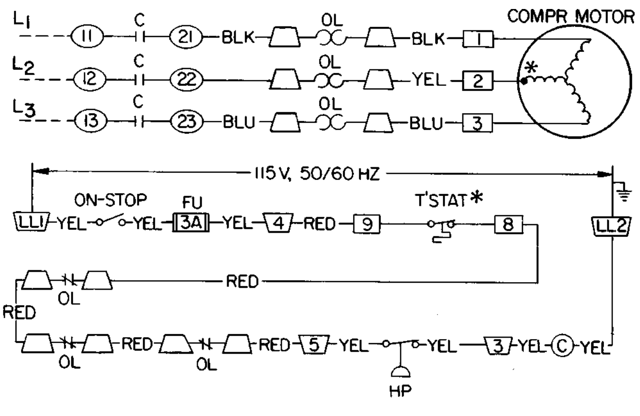


Fig. 32 — Pumpout Arrangement and Valve Number Locations (12-ft Vessel Shown) (cont)



LEGEND

C — Contactor
Fu — Fuse, 3 Amps
HP — High-Pressure Cutout
OL — Compressor Overload
T'stat — Internal Thermostat

Compressor Terminal
Contactor Terminal
Overload Terminal
Pumpout Unit Terminal

*Bimetal thermal protector imbedded in motor winding.

Fig. 33 — Pumpout Unit Wiring Schematic (19EX Shown)

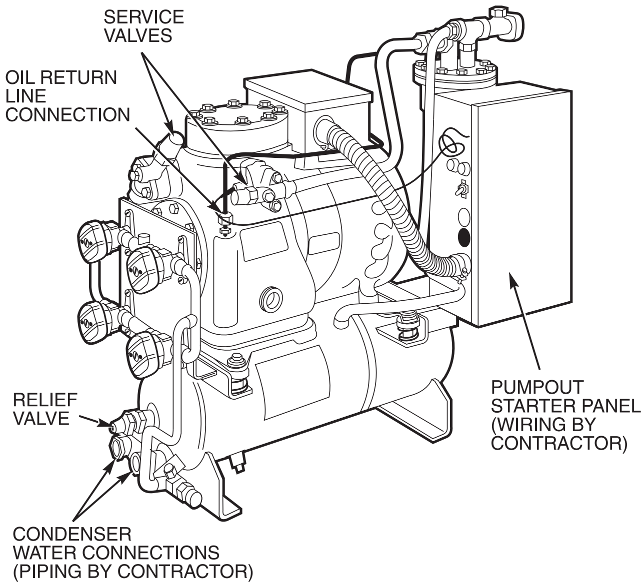


Fig. 34 — Optional Pumpout Compressor

Transferring Refrigerant From Normal Operation into the Utility Vessel — These steps describe the method of moving refrigerant from the cooler/condenser/compressor sections into the utility vessel. This is normally performed for service work on the cooler, condenser, or the compressor components or for long-term machine shutdown.

1. Isolate and push refrigerant into the utility vessel with the pumpout compressor.
   a. Valve positions: (Blank spaces indicate open valves).

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION			C	C				C	C	C	C

   b. Turn off the machine water pumps and pumpout condenser water.
   c. Turn on pumpout compressor to push liquid out of the cooler/condenser/compressor section.
   d. When all liquid has been pushed into the utility vessel, close the cooler isolation valve 7.
   e. Access the Control Test, Pumpdown function on the LID display to turn on the machine water pumps and view the machine pressures.
   f. Turn off pumpout compressor.
2. Evacuate refrigerant gas from the cooler/condenser/compressor vessel.
   a. Valve positions: close valves 2 and 5, open valves 3 and 4.

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION		C			C		C	C	C	C	C

   b. Turn on pumpout condenser water.
   c. Run pumpout compressor until the suction reaches 15 in. Hg (50 kPa abs). Monitor pressures on the LID and on the refrigerant gages.
   d. Close valve 1.
   e. Turn off pumpout compressor.
   f. Close valves 3, 4, and 6. (All valves are now closed.)
   g. Turn off pumpout condenser water.
   h. Continue pumpdown function on the LID to turn off the machine water pumps and to lock out the machine compressor from operation.

Transferring Refrigerant from Normal Operation into the Cooler/Condenser/Compressor Section — These steps describe the method of moving refrigerant from the utility vessel into the cooler/condenser/compressor section. This is normally performed for service work on the utility vessel.

1. Isolate and push refrigerant into the cooler/condenser/compressor section:
   a. Valve positions:

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION		C			C			C	C	C	C

   b. Turn off machine water pumps and pumpout condenser water.
   c. Turn on pumpout compressor to push refrigerant out of the utility vessel.
   d. When all liquid is out of the utility vessel, close cooler isolation valve 7.
   e. Turn off pumpout compressor.
2. Evacuate refrigerant from the utility vessel.
   a. Access the Control Test, pumpout function on the LID display to turn on the machine water pumps and monitor vessel pressures.
   b. Valve positions: Close valves 3 and 4, open valves 2 and 5.

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION			C	C			C	C	C	C	C

   c. Turn on pumpout condenser water.
   d. Run the pumpout compressor until the suction reaches 15 in. Hg (50 kPa abs). Monitor pressures on the LID and on refrigerant gages.
   e. Close valve 6.
   f. Turn off pumpout compressor.
   g. Close valves 1, 2, and 5 (all valves are now closed).
   h. Turn off pumpout condenser water.
   i. Continue pumpdown function on the LID to turn off machine water pumps and lock out the machine compressor from operation.

Return Refrigerant to Normal Operating Conditions

1. Be sure that the vessel that was opened has been evacuated and dehydrated.
2. Access the Control Test, terminate lockout function to view vessel pressures and to turn on machine water pumps.
3. Open valves 1, 3, and 6.

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION		C		C	C		C	C	C	C	C

4. Slowly open valve 5, gradually increasing pressure in the evacuated vessel to 35 psig (141 kPa) for HFC-134a. Feed refrigerant slowly to prevent freezeup.
5. Perform leak test at 35 psig (141 kPa).
6. Open valve 5 fully. Let vessel pressures equalize.

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION		C		C			C	C	C	C	C

7. Open valves 9 and 10.
8. Open valve 7 to equalize liquid refrigerant levels.
9. Close valves 1, 3, 5, and 6.

VALVE	1	2	3	4	5	6	7	8	9	10	11
CONDITION	C	C	C	C	C	C		C			C

10. Continue on with the terminate lockout function on the LID to turn off water pumps and enable the compressor for operation.

→ ## GENERAL MAINTENANCE

Refrigerant Properties — HFC-134a is the standard refrigerant in the 17/19EX. At normal atmospheric pressure, HFC-134a will boil at −14 F (−25 C) and must, therefore, be kept in pressurized containers or storage tanks. The refrigerant is practically odorless when mixed with air. This refrigerant is 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 57.

⚠ WARNING

Always use the compressor pumpdown function in the Control Test mode to turn on the evaporator pump and lock out the compressor when transferring refrigerant. Liquid refrigerant may flash into a gas and cause possible freeze-up when the machine pressure is below 30 psig (207 kPa) for HFC-134a.

Removing Refrigerant — When the optional pumpout system is used, the 17/19EX refrigerant charge may be transferred to a storage vessel, or within the utility vessel. Follow procedures in the Pumpout and Refrigerant Transfer Procedures section when removing refrigerant.

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 ultra-sonic leak detector. Be sure that the room is well ventilated and free from concentration of refrigerant to keep false readings to a minimum. Before making any necessary repairs to a leak, transfer all refrigerant from the leaking vessel.

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 pressured and leak tested. Refer to the Leak Test Machine section (page 48) to perform a leak test.

⚠ WARNING

HFC-134a MUST 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, pages 49 and 51.

Checking Guide Vane Linkage — Refer to Fig. 35.

If slack develops in the drive chain, backlash can be eliminated as follows:

1. With machine shut down (guide vanes closed), remove chain guard, loosen actuator holddown bolts and remove chain.
2. Loosen vane sprocket set screw and rotate sprocket wheel until set screw clears existing spotting hole.
3. With set screw still loose, replace chain and move vane actuator to the left until all chain slack is taken up.
4. Tighten actuator holddown bolts and retighten set screw in new position.
5. Realign chain guard as required to clear chain.

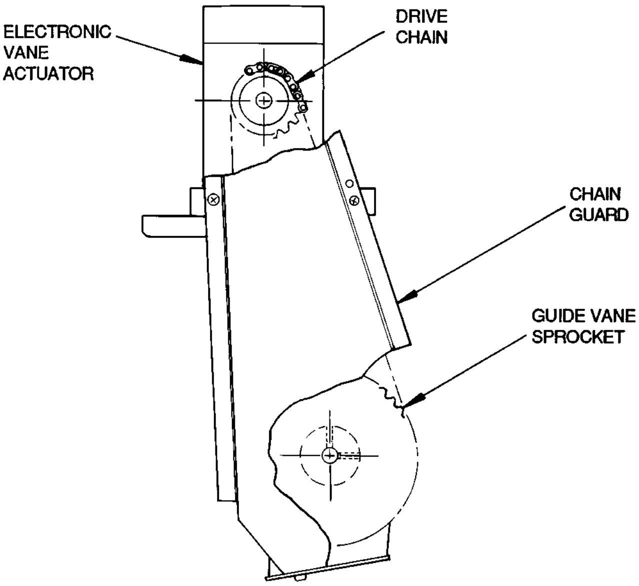


Fig. 35 — Electronic Vane Actuator Linkage

Contact Seal Maintenance (Open-Drive Machines) (Refer to Fig. 36) — During machine operation, a few drops of oil per minute normally seeps through the space between the contact sleeve (Item 16) and the shaft locknut (Item 8). This oil slowly accumulates in an atmospheric oil chamber and is automatically returned to the system by a seal oil return pump.

Oil should never leak between the contact sleeve and the packing gland (Item 14). If oil is found in this area, the O-ring (Item 12) should be checked and replaced.

The oil passing through the shaft seal carries with it some absorbed refrigerant. As the oil reaches the atmosphere, the absorbed refrigerant flashes to gas because of the reduction in pressure. For this reason, a detector will indicate the presence of a slight amount of refrigerant around the compressor shaft whenever the machine is running.

During machine shutdown, however, no refrigerant should be detected nor should there be any oil seepage. If oil flow or the presence of refrigerant is noted while the machine is shut down, a seal defect is indicated. Arrange for a seal-assembly inspection by a qualified serviceman to determine the cause of the leakage and make the necessary repairs.

SEAL DISASSEMBLY (Fig. 36) — Contact seal disassembly and repair should be performed only by well qualified compressor maintenance personnel. These disassembly instructions are included only as a convenient reference for the authorized serviceman.

For ease of disassembly, refer to Fig. 36 while following these instructions.

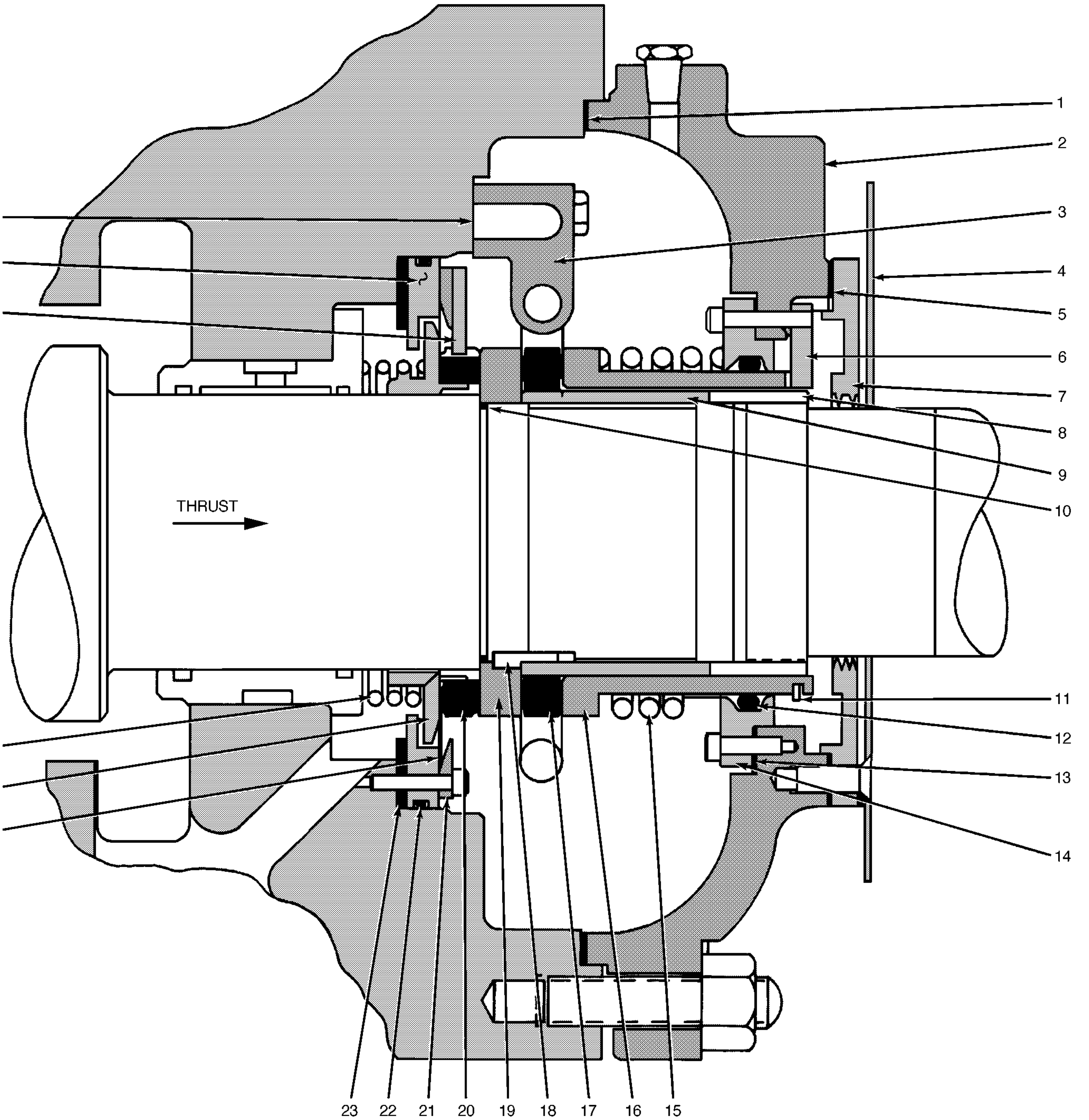
1. Remove refrigerant.
2. Remove shaft coupling and spacer (if any).
3. Remove screws holding windage baffle (Item 4) and remove baffle.
4. Remove shaft-end labyrinth (Item 7), gasket (Item 5) and necessary piping.
5. Remove snap ring (Item 11) from shaft-end baffle and assemble to contact sleeve (Item 16).
6. Remove seal housing cover (Item 2). The contact sleeve, spring (Item 15) and packing gland (Item 14) will come out with the cover.
7. Place assembly on bench with contact sleeve assembly face down on a soft cloth or clean cardboard. *Protect seal faces at all times.*
8. Press down on seal housing cover to compress the contact sleeve spring.
9. Maintain pressure and remove snap ring.
10. Slowly release pressure on cover. Spring tension will force contact sleeve out of housing. For further inspection, remove packing gland and O-ring (Item 12).
11. Place contact sleeve in a protected area to avoid damage to lapped face.
12. Remove outer carbon ring (Item 17). *Handle carefully.*
13. Remove spray header (Item 3).
14. Use a spanner wrench to remove shaft nut (Item 8).
15. Remove shaft sleeve (Item 9) and contact ring key (Item 18).
16. Carefully remove contact ring (Item 19), avoiding a jammed or cocked position. If binding occurs, reinstall shaft sleeve and nut to free the ring.
17. Replace O-ring (Item 10) if damaged or deformed.
18. Remove inner carbon ring key (Item 27) and retaining ring (Item 21). Screws must be loosened evenly against guide-ring spring pressure.
19. Remove guide ring assembly consisting of inner carbon ring (Item 20), diaphragm (Item 24) and guide ring (Item 25). *Protect seal faces of ring.*
20. Remove guide-ring spring (Item 26).

Clean all parts to be reused with solvent, coat with oil and place in a protected area until needed.

NOTE: Items 22, 23, and 28 are not part of the seal disassembly process. They are removed only if the journal bearing is removed.

SEAL REASSEMBLY (Fig. 36) — Be sure that all gasket surfaces are clean and that all holes, including oil holes, are properly aligned between gasket and mating flange. Coat gasket with oil-graphite mixture to prevent sticking.

1. Assembly guide-ring spring (Item 26) and guide-ring assembly (Items 20, 24 and 25). Check that travel of inner carbon seal ring (Item 20) is .06 in. minimum in each direction.
2. Install retaining ring (Item 21) and inner carbon ring key (Item 27). *Tighten screws evenly against spring pressure.*
3. Replace O-ring (Item 10) in shaft shoulder groove.
4. Install spray header gasket (Item 29) and spray header (Item 3).
5. Install contact ring (Item 19), contact ring key (Item 18), shaft sleeve (Item 9) and shaft nut (Item 8).
6. Carefully install outer carbon ring (Item 17).



LEGEND

1 — Housing Cover Gasket
2 — Seal Housing Cover
3 — Spray Header
4 — Windage Baffle
5 — Shaft-End Labyrinth Gasket
6 — Key
7 — Shaft-End Labyrinth
8 — Shaft Locknut
9 — Shaft Sleeve
10 — O-Ring
11 — Snap Ring (Assembly Tool Only. See Text.)
12 — O-Ring
13 — Packing Gland Gasket
14 — Packing Gland
15 — Outer Spring
16 — Contact Sleeve
17 — Outer Carbon Ring Seal
18 — Contact Ring Key
19 — Contact Ring
20 — Inner Carbon Seal Ring
21 — Retaining Ring
22 — O-Ring
23 — Shim
24 — Diaphragm
25 — Guide Ring
26 — Inner Spring
27 — Inner Carbon Ring Key
28 — Shut Down Seal Retainer
29 — Spray Header Gasket

Fig. 36 — Compressor Contact Seal (Open-Drive Machines)

7. Insert O-ring (Item 12) into packing gland (Item 14).
8. Place contact sleeve (Item 16) face down on clean cloth or cardboard.
9. Place outer spring (Item 15) over sleeve.
10. Separately assemble seal housing cover (Item 2), packing gland gasket (Item 13), packing gland (Item 14), and O-ring (Item 12).
11. Oil the contact sleeve and the O-ring and place the housing and gland assembly over the sleeve.
12. Carefully depress the spring until snap ring (Item 11) can be attached to the sleeve.
13. Position key (Item 6) to complete the bench assembly.
14. Install seal housing cover gasket (Item 1) and cover assembly on the compressor.
15. Remove the snap ring.
16. Install shaft-end labyrinth gasket (Item 5) and labyrinth (Item 7).
17. Install windage baffle (Item 4). Attach snap ring to baffle for safekeeping.

Machine Alignment (Open-Drive Machines)

ALIGNMENT METHODS — There are several established procedures for aligning shafts. The dial indicator method is presented here since it is considered to be one of the most accurate and reliable. Another faster and easier method for alignment involves the use of laser alignment tools and computers. Follow the laser tool manufacturer's guidelines when using the laser technique.

Where job conditions such as close-spaced shafts prohibit the use of dial indicators for coupling face readings, other instruments such as a taper gage may be used. The same procedures described for the dial indicator may be used with the taper gage.

Shafts placed in perfect alignment in the nonoperating (cold) condition will always move out of alignment to some extent as the machine warms to operating temperature. In most cases, this shaft misalignment is acceptable for the initial run-in period before hot check and alignment can be made (see Hot Alignment Check section, page 60.)

NOTE: The physical configuration of the 17FA compressor makes the oil sump temperature a more significant factor in alignment than the suction and discharge temperatures. Therefore, warm the sump oil to operating temperature (approximately 140 F [60 C]), if possible, before beginning alignment procedures.

General

1. Final shaft alignment must be within .002-in. TIR (Total Indicated Runout) in parallel. Angular alignment must be within .00033 inches per inch of traverse across the coupling face (or inch of indicator swing diameter) *at operating temperatures.* For example, if a bracket-mounted indicator moves through a 10-in. diameter circle when measuring angular misalignment, the allowable dial movement will be 10 times .00033 for a total of .0033 inches.
2. Follow the alignment sequence specified in the Near Final Alignment section.
3. All alignment work is performed on gear and drive equipment. Once the compressor is bolted in a perfectly level position and is piped to cooler and condenser, it must not be moved prior to hot check.
4. All alignment checks must be made with equipment hold-down bolts tightened.
5. In setting dial indicators on zero and when taking readings, both shafts should be tight against their respective thrust bearings.
6. Space between coupling hub faces must be held to coupling manufacturer's recommendations.
7. Accept only repeatable readings.

Gear and Drive Coupling Alignment

1. Move gear with coupling attached into alignment with compressor coupling. Adjust jackscrews to reach close alignment. Follow procedures outlined in Correcting Angular Misalignment and Correcting Parallel Misalignment sections.
2. Generally, a 5-in. long spacer hub is supplied between gear and compressor. Maintain exact hub-to-hub distance specified on job drawings.
3. Where shaft ends are very close, a taper gage may be used in place of the dial indicator.
4. Get drive alignment as close as possible by jackscrew adjustment.

NOTE: Drive shaft end-float at final drive position must not allow coupling hub faces to contact, or the coupling shroud to bind.

PRELIMINARY ALIGNMENT — To get within dial indicator range, roughly align the equipment as shown in Fig. 37 and as described below.

Place a straight edge across the OD of one coupling to the OD of the other. Measure the gap between the straight edge and the OD of the second coupling with a feeler gage. Then, by adding or removing shims at each corner, raise or lower the equipment by the measured amount.

In a similar manner, measure the shaft offset from side to side and jack the equipment over as required to correct.

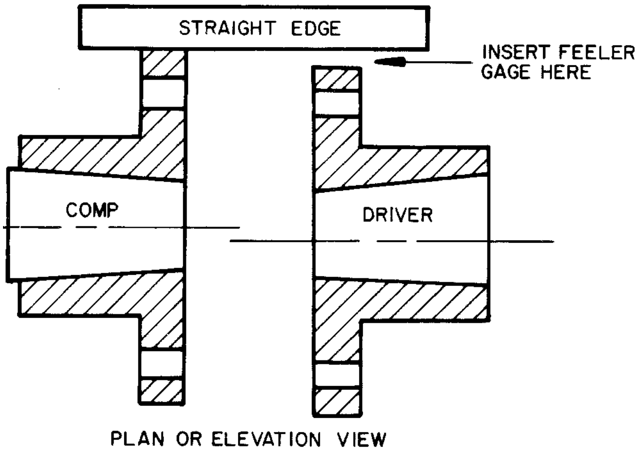
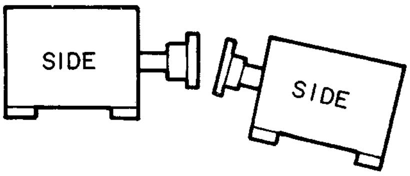


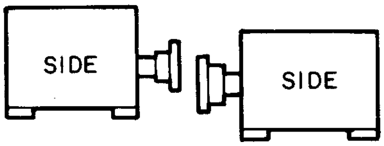
Fig. 37 — Checking Preliminary Alignment

NEAR FINAL ALIGNMENT — Once the machine components are within dial indicator range, the adjustments for misalignment should be made in a specific sequence. The four positions of alignment described below are arranged in the recommended order.

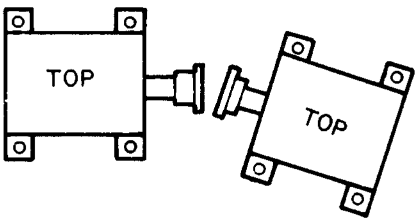
1. Angular in elevation — This alignment is adjusted with shims and is not readily lost in making the other adjustments.



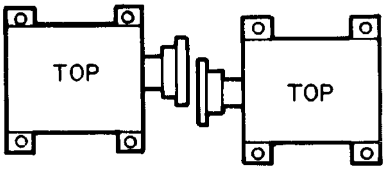
2. Parallel in elevation — This alignment is also made with shims, but it cannot be made while there is angular misalignment in elevation.



3. Angular in plan — This position can easily be lost if placed ahead of the two adjustments in elevation.



4. Parallel in plan — This adjustment cannot be made while there is still angular misalignment in plan, and can easily be lost if elevation adjustments are made.

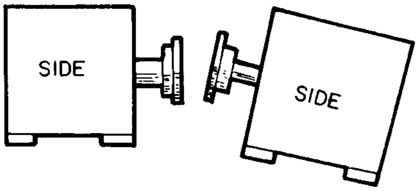


Correcting Angular Misalignment

Preparation — Shaft angular misalignment is measured on the face of the coupling hubs or on brackets attached to each shaft (see Fig. 38 and 39). Brackets are preferred since they extend the diameter of the face readings.

Attach a dial indicator to one coupling hub or shaft and place the indicator button against the face of the opposite hub. Position the indicator so that the plunger is at approximately mid-position when the dial is set to zero. Both shafts should be held tightly against their thrust bearings when the dial is set and when readings are taken.

To be sure that the indicator linkage is tight and the button is on securely, rotate the coupling exactly 360 degrees. The dial reading should return to zero. Accept only repeatable readings.



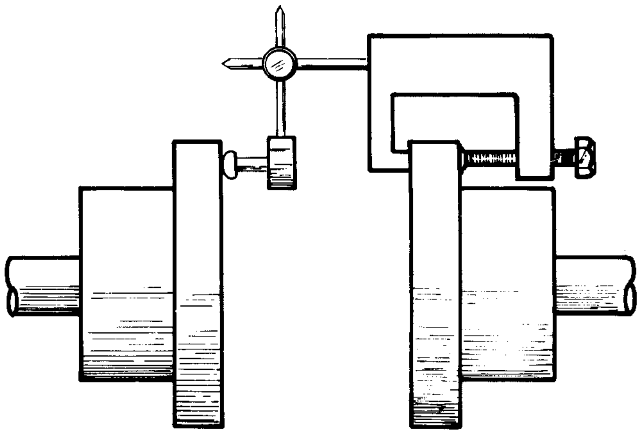


Fig. 38 — Measuring Angular Misalignment in Elevation

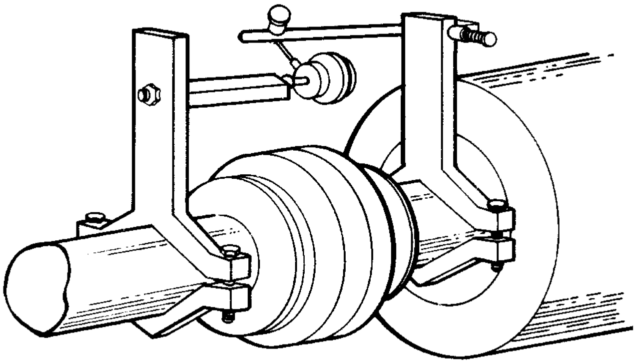
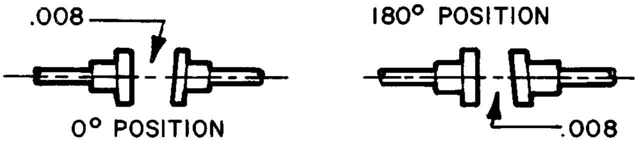


Fig. 39 — Measuring Angular Misalignment in Elevation

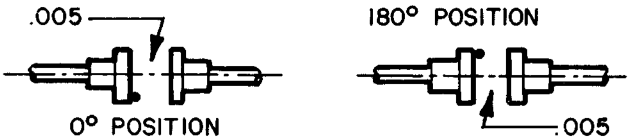
Measurement — Occasionally, coupling faces may not be perfectly true, or may have been damaged in handling. To compensate for any such runout, determine the actual or "net" shaft misalignment as follows:

Check the opening at the top and at the bottom of the coupling faces (or at each side when making plan adjustment). Rotate *both* shafts exactly 180 degrees and recheck the openings. Record the difference. (Example below is in inches.)

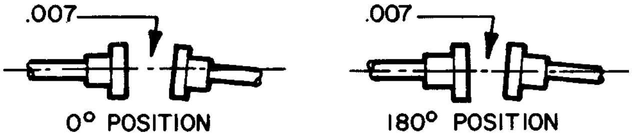


NET MISALIGNMENT = 0

If the larger opening remains the same but changes from side to side, the shafts are in perfect alignment. The change in opening is due entirely to coupling runout, as above, or to a burr or other damage to the coupling face.

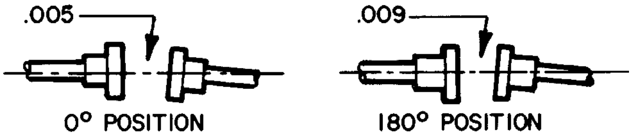


NET MISALIGNMENT = 0



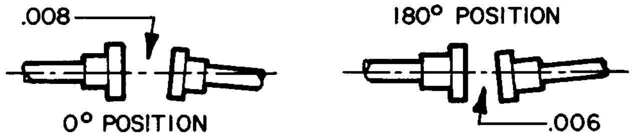
NET MISALIGNMENT = .007

If the larger opening remains the same, and remains on the same side, the amount is entirely shaft (net) misalignment.



NET MISALIGNMENT = $\frac{.005+.009}{2} = .007$

If the larger opening remains on the same side but changes amount, misalignment *and* runout are present. Add the two amounts and then divide by two to get the actual or net misalignment.



NET MISALIGNMENT = $\frac{.008-.006}{2} = .001$

If the larger opening changes amount and also changes from side to side, subtract the smaller amount from the larger and divide by two to obtain the net misalignment.

Adjustment — Having obtained the net misalignment, the amount by which the equipment must be moved can now be calculated.

To determine:

S — amount of movement (in plan) or the thickness of shim (in elevation) required.

Obtain:

D — coupling face diameter in inches (or indicator button circle)

L — distance between front and rear holddown bolts (inches)

M — net misalignment in inches

And:

Divide L, the bolt distance, by D, the coupling diameter. Multiply the result by M, the net misalignment.

$$S = \frac{L}{D} \times M$$

Example: Face diameter 5 in. (D). Distance between front and rear holddown bolts 30 in. (L). Net misalignment in elevation .012 in. (M).

30 divided by 5 is 6

6 multiplied by .012 is .072 in.

S = .072 in.

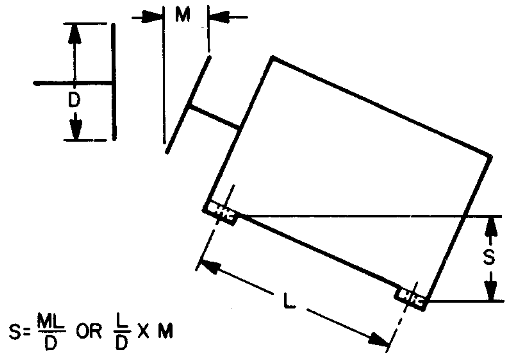
If the larger opening between coupling faces is at the top, place .072 in. of shim under each rear foot or remove .072 in. from the front footings to bring the couplings into angular alignment in elevation.

Tighten the holddown bolts and recheck the net misalignment.

The height of the shaft above the footings and the distance the shaft extends beyond the equipment will not affect the calculations.

Determine the angular adjustment in plan by the same method of calculation. At this point, however, the procedure should include a correction for the change in coupling gap which always occurs in adjusting angular alignment (Fig. 40). By selecting the proper pivot point (Fig. 41), the coupling gap can be kept at the dimension specified in the job data.

1. Pivot on the front bolt at the closed side of the couplings to shorten the gap; pivot on the front bolt at the open side to lengthen it. It may sometimes be advantageous to pivot half the required amount on one front footing and half on the other.
2. Place a dial indicator against the rear foot as indicated in Fig. 41.
3. Place a screw jack on the other rear foot to move the equipment towards the indicator.
4. Loosen all holddown bolts except the pivot bolt. Turn the screw jack until the rear end of the equipment moves against the indicator by the desired amount.



S — Thickness of Shim Required
L — Distance Between Front and Rear Holddown Bolt in Inches
D — Diameter of Coupling in Inches
M — Net Misalignment in Inches

Fig. 40 — Alignment Formula

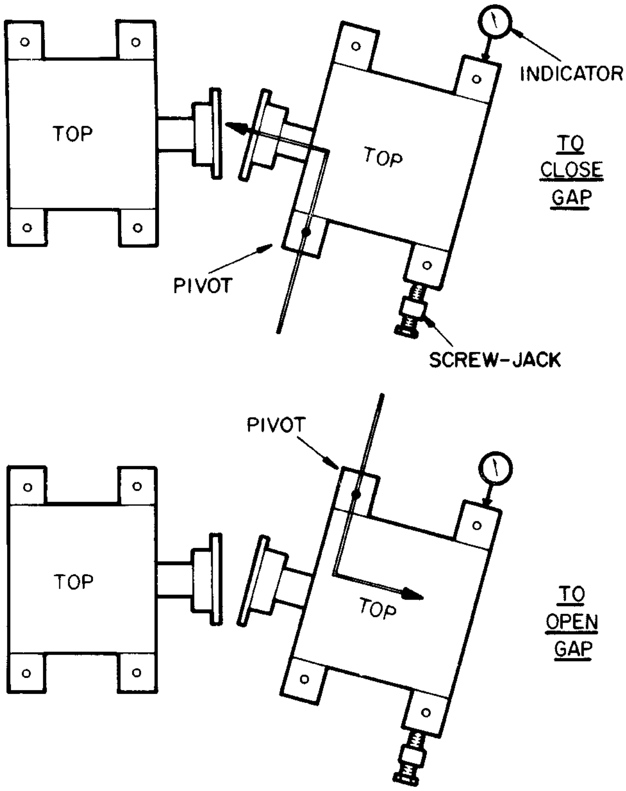


Fig. 41 — Adjusting Angular Misalignment in Plan

5. Tighten the holddown bolts and recheck the indicator. If the reading has changed, loosen the three bolts and re-adjust. It may be necessary to over or undershoot the desired reading to allow for the effect of bolt tightening.

Correcting Parallel Misalignment

Preparation — Attach the dial indicator to one shaft or coupling hub and place the indicator button on the O.D. of the other hub. The reach of the dial from one hub to the other should be parallel to the shafts, and the dial button shaft should point directly through the center of the shaft on which it rests. Compress the plunger to about mid-position and set the dial at zero.

Check the tightness of the dial button and the indicator linkage by rotating the shaft to which the indicator is attached 360 degrees. The dial should return to zero. Check for repeatability.

Check for runout by rotating the hub on which the dial button rests 180 degrees. If the runout exceeds .001 total indicator reading, the hub should be removed and the shaft checked. Shaft runout must not exceed .001 TIR.

The effect of hub runout can be eliminated by locating a position on the half coupling where two readings 180 degrees apart read zero. Rotate the coupling so that one zero point is at the top and the other at the bottom when checking for misalignment in elevation. Place the zero points side to side in a similar manner when checking for misalignment in plan.

Measurement — With dial set at zero in the top position, rotate the shaft to which the indicator is attached 180 degrees. If the dial reading is plus, the shaft on which the button rests is low. If the reading is minus, the shaft on which the button rests is high.

Never accept a single reading. Look for repeatability. Rotate the shaft several times to see if the reading remains the same. It is good practice to reverse the procedure and read from zero at the bottom.

Always rotate the shafts in the same direction when taking readings. Backlash in the coupling teeth could cause some differences.

Adjustment — Divide the total indicator reading by two to obtain the exact amount of shaft offset. As illustrated in Fig. 42, the indicator will read the total of A plus B but the required shaft adjustment is only half of this as indicated by C.

Add or remove identical amounts of shims at all footings to bring the shaft to the proper elevation. Tighten all the holddown bolts and recheck the readings. Parallel alignment must be within .002 TIR.

To correct parallel misalignment in plan, use a screw jack and dial indicator as shown in Fig. 42. With a front holddown bolt as the pivot, move the rear of the equipment over. Then, with the rear holddown bolt *on the same side* acting as the pivot, move the front end of the equipment over by the same amount.

FINAL ALIGNMENT — The procedures and tolerance requirements for final alignment are the same as those described in the Near Final Alignment section. Final alignment is performed just prior to grouting and machine hot check. All piping, including water and steam, must be completed, but the water and refrigerant charges need not be in place.

HOT ALIGNMENT CHECK

General — When all machine components have reached operating temperature (after running near full load for from 4 to 8 hours), a hot alignment check must be made. Hot alignment check may be made with couplings assembled or disassembled.

Disassembled Couplings

1. Shut down machine.
2. With machine hot, quickly disassemble couplings.
3. Check angular and parallel alignment in plan and elevation as described in the Near Final Adjustment section. Record the indicator readings (see page CL-12) and make necessary adjustments to bring alignment within .002 TIR and .00033 inches per in. of coupling face traverse (or in. of indicator swing). Follow procedures described in the Near Final Alignment section.
4. Reinstall couplings and run machine until it again reaches operating temperature.

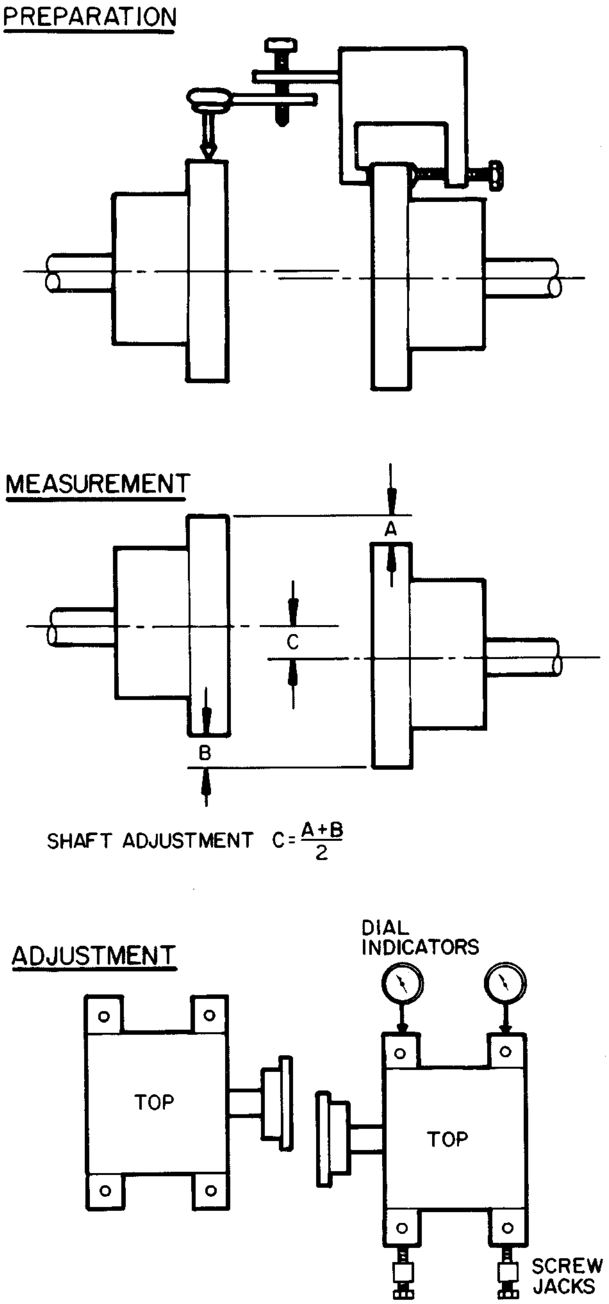


Fig. 42 — Correcting Parallel Misalignment

5. Repeat steps 1 through 4 until alignment remains within specified tolerances.

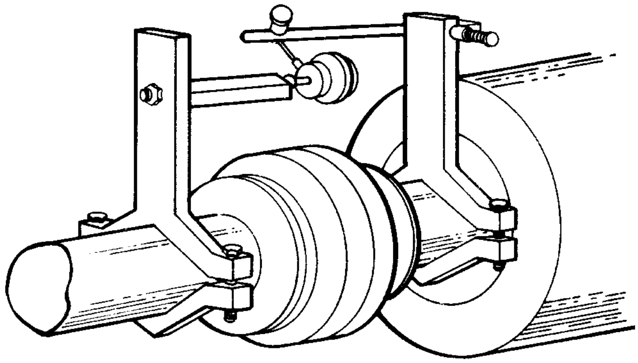
Assembled Couplings — If there is room on the shaft between coupling and component to clamp a sturdy bracket, the arrangement illustrated in Fig. 43 may be used. The clamps must have room to rotate with the shaft.

This method is quicker because the couplings do not have to be disassembled. In addition, eccentricity or coupling face runout are not problems since both shafts rotate together.

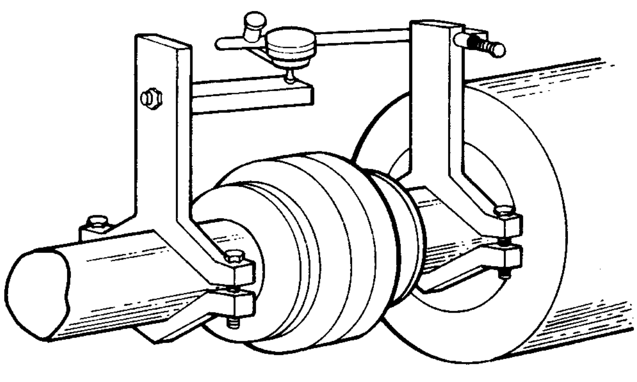
When using brackets, the diameter in the alignment formula (see Near Final Alignment, Connecting Angular Misalignment section) will be that of the circle through which the dial indicator rotates.

1. Shut down the machine.
2. With machine at operating temperature, quickly install brackets.
3. Check that alignment is within .002 TIR and .00033 per in. of traverse across the diameter of measurement. Adjust alignment as required. (Refer to Near Final Alignment section.)
4. Remove brackets and run machine until operating temperature is again reached.
5. Recheck the alignment per steps 1 through 4 until it remains within the specified tolerances.

Be sure that coupling guards are replaced after these checks.



TO CHECK ANGULAR ALIGNMENT



TO CHECK PARALLEL ALIGNMENT

Fig. 43 — Alignment Check — Assembled Coupling

DOWELING

Techniques — After hot alignment check has been completed, the compressor, gear and drive must be doweled to their soleplates. Doweling permits exact repositioning of components if they have to be moved.

1. Doweling must be completed with equipment at maximum operating temperature (full load).
2. Use no. 8 taper dowels to dowel compressor, gear and drive to the base. Use a $^{13}/_{32}$-in. drill and no. 8 taper reamer with straight flutes. Drill pilot hole and then expand the pilot hole to final dimension.
3. Fit dowel so that $^{1}/_{16}$-in. of taper is left above the equipment foot. If dowel holes are rereamed as a result of realignment, be sure dowels are tight and do not bottom.
4. Place dowels as nearly vertical as possible.
5. Coat the dowels with white lead or other lubricant to prevent rusting.
6. Tap dowel lightly into position with a small machinist's hammer. A ringing sound will indicate proper seating.

Dowel the suction end of the compressor base, the two feet at the high speed end of the gear, and the drive feet in accordance with the drive manufacturer's instructions. The number of dowels used in the drive is usually four, but some manufacturers require more.

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 oil as follows:

On hermetic machines, add oil through the oil drain charging valve (Fig. 3, Item 26.) A pump is required for adding oil against refrigerant pressure. On open-drive machines, oil may be added through the oil drain and charging valve (Fig. 2, Item 18) using a pump. However, an oil charging elbow on the seal-oil return chamber (Fig. 6) allows oil to be added without pumping. The seal oil return pump automatically transfers the oil to the main oil reservoir. A pump is required for adding oil against refrigerant pressure. The oil charge is approximately 15 gallons (57 L) for EX and FA (size 421-469) style compressors; 20 gallons (76 L) for EA (size 531-599) style compressors. The added oil *must* meet Carrier's specifications. Refer to Changing 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, and must be removed when the level is high.

An oil heater is controlled by the PIC to maintain oil temperature above 150 F (65.5 C) or refrigerant temperature plus 70° F (38.9° C) (see the Controls section) when the compressor is off. The LID Status02 screen 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.

After the initial start or a 3 hour power failure, the controls will allow the machine to start once the oil is up to proper temperature, but a slow ramp load rate of 2° F (1.6° C) per minute is used.

Be sure that the hand isolation valves on the oil line near the filter(s) (Fig. 44, Items 1 and 2) are fully open before operating the compressor.

Lubrication requirements for the FA coupling and drive are contained in the manufacturer's instructions for these components.

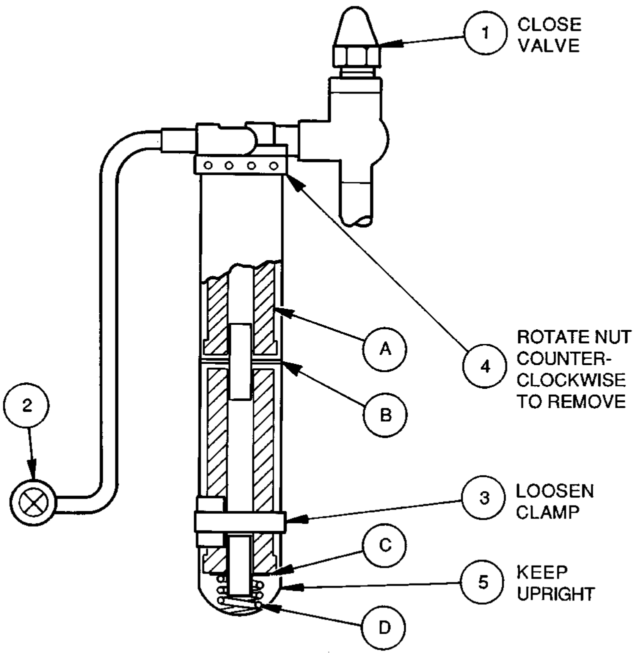


Fig. 44 — Removing the Oil Filter

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 screen. 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.

Changing Oil Filter

19EX COMPRESSORS — Change the oil filter on an annual basis or when the machine is opened for repairs. The 19EX compressor has an isolatable oil filter so that the filter may be changed with the refrigerant remaining in the machine. See Fig. 44. Use the following procedure:

1. Make sure that the compressor is off, and the disconnect for the compressor is open.
2. Disconnect the power to the oil pump.
3. Close the oil filter isolation valves (Fig. 44, Items 1 and 2).
4. Loosen the filter holding clamp, (Fig. 44, Item 3).
5. Rotate the filter nut, (Fig. 44, Item 4), counterclockwise to remove the filter housing. Keep the filter housing upright to avoid an oil spill.
6. Drain the oil; use this oil to obtain an oil analysis; remove and replace the filter cartridges. Do not use any of the extra felt washers supplied with the filters.
7. Bench assemble Items A-D upside down, then slide the filter housing (Item 5) over the stack to ensure that the spring (Item D) is centered in the bottom of the housing as indicated. Screw the assembly into the locking ring.
8. Evacuate the filter/piping assembly.
9. Open the isolation valves.

FA STYLE COMPRESSORS

1. Turn off oil heater.
2. Close the line valve (Fig. 44, Item 1) to isolate the oil filter(s).

   NOTE: FA STYLE COMPRESSORS DO NOT HAVE ISOLATION VALVE NO. 2, ONLY A CHECK VALVE. Vent the pressure in the oil filter by opening the Schrader valve on the oil filter housing. Run a hose from the valve to a bucket to catch the oil. Check to ensure that the check valve is properly seating.
3. Loosen the filter holding clamp (Item 3).

4. Rotate filter nut (Item 4) counterclockwise to remove filter housing. Keep the filter housing upright to avoid oil spill.
5. Drain the oil; remove and replace filter cartridges. Do not use any of the extra felt washers supplied with the filters.
6. Bench assemble Items A-D upside down. Then slide filter housing (Item 5) over the stack to ensure that spring (Item D) is centered in the bottom of the filter housing as indicated.
7. Evacuate air from the filter assembly. Open the isolation valve.
8. 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.

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

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

The polyolester-based oil may be ordered from your local Carrier representative (Carrier Part No. PP23BZ103).

Oil Changes — Carrier recommends changing the oil after the first year of operation and every three to five 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.

TO CHANGE THE OIL

1. Open the control and oil heater circuit breaker.
2. Drain the oil reservoir by opening the oil charging valve, (Fig. 2, Item 18 or Fig. 3, Item 26). Slowly open the valve against refrigerant pressure.
3. Change the oil filter at this time. See Changing Oil Filter section.
4. Change the refrigerant filter at this time, see the next section, Refrigerant Filter.
5. Charge the machine with oil. The EX uses approximately 15 gallons (57 L), for EX and FA (size 421-469) style compressors; 20 gallons (76 L) for FA (size 531-599) style compressors in order to bring the level to the middle of the upper sight glass (Fig. 2, Item 17 and Fig. 3, Item 17). Turn on the power to the oil heater and let the PIC warm it up to at least 140 F (60 C). Operate the oil pump manually, through the Control Test, for 2 minutes. The oil level should be between the lower sight glass and one-half full in the upper sight glass for shutdown conditions.

Refrigerant Filter — On hermetic machines with EX compressor, a replaceable core refrigerant filter drier is located on the refrigerant cooling line to the motor (Fig. 3, Item 29). On FA style machines, the refrigerant filter is located behind the compressor. The filter core should be 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 dry-eye indicates moisture, locate the source of water immediately by performing a thorough leak check.

Oil Reclaim Filter — The oil reclaim system has a filter on the cooler scavenging line. Replace this filter once per year, or more often if filter condition indicates a need for more frequent replacement. Change this filter with the cooler/condenser/compressor vessel at 0 psig (0 kPa) by transferring the refrigerant charge to the utility vessel.

Inspect Refrigerant Float System — Perform inspection once every 5 years or when the utility vessel is opened for service. Transfer the refrigerant into the cooler vessel, or into a storage tank. There are two floats on the 17/19EX, one on each side of the utility vessel. Remove the float access covers. Clean the chambers and valve assembly thoroughly. Be sure that the valves move freely. Make sure that all openings are free of obstructions. Examine the cover gaskets and replace if necessary. See Fig. 45 for a view of both floats.

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.

Coupling Maintenance (Open-Drive Machines) — Proper maintenance of the coupling is important since the coupling supports the outboard end of the compressor low speed shaft. Only the compressor end of the coupling has gear teeth and these are manufactured with special tolerances for this application.

PROCEDURE — Clean and inspect the gear teeth in the compressor end coupling for wear yearly. If the teeth are worn, replace the tapered coupling hub, sleeve and O-ring. Repack the gear teeth and spacer with 8 oz. of Kop-Flex KHP high performance coupling grease (Carrier Part No. 17DK 680 001). Install new gaskets.

When the coupling assembly is removed for scheduled service of the carbon seal, replace the O-ring, spacer gaskets, and hex bolts.

Operating conditions such as high temperatures or severe environments may require more frequent inspection and relubrication.

Misalignment causes undue noise and wear. Check alignment yearly, or more often if vibration or heating occur. Refer to Machine Alignment section, page 70.

⚠ WARNING

Never operate drive without coupling guards in place. Contact with moving shaft or coupling can cause serious injury.

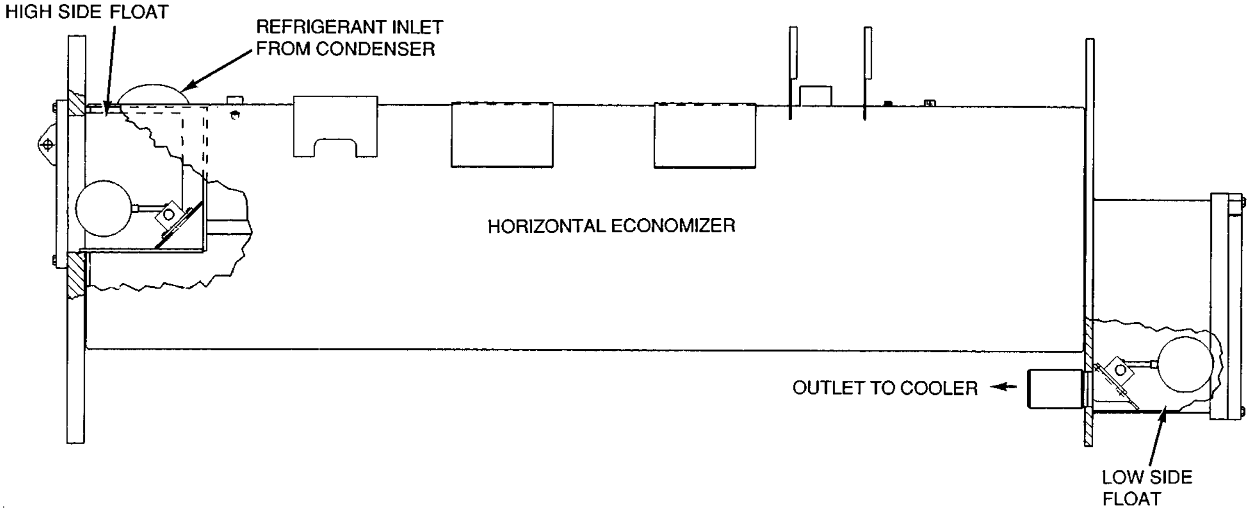


Fig. 45 — Typical Float Valve Arrangement

Motor Maintenance (Open-Drive Machines) — A carefully planned and executed program of inspection and maintenance will do much to ensure maximum motor availability and minimum maintenance cost. If it becomes necessary to repair, recondition, or rebuild the motor, it is recommended that the nearest Westinghouse apparatus repair facility be consulted.

In addition to a daily observation of the appearance and operation of the motor, it is recommended that a general inspection procedure be established to periodically check the following items:

1. Cleanliness, both external and internal
2. Stator and rotor (squirrel-cage) windings
3. Bearings

CLEANLINESS — On open ventilated motors, screens and louvers over the inlet air openings should not be allowed to accumulate any build-up of dirt, lint, etc. that could restrict free air movement. Screens and louvers should never be cleaned or disturbed while the motor is in operation because any dislodged dirt or debris can be drawn directly into the motor.

If the motor is equipped with air filters, they should be replaced (disposable type) or cleaned and reconditioned (permanent type) at a frequency that is dictated by conditions. It is better to replace or recondition filters too often than not often enough.

Totally enclosed, air-to-air cooled (TEAAC) motors and totally enclosed, fan-cooled (TEFC) motors require special cleaning considerations. The external fan must be cleaned thoroughly since any dirt build-up not removed can lead to imbalance and vibration. All of the tubes of the air-to-air heat exchanger of TEAAC motors should be cleaned using a supplied tube brush having synthetic fiber bristles (not wire of any type). The standard cooler is equipped with steel tubes, however, in special cases aluminum tubes may be used and wire brushes can seriously erode the tube interiors over several cleanings. All tube brushing should be conducted from the front (fan end) toward the drive end of the motor such that dislodged dirt will not fall into the fan housing.

⚠ CAUTION

Water spray washing of motors is not recommended. Manual or compressed air cleaning is preferred. If it becomes necessary to spray wash a motor, it should be done with extreme care. Do not aim high pressure sprays directly at air inlet openings, conduit connections, shaft seals, or gasketed surfaces to prevent the possibility of forcing water inside the machine.

The stator windings of motors with open ventilation systems can become contaminated with dirt and other substances brought into the motor by the ventilating air. Such contaminants can impair cooling of the winding by clogging the air passages in the winding end-turns and vent ducts through the stator core and by reducing heat transfer from the winding insulation surfaces to the cooling air. Conducting contaminants can change or increase electrical stresses on the insulation and corrosive contaminants can chemically attack and degrade the insulation. This may lead to shortened insulation life and failure.

Several satisfactory methods of cleaning stator windings and stator cores are offered below:

Compressed Air — Low pressure (30 psi max.), clean (no oil) and dry air can be used to dislodge loose dust and particles in inaccessible areas such as air vent ducts in the stator core and vent passages in the winding end-turns. Excessive air pressure can damage insulation and can drive contaminants into inaccessible cracks and crevices.

Vacuum — Vacuum cleaning can be used, both before and after other methods of cleaning, to remove loose dirt and debris. It is a very effective way to remove loose surface contamination from the winding without scattering it. Vacuum cleaning tools should be nonmetallic to avoid any damage to the winding insulation.

Wiping — Surface contamination on the winding can be removed by wiping, using a soft, lint-free wiping material. If the contamination is oily, the wiping material can be moistened (not dripping wet) with a safety-type petroleum solvent, such as Stoddard solvent. In hazardous locations, a solvent such as inhibited methyl chloroform may be used, but must be used sparingly and immediately removed. While this solvent is non-flammable under ordinary conditions, it is toxic and proper health and safety precautions should be followed while using it.

Solvents of any type should never be used on windings provided with abrasion protection. Abrasion protection is a grey, rubber-like coating applied to the winding end-turns.

⚠ WARNING

Adequate ventilation must always be provided in any area where solvents are being used to avoid the danger of fire, explosion or health hazards. In confined areas (such as pits) each operator should be provided with an air line respirator, a hose mask or a self-contained breathing apparatus. Operators should wear goggles, aprons and suitable gloves. Solvents and their vapors should never be exposed to open flames or sparks and should always be stored in approved safety containers.

SLEEVE BEARINGS

Oil Changing — The oil reservoirs of the self lubricated bearings should be drained and refilled every 6 months. More frequent changes may be needed if severe oil discoloration or contamination occurs. In conditions where contamination does occur, it may be advisable to flush the reservoir with kerosene to remove any sediment before new oil is added. Proper care must be taken to thoroughly drain the reservoir of the flushing material before refilling with the new oil.

Refill the reservoir to the center of the oil sight glass with a rust and oxidation inhibited, turbine grade oil. The viscosity of the oil must be 32 ISO (150 SSU) at 100 F (37.7 C). Oil capacity in each of the 2 bearings is 0.6 gal. (2 l) per bearing. Use of Carrier Oil Specification PP16-0 is approved (Mobil DTE Light or Sun Oil SUNVIS 916).

Disassembly — The bearing sleeve is of the spherically seated, self-aligning type. The opposite drive end bearing is normally insulated for larger motors (or when specified). On some motors, the insulation is bonded to the spherical seat of the bearing housing. Use extreme care when removing the sleeve from the insulated support to avoid damaging this insulation.

Note that some bolts and tapped holes associated with the bearing housings, bearing sleeves, and seals are metric.

The following is the recommended procedure for removing the bearing sleeve:

1. Remove the oil drain plug in the housing bottom and drain the oil sump.
2. Remove all instrumentation sensors that are in contact with the bearing sleeve. These would include resistance temperature detectors, thermocouples, temperature relay bulbs, thermometers, etc.
3. Remove the end cover.
4. Remove the socket head bolts holding the bearing cap and the inner air seal together at the horizontal split. The front end cover plate must also be removed if the front bearing is being disassembled. Remove the bearing cap and top half of the inner air seal by lifting straight up to avoid damaging the labyrinth seals. Place them on a clean, dry surface to avoid damage to the parting surfaces.
5. Remove any split bolts that may be holding the two bearing halves together. Remove the top half of the bearing sleeve using suitable eye-bolts in the tapped holes provided. Lift the bearing top straight up and avoid any contact with the shoulders of the shaft journals that might damage the thrust faces of the bearing. Place on a clean, dry surface taking care to prevent damage to either the parting surfaces or the locating pins that are captive in the top bearing half.
6. Remove the 4 screws at the partings in the oil ring and dismantle the ring by gently tapping the dowel pin ends with a soft face mallet. Remove the ring halves and immediately reassemble them to avoid any mix up in parts or damage to the surfaces at the partings.
7. When removing the labyrinth seals, make note of the position of the anti-rotation button located on the inside of the top half of the seal. Pull up the garter spring surrounding the floating labyrinth seal and carefully slip out the top half. Rotate the garter spring until the lock is visible. Twist counterclockwise to disengage the lock, remove the garter spring, then rotate the lower half of the seal out of the groove in the bearing housing while noting the orientation of the oil drain holes. Note the condition of these floating labyrinth seals. If they are cracked or chipped, they must be replaced. Do not attempt to reuse a damaged seal.
8. To remove the bottom bearing half, the shaft must be raised a slight amount to relieve pressure on the bearing. On the rear end, this can be done by jacking or lifting on the shaft extension. (Care must be taken to protect the shaft from damage). On the front end, jacking or lifting can be done using bolts threaded into the tapped holes provided in the shaft end.

   NOTE: Lift only enough to free the bearing; overlifting the shaft can cause difficulty in removal of the bearing.
9. Roll the bottom bearing half to the top of the shaft journal and then lift it using suitable eyebolts threaded into the holes provided. Again avoid any contact with the shaft shoulders that could damage the bearing thrust faces. Place the lower bearing half on a clean, dry surface to protect the parting surfaces.

⚠ WARNING

Use extreme care when rolling out the lower bearing half. Keep the hands and fingers well clear of any position where they might be caught by the bearing half if it were accidentally released and rotated back to its bottom position. Serious personal injury could result.

10. Protect the shaft journal by wrapping it with clean, heavy paper or cardboard.

Reassembly — Bearing reassembly is basically a reversal of the disassembly procedures outlined above, with the following additional steps.

⚠ CAUTION

Curil-T is the only approved compound for use in the assembly of the bearings on this motor. Other products may harden and impede the operation.

⚠ CAUTION

During the reassembly of the bearing parts, a thin layer of Curil-T should be applied to all gasketed and machined interface surfaces. This suggestion does not apply to the machined surfaces of the bearing liner halves.

⚠ CAUTION

When seating the bearing shell, apply a thin layer of lube oil at the spherical surface of the liner. Slowly roll the lower bearing liner into the bearing housing making sure that the split surfaces of the liner and the housing are flush. Gradually lower the shaft onto the bearing. The weight of the shaft will help rotate the bearing liner so that the babbitt surface of the liner will match the slope of the journal. Sometimes it is required to use a rubber mallet to tap lightly on the bearing housing while slowly rolling the shaft to help this seating operation.

1. The interior of the bearing housing should be cleaned and then flushed with clean oil or kerosene.
2. The bearing halves and the shaft journal should be wiped clean using lint-free cloth soaked with clean oil.
3. All parts should be carefully inspected for nicks, scratches, etc., in any contact surfaces. Such imperfections should be removed by an appropriate method such as stoning, scraping, filing, etc., followed by thorough cleaning.
4. Apply a few drops of oil to the journal and bearing saddles.
5. Roll the bottom half of the bearing into place and lower the shaft.
6. Before installing the floating labyrinth seal halves, observe their condition. Do not attempt to use a cracked or chipped seal. The bottom half seal has a set of drilled holes in its side face. These must be placed at the bottom toward the inside of the bearing so that accumulating oil may drain back into the housing.
7. Put a small bead of Curil-T around the bottom seal half outside diameters on both sides adjacent to the garter spring groove. This will prevent oil by-passing the seal around its outside.
8. Place the bottom seal half on top of the shaft (ensuring that the proper orientation of the drain holes is provided and roll it into position. Install the top half of the seal making sure that the anti-rotation button is located in the proper position on the inboard side of the bearing. Insert the garter spring pulling up on both ends to permit engaging the lock. Run a small bead of Curil-T around the outside diameters on both sides adjacent to the garter spring groove on this half also.
9. Carefully reassemble the two oil ring halves. Inspect the dowel pins for burrs and straightness and make any corrections required. Do not force the ring halves together. Excessive force may alter the roundness or flatness of the ring which can change its oil delivery performance. Apply locking compound to the oil ring screws prior to reassembly.
10. Assemble the top half of the bearing liner making sure that the match marks on the liner halves align with one another. Failure to ensure alignment of match marks can cause misalignment and possible damage to bearings and journal surfaces. Reinstall any split bolts, if supplied, between the bearing halves.
11. Some of the pipe plugs in the housing are metric thread type. These are identified as those which have a copper, lead, or similar material washer. If these plugs are removed, be careful not to lose the washers. Before reassembly, inspect the washers and replace them as required.
12. Before installing the bearing cap, observe the position of the floating labyrinth seal. The ‘‘tab’’ must be on top to engage the pocket. Failure to position the seal properly will result in damage when the cap is assembled.
13. Carefully lower the bearing housing cap over the floating seals. Keep the bearing cap level to avoid binding and possibly damaging the seals. The bearing cap should seat evenly on the bearing housing base.

⚠ CAUTION

Do not force bearing cap down. Damage could occur to the labyrinth seals.

If the bearing cap does not seat completely, remove and reset the floating labyrinth seal position. When installing upper bearing cap the floating labyrinth seals sometimes rotate and the anti-rotation ‘‘tab’’ does not seat in its holder, thus preventing the bearing housing from seating properly. This procedure should be repeated until the bearing cap seats properly.

14. Reinstall the bearing housing split bolts. Before torquing bearing housing cap bolts, rotate shaft by hand while bumping bearing housing with a rubber or rawhide mallet in the horizontal and axial planes to allow the bearings to align themselves to the shaft journals.
15. Torque the bearing housing cap bolts by following the torque values as provided in Table 6 on page 53.

Open-Drive Motor Handling/Rigging — Each motor is provided with lifting lugs, welded to the four corners of the motor frame, for lifting the assembled machine. The motor should always be lifted by using the lifting lugs located on all four corners of the motor frame. (See Fig. 46.)

⚠ CAUTION

Spreader bars of adequate capacity and number must be used to avoid applying any pressure against the top air housing with the lifting plugs.

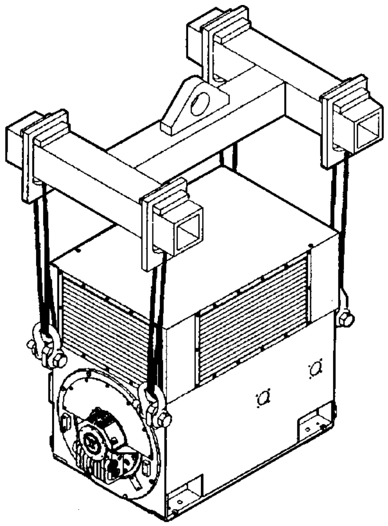


Fig. 46 — Lifting Open-Drive Motor

If the motor is lifted with the top air housing removed, the angle of the lifting slings with the horizontal should never be less than 45 degrees.

With the exclusion of the TEWAC cooler, the top air housing is provided with ¾-10 tapped holes for lifting devices to be installed in order to remove the air housing from the motor. The top air housing can be detached by removing the enclosure holddown bolts, located in the inside corners of the enclosure. These enclosure holddown bolts are accessed through the louver/screens located on the front and rear end of the machine or through access panels bolted to the sides of the enclosure.

⚠ CAUTION

Uneven lifting must always be avoided. When single point lifting is to be used, slings of equal lengths must always be used to avoid uneven lifting.

⚠ CAUTION

Under no circumstances should the motor be lifted using the shaft as an attachment point.

NOTE: Refer to weights specified on certified drawing to determine proper lifting equipment required for specific components or assemblies.

Open-Drive Motor Storage — If the machine is to be placed in extended shutdown, certain precautions must be taken to provide proper protection while the motor is being stored. The motor should be stored under cover in a clean, dry location and should be protected from rapid temperature changes.

Since moisture can be very detrimental to electrical components, the motor temperature should be maintained at approximately 5° F (3° C) above the dew point temperature by providing either external or internal heat. If the motor is equipped with space heaters, they should be energized at the voltage shown by the space heater nameplate attached to the motor. Incandescent light bulbs can be placed within the motor to provide heat. However, if used, they must not be allowed to come in contact with any parts of the motor because of the concentrated hot spot that could result.

This motor has been provided with a shaft shipping brace or shipping bolt (normally painted yellow) to prevent shaft movement during transit, it must be removed to allow shaft rotation (refer to Before Initial Start-Up, Remove Shipping Packaging section, page 47.) It is very important that this brace be reinstalled exactly as it was originally, before the motor is moved from storage or any time when the motor is being transported. This prevents axial rotor movement that might damage the bearings.

Motors equipped with sleeve bearings are shipped from the factory with the bearing oil reservoirs drained. In storage, the oil reservoirs should be properly filled to the center of the oil level gage with a good grade of rust inhibiting oil (refer to the certified drawing for oil viscosity and any special requirements). To keep the bearing journals well oiled and to prevent rusting, the motor shaft should be rotated several revolutions every 2 weeks. While the shaft is rotating it should be pushed to both extremes of the endplay to allow for oil flow over the entire length of the journals.

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 slime, 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 slime, 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 HFC134-a is a high-pressure refrigerant, air usually does not enter the machine, rather, the refrigerant leaks out.

During the tube cleaning process, use brushes especially designed to avoid scraping and scratching the tube wall. Contact your Carrier representative to obtain these brushes. *Do not* use wire brushes.

⚠ CAUTION

Hard scale may require chemical treatment for its prevention or removal. Consult a water treatment specialist for proper treatment.

Water Leaks — Water in the refrigerant is indicated during machine operation by the refrigerant moisture indicator on the refrigerant motor cooling line (Fig. 8). Water leaks should be repaired immediately.

⚠ CAUTION

Machine must be dehydrated after repair of water leaks. See Machine Dehydration section, page 51.

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 deenergize all internal circuits. Open all internal and remote disconnects before servicing the starter.

⚠ WARNING

Never open isolating knife switches while equipment is operating. Electrical arcing can cause serious injury.

Inspect starter contact surfaces for wear or pitting on mechanical-type starters. Do not sandpaper or file silverplated contacts. Follow the starter manufacturer’s instructions for contact replacement, lubrication, spare parts ordering, and other maintenance requirements.

Periodically vacuum or blow off accumulated debris on the internal parts with a high-velocity, low-pressure blower.

Power connections on newly installed starters may relax and loosen after a month of operation. Turn power off and retighten. Recheck annually thereafter.

⚠ CAUTION

Loose power connections can cause voltage spikes, overheating, malfunctioning, or failures.

Check Pressure Transducers — Once a year, the pressure transducers should be checked against a pressure gage reading. Check all three transducers: oil pressure, condenser pressure, cooler pressure.

Note the evaporator and condenser pressure readings on the Status01 screen 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.

Pumpout System Maintenance — For compressor maintenance details, refer to the 06D, 07D Installation, Start-Up, and Service Instructions.

OPTIONAL PUMPOUT COMPRESSOR OIL CHARGE — Use oil conforming to Carrier specifications for reciprocating compressor usage. Oil requirements are as follows:

HFC-134a
ISO Viscosity 68
Carrier Part Number PP23BZ103

The total oil charge, 4.5 pints (2.6 L), consists of 3.5 pints (2.0 L) for the compressor and one additional pint (0.6 L) for the oil separator.

Oil should be visible in the compressor sight glass both during operation and at shutdown. Always check the oil level before operating the compressor. Before adding or changing oil, relieve the refrigerant pressure as follows:

1. Attach a pressure gage to the gage port of either compressor service valve (Fig. 34).
2. Close the suction service valve and open the discharge line to the storage tank or the machine.
3. Operate the compressor until the crankcase pressure drops to 2 psig (13 kPa).
4. Stop the compressor and isolate the system by closing the discharge service valve.
5. Slowly remove the oil return line connection (Fig. 34). Add oil as required.
6. Replace the connection and reopen the compressor service valves.

PUMPOUT SAFETY CONTROL SETTINGS (Fig. 47) — The pumpout system high-pressure switch should open at 161 psig (1110 kPa) and closes at 130 psig (896 kPa). Check the switch setting by operating the pumpout compressor and slowly throttling the pumpout condenser water.

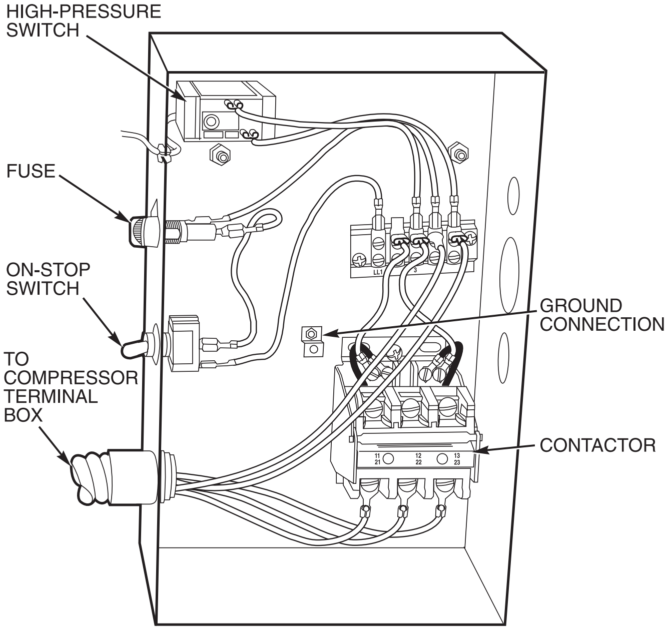


Fig. 47 — Controls for Optional Pumpout Compressor

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

OPEN-DRIVE MOTOR RENEWAL PARTS — Renewal parts information for the motor and any auxiliary devices can be obtained from the nearest Westinghouse Motor Company sales office. A complete description of the part(s) required is necessary, together with the complete motor nameplate reading for positive motor identification.

TROUBLESHOOTING GUIDE

Overview — The PIC has many features to aid the operator and the technician in troubleshooting a 17/19EX machine.

- By using the LID display, the chiller actual operating conditions can be viewed while the unit is running.
- The Control Algorithm Status screens will display various screens of information in order to diagnose problems with chilled water temperature control, chilled water temperature control overrides, hot gas bypass, surge algorithm status, and time schedule operation.
- The Control Test feature 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 17/19EX is the LID display. If the alarm light is flashing, check the primary and secondary message lines on the LID default screen (Fig. 14). 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 8. 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 9A or B.

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 9A or B. 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 9A or B 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. 7 and 8 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 temperature sensors (hermetic and open-drive machines) and motor temperature sensors (hermetic machines only) 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 hermetic machines. These determine cooler, condenser, and oil pressure. Open-drive machines have 4 transducers. These transducers sense cooler pressure, condenser pressure, oil supply pressure, and oil sump pressure. The oil supply pressure and the oil transmission sump pressure difference is calculated by a differential pressure power supply module on open-drive machines. The PSIO then reads this differential. In effect, then, the PSIO reads 3 pressure inputs for open-drive machines and 3 pressure inputs for hermetic machines. The cooler and condenser transducers are used by the PIC to determine refrigerant temperatures.

All pressure inputs 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: For hermetic machines, 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.

To calibrate oil pressure differential on open-drive machines, refer to Oil Pressure Differential Calibration at the end of this section.

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 240 and 260 psig (1655 to 1793 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 240 and 260 psig (1655 and 1793 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 screen, 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.

OIL DIFFERENTIAL PRESSURE/POWER SUPPLY MODULE CALIBRATION — (See Fig. 48.) The oil reservoir in the 17EX machine is not common to cooler pressure. Therefore, a comparison of pump output to cooler pressure could not be used to provide differential oil pressure information. A different method has been developed.

Oil transmission sump pressure and oil supply pressure are fed to a comparator circuit on a 5V power supply board. The output of this circuit, which represents differential oil pressure, is fed to the PSIO. The oil differential pressure is calibrated to zero PSIO (0 kPad) by selecting the oil pressure input on the Service1 screen. Then, with the oil pump turned OFF and the transducers CONNECTED, press ENTER to zero the point. No high end calibration is needed or possible.

17EX OIL PRESSURE INPUT

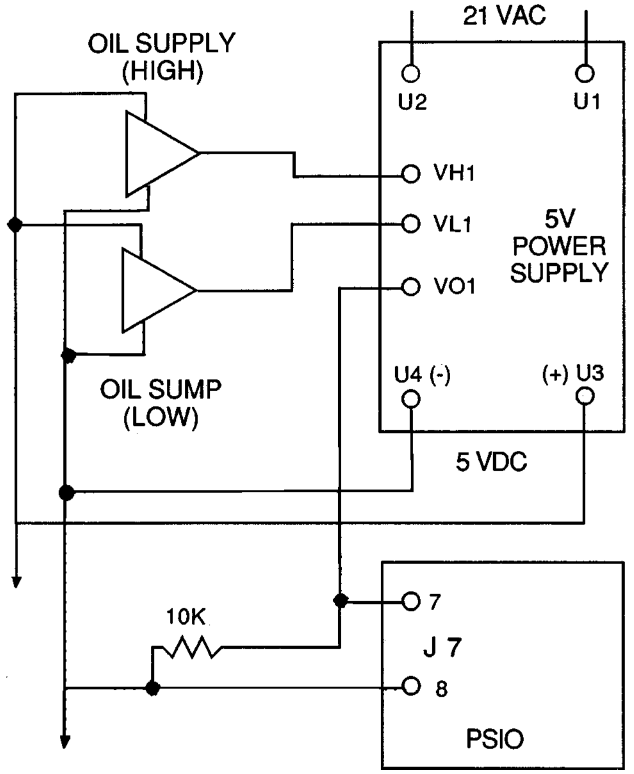


Fig. 48 — Oil Differential Pressure/Power Supply Module

TROUBLESHOOTING TRANSDUCERS — When troubleshooting transducers, keep the negative lead of your volt-ohmmeter on terminal U4 of the power supply (or terminal 4 on power supplies without the comparator circuit).

voltage VO1 = (VH1-VL1) + .467 ± .1 V

For all PIC transducers:

Measured pressure = $(507.97 \times (V_{out}/V_{in})) - 47.33$

V_{out} = transducer output ref. to neg. terminal (4 or U4) i.e., VH1 to U4 or VL1 to U4

V_{in} = power supply output, i.e., U3 to U4

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 a transducer.

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

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 allows the operator to 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 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 function after the pumpdown procedure is reversed and refrigerant is added.

→ **LEGEND FOR TABLE 8, A - N**

1CR_AUX	—	Compressor Start Contact
CA_P	—	Compressor Current
CCN	—	Carrier Comfort Network
CDFL	—	Condenser Water Flow
CHIL_S_S	—	Chiller Start/Stop
CHW	—	Chilled Water
CMPD	—	Discharge Temperature
CRP	—	Condenser Pressure
ECW	—	Entering Chilled Water
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
SMM	—	Starter Management Module
SPR_PL	—	Spare Protective Limit Input
STR_FLT	—	Starter Fault
TXV	—	Thermostatic Expansion Valve
V_P	—	Line Voltage: Percent
V_REF	—	Voltage Reference

Table 8 — 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, chilled 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.
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.
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.
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.
PRESTART ALERT	LOW LINE VOLTAGE	V__ P [VALUE] exceeded limit of [LIMIT]*. Check voltage suppy.	Check voltage supply. Check voltage transformers. Consult power utility if voltage is low. Calibrate voltage reading on STATUS01 Table.
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. Calibrate voltage reading on STATUS01 table.
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., 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 8 — 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. For hermetic compressors, check both oil pressure and cooler pressure. For open-drive units, check calibration of oil pressure differential amplifier modules. Check wiring. Replace transducers 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, check ICR relay before restarting machine.
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.
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	CHECK REFRIGERANT TYPE	Current Refrigerant Properties Abnormal — Check Selection of refrigerant type	Pressures at transducers indicate another refrigerant type in Control Test. Make sure to access the ATTACH TO NETWORK DEVICE table after specifying HFC-134a refrigerant type.
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.

Table 8 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

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. Throw 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 and run and start contacts are energized while control tried to shut down. Disconnect power to starter.
LOSS OF COMMUNCIATION	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.

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.

Table 8 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

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 set-point, 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 temperature sensor.	
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 8 — LID Primary and Secondary Messages and Custom Alarm/Alert Messages with Troubleshooting Guides (cont)

K. MACHINE PROTECT LIMIT FAULTS

⚠ WARNING

Excessive numbers of the same fault can lead to severe machine damage. Seek service expertise.

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] exceeed 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 motor cooling solenoid for proper operation. 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 thermal expansion 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.
		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.
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 24-vac input on the SMM (terminals 23 and 24). Check transformers to SMM. Check power to PSIO module. Check distribution bus. Consult power company.
PROTECTIVE LIMIT	LOW LINE VOLTAGE	V_P [VALUE] exceeded limit of [LIMIT]*. Check voltage supply.	
PROTECTIVE LIMIT	HIGH LINE VOLTAGE	V_P [VALUE] exceeded limit of [LIMIT]*. Check voltage supply.	
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.	
PROTECTIVE LIMIT	HIGH CONDENSER PRESSURE	High Cond Pressure [OPEN]*: Check switch, oil pressure contact, 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.
		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	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	SPR_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.
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.

*[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. [OPEN] indicates that an input circuit is open.

Table 8 — 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	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.
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.
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 8 — 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)	Chilled water set point set too high. Access set point on LID and verify. Capacity override or excessive cooling load (machine at design capacity). Check LID status messages. Check for outside air infiltration into conditioned space. Condenser temperature too high. Check for proper flow, examine cooling tower operation, check for air or water leaks, check for fouled tubes. Refrigerant level low. Check for leaks, add refrigerant, and trim charge. Liquid bypass in waterbox. Examine division plates and gaskets for leaks. Guide vanes fail to open. Use Control Test to check operation. Chilled water control point too high. Access control algorithm status and check chilled water control operation. 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.
Chilled Water/Brine Temperature Too Low (Machine Running)	Chilled water set point set too low. Access set point on LID and verify. Chilled water control point too low. Access control algorithm status and check chilled water control for proper resets. High discharge temperature keeps guide vanes open. 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.
Chilled Water Temperature Fluctuates. Vanes Hunt	Deadband too narrow. Configure LID for a larger deadband. Proportional bands too narrow. Either INC or DEC proportional bands should be increased. Loose guide vane drive. Adjust chain drive. Defective vane actuator. Check through Control Test. Defective temperature sensor. Check sensor accuracy.
Low Oil Sump Temperature While Running (Less than 100 F [38 C])	Check for proper oil level (not enough oil).
At Power Up, Default Screen Does Not Appear, "Tables Loading" Message Continually Appears	Check for proper communications wiring on PSIO module. Check that the COMM1 communications wires from the LID are terminated to the COMM1 PSIO connection. Check for ground or short on CCN system wiring.
SMM Communications Failure	Check that PSIO communication plugs are connected correctly. Check SMM communication plug. Check for proper SMM power supply. See Control Modules section on page 95.
High Oil Temperature While Running	Check for proper oil level (too much oil). On hermetic EX compressors, check that TXV valve is operating properly. On hermetic or open-drive FA compressors, check water supply to oil cooler.
Blank LID Screen (Minimal Contrast Visible)	Increase contrast potentiometer. See Fig. 50. 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). Check light bulb if backlit model.
"Communications Failure" Highlighted Message At Bottom of LID Screen	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.
Control Test Disabled	Press the "Stop" pushbutton. The PIC must be in the OFF mode for the Control 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.
Vanes Will Not Open in Control Test	Low pressure alarm is active. Put machine into pumpdown mode or equalize pressure. Check guide vane actuator wiring.
Oil Pump Does Not Run	Check oil pump voltage supply. Cooler vessel pressure under vacuum. Pressurize vessel. Check temperature overload cutout switch.
LID Default Screen Does Not Update	This is normal operation when an alarm is present. The screen freezes the moment the alarm is activated to aid in troubleshooting. The Status01 screen provides current information.
Machine Does Not Stop When the STOP Button is Pressed	The STOP button wiring connector on the LID module is not properly connected or the machine is in soft stop mode and the guide vanes are closing.
LID Screen Dark	Light bulb burned out. Replace as needed.

Table 9A — Thermistor Temperature (F) vs Resistance/Voltage Drop

TEMPERATURE (F)	VOLTAGE DROP (V)	RESISTANCE (OHMS)
−25.0	4.821	98010
−24.0	4.818	94707
−23.0	4.814	91522
−22.0	4.806	88449
−21.0	4.800	85486
−20.0	4.793	82627
−19.0	4.786	79871
−18.0	4.779	77212
−17.0	4.772	74648
−16.0	4.764	72175
−15.0	4.757	69790
−14.0	4.749	67490
−13.0	4.740	65272
−12.0	4.734	63133
−11.0	4.724	61070
−10.0	4.715	59081
−9.0	4.705	57162
−8.0	4.696	55311
−7.0	4.688	53526
−6.0	4.676	51804
−5.0	4.666	50143
−4.0	4.657	48541
−3.0	4.648	46996
−2.0	4.636	45505
−1.0	4.624	44066
0.0	4.613	42679
1.0	4.602	41339
2.0	4.592	40047
3.0	4.579	38800
4.0	4.567	37596
5.0	4.554	36435
6.0	4.540	35313
7.0	4.527	34231
8.0	4.514	33185
9.0	4.501	32176
10.0	4.487	31202
11.0	4.472	30260
12.0	4.457	29351
13.0	4.442	28473
14.0	4.427	27624
15.0	4.413	26804
16.0	4.397	26011
17.0	4.381	25245
18.0	4.366	24505
19.0	4.348	23789
20.0	4.330	23096
21.0	4.313	22427
22.0	4.295	21779
23.0	4.278	21153
24.0	4.258	20547
25.0	4.241	19960
26.0	4.223	19393
27.0	4.202	18843
28.0	4.184	18311
29.0	4.165	17796
30.0	4.145	17297
31.0	4.125	16814
32.0	4.103	16346
33.0	4.082	15892
34.0	4.059	15453
35.0	4.037	15027
36.0	4.017	14614
37.0	3.994	14214
38.0	3.968	13826
39.0	3.948	13449
40.0	3.927	13084
41.0	3.902	12730
42.0	3.878	12387
43.0	3.854	12053
44.0	3.828	11730
45.0	3.805	11416
46.0	3.781	11112
47.0	3.757	10816
48.0	3.729	10529
49.0	3.705	10250
50.0	3.679	9979
51.0	3.653	9717
52.0	3.627	9461
53.0	3.600	9213
54.0	3.575	8973
55.0	3.547	8739
56.0	3.520	8511
57.0	3.493	8291
58.0	3.464	8076
59.0	3.437	7868
60.0	3.409	7665
61.0	3.382	7468
62.0	3.353	7277
63.0	3.323	7091
64.0	3.295	6911
65.0	3.267	6735
66.0	3.238	6564
67.0	3.210	6399
68.0	3.181	6238
69.0	3.152	6081
70.0	3.123	5929
71	3.093	5781
72	3.064	5637
73	3.034	5497
74	3.005	5361
75	2.977	5229
76	2.947	5101
77	2.917	4976
78	2.884	4855
79	2.857	4737
80	2.827	4622
81	2.797	4511
82	2.766	4403
83	2.738	4298
84	2.708	4196
85	2.679	4096
86	2.650	4000
87	2.622	3906
88	2.593	3814
89	2.563	3726
90	2.533	3640
91	2.505	3556
92	2.476	3474
93	2.447	3395
94	2.417	3318
95	2.388	3243
96	2.360	3170
97	2.332	3099
98	2.305	3031
99	2.277	2964
100	2.251	2898
101	2.217	2835
102	2.189	2773
103	2.162	2713
104	2.136	2655
105	2.107	2597
106	2.080	2542
107	2.053	2488
108	2.028	2436
109	2.001	2385
110	1.973	2335
111	1.946	2286
112	1.919	2239
113	1.897	2192
114	1.870	2147
115	1.846	2103
116	1.822	2060
117	1.792	2018
118	1.771	1977
119	1.748	1937
120	1.724	1898
121	1.702	1860
122	1.676	1822
123	1.653	1786
124	1.630	1750
125	1.607	1715
126	1.585	1680
127	1.562	1647
128	1.538	1614
129	1.517	1582
130	1.496	1550
131	1.474	1519
132	1.453	1489
133	1.431	1459
134	1.408	1430
135	1.389	1401
136	1.369	1373
137	1.348	1345
138	1.327	1318
139	1.308	1291
140	1.291	1265
141	1.289	1240
142	1.269	1214
143	1.250	1190
144	1.230	1165
145	1.211	1141
146	1.192	1118
147	1.173	1095
148	1.155	1072
149	1.136	1050
150	1.118	1029
151	1.100	1007
152	1.082	986
153	1.064	965
154	1.047	945
155	1.029	925
156	1.012	906
157	0.995	887
158	0.978	868
159	0.962	850
160	0.945	832
161	0.929	815
162	0.914	798
163	0.898	782
164	0.883	765
165	0.868	750
166	0.853	734
167	0.838	719
168	0.824	705
169	0.810	690
170	0.797	677
171	0.783	663
172	0.770	650
173	0.758	638
174	0.745	626
175	0.734	614
176	0.722	602
177	0.710	591
178	0.700	581
179	0.689	570
180	0.678	561
181	0.668	551
182	0.659	542
183	0.649	533
184	0.640	524
185	0.632	516
186	0.623	508
187	0.615	501
188	0.607	494
189	0.600	487
190	0.592	480
191	0.585	473
192	0.579	467
193	0.572	461
194	0.566	456
195	0.560	450
196	0.554	445
197	0.548	439
198	0.542	434
199	0.537	429
200	0.531	424
201	0.526	419
202	0.520	415
203	0.515	410
204	0.510	405
205	0.505	401
206	0.499	396
207	0.494	391
208	0.488	386
209	0.483	382
210	0.477	377
211	0.471	372
212	0.465	367
213	0.459	361
214	0.453	356
215	0.446	350
216	0.439	344
217	0.432	338
218	0.425	332
219	0.417	325
220	0.409	318
221	0.401	311
222	0.393	304
223	0.384	297
224	0.375	289
225	0.366	282

Table 9B — Thermistor Temperature (C) vs Resistance/Voltage Drop

TEMPERATURE (C)	VOLTAGE DROP (V)	RESISTANCE (Ohms)
−40	4.896	168 230
−39	4.889	157 440
−38	4.882	147 410
−37	4.874	138 090
−36	4.866	129 410
−35	4.857	121 330
−34	4.848	113 810
−33	4.838	106 880
−32	4.828	100 260
−31	4.817	94 165
−30	4.806	88 480
−29	4.794	83 170
−28	4.782	78 125
−27	4.769	73 580
−26	4.755	69 250
−25	4.740	65 205
−24	4.725	61 420
−23	4.710	57 875
−22	4.693	54 555
−21	4.676	51 450
−20	4.657	48 536
−19	4.639	45 807
−18	4.619	43 247
−17	4.598	40 845
−16	4.577	38 592
−15	4.554	38 476
−14	4.531	34 489
−13	4.507	32 621
−12	4.482	30 866
−11	4.456	29 216
−10	4.428	27 633
−9	4.400	26 202
−8	4.371	24 827
−7	4.341	23 532
−6	4.310	22 313
−5	4.278	21 163
−4	4.245	20 079
−3	4.211	19 058
−2	4.176	18 094
−1	4.140	17 184
0	4.103	16 325
1	4.065	15 515
2	4.026	14 749
3	3.986	14 026
4	3.945	13 342
5	3.903	12 696
6	3.860	12 085
7	3.816	11 506
8	3.771	10 959
9	3.726	10 441
10	3.680	9 949
11	3.633	9 485
12	3.585	9 044
13	3.537	8 627
14	3.487	8 231
15	3.438	7 855
16	3.387	7 499
17	3.337	7 161
18	3.285	6 840
19	3.234	6 536
20	3.181	6 246
21	3.129	5 971
22	3.076	5 710
23	3.023	5 461
24	2.970	5 225
25	2.917	5 000
26	2.864	4 786
27	2.810	4 583
28	2.757	4 389
29	2.704	4 204
30	2.651	4 028
31	2.598	3 861
32	2.545	3 701
33	2.493	3 549
34	2.441	3 404
35	2.389	3 266
36	2.337	3 134
37	2.286	3 008
38	2.236	2 888
39	2.186	2 773
40	2.137	2 663
41	2.087	2 559
42	2.039	2 459
43	1.991	2 363
44	1.944	2 272
45	1.898	2 184
46	1.852	2 101
47	1.807	2 021
48	1.763	1 944
49	1.719	1 871
50	1.677	1 801
51	1.635	1 734
52	1.594	1 670
53	1.553	1 609
54	1.513	1 550
55	1.474	1 493
56	1.436	1 439
57	1.399	1 387
58	1.363	1 337
59	1.327	1 290
60	1.291	1 244
61	1.258	1 200
62	1.225	1 158
63	1.192	1 118
64	1.160	1 079
65	1.129	1 041
66	1.099	1 006
67	1.069	971
68	1.040	938
69	1.012	906
70	0.984	876
71	0.949	836
72	0.920	805
73	0.892	775
74	0.865	747
75	0.838	719
76	0.813	693
77	0.789	669
78	0.765	645
79	0.743	623
80	0.722	602
81	0.702	583
82	0.683	564
83	0.665	547
84	0.648	531
85	0.632	516
86	0.617	502
87	0.603	489
88	0.590	477
89	0.577	466
90	0.566	456
91	0.555	446
92	0.545	436
93	0.535	427
94	0.525	419
95	0.515	410
96	0.506	402
97	0.496	393
98	0.486	385
99	0.476	376
100	0.466	367
101	0.454	357
102	0.442	346
103	0.429	335
104	0.416	324
105	0.401	312
106	0.386	299
107	0.370	285

Control Modules

> **⚠ 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 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 per second, 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 1 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:

<u>LID Module</u>

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

Lower LED — Communication with PSIO module; must blink every 5 to 8 seconds when the LID default screen is displayed.

<u>PSIO Module</u>

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.

<u>8-Input Modules and SMM</u>

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

Notes on Module Operation

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 bus. The communication between the PSIO, SMM, and both 8-input modules is accomplished through the sensor bus, which is a 3-wire cable.

   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. See Fig. 49-53. 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 operation. If the red LED is normal, check the module address switches (Fig. 49-53). 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 (CCN bus — 1:red, 2:wht, 3:blk; Sensor bus — 1:red, 2:blk, 3:clr/wht). If a good connection is assured and the condition persists, replace the PSIO module.

   If only one 8-input module or SMM indicates communication failure, check the communications plug on that module. 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.

Processor Module (PSIO) (Fig. 51)

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.

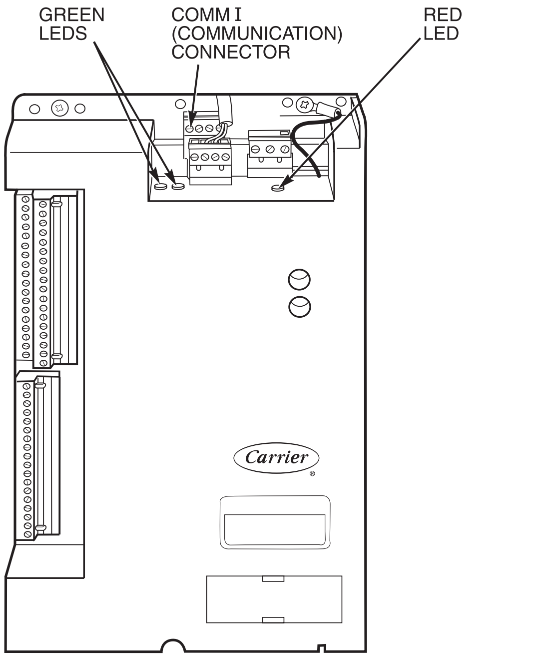
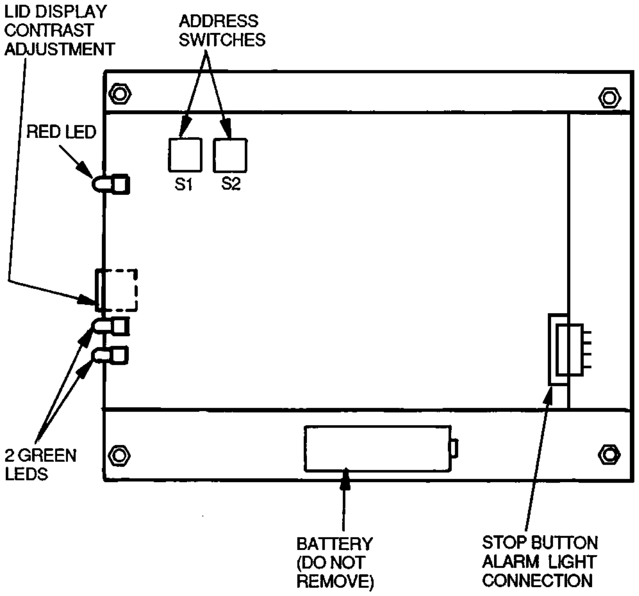
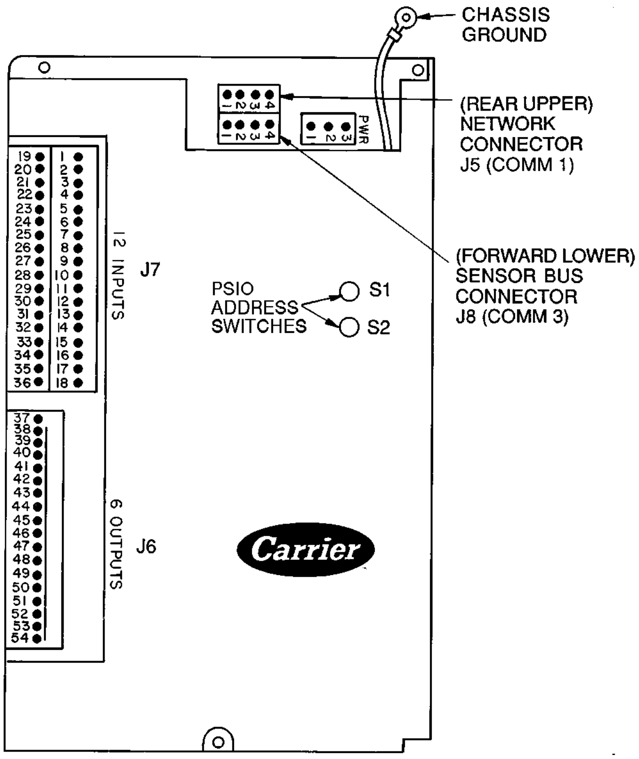


Fig. 49 — PSIO Module LED Locations



NOTE: Address switches on this module can be at any position. Addresses are only changed through the LID screen or CCN.

Fig. 50 — LID Module (Rear View) and LED Locations



NOTE: Address switches on this module can be at any position. Addresses can only be changed through the LID or CCN.

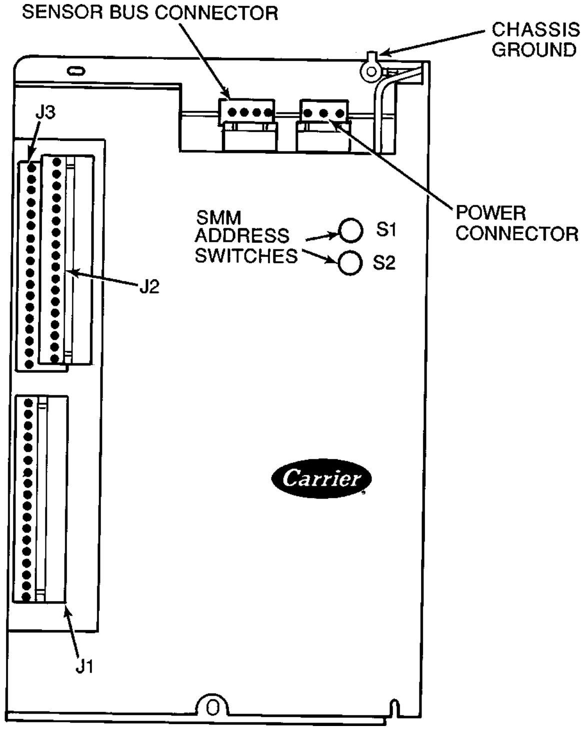
Fig. 51 — Processor (PSIO) Module

Starter Management Module (SMM) (Fig. 52)

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.

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



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

Fig. 52 — Starter Management Module (SMM)

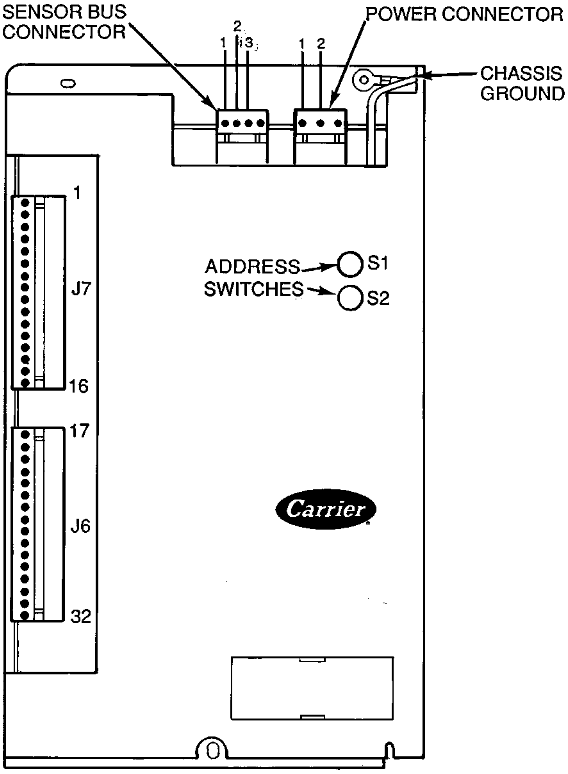
inputs. Each option module contains 8 inputs, each input meant for a specific duty. See the wiring diagram for exact module wire terminations. Inputs for each of the options modules available include the following:

OPTIONS 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

OPTIONS 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

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. 53) and to configure the chiller for each feature being used.

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. 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. Follow the procedures described in the Set Up Machine Control Configuration section on page 55.



SWITCH SETTING	OPTIONS MODULE 1	OPTIONS MODULE 2
S1	6	7
S2	4	2

Fig. 53 — Options Module

⚠ CAUTION

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

INSTALLATION OF NEW PSIO MODULE

1. Verify if the existing PSIO module is defective, by using the procedure described in the Notes on Module Operation section, page 95, and Control Modules section, page 95. 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 LID. If this data is not available, follow the procedures described in the Set Up Machine Control Configuration section. Record the TOTAL COMPRESSOR STARTS and the COMPRESSOR ONTIME from the STATUS01 table on the LID.

   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 (if the software version is the same).

   Any communication wires from other machines or CCN modules must be disconnected.
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 box. 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. Restore control system power (LID will show "COMMUNICATION FAILURE" at bottom of screen).
7. Access the SERVICE menu. Highlight and select "ATTACH TO NETWORK DEVICE." Push the "ATTACH" softkey. (The LID will show "UPLOADING TABLES. PLEASE WAIT," then show "COMMUNICATION FAILURE.") Press the EXIT softkey.
8. Turn off control power.
9. 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.
10. Connect the LID communication wires (CCN bus) and the power wires. If CCN wiring has been attached to the CCN bus, disconnect the wires. Attach the sensor bus plug and the input and output plugs.
11. Carefully check all wiring connections before restoring power.
12. Restore control power and verify that the red and green LEDs on the PSIO are functioning properly.
13. The LID should indicate "AVAILABLE MEMORY" and a value. This value should start to decrease. (If not, check LID wiring to PSIO, ensure connection to the proper plug.) The bottom of the screen will indicate "UPLOADING TABLES, PLEASE WAIT."
14. After the PSIO tables have been uploaded into the LID, access the STATUS01 screen. Move the highlight bar to the "TOTAL COMPRESSOR STARTS" value. Select this value and increase the value until it is the same as the value from the old module. Press ENTER to save this value.
15. Move the highlight bar to the "COMPRESSOR ONTIME" value. Select this point and increase the value until it matches the old module run hours. Press SELECT to save this value.
16. Change the address of the PSIO in the Controller Identification table back to the previous value. Write the address on the PSIO.
17. Use the configuration sheets to input setpoint, 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.
18. 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.
19. Restore chiller to normal operation, calibrate motor amps.

17/19EX PHYSICAL DATA AND WIRING SCHEMATICS

Tables 10-18 and Fig. 54-62 provide additional information regarding compressor fits and clearances, physical and electrical data, and wiring schematics for operator convenience during troubleshooting.

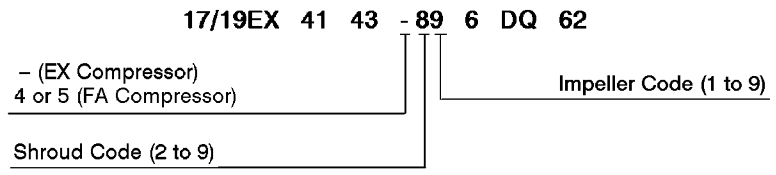


Fig. 54 — Model Number Nomenclature for Compressor Size (See Fig. 1 Also)

Table 10 — 17/19EX Heat Exchanger, Economizer/Storage Vessel, Piping, and Pumpout Unit Weights*

COOLER SIZE†	COOLER TOTAL WEIGHT				COOLER CHARGE						ECONOMIZER/ STORAGE VESSEL**		ECONOMIZER REFRIGERANT		MISCELLANEOUS PIPING		PUMPOUT UNIT	
	Dry		Operating††		Refrigerant		Water											
	lb	kg	lb	kg	lb	kg	lb	gal	kg	L	lb	kg	lb	kg	lb	kg	lb	kg
31	14,173	6 429	17,518	7 946	1,540	699	1,810	217	821	821	7,169	3252	610	277	820	372	210	95
32	14,538	6 594	18,117	8 218	1,640	744	1,944	233	882	882								
33	14,904	6 760	18,722	8 492	1,740	789	2,078	249	943	943								
41	21,674	9 831	26,120	11 848	1,900	862	2,441	293	1 107	1 107	7,169	3 252	610	277	1,095	497		
42	22,019	9 988	26,736	12 127	2,000	907	2,575	309	1 168	1 168								
43	22,364	10 144	27,322	12 393	2,100	953	2,709	325	1 229	1 229								
44	23,841	10 814	29,836	13 533	2,190	993	3,285	394	1 490	1 490								
45	25,032	11 354	30,790	13 966	2,260	1 025	3,006	361	1 363	1 363	7,900	3 583	840	381	1,149	521		
46	25,529	11 580	31,658	14 360	2,360	1 070	3,192	383	1 448	1 448								
47	26,025	11 805	32,496	14 740	2,460	1 116	3,378	405	1 532	1 532								
48	28,153	12 770	36,053	16 353	2,540	1 152	4,173	500	1 893	1 893								

CONDENSER SIZE†	CONDENSER TOTAL WEIGHT				CONDENSER CHARGE					
	Dry		Operating††		Refrigerant		Water			
	lb	kg	lb	kg	lb	kg	lb	gal	kg	L
31	10,454	4 742	13,022	5 907	950	431	1,613	193	732	732
32	10,809	4 903	13,514	6 130	950	431	1,750	210	794	794
33	11,164	5 064	14,000	6 350	950	431	1,886	226	855	855
41	13,768	6 245	16,999	7 711	1,090	494	2,146	257	973	973
42	14,118	6 404	17,498	7 937	1,090	494	2,282	274	1 035	1 035
43	14,468	6 563	17,978	8 155	1,090	494	2,419	290	1 097	1 097
45	16,676	7 564	20,800	9 435	1,400	635	2,720	326	1 234	1 234
46	17,172	7 789	21,489	9 747	1,400	635	2,908	348	1 319	1 319
47	17,669	8 015	22,178	10 060	1,400	635	3,096	371	1 404	1 404
51	17,188	7 796	20,993	9 522	1,100	499	2,707	325	1 228	1 228
52	17,848	8 096	21,923	9 944	1,100	499	2,964	355	1 344	1 344
53	18,400	8 346	22,682	10 288	1,100	499	3,178	381	1 442	1 442
55	20,725	9 401	25,598	11 611	1,420	644	3,453	412	1 566	1 566
56	21,663	9 826	26,896	12 199	1,420	644	3,808	457	1 727	1 727
57	22,446	10 181	27,980	12 691	1,420	644	4,105	492	1 862	1 862

*If a machine configuration other than 2-pass, 150 psig (1034 kPa), NIH waterbox configuration is used, refer to Tables 11 and 13 to obtain the additional dry and water weights that must be added to the values shown in this table.

†Cooler and condenser weights shown are based upon 2-pass, nozzle-in-head (NIH) waterboxes with 150 psig (1034 kPa) covers. Includes components attached to cooler, but does not include suction/discharge, elbow, or other interconnecting piping.

**Dry weight includes all components attached to economizer: Covers, float valves, brackets, control center (31 lb [14 kg]), and power panel (20 lb [9 kg]). Dry weight does not include compressor weight, motor weight, or pumpout condensing unit weight. The pumpout condensing unit weight is 210 lb (95 kg). For compressor and motor weights, refer to Table 12.

††Operating weight is the sum of the dry weight, refrigerant weight, and water weight.

Table 11 — Additional Condenser Weights*

COMPONENT	HEAT EXCHANGER SIZE	WATERBOX TYPE	NUMBER OF PASSES	DESIGN MAXIMUM WATER PRESSURE		ADDITIONAL DRY WEIGHT		ADDITIONAL WATER WEIGHT			
				psig	kPa	lb	kg	lb	gal	kg	L
CONDENSER	31 - 33	NIH	3	150	1034	262	119	—	—	—	—
		NIH	3	300	2068	1328	602	—	—	—	—
		NIH	2	300	2068	872	396	—	—	—	—
		Marine	3	150	1034	842	382	2 276	273	1 032	1 032
		Marine	2	150	1034	421	191	1 138	136	516	516
		Marine	3	300	2068	1520	689	2 276	273	1 032	1 032
		Marine	2	300	2068	1099	498	1 138	136	516	516
	41 - 43 45 - 47	NIH	1, 3	150	1034	344	156	—	–	—	—
		NIH	1, 3	300	2068	1652	749	—	–	—	—
		NIH	2	300	2068	1132	513	—	–	—	—
		Marine	1, 3	150	1034	1692	767	3 400	408	1 542	1 542
		Marine	2	150	1034	674	306	1 700	204	771	771
		Marine	1, 3	300	2068	2651	1 202	3 400	408	1 542	1 542
		Marine	2	300	2068	1630	739	1 700	204	771	771
	51 - 53 55 - 57	NIH	1	150	1034	†	†	—	—	—	—
		NIH	1	300	2068	1588	720	—	—	—	—
		NIH	2	300	2068	1591	721	—	—	—	—
		Marine	2	150	1034	25	11	1 734	208	787	787
		Marine	2	300	2068	1225	555	1 734	208	787	787

NIH — Nozzle-In-Head

*When using a machine configuration other than 2-pass, NIH waterboxes with 150 psig (1034 kPa) covers, add the weights listed in this table to the appropriate weights in Table 10 to obtain the correct condenser weight.

†Subtract 228 lb (103 kg) from the weight shown in Table 10.

Table 12 — Compressor/Motor/Suction Elbow Weights

(English)

COMPRESSOR/ MOTOR/ SUCTION ELBOW	WEIGHT (lb)
17 Series, All Compressor Sizes*	14,650
19 Series, 51-89 Compressor Sizes†	8,853
19 Series, 421-469 Compressor Sizes**	6,352
19 Series, 531-599 Compressor Sizes††	9,950

*Based on 4160 v, FD motor.
†Based on 6900 v, DQ motor.
**Based on 6900 v, DP motor.
††Based on 6900 v, EE motor.

(SI)

COMPRESSOR/ MOTOR/ SUCTION ELBOW	WEIGHT (kg)
17 Series, All Compressor Sizes*	6 645
19 Series, 51-89 Compressor Sizes†	4 081
19 Series, 421-469 Compressor Sizes**	2 927
19 Series, 531-599 Compressor Sizes††	4 638

*Based on 3300 v, FD motor.
†Based on 6300 v, DQ motor.
**Based on 6300 v, DP motor.
††Based on 6300 v, EE motor.

Table 13 — Additional Cooler Weights*

COOLER FRAME	WATERBOX TYPE	NUMBER OF PASSES	DESIGN MAXIMUM WATER PRESSURE		ADDITIONAL DRY WEIGHT		ADDITIONAL WATER WEIGHT			
			psig	kPa	lb	kg	lb	gal	kg	L
3	NIH	1, 3	150	1034	655	297	—	—	—	—
	NIH	1, 3	300	2068	2226	1010	—	—	—	—
	NIH	2	300	2068	1406	638	—	—	—	—
	Marine	1, 3	150	1034	780	354	3192	383	1448	1 448
	Marine	2	150	1034	390	177	1596	191	724	724
	Marine	1, 3	300	2068	3412	1548	3192	383	1448	1 448
	Marine	2	300	2068	1706	774	1596	191	724	724
4	NIH	1, 3	150	1034	515	234	—	—	—	—
	NIH	1, 3	300	2068	2941	1334	—	—	—	—
	NIH	2	300	2068	2085	946	—	—	—	—
	Marine	1, 3	150	1034	2100	953	5102	612	2314	2 314
	Marine	2	150	1034	792	359	2551	306	1157	1 157
	Marine	1, 3	300	2068	3844	1744	5102	612	2314	2 314
	Marine	2	300	2068	2536	1150	2551	306	1157	1 157

NIH — Nozzle-In-Head

*When using a machine configuration other than 2-pass, NIH waterboxes with 150 psig (1038 kPa) covers, add the weights listed in this table to the appropriate weights in Table 10 to obtain the correct cooler weight.

Table 14 — Marine Waterbox Cover Weights*

HEAT EXCHANGER SIZE	DESIGN MAXIMUM WATER PRESSURE		COOLER		CONDENSER	
	psi	kPa	lb	kg	lb	kg
31 - 33	150	1034	1667	756	1092	495
	300	2068	2280	1034	1436	651
41 - 48	150	1034	2236	1015	1275	579
	300	2068	3060	1389	1660	754
51 - 57	150	1034	—	—	1643	746
	300	2068	—	—	2243	1018

*Heat exchangers with marine waterboxes have heavier dry and operating weights than heat exchangers with nozzle-in-head waterboxes.

Table 15 — NIH Waterbox Cover Weights*

HEAT EXCHANGER SIZE	PASSES	DESIGN MAXIMUM WATER PRESSURE		COOLER		CONDENSER	
		psi	kPa	lb	kg	lb	kg
31 - 33	1	150	1034	1880	853	—	—
		300	2068	2748	1247	—	—
	2	150	1034	2168	983	1356	615
		300	2068	3107	1409	1959	889
	3	150	1034	2105	955	1283	582
		300	2068	2991	1357	1828	829
41 - 48	1	150	1034	2997	1361	1735	788
		300	2068	4225	1918	2510	1140
	2†	150	1034	2984	1355	1885	856
		300	2068	4188	1901	2590	1176
	3	150	1034	3035	1378	1777	807
		300	2068	4244	1927	2539	1153
51 - 57	1	150	1034	—	—	2032	923
		300	2068	—	—	2940	1335
	2†	150	1034	—	—	2649	1203
		300	2068	—	—	3640	1653
	3	150	1034	—	—	—	—
		300	2068	—	—	—	—

NIH — Nozzle-in-Head

*The 150 psig (1034 kPa) waterbox cover weights are included in the dry weight shown in Table 10.

†Two different waterbox covers are present on 2-pass machines. The weight shown in this table represents the weight of the waterbox cover that contains the nozzles. A blank waterbox cover is also present on 2-pass units. The weight of the blank waterbox cover is identical to the weight of the same size marine waterbox cover. Refer to Table 14.

Table 16 — Auxilliary Systems, Electrical Data

POWER SOURCE	ITEM	SUPPLY V-PH-Hz	FLA	LRA
1	Control Module and Actuator	115-1-60 115-1-50	3.50	—
	Oil Sump Heater	115-1-60 115-1-50	8.70	—
2	Oil Pump	200/240-3-60 380/480-3-60 507/619-3-60	4.32 2.15 2.13	24.5 12.2 25.0
		220/240-3-50 346/440-3-50	4.83 2.59	28.0 12.2
3 (Optional)	Pumpout Compressor	200/208-3-60 220/240-3-60 440/480-3-60 550/600-3-60	10.90 9.50 4.70 3.80	63.5 57.5 28.8 23.0
		380/415-3-50	4.70	28.8

LEGEND

FLA — Full Load Amps
LRA — Locked Rotor 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.

Compressor Fits and Clearances — Service and repair of Carrier centrifugal compressors should be performed only by fully trained and qualified service personnel. The information in this section is included as a reference for such personnel only.

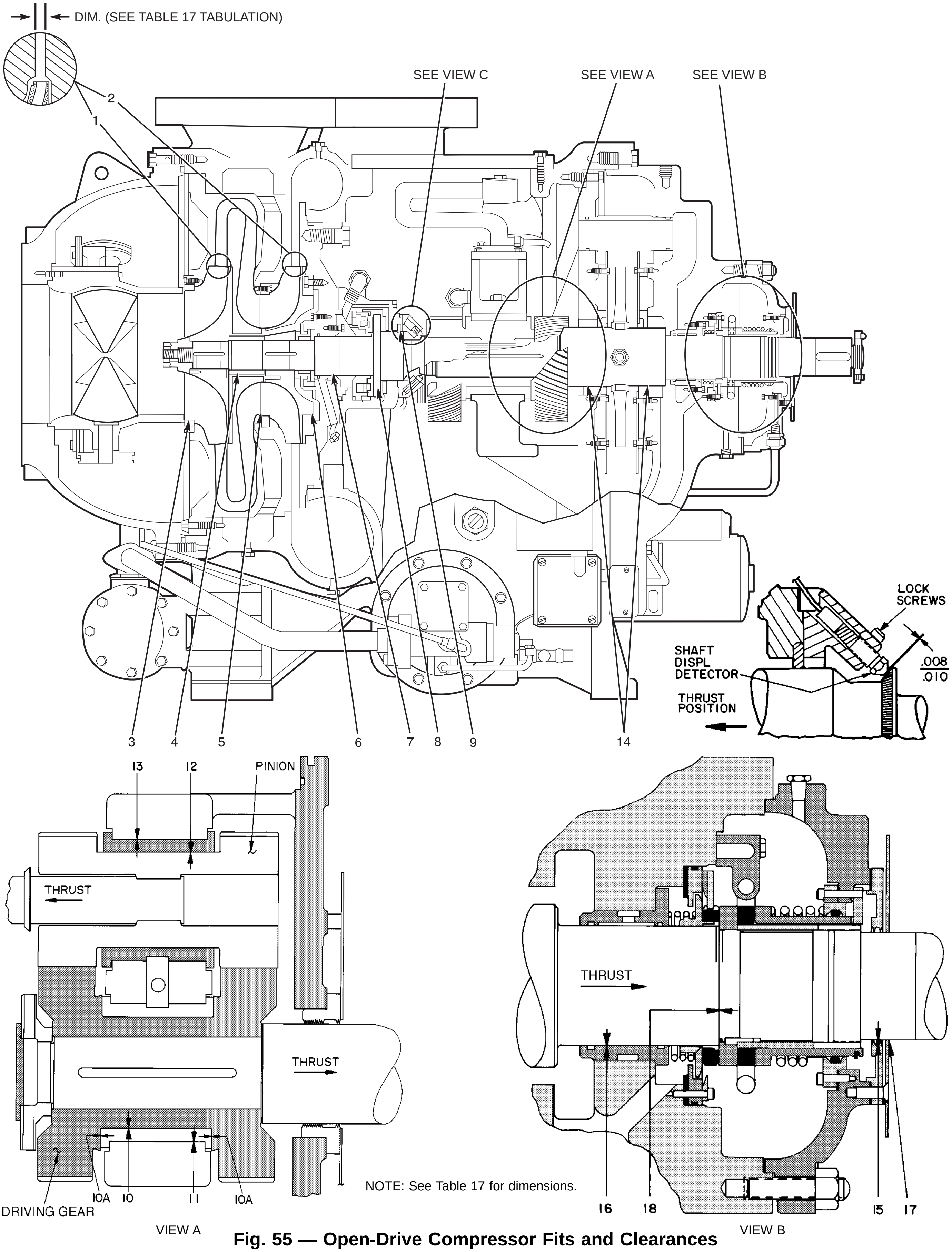


Fig. 55 — Open-Drive Compressor Fits and Clearances

Table 17 — Open-Drive Compressor Fits and Clearances

ITEM	DESCRIPTION	CLEARANCE								TYPE OF MEASURE
		17FA4				17FA5				
		Min		Max		Min		Max		
		in.	mm	in.	mm	in.	mm	in.	mm	
1	1st stage impeller to diaphragm	See tabulation								Axial
2	2nd stage impeller to discharge wall	See tabulation								Axial
3	1st stage labyrinth	.016	.4060	.020	.5080	.016	.4060	.020	.5080	Diametral
4	Interstage labyrinth	.012	.3050	.016	.4060	.012	.3050	.016	.4060	Diametral
5	2nd stage labyrinth	.008	.2030	.012	.3050	.008	.2030	.012	.3050	Diametral
6	Balancing piston labyrinth	.008	.2030	.012	.3050	.008	.2030	.012	.3050	Diametral
7	Impeller shaft journal bearing	.0020	.0510	.0035	.0889	.0030	.0762	.0045	.1143	Diametral
8	Thrust-end float	.010	.2540	.015	.381	.010	.2540	.015	.381	Axial
9	Counterthrust bearing seal ring	.002	.0510	.004	.1020	.002	.0510	.004	.1020	Diametral
10	Gear bearing to gear	.0040	.1016	.0055	.1397	.0050	.1270	.0065	.1651	Diametral
10a	Gear bearing to gear	.010	.2540	.0185	.4699	.010	.2540	.0185	.4699	Axial
11	Gear bearing to bearing housing	.0005	.0127	.0025	.0635	.0005	.0127	.0025	.0635	Diametral
12	Pinion bearing to pinion	.0020	.0510	.0035	.0889	.0040	.1016	.0055	.1397	Diametral
13	Pinion bearing to bearing housing	.001	.0254	.003	.0762	.0005	.0127	.0025	.0635	Diametral
14	Transmission labyrinth	.006	.1520	.010	.2540	.006	.1520	.010	.2540	Diametral
15	Shaft end labyrinth	.001	.0254	.005	.1270	.001	.0254	.005	.1270	Diametral
16	Drive-end journal bearing	.003	.0762	.005	.1270	.0035	.0889	.0055	.1397	Diametral
17	Windage baffle to shaft	.083	2.108	.104	2.642	.079	2.007	.100	2.540	Diametral
18	Inner carbon ring travel	.06 MIN Each Direction				.06 MIN Each Direction				Axial

See Fig. 55 for item callouts.

Tabulation — Impeller Clearances (Open-Drive Compressors)

COMPRESSOR SIZE	SHROUD	DIAM CODE	IMPELLER DIAMETER		DIMENSION*			
					Item 1		Item 2	
			in.	mm	in.	mm	in.	mm
17FA5	3	1	12.00	304.8	.837	21.26	.638	16.21
		3	12.38	314.5	.797	20.24	.609	15.47
		5	12.75	323.8	.757	19.23	.579	14.71
		7	13.25	336.6	.717	18.21	.541	13.74
		9	13.75	349.2	.690	17.53	.541	13.74
	4	1	12.00	304.8	.977	24.82	.760	19.30
		3	12.38	314.5	.937	23.80	.726	18.44
		5	12.75	323.8	.897	22.78	.688	17.48
		7	13.25	336.6	.837	23.62	.639	16.23
		9	13.75	349.2	.810	20.57	.632	16.05
	5	1	12.00	304.8	1.177	29.90	.895	25.02
		3	12.38	314.5	1.137	28.88	.852	21.64
		5	12.75	323.8	1.077	27.36	.809	20.55
		7	13.25	336.6	1.017	25.83	.750	19.05
		9	13.75	349.2	.970	24.64	.731	18.57
	6	1	12.00	304.8	1.297	32.94	.972	24.69
		3	12.38	314.5	1.237	31.42	.928	23.57
		5	12.75	323.8	1.177	29.90	.880	22.35
		7	13.25	336.6	1.097	27.86	.817	20.75
		9	13.75	349.2	1.050	26.67	.796	20.22
	8	1-9	13.75†	349.2†	4.425	112.39	.876	22.25
			13.50**	342.9**				
	9	1-9	13.75†	349.2†	4.425	112.39	1.055	26.80
			13.50**	342.9**				

*Measured with shaft in thrust position (towards suction end); tolerance = ± .005 in. (± .127 mm).
†First-stage diameter.
**Second-stage diameter.

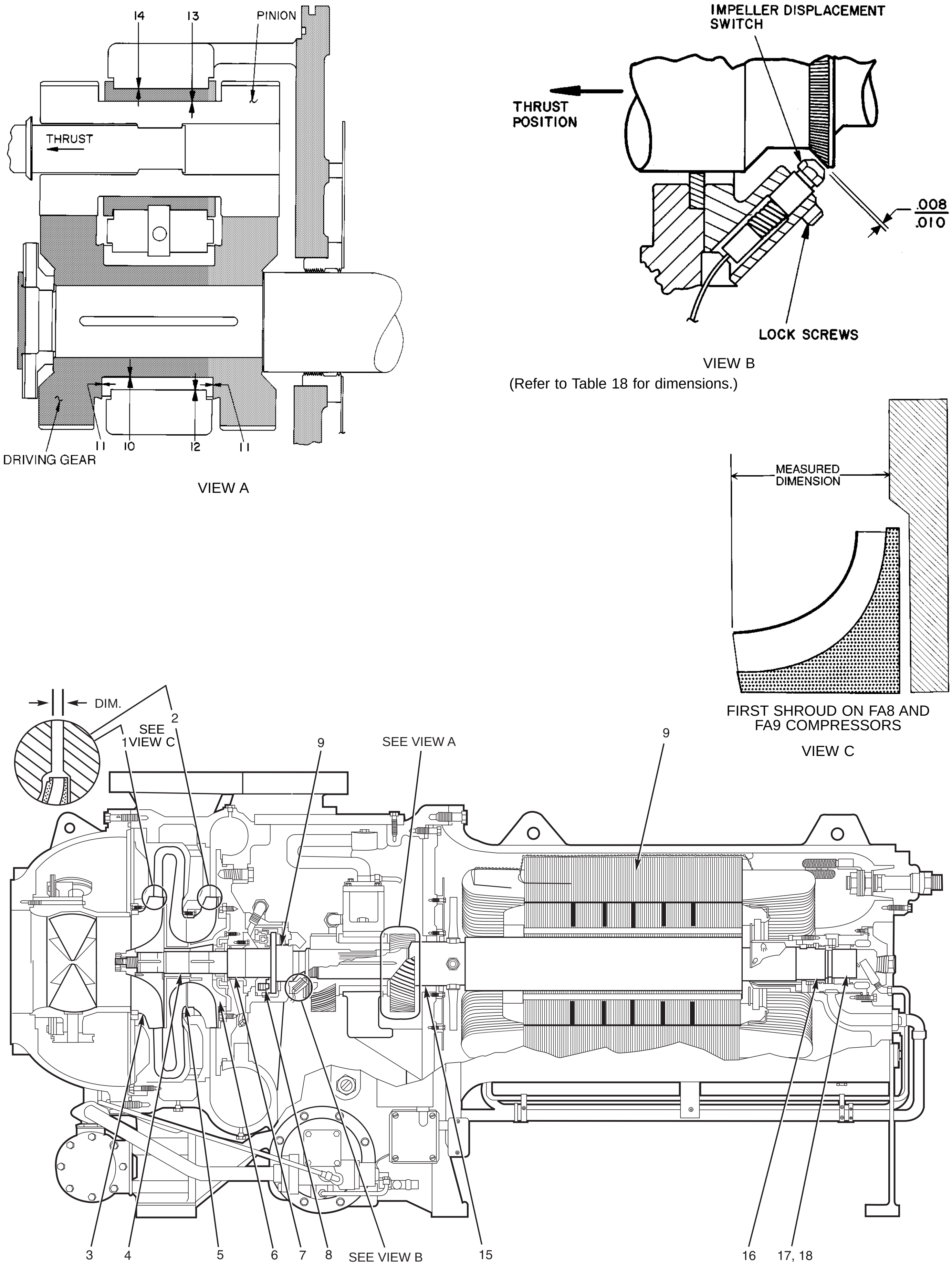


Fig. 56 — Hermetic Compressor Fits and Clearances

Table 18 — Hermetic Compressor Fits and Clearances

ITEM*	DESCRIPTION	CLEARANCE† in. Minimum	CLEARANCE† in. Maximum	CLEARANCE† mm Minimum	CLEARANCE† mm Maximum	TYPE OF MEASURE
1	1st Stage Impeller to Diaphragm	See Tabulation				Axial
2	2nd Stage Impeller to Discharge Wall					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. 56 for item callouts.
†Clearances represent factory tolerances for new components.

Tabulation — Impeller Clearances (Hermetic Compressors)

19EX SHROUD CODE	FA SHROUD CODE	IMPELLER CODE	IMPELLER DIAMETER in.	IMPELLER DIAMETER mm	DIMENSION* Item 1 in.	DIMENSION* Item 1 mm	DIMENSION* Item 2 in.	DIMENSION* Item 2 mm
5	3	1	12.00	304.8	0.837	21.26	0.638	16.21
		3	12.38	314.5	0.797	20.24	0.609	15.47
		5	12.75	323.8	0.757	19.23	0.579	14.71
		7	13.25	336.6	0.717	18.21	0.541	13.74
		9	13.75	349.2	0.690	17.53	0.541	13.74
6	4	1	12.00	304.8	0.977	24.82	0.760	19.30
		3	12.38	314.5	0.937	23.80	0.726	18.44
		5	12.75	323.8	0.897	22.78	0.688	17.48
		7	13.25	336.6	0.837	23.62	0.639	16.23
		9	13.75	349.2	0.810	20.57	0.632	16.05
7	5	1	12.00	304.8	1.177	29.90	0.895	25.02
		3	12.38	314.5	1.137	28.88	0.852	21.64
		5	12.75	323.8	1.077	27.36	0.809	20.55
		7	13.25	336.6	1.017	25.83	0.750	19.05
		9	13.75	349.2	0.970	24.64	0.731	18.57
8	6	1	12.00	304.8	1.297	32.94	0.972	24.69
		3	12.38	314.5	1.237	31.42	0.928	23.57
		5	12.75	323.8	1.177	29.90	0.880	22.35
		7	13.25	336.6	1.007	27.86	0.817	20.75
		9	13.75	349.2	1.050	26.67	0.796	20.22
—	8	1-9	13.75†	349.2†	4.425	112.39	.876	22.25
			13.50**	342.9**				
—	9	1-9	13.75†	349.2†	4.425	112.39	1.055	26.80
			13.50**	342.9**				

*Measured with shaft in thrust position (towards suction end); tolerance = ± .005 in. (± .127 mm).
†First-stage diameter.
**Second-stage diameter.

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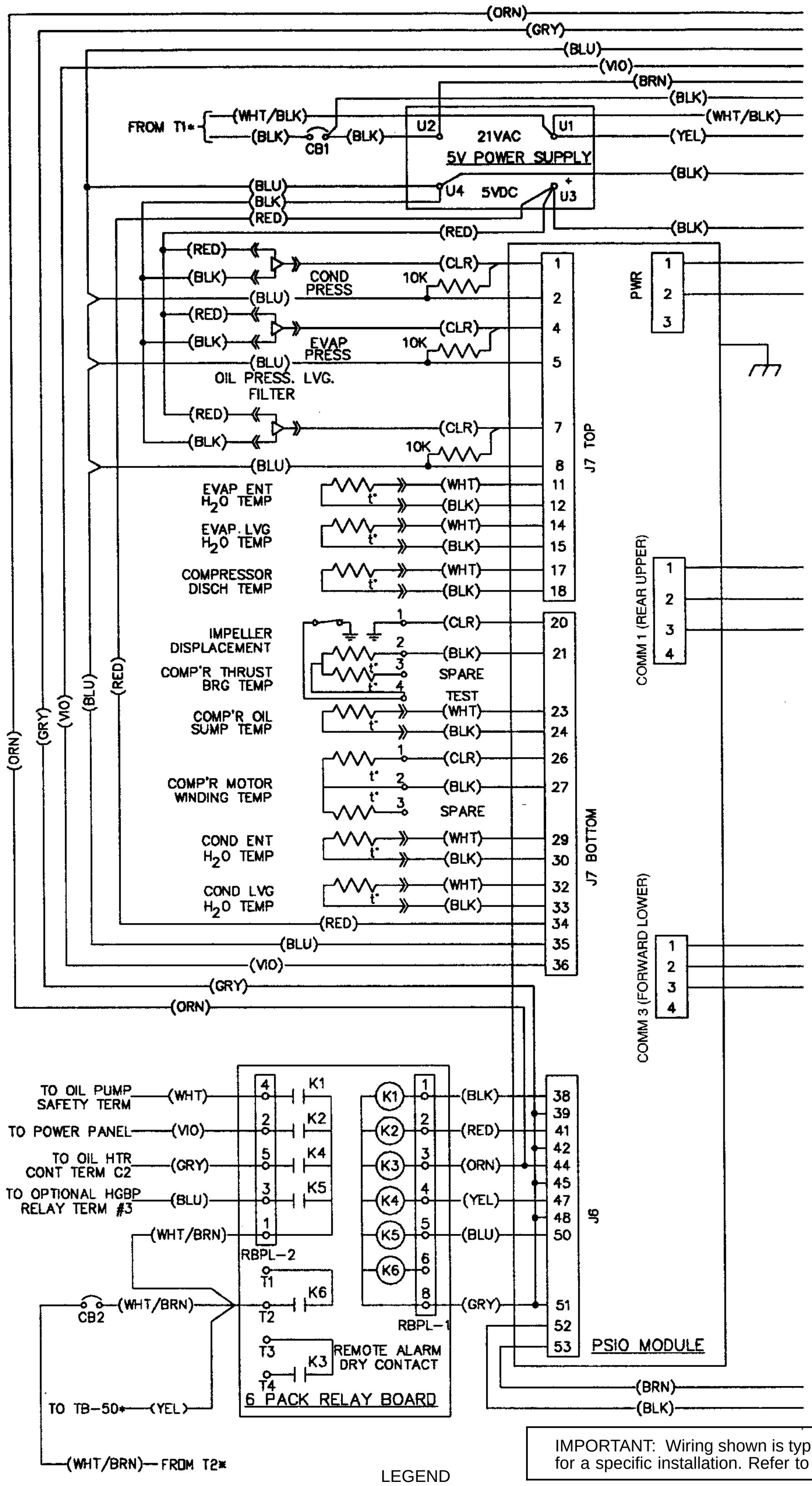


IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.

LEGEND

CB	—	Circuit Breaker
G.V.	—	Guide Vane
HGBP	—	Hot Gas Bypass
J	—	Module Connector
LID	—	Local Interface Device
L1,L2	—	Line Terminals
PSIO	—	Processor/Sensor Input/Output Module
RBPL	—	Relay Board Plug
T	—	Terminal
T1*,T2*,T4*	—	Power Panel Transformers
TB	—	Terminal Board
*****		Power Panel Connection

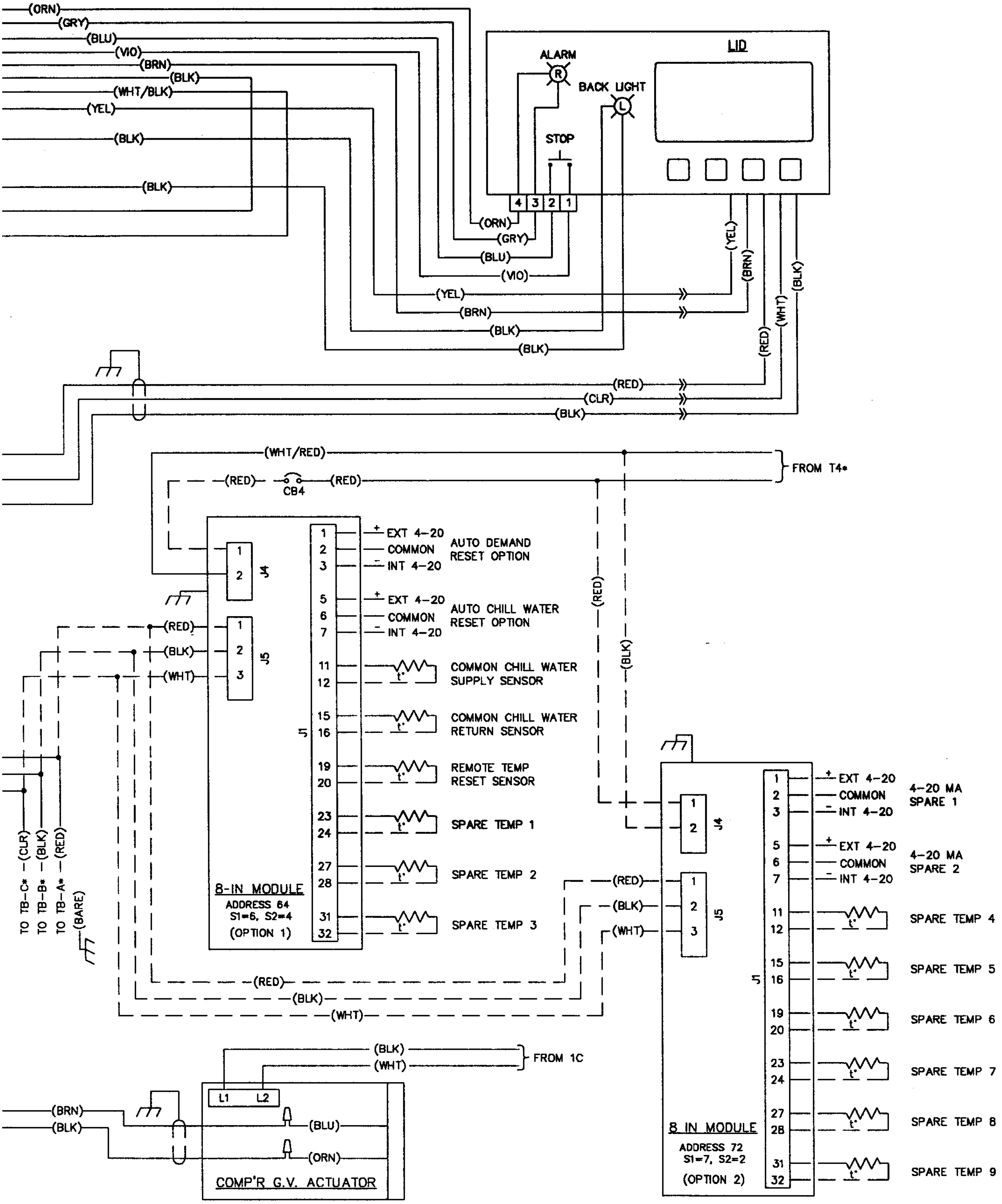
○ Denotes Component Terminal

Denotes Wire Crimp Joint

—›)— Denotes Conductor Male/Female Connector

- - - - Option Wiring

→ **Fig. 57 — Electronic PIC Controls Wiring Schematic — Hermetic Machine**



IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.

→ **Fig. 57 — Electronic PIC Controls Wiring Schematic — Hermetic Machine (cont)**

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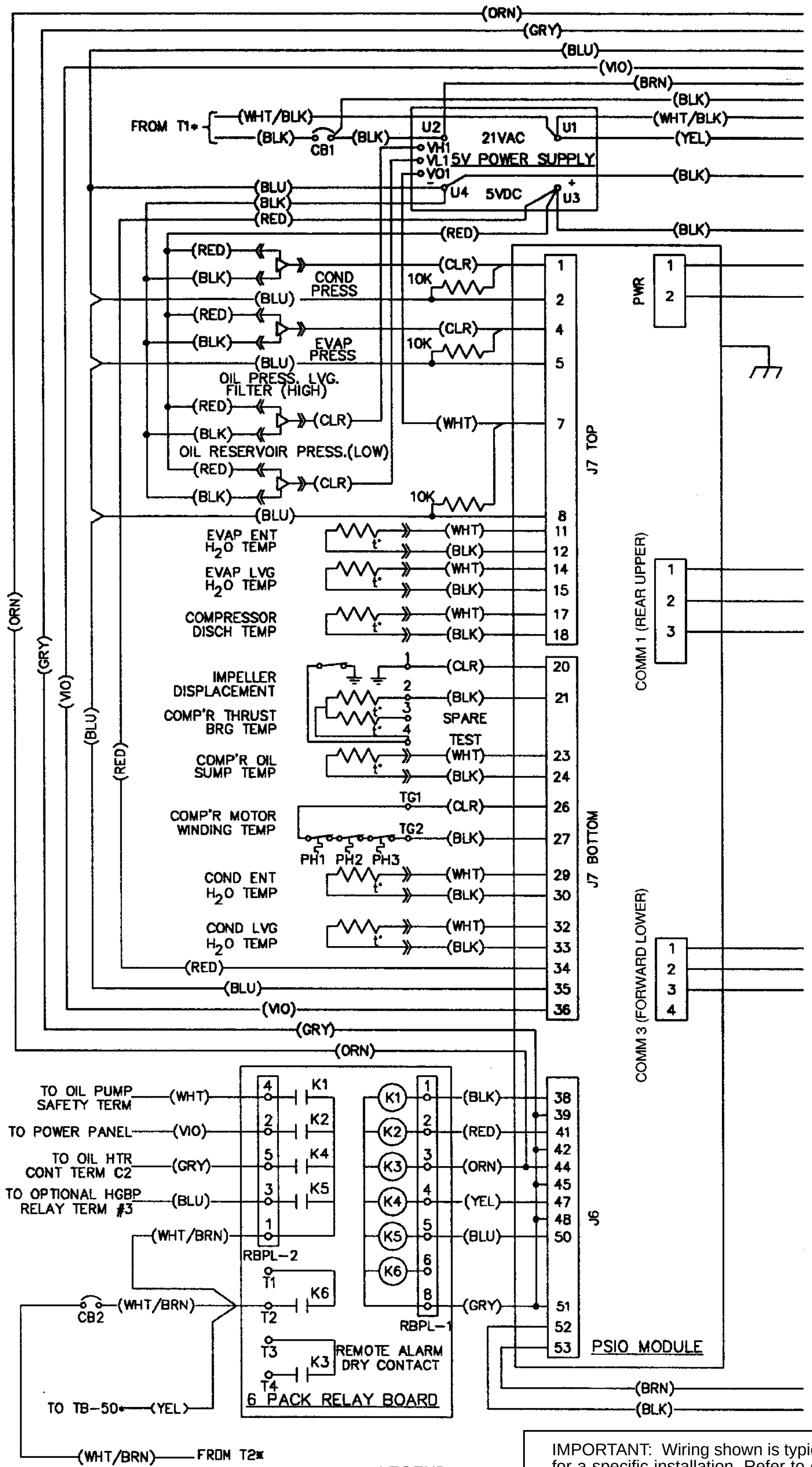


IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.

LEGEND

CB	—	Circuit Breaker
G.V.	—	Guide Vane
HGBP	—	Hot Gas Bypass
J	—	Module Connector
LID	—	Local Interface Device
L1,L2	—	Line Terminals
PSIO	—	Processor/Sensor Input/Output Module
RBPL	—	Relay Board Plug
T	—	Terminal
T1*,T2*,T4*	—	Power Panel Transformers
TB	—	Terminal Board
*		Power Panel Connection

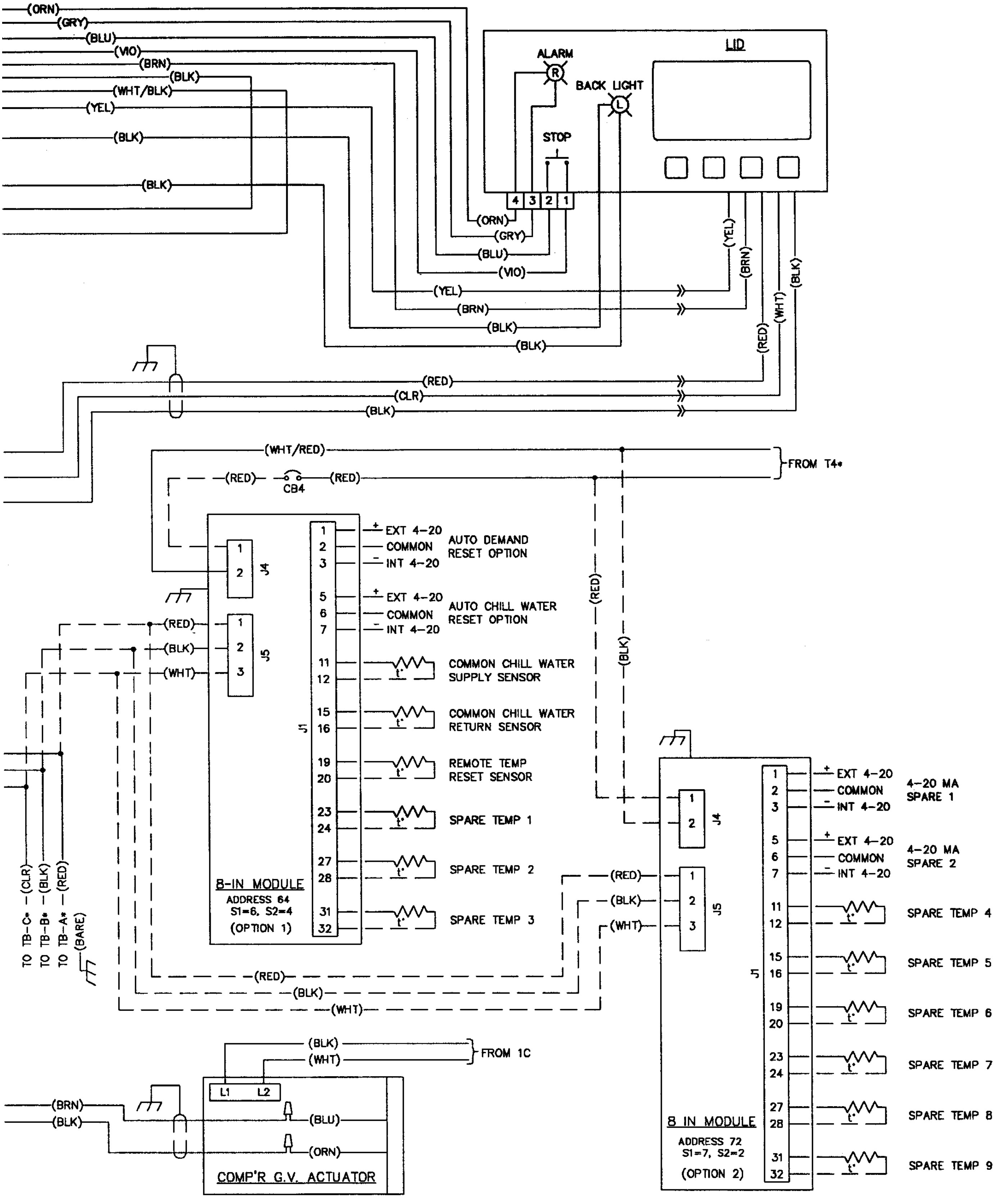
○ Denotes Component Terminal

Denotes Wire Crimp Joint

—→≻— Denotes Conductor Male/Female Connector

– – – – Option Wiring

→ **Fig. 58 — Electronic PIC Controls Wiring Schematic — Open-Drive Machine**



IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.

→ **Fig. 58 — Electronic PIC Controls Wiring Schematic — Open-Drive Machine (cont)**

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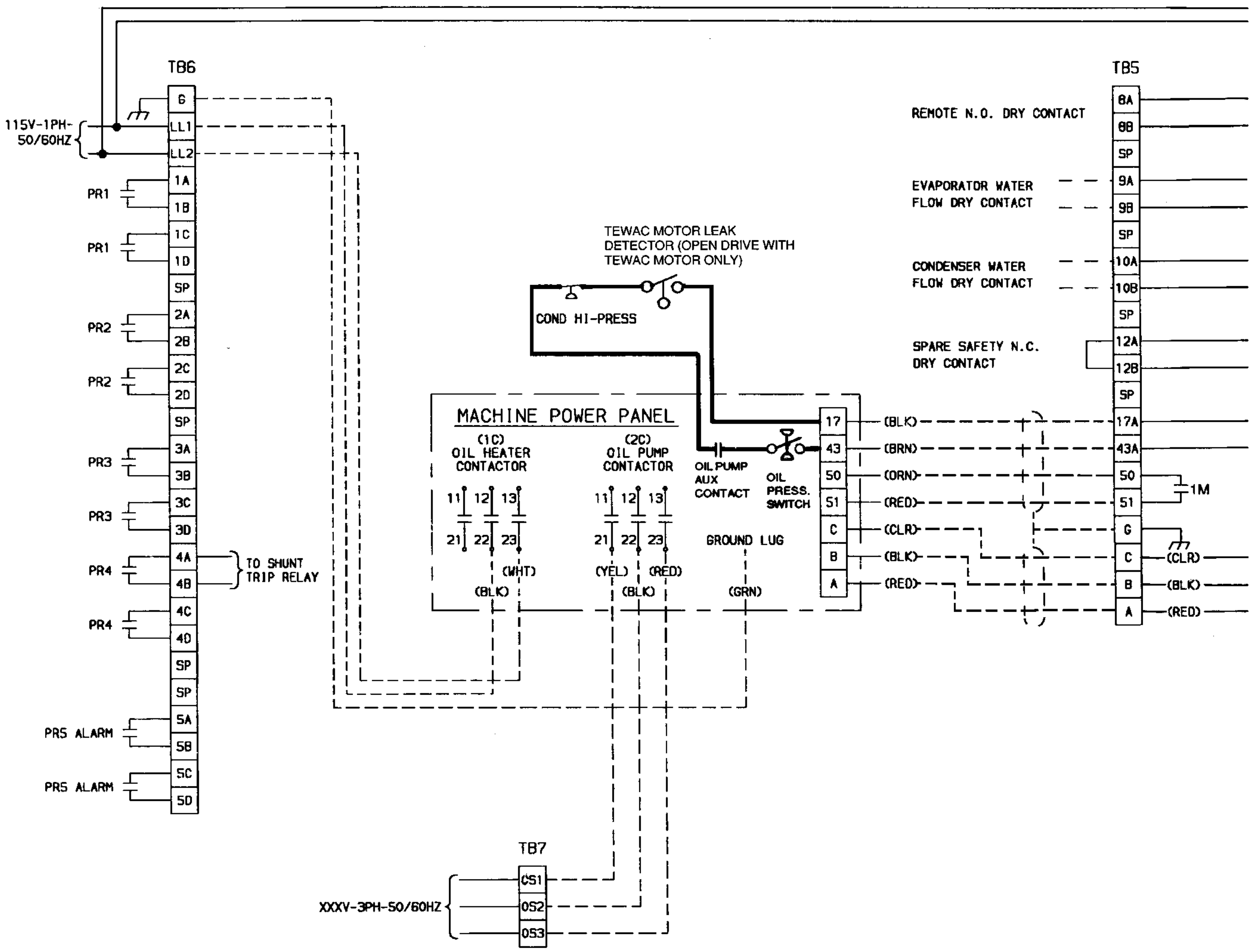
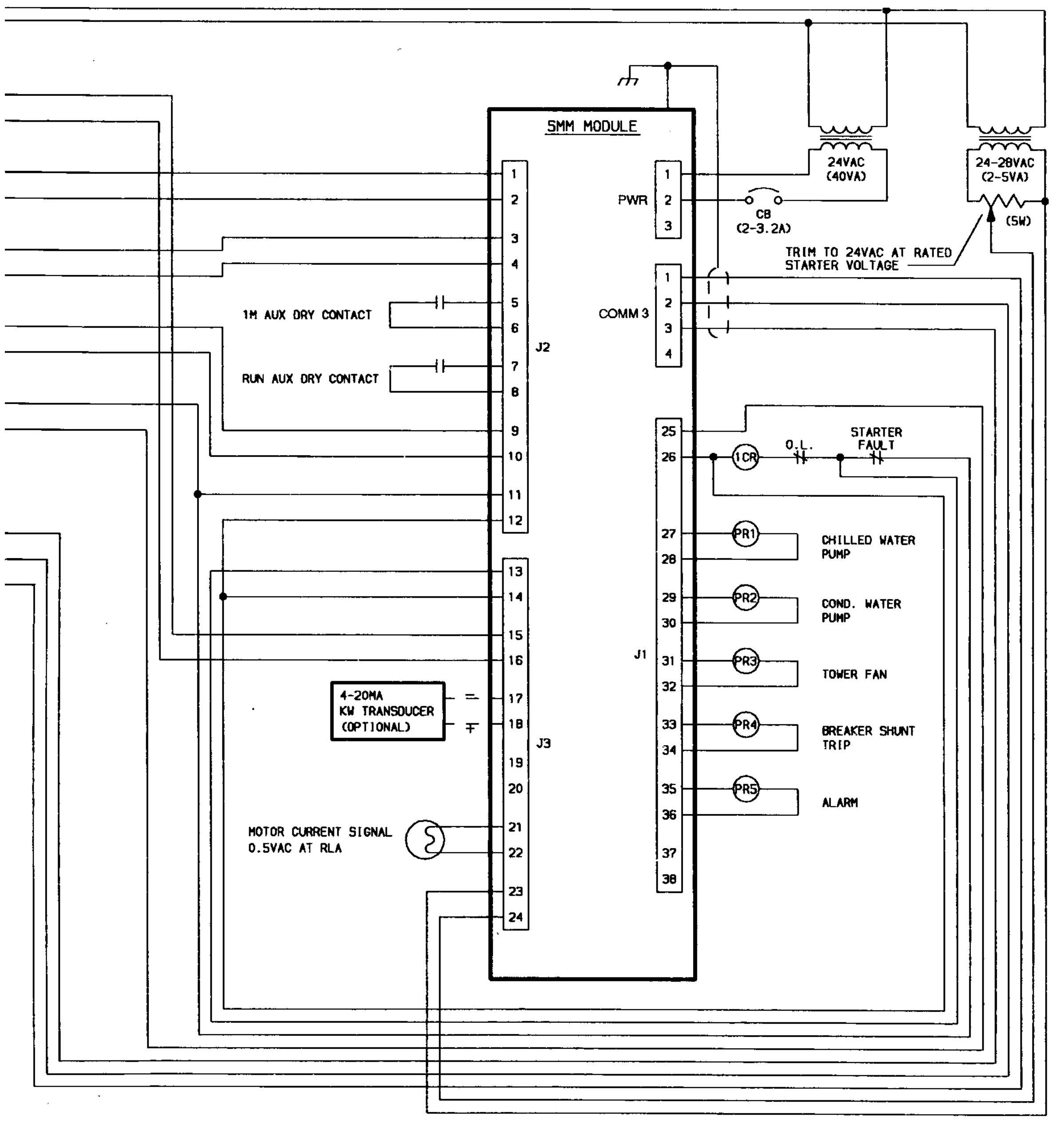


LEGEND

CB	—	Circuit Breaker
COMM	—	Communications
N.C.	—	Normally Closed
N.O.	—	Normally Open
O.L.	—	Overload
PR	—	Pilot Relay
PWR	—	Power
RLA	—	Rated Load Amps
SMM	—	Starter Management Module
TB	—	Terminal Board
TEWAC	—	Totally-Enclosed Water-To-Air Cooled
———		Starter Vendor Supplied Wiring
- - - -		Field Wiring
▬▬		Carrier Factory Wiring

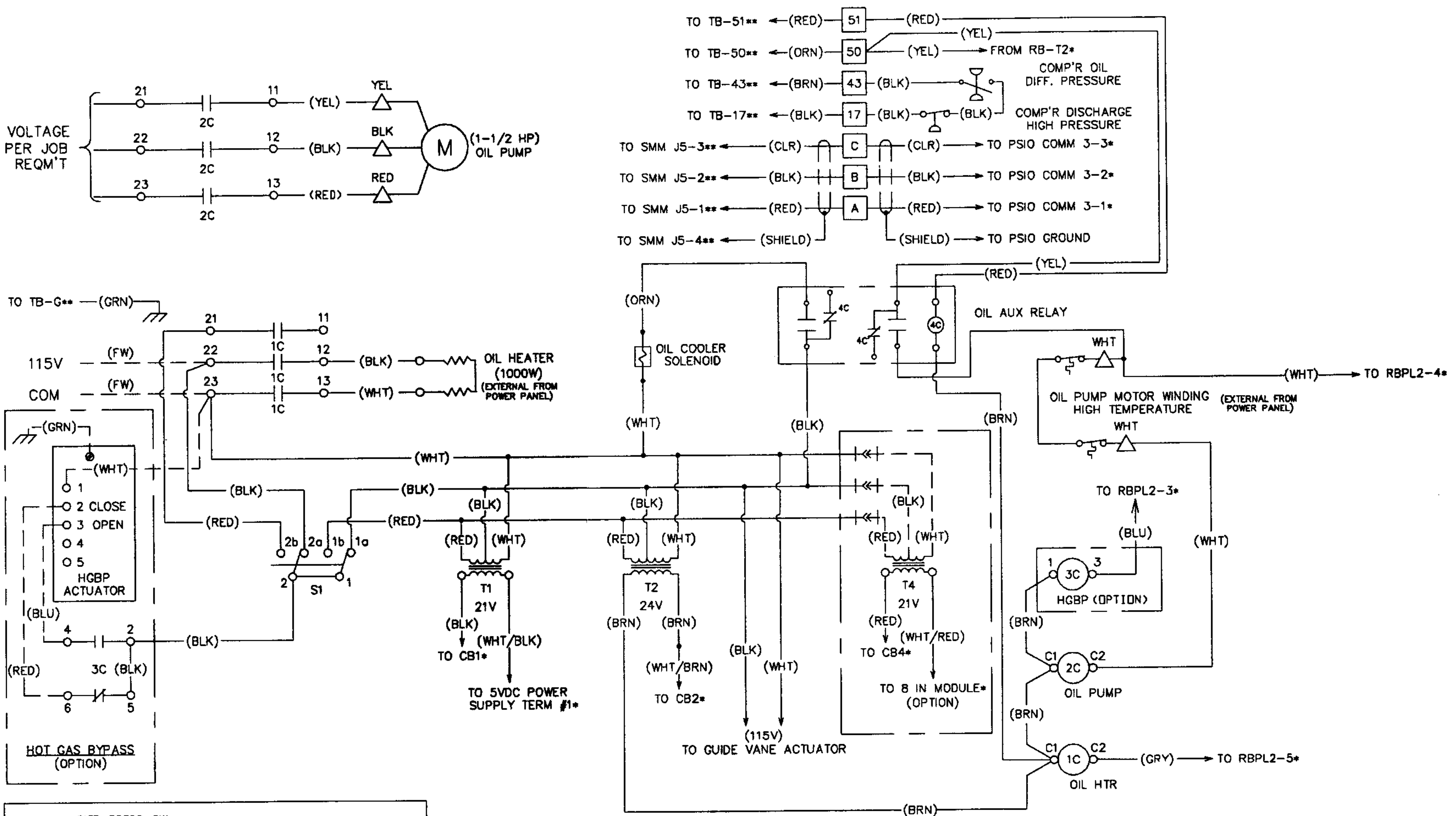
NOTE: Voltage to terminals LL1 and LL2 comes from a control transformer in a starter built to Carrier specifications. Do not connect an outside source of control power to the compressor motor starter (terminals LL1 and LL2). An outside power source will produce dangerous voltage at the line side of the starter, because supplying voltage at the transformer secondary terminals produces input level voltage at the transformer primary terminals.

→ **Fig. 59 — Elementary Wiring Diagram for Starter Management Module (SMM) and Control Interface Between Starter and Machine Power Panel (For Low and Medium Free-Standing Starters)**

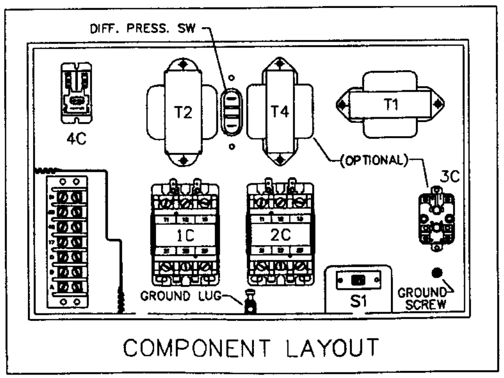


IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.

→ **Fig. 59 — Elementary Wiring Diagram for Starter Management Module (SMM) and Control Interface Between Starter and Machine Power Panel (For Low and Medium Free-Standing Starters) (cont)**



POWER PANEL WIRING SCHEMATIC



COMPONENT LAYOUT

IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.

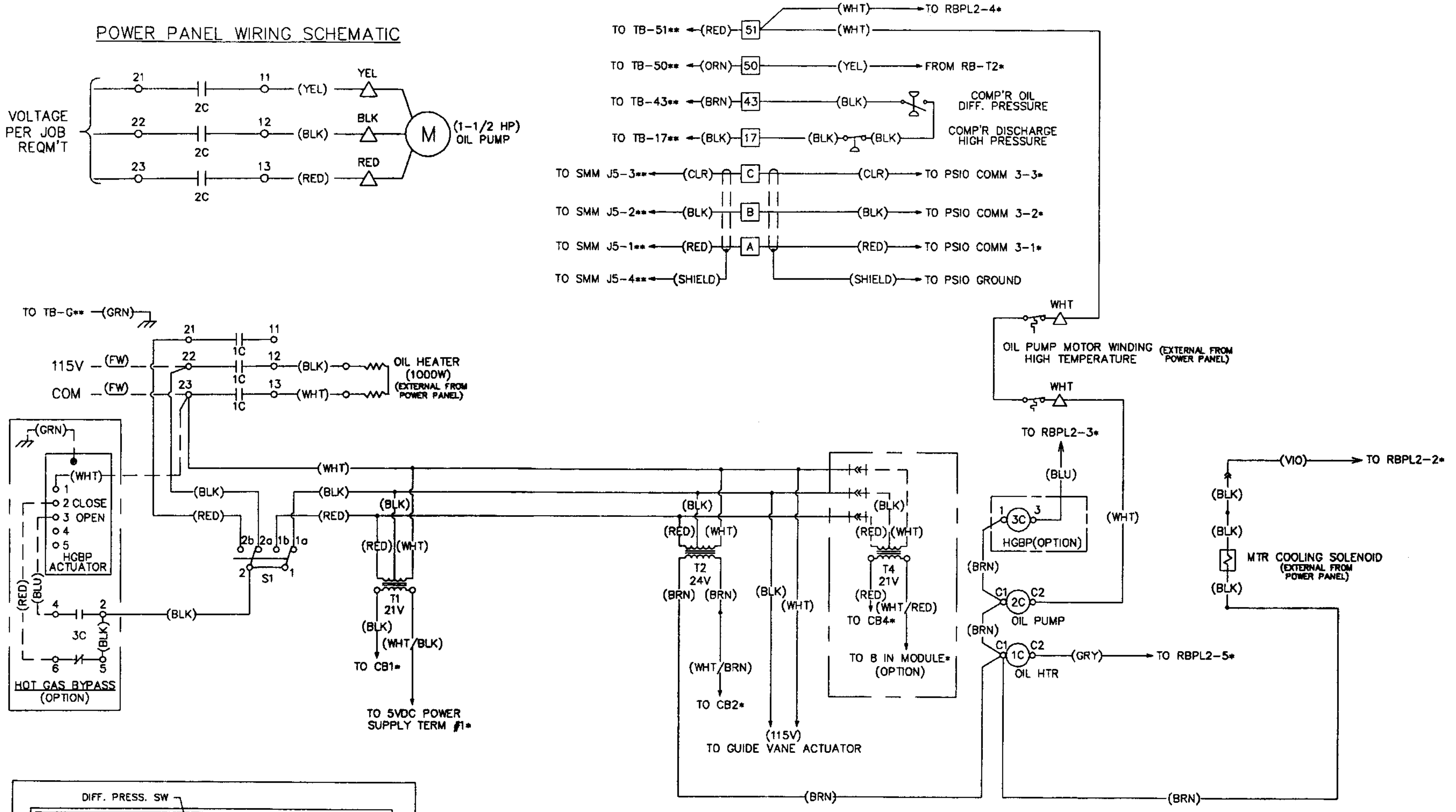
LEGEND

CB — Circuit Breaker
COMM — Communications
HGBP — Hot Gas Bypass
HTR — Heater
PSIO — Processor-Sensor Input/Output Module
RB — Relay Board
RBPL — Relay Board Plug
SMM — Starter Management Module

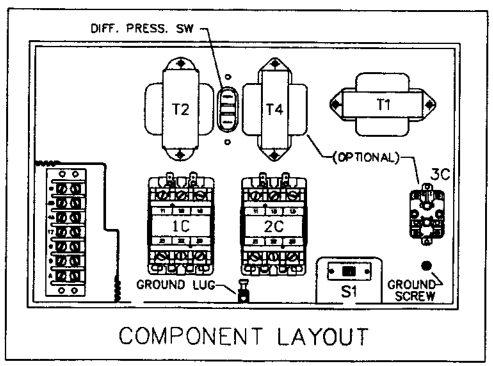
TB — Terminal Board
△ Denotes Oil Pump Terminal
□ Denotes Power Panel Terminal
○ Denotes Component Terminal
● Wire Splice

- - - - Option Wiring
(FW) Field Wiring (By Others)
* Denotes Mach. Control Panel Conn.
** Denotes Motor Starter Panel Conn.
Denotes (3) Conductor Connector

→ **Fig. 60 — Hermetic Drive — Power Panel With Water-Cooled Oil Cooler**



IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.



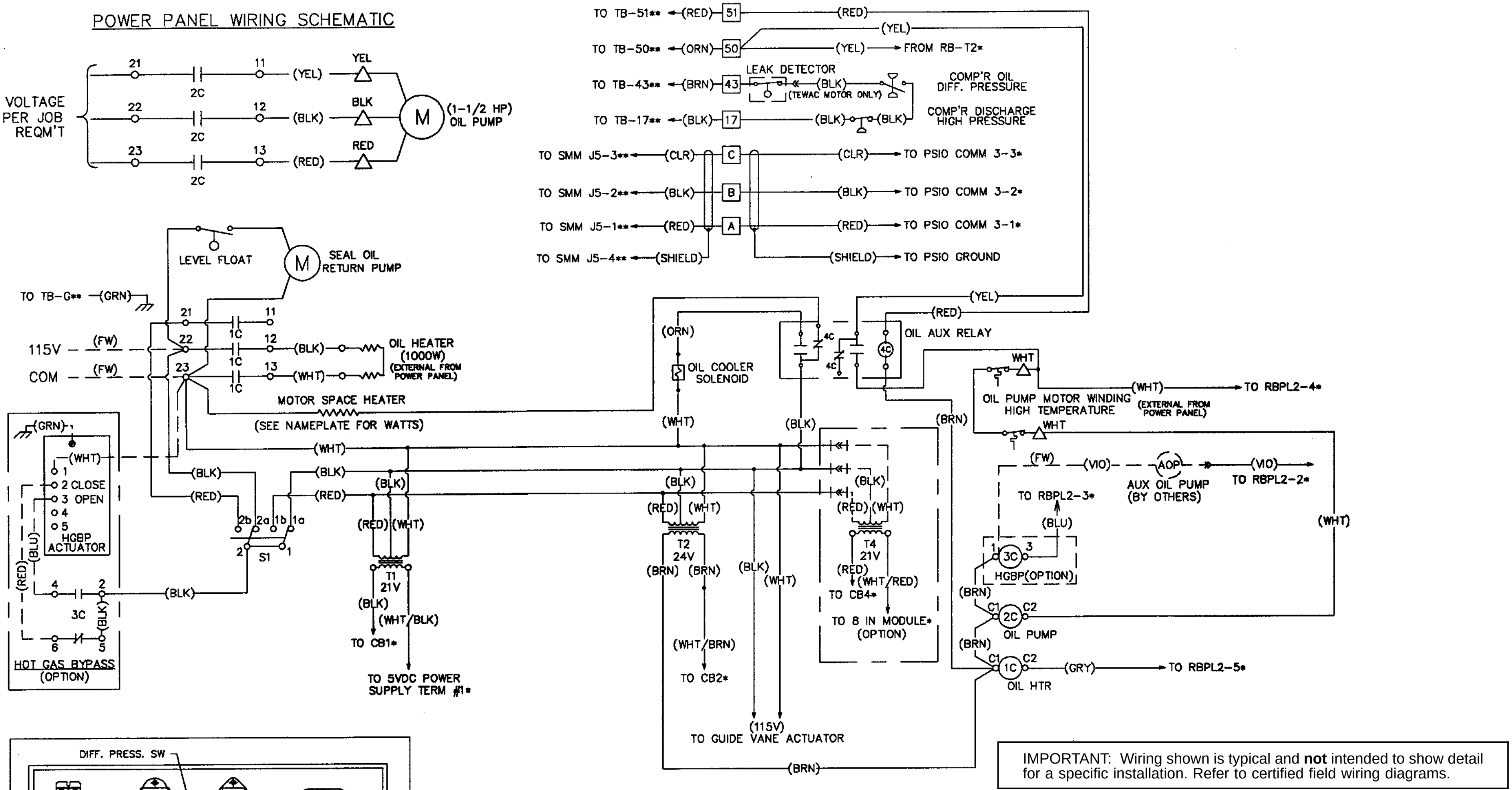
LEGEND

CB	—	Circuit Breaker
COMM	—	Communications
HGBP	—	Hot Gas Bypass
HTR	—	Heater
PSIO	—	Processor-Sensor Input/Output Module
RB	—	Relay Board
RBPL	—	Relay Board Plug
SMM	—	Starter Management Module

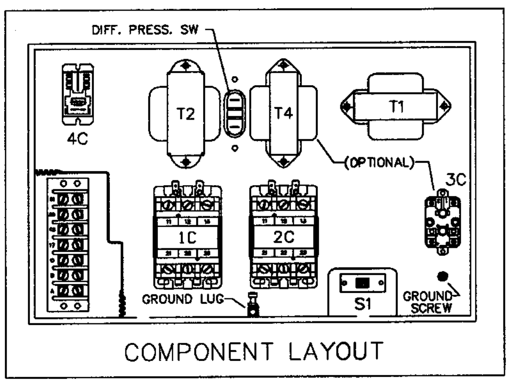
TB — Terminal Board
△ Denotes Oil Pump Terminal
□ Denotes Power Panel Terminal
○ Denotes Component Terminal
● Wire Splice

- - - - Option Wiring
(FW) Field Wiring (By Others)
* Denotes Mach. Control Panel Conn.
** Denotes Motor Starter Panel Conn.
Denotes (3) Conductor Connector

→ **Fig. 61 — Hermetic Drive — Power Panel With Motor Cooling Solenoid**



IMPORTANT: Wiring shown is typical and **not** intended to show detail for a specific installation. Refer to certified field wiring diagrams.



LEGEND

CB	—	Circuit Breaker
COMM	—	Communications
HGBP	—	Hot Gas Bypass
HTR	—	Heater
LID	—	Local Interface Device
PSIO	—	Processor-Sensor Input/Output Module
RB	—	Relay Board
RBPL	—	Relay Board Plug
SMM	—	Starter Management Module
TB	—	Terminal Board
TEWAC	—	Totally-Enclosed Water-To-Air Cooled

- △ Denotes Oil Pump Terminal
- □ Denotes Power Panel Terminal
- ○ Denotes Component Terminal
- ● Wire Splice
- - - - Option Wiring
- (FW) - - - Field Wiring (By Others)
- Denotes Male/Female Q.C.
- * Denotes Mach. Control Panel Conn.
- ** Denotes Motor Starter Panel Conn.
- Denotes (3) Conductor Connector
- Denotes (2) Conductor Connector

→ **Fig. 62 — Open Drive — Power Panel**

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