Liebert® HPC-S™ Free-Cooling Chiller with Scroll Compressors

User Manual

Technical Support Site

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures. Visit https://www.VertivCo.com/en-us/support/ for additional assistance.

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IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important safety instructions that should be followed during the installation and maintenance of the Liebert HPC-S chiller. Read this manual thoroughly before attempting to install or operate this unit.

Only qualified personnel should move, install or service this equipment.

Follow to all warnings, cautions and installation, operating and safety instructions on the unit and in this manual. Follow all operating and user instructions.

This manual has been prepared to enable the end-user to carry out operations that can done with the panels closed. Any operations that require the opening of doors or equipment panels must be carried out only by properly trained and qualified personnel.

Each machine is equipped with an electric isolating device that allows the operator to work in safe conditions. This device must always be used to eliminate risks during maintenance (. The panel key supplied with the unit must be kept by the person responsible for maintenance.

Read the identification labels affixed to the outside and inside of the unit for identification of the unit (model and serial no.). The model and serial number are necessary to receive the most-effective support from the factory.

WARNING! Arc flash and electric shock hazard. Can cause equipment damage, injury and death.
Open all local and remote electric power supply disconnect switches, verify that power is off with a voltmeter and wear appropriate personal protective equipment per NFPA 70E before working within the electric control enclosure. Failure to comply can cause serious injury or death.
Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.
Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.
The Liebert iCOM® microprocessor does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the Unit Off mode of Liebert iCOM control.
The factory-supplied optional disconnect switch is inside the unit. The line side of this switch contains live high-voltage.
The only way to ensure that there is no voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.

WARNING! Risk of refrigerant system rupture and/or explosive discharge of high-pressure refrigerant from overpressurization. Can cause equipment damage, injury or death.
Do no exceed nameplate pressure ratings and relieve system pressure through an access port before working on the refrigeration system.

WARNING! Risk of contact with high-speed moving parts. Can cause injury or death. Disconnect all local and remote electric power supplies and confirm that all fan blades have stopped rotating before working in the unit. Do not operate unit with any or all cabinet panels removed.

WARNING! Risk of electric shock. Can cause injury or death. Disconnect all local and remote electric power supplies before working within the unit's electric power connection enclosures. When connecting the EC fan motor to input power, dangerous voltages occur. Do not open the motor within the first 5 minutes after disconnection of all phases.

WARNING! Risk of electric shock. Can cause injury or death. Disconnect all local and remote electric power supplies before working within.
Dangerous external voltages can be present at main fan Terminal KL2 even after the EC fan motor has been turned Off.

CAUTION: Risk of handling heavy and lengthy parts. Can cause equipment damage and injury. Unit panels can exceed 5ft. (1.5m) in length and weigh more than 35lb. (15.9kg). Follow OSHA lifting recommendations and consider using a two-person lift for safe and comfortable removal and installation of cabinet panels. Only properly trained and qualified personnel wearing appropriate safety headgear, gloves and shoes should attempt to remove or install cabinet panels.

CAUTION: Risk of contact with hot surfaces. Can cause injury.
The compressors, fan motors, pump motors and refrigerant discharge lines are extremely hot during unit operation. Allow sufficient time for them to cool before working within the unit. Use extreme caution and wear protective gloves and arm protection when working on or near hot compressors, fan motors, pump motors and discharge lines.

NOTICE

Risk of freezing and/or corrosion. Can cause equipment and building damage.

Fluids in these systems must contain the proper antifreeze and inhibitors to prevent freezing and premature coil corrosion.

The water or water/glycol solution must be analyzed by a competent water treatment specialist before startup to establish the inhibitor requirement. The water or water/glycol solution must be analyzed every six months to determine the pattern of inhibitor depletion.

The complexity of water-caused problems and their correction makes it important to obtain the advice of a water treatment specialist and follow a regularly scheduled maintenance program.

1 LIEBERT HPC-S COMPONENTS AND NOMENCLATURE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
F	G	0	0	8	0	0	0	5	1	3	1	0	B	0	0	1	0

Digits 7, 8, 11, 13, 15, 16 and 18 - Factory-Determined

Digits 7, 8, 15, 16 and 18 = 0

Digit 13 = 1

Digit 11 = 3

Digits 4-6 - Air-Cooled Chiller with Economizer Nominal Size*

052 = Nominal 175 kW (50 ton)

080 = Nominal 264 kW (75 ton)

110 = Nominal 338 kW (96 ton)

Digit 9 - Monitoring

0 = No monitoring card provided

2 = IS-WEBL (Liebert IntelliSlot® Web Card)

3 = IS-485L (Liebert IntelliSlot Modbus Card

4 = IS-485EXI (Liebert SiteScan® Protocol Card)

5 = IS-WEBL (Liebert IntelliSlot Web Card) + IS-485L (Liebert IntelliSlot 485 Modbus Card)

6 = IS-WEBL (Liebert IntelliSlot Web Card) + IS-485EXI (Liebert SiteScan Protocol Card)

7 = IS-485L (Liebert IntelliSlot 485 Modbus Card) + IS-485EXI (Liebert SiteScan™ Protocol Card)

8 = IS-IPBML (Liebert IntelliSlot Web/Modbus IP/BACnet IP Card)

Digit 10 - Buffer Tank

0 = No buffer tank provided

1 = With buffer tank factory-installed

Digit 12 - Pumps and Piping Options

0 = No pumps or piping options

1 = No pumps provided; with piping options

2 = Single standard head centrifugal pump with piping options

3 = Single high head centrifugal pump with piping options

4 = Dual standard head centrifugal pumps with piping options

5 = Dual high head centrifugal pumps with piping options

6 = Single inverter driven standard head centrifugal pump with piping options

Digit 14 - Electrical Panel Options

0 = No electric panel options

1 = With electric heaters

A = Fast start ramp

B = Fast start ramp and electric heaters

Digit 17 - Condenser Coil Filter Guard

0 = No condenser coil guard / filter

1 = With condenser coil guard / filter

*Capacity Rating Point at 95°F ambient, 10% EG, 50°F Leaving Fluid Temperature and 62°F Entering Fluid Temperature

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2 INTRODUCTION

The manual is intended to enable both the installer and the operator to install, operate and maintain the Liebert HPC-S without damaging it or harming personnel.

2.1 Smart Design®

The Liebert HPC-S is a SmartDesign™ technology, appropriate for use with the SmartDesign approach.

2.2 Responsibility

Vertiv accepts no present or future responsibility for damage to persons, things or to the machine itself due to operators' negligence, failing to comply with the installation, operation and maintenance instructions of this handbook, failed application of the safety norms in force for the system and the qualified staff charged with the operation and maintenance.

2.3 Product Description

The Liebert HPC-S is an air-cooled liquid chiller utilizing scroll compressors, electrically commutated (EC) condenser fans, thermal expansion device, integral economizing coil, brazed plate heat exchanger and Liebert iCOM® microprocessor controls. The entire unit is run tested at the factory prior to shipment to the customer site. The unit is only used with constant flow through the chiller. All units are 460/3/60 only.

2.3.1 Frame and Unit Cabinet

The unit frame and unit cabinet are constructed of 2mm steel with a highly robust polyester-powder, RAL7032 paint. The base is constructed of 3 mm galvanized steel channels with use of strategic rivets to increase resistance to mechanical deformation. All sections containing the refrigerant and hydronic circuits, low-voltage and high-voltage sections use removable panels with captive, quarter turn, keyed fasteners to provide access and weather protection. Unit panels for sections used for access to condenser fans are secured with captive screws. All non-structural panels are removable for maintenance. The cabinet contains all factory wiring, refrigeration components, hydronic piping, high-voltage electrical components, low-voltage electrical components, economizing coil and any special features required.

2.3.2 Electrically Commutated (EC) Condenser Fans

Condenser fans are direct driven with electronically commutated (EC) motors and fan blades to deliver industry-leading efficiency and noise levels.

Fans are statically and dynamically balanced prior to use in the unit. Integral fan guards protect fans from contacting foreign objects and provide for safety of operating personnel. Condenser air is discharged vertically upward and intake is on single side only. Fan speed is varied to maximize refrigeration and economizer system control at low ambient conditions. Fans are removed from unit for shipment after run testing in factory and shipped in an export packaging container with the unit. The installation of the fans is the responsibility of the installing contractor.

2.3.3 Compressors

Each unit contains four compressors arranged in two independent circuits to provide overall unloading capability of the entire unit down to 25% (single compressor operating). Compressors are Copeland scroll compressors with self-lubricated Teflon bearings and use R-410A refrigerant. Compressors are solid mounted as close as possible on rigid rails to minimize stress of interconnected tubing and reduce gas-oil equalization line length. These compressors rails are mounted on rubber mounts to prevent vibration transmission to the structure. The compressors include crankcase heater, oil indicating sight glass and oil charge/discharge connections.

2.3.4 Evaporator

The evaporator is a direct expansion, weld-brazed plate type evaporators fabricated from seamless carbon stainless steel AISI 316 with welds of pure copper. The design includes intertwined circuits so the primary fluid is always cooled by at least one circuit. Evaporators are externally insulated with closed-cell elastomer and connected with lines equipped for drainage and vent connections. The corrugation of the plates is optimized specifically for R-410A refrigerant.

2.3.5 Combination Condenser and Economizer Coil

Condenser coils are constructed of copper tubes and aluminum fins mounted in vertical configuration. The combination condenser coil pack has headers at opposite end of the coil for the two different heat exchange media (refrigerant and water/glycol solution). Condenser coil tubes are leak tested to 650 psi (45 bar). The condenser coil shall be equipped with additional subcooling circuit that increases the efficiency of the refrigeration system. Fluid economizer coil headers shall have vent and drainage valves.

2.3.6 Refrigeration Circuit Components

Each refrigeration circuit includes a high pressure safety switch, low pressure safety switch, TXV, filter dryer with disposable cartridge, moisture indicating sight glass, high pressure safety valves, manual shut-off valves, high pressure gauges and low pressure gauges.

2.3.7 Fluid Circuit

Fluid circuit piping is constructed of carbon steel pipes connected with grooved, rigid couplings with gaskets. Piping and fluid-containing components are insulated with closed-cell, synthetic elastomer. A factory-installed flow switch is provided to confirm fluid flow to the evaporator. The fluid circuit requires a minimum of 10% glycol solution and must not exceed a 50% glycol solution. Units with factory-provided pumps must not exceed a 30% glycol solution.

2.3.8 High-Voltage Electrical

The electrical panel is designed, constructed and tested in compliance with CSA standards. The panel contains the main unit switch, electrical contactors and overcurrent protection devices. The electrical panel is kept cool through ventilation and has an option for heaters for low ambient installations. Electrical panel uses cleanable filters for ventilation air openings.

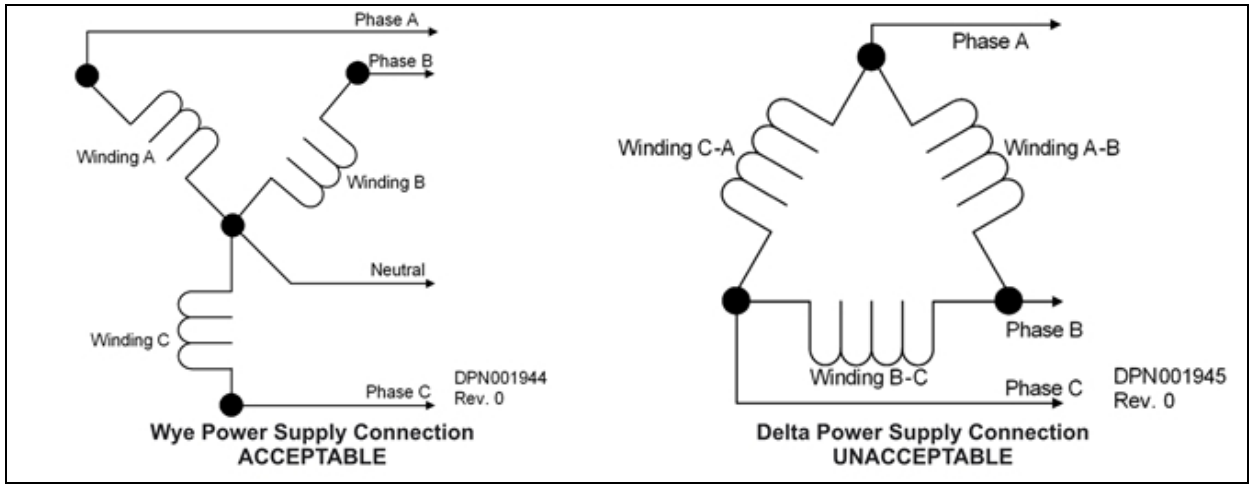
This unit has a high Short Circuit Current Rating (SCCR) of 65kA at the unit's rated voltage. The SCCR value is the maximum amperage that the unit can withstand (for a very short duration) when a short circuit occurs. The SCCR should not be confused with a kAIC value that includes a device that can interrupt when a short occurs. All Liebert HPC-S's for the U.S. and Canadian markets are designed for 460V, 3-phase, 60Hz single point power only.

Input Power Connections—Wye Connection with Earthed Neutral Required

The Liebert HPC-S is designed to operate properly with Wye-connected power with earthed neutral. The neutral wire does not need to be connected to the HPC-S unit.

Three-phase distribution Delta-connected and Wye-connected power systems without a ground or with a floating ground are unacceptable power. A Wye-connected power system with a high resistance ground (HRG) is unacceptable.

Figure 2.1 Wye vs. Delta power supply connection diagram



Acceptable Power Supply

- 460V Wye with solidly grounded neutral (277V line to ground)

Unacceptable Power Supply

- 460V Wye without ground connection or with high-resistance (or impedance) ground
- 460V without ground or with high-resistance (or impedance) ground

2.3.9 Liebert iCOM®

The Liebert HPC-S uses the Liebert iCOM microprocessor-based unit controller to control all functions of the chiller including, but not limited to: compressor staging, condenser fan staging and speed control, economizer system control including three-way valve position and compressor run time management to ensure equal run time of compressors. The Liebert iCOM controller has a display interface measuring at least 320 x 240 pixels and push buttons for data entry.

2.3.10 Monitoring Cards

The Liebert HPC-S can come equipped with Liebert IntelliSlot® Cards directly from the factory. Up to two cards can be installed in each chiller. The card options are:

- Liebert IntelliSlot Web Card (IS-WEBL) shall be provided to deliver 10/100 baseT Ethernet and RS-485 Modbus network connectivity. The supported management interfaces shall include: SNMP for Network Management Systems (example, HP OpenView™), Web pages and RS-485 Modbus for Building Management Systems
- Liebert IntelliSlot Web Card (IS-IPBML) shall be provided to deliver communications via the following protocols: HTTP, HTTPS, Telnet, Modbus IP, BACnet IP and Vertiv® Protocol.

- Liebert IntelliSlot 485 Card (IS485-L) shall be provided to deliver RS-485 Modbus network connectivity to Building Management Systems for unit monitoring and management.
- Liebert IntelliSlot SiteScan Web Protocol (IS-485EXI) shall be provided to deliver ground fault isolated EIA-485 Vertiv Protocol connection to a Liebert SiteLink-E® allowing Liebert SiteScan® Web 4.0 monitoring and communications.

2.3.11 Buffer Tank

The Liebert HPC-S can come with buffer tank pre-installed from the factory. This buffer tank can also be ordered as a shipped loose item. The tank is 264 gallons (1,000 liters) whether pre-installed at the factory or shipped loose. The purpose of the tank is to provide increased thermal inertia and system volume in applications with short piping runs. This will reduce the frequency of compressor starts and diminishes the operation issues associated with sudden load variations. It is not meant to provide ride-through in the event of a unit failure. The buffer tank is built of carbon steel and coated with an anti-condensate insulation with woven PVC outer layer for outdoor installation. The tank comes with a manometer and temperature sensor well, air purge valve, discharge valve and sinking connection for electric heaters. The buffer tank is installed on the return side of the piping system internal to the chiller. Refer to Figure 4.6 on page 26,Figure 4.7 on page 26 andFigure 4.8 on page 27 the piping system diagram for further information. This tank is not ASME certified.

2.3.12 Pumps and Piping Options

The Liebert HPC-S can come with a variety of different pump options factory-installed. These pumps are controlled by the Liebert iCOM®. These pumps may be utilized to provide flow through the entire chilled water system as long as the system head is not in excess of what the pump can provide. In multi-chiller systems, these unit-based pumps will typically just provide the pumping power through their respective chiller and pumping for the rest of the system is provided by a variable speed system pump separate from the chiller. It is important to note that the Liebert HPC chillers require constant flow through the evaporator to operate properly. Pumping options for the Liebert HPC-S are:

- No pumps or piping options provided
- No pumps provided, with piping options
- Single standard head centrifugal pump with piping options
- Single high head centrifugal pump with piping options
- Dual standard head centrifugal pump with piping options
- Dual high head centrifugal pump with piping options
- Single inverter driven, standard head centrifugal pump with piping options

2.3.13 Electrical Panel Options

The Liebert HPC-S electrical panel can be provided with a fast start ramp and/or electric heater from the factory.

- Fast Start Ramp—Speeds up restarting the unit and reduces the time required to return to full power. To do this, the Liebert iCOM overrides internal compressor start and restart time restrictions. This requires UPS power to the Liebert iCOM main board (UPS power feed by others).
- Electric Panel Heater—This is option is used in applications in areas with extended periods with low ambient temperatures. It is recommended whenever the minimum ASHRAE design temperature is below 23°F (-5°C).

2.3.14 Condenser Coil Filter Guard

The condenser coil filter guard is composed of expanded metal cloth sandwiched between two layers of rigid metal netting in a sheet metal frame. These filter guards are removable without tools. The condenser coil filter guards protect against hail and other debris and help filter out airborne objects such as milkweed, cottonwood and leaves.

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3 PRELIMINARY OPERATIONS

3.1 Packing Removal

Remove the polythene package, taking care not to damage the unit. Dispose of the packaging properly or recycle it, if applicable.

3.2 Inspection

All the units are assembled and wired at the factory. Before shipment, they are charged with the correct quantities of refrigerant and oil, and then tested under the operating conditions required by the customer. The machine's hydraulic circuit is equipped with drain plugs and open vent valves.

The free-cooling coils are supplied dry to avoid the possibility of water freezing while the unit is being transport and while it is stored. Inspect the machine carefully on delivery to check for damage during transportation or missing components. Claims must be made immediately to the carrier and the factory or its representative.

3.3 Operating Range

Review all the parameters in this section for the operating limits for each model; contact your local Vertiv representative if your installation requires operation outside these limits.

3.3.1 Outer Air Temperature

The units are designed to operate at:

- Minimum temperatures:

  -13°F (-25°C) for free-cooling;

- Maximum temperatures:

  Depending on the model as indicated in the Table 10.3 on page 44.

  All working limits refer to steady-state operation mode.

NOTE: Avoid installation in areas where strong winds may be expected. Excessive wind may impair the operation and affect the indicated limits.

The units are designed to be stored at:

- Temperatures: 14-113°F (-10 and 45°C)
- Humidity: 80% R.H., non-condensing.

3.3.2 Fluid Circuit

- Chiller is designed for constant flow only
- Maximum water flow allowed:
  - FG0052: 177 gallons per minute (11.2 liters per second)
  - FG0080: 265 gallons per minute (16.7 liters per second)
  - FB0110: 313 gallons per minute (19.7 liters per second)
- Minimum allowed water flow:

- FG0052: 90 gallons per minute (5.7 liters per second)
- FG0080: 134 gallons per minute (8.5 liters per second)
- FB0110: 184 gallons per minute (11.6 liters per second)

- Maximum leaving fluid temperature: 68°F (20 °C) and maximum entering fluid temperature of temperature of 78.8°F (26 °C)
  - Higher temperatures are allowed only at the system startup for limited periods of time and not during normal operation
  - Temperature range limits must be met at all times
- Maximum glycol concentration:
  - 50% for units without factory installed pumps
  - 30% with the optional pump assembly installed
- Minimum allowed glycol concentration: determined by design authority to provide either burst or freeze level protection at the site location (see Table 4.1 on page 21).
- Maximum pressure of the hydraulic circuit:
  - 87 psi—limit is independent of presence / absence of pumps installed from factory in unit
  - It is the responsibility of the design authority to confirm that the combined total of maximum pump static head (indicated on pump nameplate) and pressurized the water circuit are not more than the pressure limit of the unit

3.3.3 Power Supply

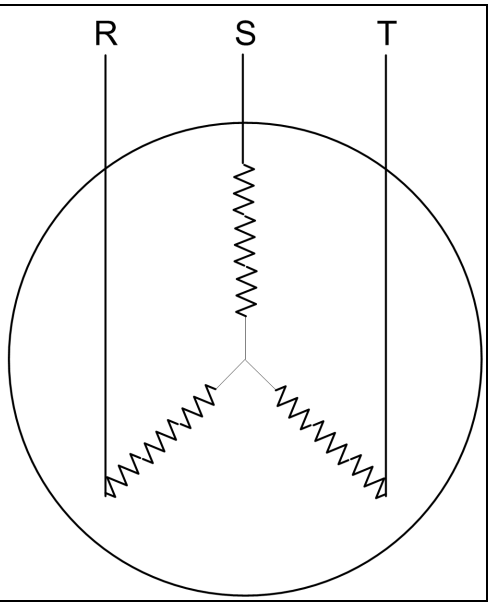
Make all wiring and electrical connections in accordance with local and national codes. Refer to electrical schematic when making connections.

- Voltage: in standard operating conditions, from 0.9 to 1.1 times the rated voltage.
- Frequency: from 0.99 to 1.01 times the rated frequency continuously.
- Voltage unbalance: must be lower than 2%.

Figure 3.1 on the facing page shows a calculation example of the voltage imbalance.

Figure 3.1 Calculating phase-to-phase variability—example

1. The 460V supply has the following variability:
   RS = 458V
   ST = 469V
   RT = 465V
2. The average voltage is:
   $\frac{458 + 465 + 469}{3} = 464$
3. The maximum deviation from the average is:
4. The phase-to-phase variability is:
   464 - 458 = 6V
   $\frac{6}{462} \times 100 = 1.29$



3.4 Sound Pressure Levels

The Table 10.6 on page 45 shows the noise data for the units in standard configuration (without pumps), operating continuously and measured according to the ISO 3744 norm, in free-field conditions.

The highest noise levels are detected on the condenser coil side.

NOTE: Avoid positioning in areas with possible reverberation of the sound waves, which can adversely effect the noise levels.

3.5 Transport

- Handle the unit by lifting it with a crane
- Lifting holes are positioned in the frame's base Lifting holes are positioned in the frame's base for use with lifting pipes provided by others. Use spreader bars when lifting to protect the sides (see Figure 10.6 on page 53).

NOTE: Place the lifting pipes in the holes in the base indicated by "LIFT HERE". The capacity of the lifting gear must be adequate to lift the load in question. Check the weight of the units, the capacity of the lifting gear and ropes and the condition and suitability of the aforementioned equipment.

3.6 Foundation

- The chiller must be placed on a level surface that will support the unit's weight while it is in operation. A sufficiently thick concrete pad is the recommended surface.
- Chiller must be installed level to within 1/8" per foot (3.2mm per 305mm).
- If necessary, position the unit on suitable anti-vibration supports (supplied by others).
- Position the anti-vibration supports on a level surface, lower the chiller onto them and attach the antivibration supports to the chiller. Then adjust the unit's position on the supports.

NOTE: For weight distribution see Figure 10.8 on page 55.

- The weights and their distribution refer to standard units with/without tank but without options. Add the weights of any installed accessories to those of the standard units (see Table 10.7 on page 45).

3.7 Service Area

- Minimum area must be left free of obstructions around the unit to allow free air flow and maintenance, (see Figure 10.1 on page 48).
- The hot air expelled by the fans must be allowed to rise unimpeded by obstacles for a minimum height of 8.2 ft. (2.5m).
- Limit recirculation of condenser fan exhaust air to prevent reduced performance.

4 INSTALLATION

4.1 Fan Assembly

This section details how to assemble and install the condenser fans of Liebert HPC-S chiller units. The assembly must be completed before the unit is connected to the water and electric lines.

The Liebert HPC-S is factory-tested as a unit; the condenser fan assemblies are removed from the unit and shipped separately. Each individual condenser fan assembly consists of the condenser fan and motor, grille and collar section.

WARNING! Risk of electric shock. Can cause serious injury or death.
Verify that electric power is not connected to this unit before connecting electric power wires to the fan motors.
Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.
Follow all national, state and local codes.

WARNING! Risk of working with heavy objects in hazardous location. Can cause property damage, injury and death.
Each fan assembly weighs 112.5 lb. (51 kg). Two or more properly trained and qualified personnel are required for assembling and lifting the fans and attaching them to the Liebert HPC-S. Some of the work must be performed on top of the chiller. Vertiv recommends that the work area be assessed for hazards, such as high winds, tripping hazards, overhead interference and electric wires. Verify that equipment used for climbing to the top of the unit and/or lifting the fans is rated for the combined weight of the fan assemblies and the assemblers and is properly secured as appropriate. Use OSHA-recommended lifting techniques.

4.1.1 Components

- Condenser fan assembly, consisting of condenser fan and motor, grille and collar (the number depends on the Liebert HPC-S model)
- Mounting Hardware, number of items per fan
  - Bolts, 8
  - Lock washers, 8
  - Flat washers, 8
  - Cable ties, 5
- Spare mounting Hardware, packaged separately
  - Bolts, M6x20 hex head
  - Lock washers
  - Flat washers
  - Cable ties

The fans are shipped with the other sections of the Liebert HPC-S. Each fan is are identified by the identification code used in the electric schematic, typically, *M* followed by a number (e.g., *M8*, *M9* and *M10*) and shipped in a cardboard box.

Each box is identified in the same way.

WARNING! Risk of handling heavy objects. Can cause property damage, injury and death.
Each fan assembly weighs 112.5 lb. (51 kg). Two or more properly trained and qualified personnel are required for assembling the fans and attaching them to the Liebert HPC-S.
Verify that equipment used for climbing to the top of the unit and/or lifting the fans is rated for the combined weight of the fan assemblies and the assemblers and is properly secured as appropriate. Use OSHA-recommended lifting techniques.

The fans' cabling lays on the top of the unit. Each set of terminations is dedicated to a single fan. The cables are protected by a plastic bag and identified by the same code of its fan.

Each box contains a fan, collar and grille. Two of the three original cables of each fan motor are part of the cabling terminations. The respective holes in the electric box of the fan are covered by adhesive tape.

4.1.2 Required Tools

- 10mm wrench or adjustable wrench; SAE tools could damage the bolts
- T20 Torx screwdriver
- 24mm wrench or adjustable wrench
- small screwdriver

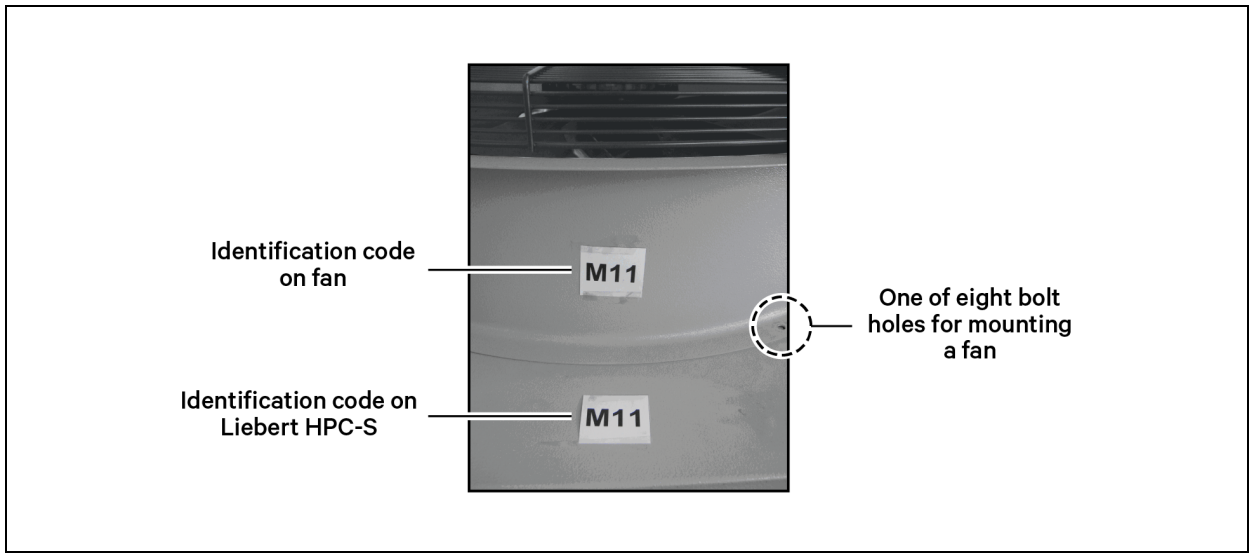
4.2 Mount and Connect the Fans

Each fan may be assembled as follows:

1. Unpack the fan.
2. Place the fan on the roof of the Liebert HPC-S on the hole marked with the same code as the fan.

   Take precautions not to damage the cables on the Liebert HPC-S roof.
3. Orient the identification tags on the roof and on the fan collar as shown below.

Figure 4.1 Fan orientation on Liebert HPC-S

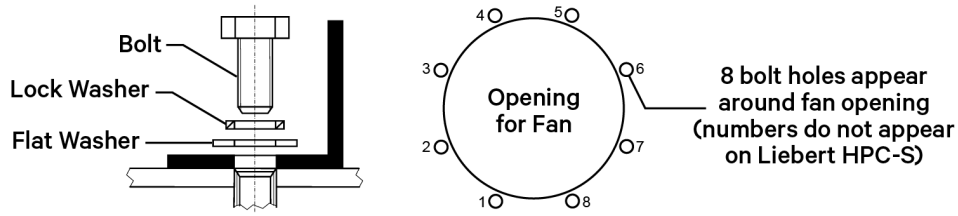


4. Assemble the bolts and washers as shown below.

5. Insert the eight M6 bolts into the holes and partly tighten them, leaving them slightly loose.

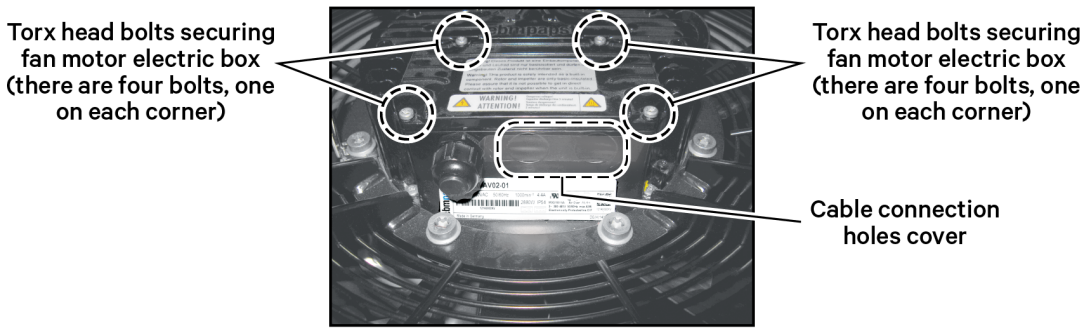
   Refer to Figure 4.2 below; begin with the bolts in hole #1 and hole #5; then insert the bolts in hole #3 and hole #7; then insert the bolts in hole #4 and hole #8; and finally insert the bolts in hole #6 and hole #2.

Figure 4.2 Fan bolts and washer arrangement and tightening sequence



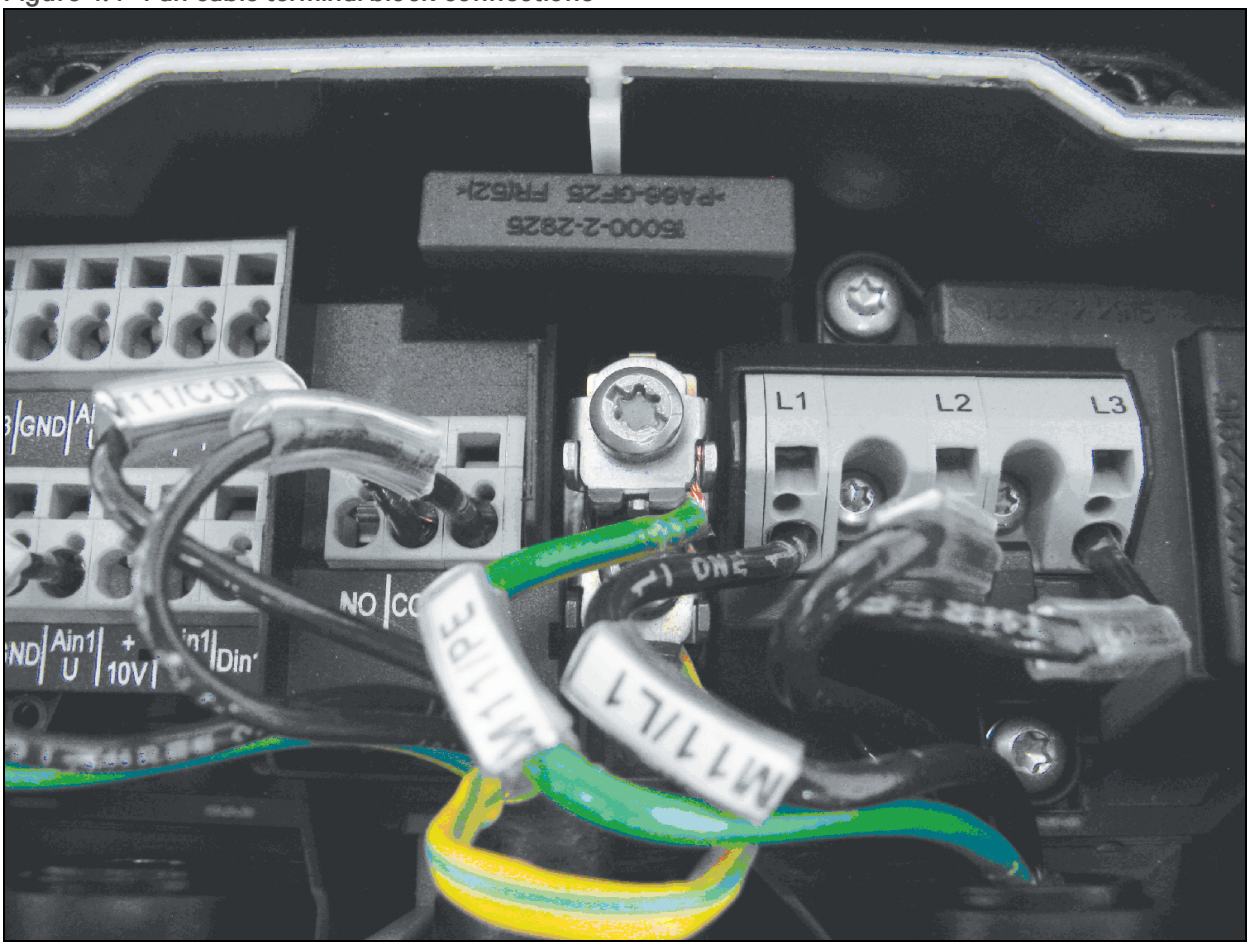
6. Tighten all eight bolts to a torque of 53 inch-lb (6Nm); the washers and bolt heads must be touching and secure against the fan collar.
7. Remove the cover over the cable connection holes on the fan motor electric box, if present (see Figure 4.3 below).

Figure 4.3 Fan motor cable connection location, bolts



8. Find the cables with the same tag as the fan and take them out of their plastic bag.
9. Open the fan motor's electric box with the Torx tool by removing the four bolts. Set the cover and bolts aside for reinstallation.
10. Insert the cables through the holes and connect them to the terminal blocks as shown in the electric schematic and as shown below.

Figure 4.4 Fan cable terminal block connections



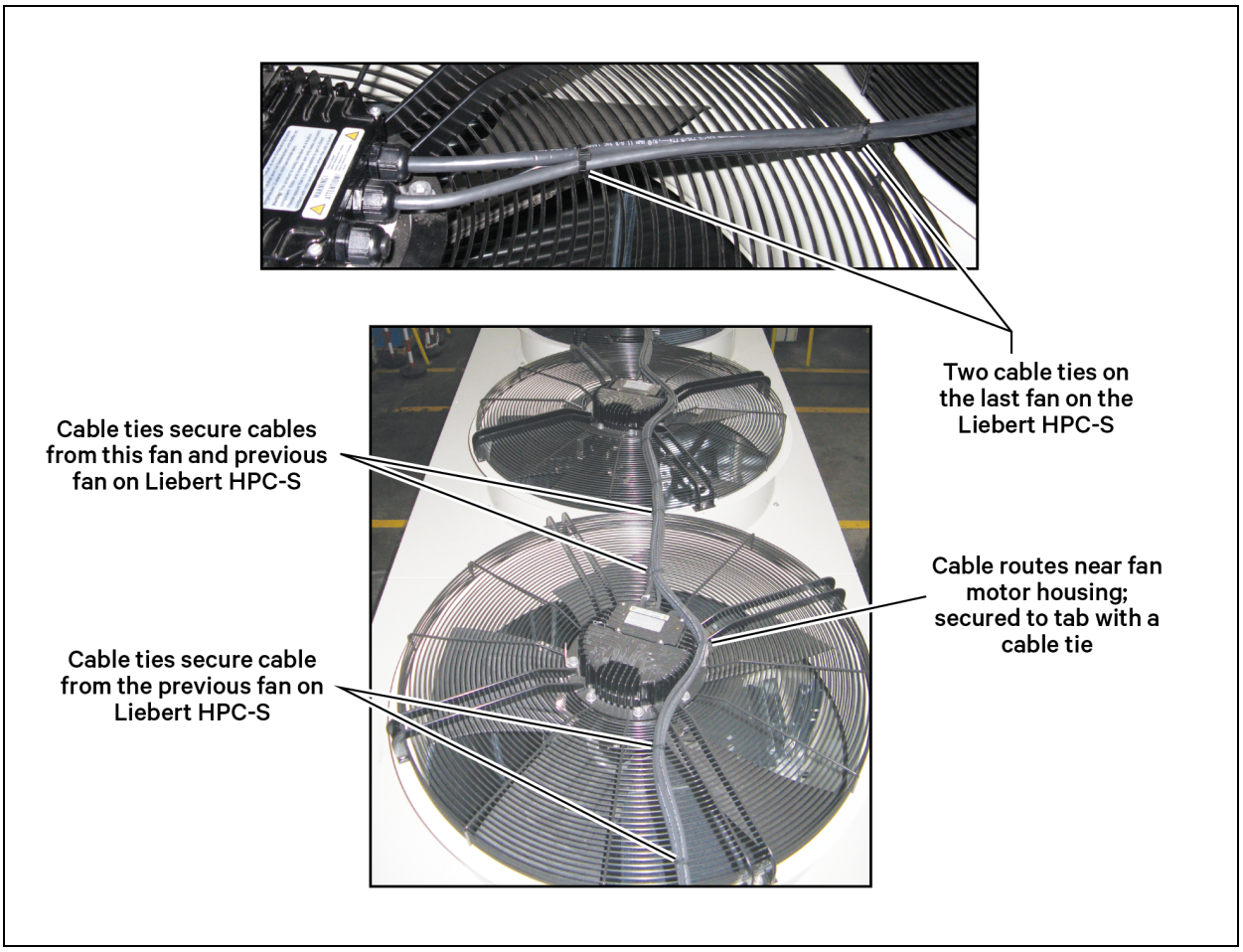
11. Hold one of the cables to keep it from twisting and screw the plastic stress-reliever to the electric box. Use the 24mm wrench or an adjustable wrench to tighten it to a torque of 31 inch-lb. (3.5Nm).
12. Screw the cable caps to secure the cables.
13. Repeat 11 and12. above for the other cable.
14. Reinstall the electric box cover using the four Torx bolts removed in 9. Tighten the screws to a torque of 31 inch-lb. (3.5Nm).

Perform 1 through14. above above for each fan.

4.2.1 Securing the Cables to the Grilles

The input power cables must be secured to the fans' grilles. Each fan has two cables to be secured as shown in Figure 4.5 on the facing page. Two ties are needed on the fan farthest from the Liebert HPC-S electric box. Cables crossing subsequent fans should have five cable ties. Wrap the cable ties around the cables and a wire in the fan guard and cut off the excess cable tie.

Figure 4.5 Securing power cables to fan grilles



4.3 Piping Connections

4.3.1 Piping Circuit Construction

The piping must be connected to the chiller. Construct a chilled water circuit as described below:

1. Place shutoff valves within the circuit to allow servicing
2. Install a pump system suitable for the flow rate required at a pressure head equal to the sum of all the pressure drops.

   Liebert HPC-S chillers can be equipped with pumps having performance as indicated in Table 10.4 on page 44.

3. Install manometers at the chiller inlet/outlet.
4. Install thermometers at the chiller inlet/outlet.
5. Use flexible joints with connecting chilled fluid supply and return lines to avoid transmitting vibrations and to allow for thermal expansion. This applies to all chillers regardless of options.
6. Vertiv recommends including a water pressure switch to give an early warning of low water pressure.
7. Place a mesh filter at the inlets of the pump and water chiller).

If the fluid contains particles larger than 0.04 in. (1 mm), Vertiv recommends installing a 14-20 mesh strainer before the exchanger. Particles of this size could block the channels in the brazed plate evaporator, causing poor performance, increased pressure drop and risk of freezing.

8. Install piping components that allow the bleeding of air and filling of glycol at the highest points in the circuit.
9. Place a drain valve at the lowest point in the circuit and immediately at the outlet of the water chiller.
10. Install a water-filling set, including:
    - filling water meter
    - manometer
    - non-return valve
    - air separator
    - removable supply tube, which must be disconnected after each charge/top-up;
11. For maximum protection ensure that all piping exposed to low outdoor temperatures is fitted with anti-freeze heaters and insulated with closed-cell synthetic rubber (elastomer).
12. The circuit must include an expansion vessel (with safety valve) of suitable capacity.

NOTE: Confirm that the combined expansion volume of the system meets minimum requirements. This is the responsibility of the engineer of record. The expansion vessel option may provide enough volume to meet requirements. If additional volume is required then another expansion vessel must be provided. See Sizing the Expansion Tank on page 22 for details on this calculation.

NOTE: The piping circuit must contain a water volume suitable for the capacity of the installed chiller. Confirm that the total fluid volume of the system is sufficient, including piping, water volume inside the chiller and the buffer tank, if one is installed. Install a secondary tank in the circuit if necessary to provide the requisite volume. See Sizing the Expansion Tank on page 22 for details on this calculation.

NOTE: The chilled fluid piping system must ensure a constant fluid supply to the evaporator in all operating conditions to prevent damage to the chiller.

NOTE: Vertiv recommends installing a water check valve if multiple chillers are installed in parallel in the piping system. The check valve should be installed on the fluid return side of each chiller before the connection to the main header.

NOTE: Maximum allowed water hardness is 7.5 mmol/gal US.

4.3.2 Additional Water and Ethylene Glycol

Add water and ethylene glycol to the fluid circuit to level required to prevent freezing. The amount will be based on the weather data for the specific site location of the chiller and is to be determined by the system designer. Do not exceed the nominal operating pressure of the circuit's components.

NOTE: To avoid stratification, run the circulation pump for at least 30 minutes after adding any glycol. If the pumps are supplied within the chiller, then all must be run all together.
Water/glycol fluid mixture has to be circulated inside the chiller hydraulic parts, including free-cooling coils and bypass pipes, in order to do it move the three-way valve on both positions for the time necessary.
Disconnect water supply lines after filling the piping system with the required amounts of fluid.
Check the glycol concentration after any topping-up of the water; add glycol as needed.

4.3.3 Water-Glycol Mixture

Water/glycol mixtures must be used as the fluid in very cold climates or with temperatures below 32°F (0°C). See Table 4.1 below to determine the ethylene glycol that must be added to the water.

Table 4.1 Ethylene glycol to be added to water (% in weight of total mixture)

Ethylene glycol (% in weight)	0	10	20	30	40	50
Freezing temperature, -°F	32	24	14	2	-13	-35
Mixture density at 68-°F (*), lb/gal US	-	8.487	8.621	8.746	8.880	9.013
(*) Values are for Clariant Antifrogen N. For different brands, check manufacturer's data.						

For the chiller internal water volume refer to Table 10.1 on page 43. If the optional buffer tank is installed on the machine, add the tank hydraulic volume.

NOTICE

Risk of frozen coolant fluid. Can cause system damage and fluid leaks resulting in expensive equipment and building damage and loss of unit operation.

Always charge the fluid circuit with the required glycol mixture necessary for the minimum ambient temperature at the installation site. Failing to comply with this instruction will invalidate the unit warranty. Refer to Table 4.1 above.

4.3.4 Protection and Cleaning of the Evaporator and Components of Hydraulic Circuit

The user must establish the quality of the water and ensure that it is compatible with the materials used in the piping components and heat exchangers. The quality of water may significantly affect the operation and the life of the exchangers. Vertiv recommends developing a regular water treatment plan based on a chemical analysis performed by a properly trained and qualified water treatment service provider. Heat exchangers must be cleaned only with a commercially available chemical product that removes scale and prevents corrosion. Maximum allowed water hardness is 7.5 mmol/gallons.

In the chiller with pumps and in all free-cooling units, water quality must be in accordance with VDI 2035.

The main factors causing corrosion are acids with sulfur and carbon components, such as sulfuric acid (see the Langelier and Ryznar indices). The oxygen dissolved in water increases the rate of corrosion. Fouling from to dust and organic matter also provides a support for bacteria, fungi and algae, which also can damage the machine and reduce cooling. Corrosion is more prevalent in materials on the liquid side of the heat exchanger. The water circuit side components are made of several metals. Table 4.2 below shows suggested limits of chemicals in the water to avoid corrosion on copper, the material in the Liebert HPC with highest corrosion risk.

Table 4.2 Water component for corrosion limit on copper

pH	-	7.5 ÷ 9.0
SO_4	ppm	< 100
HCO_3 / SO_4	—	> 10
Total hardness	dH	4.5 ÷ 8.5
CJ-	ppm	< 50
PO_4^{3-}	ppm	< 2.0
NH3	ppm	< 0.5

Table 4.2 Water component for corrosion limit on copper (continued)

Free Chlorine	ppm	< 0.5
Fe^{3+}	ppm	< 0.5
Mn^{++}	ppm	< 0.05
CO_2	ppm	< 50
H_2S	ppb	< 50
Temperature	°F	< 149
Oxygen Content	ppm	< 0.1

4.3.5 Minimum System Volume Requirements

Use the following formula to determine the minimum system volume for the chilled fluid system:

$$V = \frac{71.87 \times R_t}{X_d}$$

where:

- V = minimum required total water volume in gal (US)
- R_t = refrigerating capacity in tons
- X_d = design fluid temperature rise across the evaporator in °F

The minimum required system fluid volume (V) must be at least equal to the sum of the fluid volume of the Liebert HPC-S chiller (Am) plus the volume of the piping circuit connected to it (Vpc). It is necessary to install an buffer tank if the total system volume is not greater than or equal to the minimum volume, V, given by the volume equation.

4.3.6 Sizing the Expansion Tank

The total volume of the expansion tank is calculated with the following ratio:

$$V = \frac{C \times e}{1 - \frac{Pi}{Pf}}$$

where:

- C = quantity of water inside the system in liters
- e = water expansion coefficient, with water at 10°C as a reference
- Pi = absolute pressure of initial charging, equivalent to the tank pre-charge pressure (typical value 2.5 bara)
- Pf = absolute final tolerated pressure, lower than the operating pressure or than the safety valve calibration pressure (typical value 4.02 bara).

Use the values of the water expansion coefficient in the table below:

Table 4.3 Water expansion coefficient

T H_2O (°F)	Density (lb/ft^3)	Expansion Coefficient “e”
50	62.40	—
68	62.30	0.0017
86	62.15	0.0040
104	61.94	0.0075
122	61.69	0.0116

4.3.7 Electrical Connections

WARNING! Arc flash and electric shock hazard. Can cause injury or death.
Open all local and remote electric power supply disconnect switches, verify that power is Off with a voltmeter and wear appropriate personal protective equipment per NFPA 70E before working within the electric control enclosure.
Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.
Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.
The Liebert iCOM microprocessor does not isolate power from the unit, even in the “unit off” mode. Some internal components require and receive power even during the “unit off” mode of Liebert iCOM control.
The factory-supplied optional disconnect switch is inside the unit. The line side of this switch contains live high-voltage.
The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.
Follow all local codes.

CAUTION: Risk of contact with hot surfaces. Can cause injury.
The compressors, refrigerant discharge lines, fan and pump motors are extremely hot during unit operation. Allow sufficient time for them to cool before working within the unit cabinet.
Use extreme caution and wear protective gloves and arm protection when working on or near hot compressors, discharge lines, humidifiers and reheats.

1. Before wiring, check that:
   - the electrical components are in good condition
   - all terminal screws are well tightened
   - the supply voltage and frequency comply with those indicated on the unit and within the tolerances indicated in the paragraph Operating Range on page 11
   - the maximum unbalance between the phases does not exceed the value indicated in the paragraph Operating Range on page 11.
2. Provide NEC CLASS 1 wiring to low-voltage connections.
3. Connection of the supply cable:

The units are equipped with an electrical panel containing one main switch for the power section and one switch (option) for the control section based on the minimum wire size ampacity displayed on the unit's serial tag.
Choose a supply wire (three-conductor with ground) for the power section and a supply wire (two-conductor with ground) for the control section (if remote control of chiller is required) that is consistent with:

- all applicable electrical codes
- expected current of the unit
- unit voltage
- wire length
- Precut knockouts should be used if possible for power and control wiring entry into the unit.
- Install power and control wiring so that it does not contact any parts of the chiller that may become hot.
- Connect the power wiring to the inlet terminal board (disconnecting switch terminals for phases and ground bar for PE conductor). After connecting the power wiring, reinstall the protections against direct contact with the high-voltage components.

4. The power and control wiring protection outside the Liebert HPC-S is the responsibility of the customer.
   If the the circuit containing the Liebert HPC employs a Ground Fault Circuit Interrupter (GFCI), Vertiv recommends using a Type B device because of the use of EC fans in the Liebert HPC.
5. Ethernet cable connection.

   The Liebert HPC chiller's iCOM can be used with a remote display through an Ethernet network cable. Specific instructions are shown in the Liebert HPC iCOM User Manual 273826 Rev 4.0.

   - Fasten the control wiring to the clamp-holding plates and make it pass through the first free hole on the panel bottom (arrange a cable clamp).
   - Knockouts should be used if possible for power and control wiring entry into the unit.
   - The cable must be protected by a sheath.
6. The terminal points listed below are all on terminal block TBI in the low-voltage control panel and are provided to indicate unit status to a remote automation system.

   Remote Indicators—Normally open contact when the component is inactive

   - Terminal 450-451—Compressor 1 On (closes when active)
   - Terminal 452-453—Compressor 2 On (closes when active)
   - Terminal 454-455—Compressor 3 On (closes when active)
   - Terminal 456-457—Compressor 4 On (closes when active)
   - Terminal 458-459—Pump 1 On (closes when active) (Note this terminal is present only in units that have a factory-installed pump option)
   - Terminal 460-461—Pump 2 On (closes when active) (Note this terminal is present only in units that have a factory-installed dual pump option)
   - Terminal 462-463—Free-Cooling On (closes when active)

   General Alarm—Set through Liebert iCOM®

   - Terminal 400—common

- Terminal 401—Normally closed (opens on alarm)
- Terminal 402—Normally open (closes on alarm)

Warning Alarm—Set through Liebert iCOM

- Terminal 300—common
- Terminal 301—Normally closed (opens on alarm)
- Terminal 302—Normally open (closes on alarm)

Remote Shutdown

- Terminal 470-471—Field-supplied 24VAC (1.2VA min.) power supply to operate remote shutdown.

WARNING! Arc flash and electric shock hazard. Can cause injury or death.
Open all local and remote electric power supply disconnect switches, verify that power is Off with a voltmeter and wear appropriate personal protective equipment per NFPA 70E before working within the electric control enclosure.
Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.
Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power.
The Liebert iCOM microprocessor does not isolate power from the unit, even in the "unit off" mode. Some internal components require and receive power even during the "unit off" mode of Liebert iCOM control.
The factory-supplied optional disconnect switch is inside the unit. The line side of this switch contains live high-voltage.
The only way to ensure that there is NO voltage inside the unit is to install and open a remote disconnect switch. Refer to unit electrical schematic.
Follow all local codes.

NOTICE

Risk of no water flow to the chiller. Can cause equipment damage.

Water flow to the chiller must be present prior to starting and during operation. Incorrect operation will cause the unit to lock-out due to the internal flow switch not sensing flow.

NOTICE

Risk of improper electric power phase sequence. Can cause equipment damage.

The compressors are equipped with an electronic protection device blocking their start if the phase sequence of the power supply is not correct or stopping their operation if a thermal relay is tripped. This device is essential for the integrity of the mechanical and electrical components of the compressors. Reset the standard functions by isolating this device and removing the causes of the lock-out.

NOTICE

Risk of improper temperature control. Can cause equipment damage.

The chillers are equipped with their own microprocessor control adjustment. Using the remote On-Off input (located in the electric panel terminal board) as a system temperature control element is prohibited and will void the warranty.

Figure 4.6 Isometric views FG0052 with buffer tank

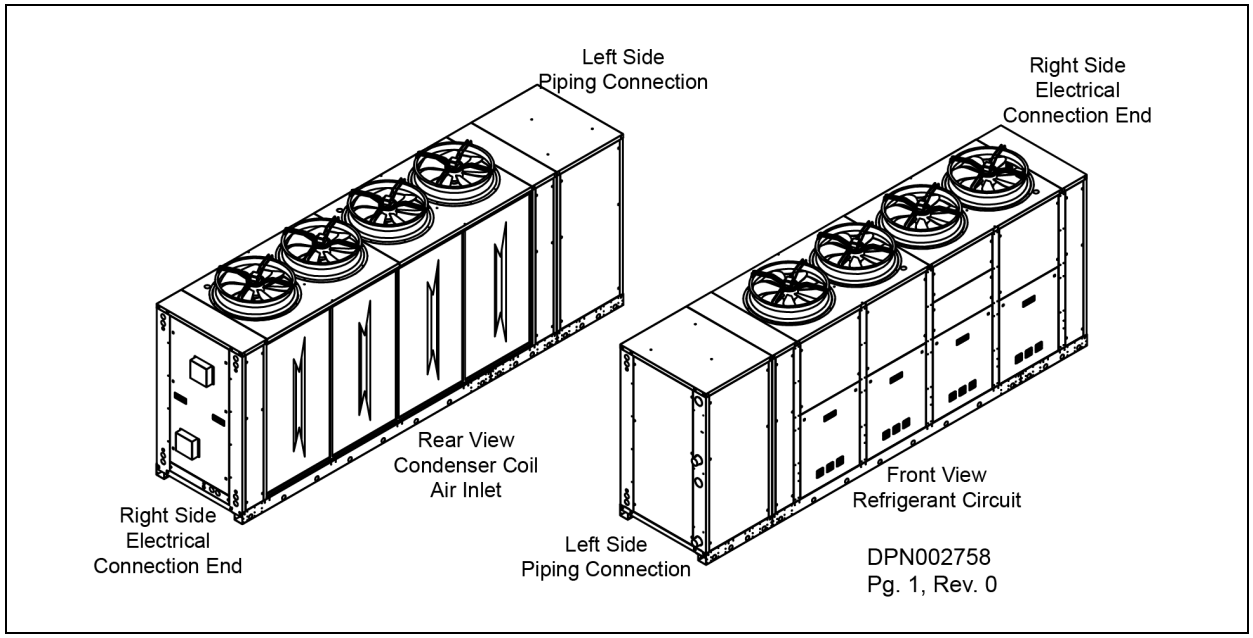


Figure 4.7 Isometric views FG0080 / FB0110 with buffer tank

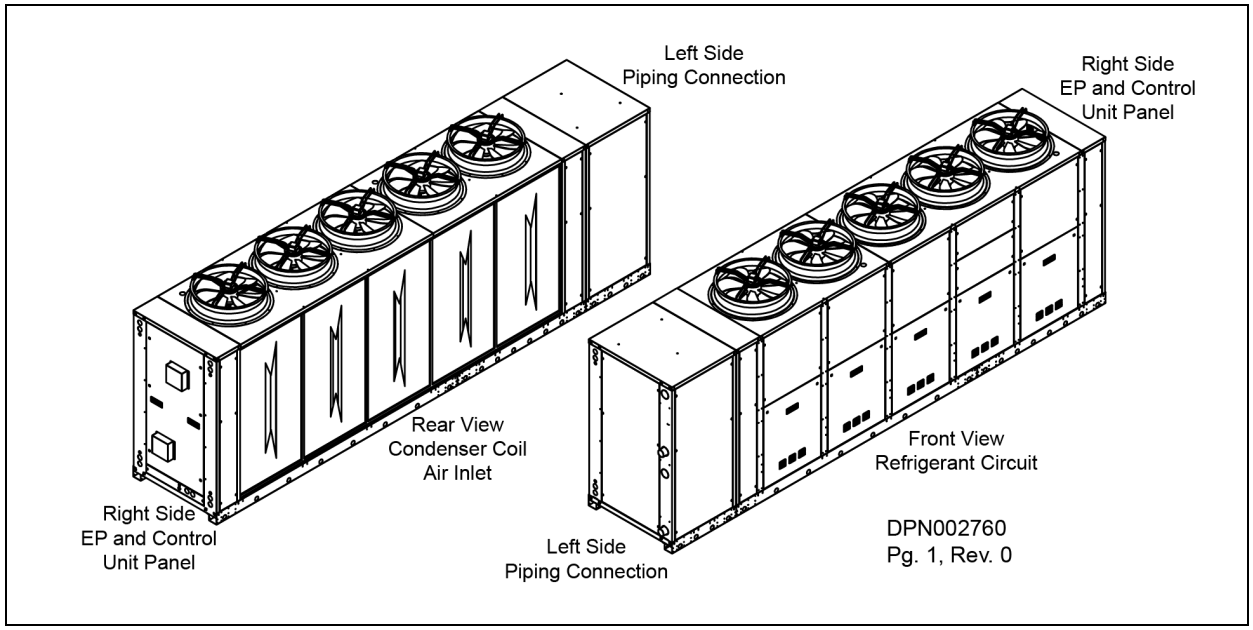
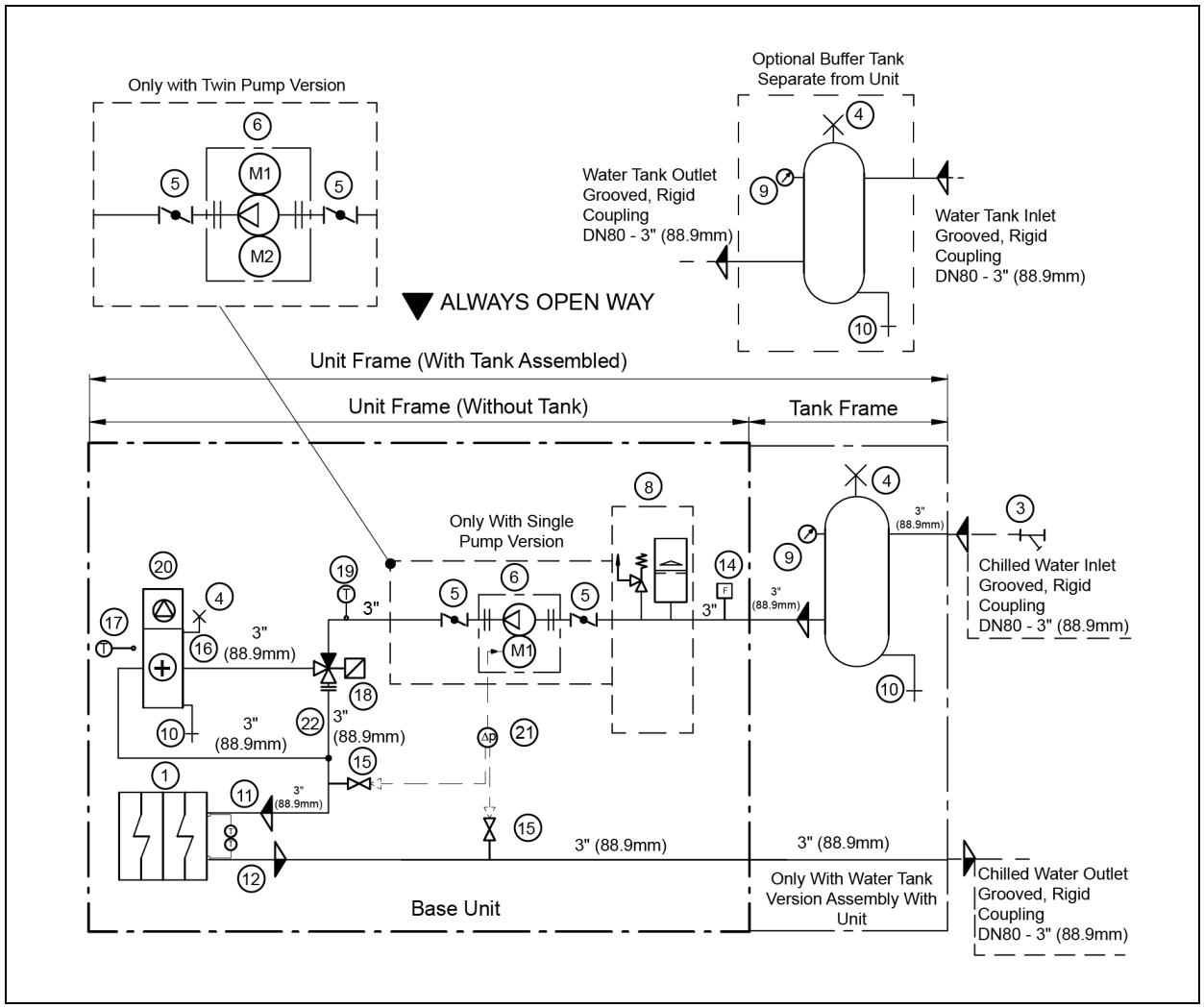


Figure 4.8 Liebert HPC-S fluid circuit schematic



Ref.	Description	Ref.	Description
1	Evaporator	12	Water Outlet Evaporator Probe
3	Water Filter (Optional)	14	Flow Switch
4	Manual Air Valve	15	Service Valve With Cap
5	Isolation Valve	16	Free-Cooling Coil
6	Single Pump (Optional)	17	Air Temperature Sensor
7	Twin Pump (Optional)	18	Three-Way Valve
8	Expansion Tank + Safety Valve (Optional)	19	Control Free-Cooling Thermostat Sensor
9	Manometer	20	Fans
10	Discharge Valve	21	Diff. Transducer (Only With Inverter Pump)
11	Water Inlet Evaporator Probe	22	Calibrate Baffle

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5 STARTUP AND OPERATION

5.1 Initial Check

NOTICE

Risk of improper start up and control. Can cause equipment damage.

Initial startup and operation must be performed by a properly trained and qualified factory-trained technician with experience on Liebert HPC chillers and the Liebert iCOM® and its software.

Verify that the unit power supply line is disconnected before performing the actions below.

Verify that the disconnect device is locked and a suitable warning tag to prevent any changes is applied to the start handle. Before working on the electrical connections, use a voltmeter or a phase detector to verify that is no voltage is present.

Some components (electronic pumps, EC fans, compressor's capacitors, soft-start, inverter) may remain at high voltage levels for a short period after power supply removal. Wait at least 5 minutes to remove their electrical box panels and access electrical components.

1. Check all the cable connections including the main power connections on the power fuses, contactors and MCB.
2. Check that all thermal protections are calibrated according the electrical data tables reported on wiring diagram.
3. Check all water connections.
4. Open the shutoff valve on the liquid line.
5. Ensure that the low pressure is higher than 101.5 psi (for R410A). If it is not higher, extend pre-heating of the compressor (see Figure 10.11 on page 58) and check that the refrigerant TXV is properly sealed.
6. Open all isolating valves and/or water ball valve.
7. In areas where temperatures go below 32°F (0°C), make sure that the chilled water circuit is filled with the correct concentration of water/glycol.
8. Bleed all air out of the chilled fluid circuit.
9. Verify the water flow rate and its direction.
10. Ensure that the thermal load is sufficient for startup.
11. Record the functional data on the Start-Up certificate.

NOTE: The outer air temperature probe must be positioned in the shade and protected against the weather

NOTE: After the safety checks above have been performed, set the handle of the door-lock general knife switch to the Position 1**. It is now safe to energize the chiller by closing the disconnection device upstream on the power supply line.**

5.2 First Startup or After an Extended Shutdown

NOTICE

Risk of improper startup. Can cause equipment damage.

Read and follow all of the instructions below before starting the unit up for operation.

Before beginning the following operations, make sure all protections on the units have been reset; set the handle of the door-lock general knife switch to the **Position 1**; verify that the display LED is switched On and check again with a voltmeter or tester if the voltage and phase difference falls within the indicated limits.

To begin the initial startup or for a startup after a long shutdown:

1. Power the crankcase heaters at least 8 hours before the start-up by setting the main isolator switch On. Make sure the auxiliary circuit has been powered and check the operation (a fault due to an incorrect procedure will void the compressor guarantee).
2. Open the valves of the refrigeration circuit that had been closed before the initial check.
3. Check the machinery supplying the thermal load connected with the unit and start the system pump(s).
4. Make sure the compressor oil has been heated for at least 8 hours. Serious compressor damage may occur if it is started before the compressor oil is properly heated.

NOTICE

Risk of low compressor oil temperature. Can cause equipment damage.

The compressor oil temperature is critical to proper operation. The oil will not reach operating temperature unless it is preheated for at least 8 hours.

5. Make sure the fans rotate in the correct direction (counterclockwise): check the electrical connections, if necessary.
6. Make sure the pumps rotate in the correct direction.
7. During the unit startup, an inlet fluid temperature higher than 64°F (18°C) is allowed. Under standard operating conditions, check that the limits indicated in Operating Range on page 11 are not exceeded.
8. Check the correct operation of the control and safety devices.
9. Check the outlet temperature of the chilled fluid (determine whether the setpoint on the controller is reached).
10. Check the oil level when both compressors are running.
11. With the compressors at full load, check the sight glass to determine whether any bubbles are visible. If there are any bubbles, contact Liebert Product Support.

5.3 Starting and Stopping

Always ensure that the compressor oil has been preheated. Maintain electric power to the compressor the crankcase heater during brief unit shutdowns.

- Start the unit by turning the microprocessor switch On.
- Stop the unit by turning the microprocessor switch Off.

- Turn the machine off by turning the microprocessor switch Off during extended times without operation. Confirm that the crankcase heater remains powered.
- For seasonal shutdown of the unit, de-energize the chiller at the main switch located on the main electrical power supply. This will disconnect power from the compressor crankcase heaters.

5.4 Chillers Serving Special Plants

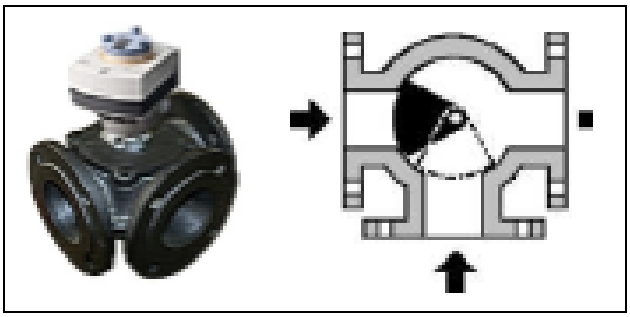
The units are capable of cooling a water-glycol mixture to temperatures close to 32°F (0°C) without the need for significant modifications. If temperatures below 32°F (0°C) are required, then special modification must be carried out in the factory (at the time of testing) or by qualified and authorized personnel at the time of installation.

5.5 Free-Cooling

The free-cooling feature (Liebert Economizer) is a system of pre-cooling and/or cooling the water/glycol mixture using ambient air when the ambient air temperature is below the return water/glycol mixture temperature. If the outside temperature is sufficiently low to dissipate the entire heat load, the refrigeration compressors automatically switch Off, and the mixture's temperature is controlled by the fan speed adjustment.

If the mixture temperature is too high for free-cooling, the compressors will operate as long as necessary to ensure the correct water/glycol mixture temperature.

5.5.1 Three-Way Valve



NOTICE

Risk of excessive water hardness and high water pressure. Can cause valve damage.

The maximum allowed water hardness to prevent valve damage is 7.5 mmol/gal US. The maximum working pressure is 87psi (5.9bar). The valve position is shown by reference on the valve end of the valve shaft (when the servo is disassembled) and by pin indicator mounted on the motor body. Valve shaft marking is visible only when the actuator has been removed from the shaft.

Actuator running time (90° angle rotation) is 90 seconds.

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6 REFRIGERANT AND OIL CHARGE

NOTICE

Risk of refrigerant system rupture and/or explosive discharge of high-pressure refrigerant from overpressurization. Can cause equipment damage, injury or death.

Do no exceed nameplate pressure ratings. Relieve system pressure in the manner approved by local building codes through an access port before working on the refrigeration system.

All work on pipes or components of the refrigerating circuit under pressure must be carried out by properly trained and qualified personnel.

6.1 Refrigerant Charge

NOTICE

Risk of improper refrigerant evacuation. Can cause compressor damage and environmental pollution.

While repairing the refrigerating circuit, recover all the refrigerant in a container: do not allow it to escape. Using the compressor for the system vacuum will invalidate the warranty.

The unit is delivered charged according to the Table 10.2 on page 44.

6.1.1 Warnings for the Refrigerant Charge Checklist

1. Ensure there are no refrigerant leaks.
2. Check the refrigerant type in the refrigeration circuit: a unit originally charged by the manufacturer with R410A cannot be charged with other gas and vice versa.
3. Charge with the compressor in operation, connecting the cylinder with the charge connector after the thermostatic expansion valve.
   Drain the connection pipe between the cylinder and the charging point; tighten the seal joint and then start charging the unit. It is imperative that the cylinder is weighed both before and after the operation.
4. Charge the unit until the bubbles in the sight glass have disappeared and the working conditions of the entire refrigeration circuit have returned to normal (subcooling and superheating within the limits indicated below).
5. Measure the superheating as follows:
   a. Measure the temperature on the suction line, close to the temperature sensor of the electronic expansion valve using a contact thermometer.
   b. Connect a pressure gauge (by maximum a 12" [305mm] length pipe) with the Schraeder connection and read the corresponding saturated evaporating temperature.
   c. The superheating is the difference between the two readings.
6. Verify that the superheating is 9°F to 14.4°F (-17.7°C to 9.8°C).
7. Measure the subcooling as follows:

   Detect the temperature on the liquid line using a contact thermometer.

Connect a pressure gauge (by maximum a 12" [305mm] length pipe) with the Schraeder connection on the liquid line and read the corresponding saturated condensing temperature.

   d. The subcooling is the difference between the two readings.

8. Verify that at the condenser outlet, subcooling is 5.4°F to 9°F (14.8°C to 12.8°C).

NOTICE

Risk of improper refrigerant charging. Can cause reduced cooling capacity.

An excess of refrigerant causes an increase in subcooling and consequent operating difficulties in the hot season; a shortage of charge generates an increase in superheating and possible compressor safety trips and failures. Whenever work is performed on the unit, ensure afterwards that the working conditions are correct, checking subcooling and superheating.

Check the oil level (3/4 of maximum) in sight glass (fitted on oil and gas equalization tube of each tandem compressor) after a short operating time of both compressors (installed in the same refrigerant circuit).

NOTE: Check the oil level moving in sight glass (fitted on oil and gas equalization tube of each tandem compressor) from the stopped compressor to the running one.

NOTE: If only one compressor is running it's possible that the oil level in sight glass (fitted on oil and gas equalization tube of each tandem compressor) reach the min level or lower: it's a normal operating mode and it doesn't affect the reliability of the unit.

6.2 Oil Charge

Contact the Technical Support Department for the specifications of the oil to be used for topping up; the oil changes according to the type of used refrigerant.

Top-ups of up to 20-30% of the total amount of oil contained in the compressor crankcase are permitted; For larger percentages contact Vertiv's technical support department.

6.2.1 Procedure for Topping-Up Oil

If any oil has been lost, it must be topped up as follows:

1. Take a clean, dry, transparent container (with volume calibrations) and fill it with at least twice the amount of oil required.
2. Isolate the compressor by closing the cock on the liquid line.
3. Connect to the fittings on the compressor body (Schraeder valves) and empty it of refrigerant until atmospheric pressure (14.5 psi) is reached.
4. Using a pipe, connect the oil container to the oil service fitting on the lower part of the compressor.
5. Open the oil service cock, lifting the container, so that the oil flows by gravity.
6. Charge the required quantity of oil (make sure the tube always remains below the oil level in the container).
7. Stop the oil flow by closing the oil service fitting, open the shutoff cock on the refrigerating circuit and restore the drained refrigerant charge.

7 SAFETY DEVICE SETTINGS

The water chiller has been tested and calibrated by the manufacturer. Vertiv suggests using the following field-settings.

Table 7.1 Factory refrigerant switch settings

Component	Setting		Notes
Low-Pressure Switch (LP)	Operation with R410A (standard factory setting)		
	START	6.5 bar – 94.3 psi	
	DIFF	1.5 bar – 21.8 psi	
	STOP	5.0 bar – 72.8 psi	
High-Pressure Switch (HP)	Operation with R410A (standard factory setting)		
	STOP	42.0 bar – 609 psi	
	START	38.0 bar – 551 psi	
	DIFF	4 bar (fixed) – 58 psi	
The settings for the safety valves installed on the machine are 65 psi.			

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8 MAINTENANCE

The Maintenance Program below must be carried out by a qualified technician, preferably working under a maintenance contract.

WARNING! Risk of electric shock. Can cause injury or death.
Disconnect all local and remote electrical power supplies before working within electric connection enclosures. When connecting the motor to input power, dangerous voltages occur. Do not open the motor electric connection enclosures within the first 5 minutes after disconnection of all phases.

Before performing any maintenance, verify that the unit power supply line is disconnected at the start. Make sure the disconnection device is locked and the suitable warning plate for no operation is applied on the start handle.

Before operating on the electrical connections, make sure there is no voltage with a voltmeter or a phase detector.

Some components (electronic pumps, EC fans, compressor's capacitors, soft-start, inverter) may remain energized for a short period after power supply removal. Wait at least 5 minutes to remove their electrical box covers and access electrical connections and internal components.

Before any intervention on the unit or accessing the inner components, always ensure the machine is turned off.

CAUTION: Risk of contact with hot surfaces. Can cause injury.
The compressors, fan motors, pump motors and refrigerant discharge lines are extremely hot during unit operation. Allow sufficient time for them to cool before working within the unit. Use extreme caution and wear protective gloves and arm protection when working on or near hot compressors, fan motors, pump motors and discharge lines.

The front part of the compressor and the discharge pipe are very hot: be careful when working near either component. Be very careful when working near the finned coils because the fins are very sharp. Do not remove the fan protection grille before shutting down the whole machine. Do not insert foreign objects through the fan protection grille. After the maintenance, always close the unit by reinstalling any panels that were removed.

If the front upper panels are removed (coil compartment), wait for the fan(s) to stop before accessing the compartment; if the front lower panels are removed, pay special attention when working near the compressor upper part and the discharge line: they are very hot; wait for them to cool.

8.1 Lubrication—Pump

The bearings of motors up to 11kW are greased for life and require no lubrication. The bearings of motors of 11kW and up must be greased in accordance with the indications on the motor nameplate. The motor should be lubricated with a lithium-based grease meeting the following specifications:

- NLGI grade 2 or 3.
- Viscosity of basic oil: 70 to 150 cSt at 40°C (104°F).
- Temperature range: -22°F to 284°F (-30°C to 140°C) during continuous operation.

8.2 Coil Cleaning Procedure

A pressure washer may be used periodically to remove dust, pollution and similar substances from between the coils fins.

Before operating:

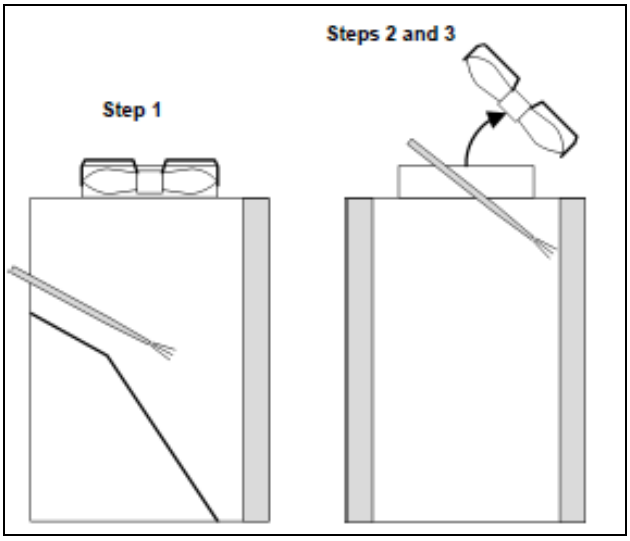
- Disconnect the unit from the electrical power supply by opening all local and remote electric disconnect switches
- Remove the air filters.
- Verify that all fan blades have stopped rotating.
- Ensure that the fans impellers cannot move for any reason (e.g.: wind). Block them mechanically to avoid accidental contacts with the rotating blades.

The high-pressure water flow should be sprayed in the direction opposite of the airflow and parallel to the coil fins.

To do this, insert the water nozzle inside the unit, following these possible methods:

1. Remove the side panels (in case of single coil units) and insert the nozzle into the internal space.
2. Remove one or more fans.
3. Insert the water nozzle though the fan opening.

Figure 8.1 Washing coils



A neutral degreaser may be used to clean away greasy obstructions.

After cleaning the chiller, reassemble the parts previously removed and unblock the blocked fans before reconnecting the electrical power supply.

8.3 Spare Parts

The use of original spare parts is recommended.

When placing an order refer to “Component List” enclosed with the machine and quote the unit model number and serial number.

8.4 Dismantling the Unit

The machine has been designed and built to ensure continuous operation. The working life of some of the main components, such as the fans and the compressors, depends on the maintenance that they receive.

The unit contains substances and components hazardous for the environment (electronic components, lead battery SUPERCAP, refrigerating gases and oils). At the end of the useful life, when the unit is dismantled, the operation must be carried out by specialized technicians. The unit must be delivered to suitable centers specialized for the collection and disposal of equipment containing hazardous substances. Lead battery, refrigerating fluid and the lubricating oil inside the circuit must be recovered according to national and local laws and regulation.

8.4.1 Monthly Maintenance

Fans

- Check that the fan motor rotates freely without any abnormal noise
- Ensure that the fan motor bearings are not running hot.
- Also check the amperage levels.

Condenser and Air Filter

- Check the conditions of the filters (if they are supplied); if necessary clean them (including the electrical panel ventilation filter).
- Check the condenser coils and clean if necessary (see Coil Cleaning Procedure on the previous page)

Control

- Check that the control equipment, LEDs and display are operating correctly.
- Check the supply voltage.
- Check the operation of the compressor's oil heaters.
- Check the conditions of the remote control switch contacts.
- Check the operation of the evaporator resistance (if present).
- Check the operation of the electrical panel fan and heaters (if present).

Electrical Circuit

- Check the electrical supply on all phases.
- Ensure that all electrical connections are tight.

Refrigeration Circuit

- Check the condensing and the evaporating pressures (to be done by a refrigeration technician).
- Check the compressor's current absorption, the delivery temperature and possible unusual noises.
- Check the refrigerant charge by means of the sight glass.
- Check that the safety devices operate correctly.
- Check the correct operation of the TXV (superheating between 9°F-14.2°C).
- Check that the oil level is approximately 3/4 indicated by the sight glass (fitted on oil and gas equalization tube of each tandem compressor) after a short operating time of both compressors.

Chilled Water Circuit

- Ensure that there are no water leaks.
- Bleed any air out of the hydraulic circuit using the bleed valves.
- Verify that the water flow rate is correct.
- Check the inlet - outlet liquid temperature and pressure.
- Check the correct operation of the three-way valve (free-cooling systems only).
- Check if the system is charged with the specified glycol percentage and that no ice has formed in the hydraulic circuit.
- Check the evaporator cleanliness.
- Check the motor pump current.
- Check the motor pump noise.
- Ensure the motor pump is lubricated periodically.

9 OPTIONS AND ACCESSORIES

9.1 Pump Set

The centrifugal pump units are direct driven, with close-coupled motors and a single shaft; the induction motor has 2 poles with IP 55 protection and class F insulation.

The pumps are of the top-pull-out design, i.e. the power head (motor, pump head and impeller) can be removed for maintenance or service while the pump housing remains in the pipe work

The electronic pump adjustment algorithm enables to modulate the pump speed to keep the delivery steady through the evaporator even if the hydraulic load changes; in this way, a significant energy saving is achieved and varies depending on the applications. In particular, in the free-cooling units this benefit is obtained above all in summer, when the free-cooling coil is short-circuited. The adjustment set of the inverter driven pump is made in the factory. It can be further adjusted during startup by an Vertiv technician.

Pump casings and impellers are in cast iron shafts are in stainless steel, the shaft seal is a brass neck ring permits ideal conditions for the use of water mixtures containing ethylene glycol. The BQQE mechanical shaft seal is a rubber bellow seal with silicon carbide/silicon carbide seal faces and secondary seals of EPDM. The pump housing, the motor stool and the motor stator housing are electrocoated.

The pump units have been chosen and sized to operate within specific limits, namely:

- Water / ethylene glycol mixtures up to 65% / 35% by weight
- Temperatures of the standard pumped fluid not lower than 40°F.

The motor stool forms connection between the pump housing and the motor and is equipped with a manual air vent screw for venting of the pump housing and the shaft seal chamber. It is very important to carry out this operation as the circulation of liquid through the duct of the air vent screw ensures lubrication and cooling of the shaft seal.

Between the outlets of the two chambers and the discharge flange, twin-head pumps have a non-return flap valve in EPDM rubber. The flap is opened by the flow of the pumped liquid and cuts off the port of the idle pump chamber.

In the electrical panel there are automatic circuit breakers for each pump; the microprocessor control manages the operating rotation between the two pumps and start-up of the standby pump if the primary pump fails.

In case of electronic inverter pump replacement, it's necessary to set specific service level control parameters (user panel is not feasible for this operation); this operation must be performed by an experienced Vertiv technician.

For the technical features of the pumps and the piping schematic see Table 10.4 on page 44 and Figure 4.8 on page 27.

9.2 Hydraulic Circuit Accessories

Made up of an expansion vessel (pre-charged at 22 psi, maximum operating pressure 145 psi) and a safety valve, set at 87 psi. Their position in the piping circuit is illustrated in Figure 4.8 on page 27.

- Expansion vessel volume: 3.2 gal for all units.

It is recommended that the total required expansion vessel capacity is always checked, depending on the unit's internal fluid volume (with the volume of the buffer tank, if installed), the user circuit volume, the glycol percentage in the mixture, and the expected maximum temperature variation of the mixture.

The water flow switch is a required device protecting the unit. It is standard on units with the optional on-board pump set and is available as a option for units without pumps on board: in the latter case the flow switch, if not installed on the machine, must be installed on the hydraulic circuit by the installer and wired to the electric panel terminal board, as indicated on the wiring diagram.

9.3 Water Chiller with Inertial Tank

The machine can be supplied complete with a buffer tank. The buffer tank provides thermal mass to stabilize the refrigeration circuit and deliver better compressor operation by offering these benefits:

- "It reduces the frequency of the compressor startups and consequent high current peaks.
- It naturally eliminates the operation troubles caused by sudden load variations (shown by variations of the chilled water temperature).

The buffer tank is supplied complete with manometer and temperature sensor well, air purge valve, discharge valve and sinking connection for electric heaters (to be installed as option, managed by the Liebert iCOM® control); max operating pressure: 87 psi. Built in carbon steel and coated with anti-condensate insulation with PVC film proper for outdoor installation. It is installed inside a cabinet which can be supplied either already connected to the unit (mechanically and hydraulically jointed to it) or loose (completely separate from the unit).

Table 9.1 Technical data

Internal volume:	264 US gal
Net weight:	882 lb
Working weight:	3086 lb

10 ELECTRICAL PANEL AND CHILLER CONTROL

The electrical panel is designed, constructed and tested in compliance with CSA standards.

It is installed on the compressor compartment side and can be accessed through the unit right side panel. It is possible to access the Liebert iCOM® control display without switching the unit off, so as to aid maintenance operations.

The electrical panel is cooled through forced ventilation controlled by a microprocessor board. For ambient temperatures below -5°C, it is possible to have an electric heater fitted inside (optional) and controlled as well by the microprocessor board.

Main features:

- Power supply: 460V ±10% / 3Ph / 60Hz.
- Auxiliary power supply circuit: 230V / 1Ph / 60Hz and 24V / 1Ph / 60Hz.
- Main switch.
- Main switch for auxiliary circuit and fast start feature (optional).
- Protection MCB's for compressors, fans and pumps.
- Contactors for compressors and pumps.
- Relay for checking phase sequence, minimum voltage, loss one or more phase.
- Manual operation through Liebert iCOM.
- Volt-free contacts for remote indication of:
    - compressors in operation
    - pump(s) in operation
    - general alarm
    - warning alarm
    - tandem compressor alarm 1/2
    - water flow alarm
    - condenser fan failure:
    - configurable free contact
    - external input for remote ON/OFF.

Table 10.1 Internal fluid volume

Model #	Unit Volume (US Gal)
FG0052	33.3
FG0080	38.8
FB0110	39.9

NOTE: Add the tank's volume for the units with optional buffer tank.

Table 10.2 Refrigerant and oil charge

Model	FG0052	FG0080	FB0110
Refrigerant charge, each circuit, lb	44.1	57.3	57.3
Oil charge (each circuit), US gal	0.90+0.90	0.90+1.80	1.80+1.66

NOTE: Refrigerant type: R410A; Oil type: ICI Emkarate RL 32 3MAF.

Table 10.3 Operating range

Models		FG0052	FG0080	FB0110
Maximum outdoor temperature*	°F	124.9	119.84	109.4
Safety devices settings				
High-pressure switch*	psig	609.16		
High-pressure safety valve	psig	653.12		
High-pressure safety valves (each circuit	#	1		
High-pressure safety valve connection	in	G. 1" ISO 228		
Low-pressure switch	psig	72.52		
*With nominal air flow; mixture outlet temperature 50°F; full load; R-410A refrigerant.				

Table 10.4 Standard head pump characteristics

Models	FG0052	FG0080	FB0110
Water Flow, gpm (US)	139.52	212.52	272.4
Available Pressure Head, psig	29	23	4
Pump/s number, Nr.	1/2	1/2	1/2
Pump Rotor Model	65-340/2	65-390/2	65-390/2
Nominal Motor Power, kW	5.5	7.5	7.5
Noise Level *, dB(A)	68	65	65
* - According to ISO 3744			

Table 10.5 High head pump characteristics

Models	FG0052	FG0080	FB0110
Water Flow, gpm (US)	139.52	212.52	274.4
Available Pressure Head, psig	39	36	17
Pump/s number, Nr.	65-390/2	65-480/2	65-480/2
Pump Rotor Model	1/2	1/2	1/2
Nominal Motor Power, kW	7.5	11	11
Noise Level (*), dB(A)	65	64.5	64.5
(*) - According to ISO 3744			

Table 10.6 on the facing page indicates the overall sound pressure level at full load conditions, measured 3 ft. (1m) from the unit, according to ISO 3774, with an outdoor temperature of 95°F (35°C) and referred to free-field conditions.

Table 10.6 Sound pressure/power level

Models	Octave Band Frequency, Hz								Total [dB(A)]
	63	125	250	500	1000	2000	4000	8000	
"SPL" Sound Pressure Levels [dB]									
FG0052	87	83	79	76	75	71	63	55	79
FG0080	88	83	79	76	75	71	63	56	79.5
FB0110	88	83	79	76	75	71	63	56	79.5
"PWL" Sound power levels [dB]									
FG0052	107	102	98	95	94	90	82	75	98.5
FG0080	108	103	99	96	95	91	83	76	99.5
FB0110	108	103	99	96	95	91	83	76	99.5
Sound power levels tolerance for each octave band: -0/+2 dB									

Table 10.7 Electrical data

Size	FG0052	FG0080	FB0110
Power Supply, V/Hz/Phase	460/60/3 (3-Wire Y System)		
Acceptable Voltage Range, Volts	±10%	±10%	±10%
Number of Fans	4	5	5
Fan Motor Power, each fan, kW	2.8	2.8	2.8
Fan Motor Nominal Current, A	4.3	4.3	4.3
Fan Motor FLA, A	4.4	4.4	4.4
Single compressor 1 and 3 - RLA current, A	25.0	46.7	60.7
Single compressor 2 and 4 - RLA current, A	25.0	29.3	46.7
Single compressor 1 and 3 - LRA current, A	140	272.0	310.0
Single compressor 2 and 4 - LRA current, A	140	179.0	272.0
Total Unit Full Load Amps (FLA) - No Pumps	117.6	174.0	236.8
Unit Wire Size Amps (WSA) - No Pumps, A	123.9	185.7	252.0
Unit Overcurrent Protection Device (OPD) Size - No Pumps, Amps	125	225	300
Total Unit Full Load Amps (FLA) - Standard Head Pumps	126.9	186.0	248.8
Unit Wire Size Amps (WSA) - Standard Head Pumps, Amps	133.2	197.7	264.0
Unit Overcurrent Protection Device (OPD) Size - Standard Head Pumps, Amps	150	225	300
Total Unit Full Load Amps (FLA) - High Head Pumps	129.6	191.2	254.0
Unit Wire Size Amps (WSA) - High Head Pumps, Amps	135.9	202.9	269.2
Unit Overcurrent Protection Device (OPD) Size - High Head Pumps, Amps	160	225	300

Table 10.8 Weights and shipping dimensions

Configuration	Shipping Dimensions, in (mm)	Weight, lb (kg)
FG0052 Shipping Weights (Condenser Fans Shipped Separately)		
Base Unit Shipping Weight without Buffer Tank	195x60x92 (4953x1524x2337)	4,880 (2,214)
Base Unit Shipping Weight with Buffer Tank	240x60x92 (6096x1524x2337)	5,848 (2,654)
Condenser Fans Shipping Crate #1 (Qty of 2 fans)	42x42x45 (1067x1067x1143)	300 (136)
Condenser Fans Shipping Crate #2 (Qty of 2 fans)	42x42x45 (1067x1067x1143)	300 (136)
Base Unit Operating Weight without Buffer Tank (accounts for mass of water in unit)	—	5,598 (2,539)
Base Unit Operating Weight with Buffer Tank (accounts for mass of water in unit)	—	7,710 (3,497)
Options—Additional Weight		
No Pumps, With Piping Specialties (Digit 12 = 1)	—	22 (10)
Single Standard Head Pump with Piping Specialties (Digit 12 = 2)	—	243 (110)
Single High Head Pump with Piping Specialties (Digit 12 = 3)	—	247 (112)
Dual Standard Head Pump with Piping Specialties (Digit 12 = 4)	—	441 (200)
Dual High Head Pump with Piping Specialties (Digit 12 = 5)	—	449 (204)
Single Inverter Driven Pump with Piping Specialties (Digit 12 = 6)	—	276 (125)
Condenser Coil Filter Guard (Digit 17 = 1)	—	66 (30)
FG0080 Shipping Weights (Condenser Fans Shipped Separately)		
Base Unit Shipping Weight without Buffer Tank	240x60x92 (6096x1524x2337)	6,070 (2,754)
Base Unit Shipping Weight with Buffer Tank	275x60x92 (6985x1524x2337)	7,038 (3,193)
Condenser Fans Shipping Crate #1 (2 Condenser Fans)	42x42x45 (1067x1067x1143)	300 (136)
Condenser Fans Shipping Crate #2 (3 Condenser Fans)	42x42x45 (1067x1067x1143)	400 (181)
Base Unit Operating Weight without Buffer Tank (accounts for mass of water in unit)	—	6,943 (3,149)
Base Unit Operating Weight with Buffer Tank (accounts for mass of water in unit)	—	9,055 (4,107)
Options—Additional Weight		
No Pumps, With Piping Specialties (Digit 12 = 1)	—	22 (10)
Single Standard Head Pump with Piping Specialties (Digit 12 = 2)	—	247 (110)
Single High Head Pump with Piping Specialties (Digit 12 = 3)	—	375 (170)
Dual Standard Head Pump with Piping Specialties (Digit 12 = 4)	—	450 (204)
Dual High Head Pump with Piping Specialties (Digit 12 = 5)	—	721 (327)
Single Inverter Driven Pump with Piping Specialties (Digit 12 = 6)	—	450 (204)
Condenser Coil Filter Guard (Digit 17 = 1)	—	110 (50)
FB0110 Shipping Weights (Condenser Fans Shipped Separately)		
Base Unit Shipping Weight without Buffer Tank	195x60x92 (4953x1524x2337)	6,174 (2,800)
Base Unit Shipping Weight with Buffer Tank	240x60x92 (6096x1524x2337)	7,144 (3,240)
Condenser Fans Shipping Crate #1 (2 Condenser Fans)	42x42x45 (1067x1067x1143)	300 (136)
Condenser Fans Shipping Crate #2 (3 Condenser Fans)	42x42x45 (1067x1067x1143)	400 (181)

Table 10.8 Weights and shipping dimensions (continued)

Configuration	Shipping Dimensions, in (mm)	Weight, lb (kg)
Base Unit Operating Weight without Buffer Tank (accounts for mass of water in unit)	—	7,053 (3,199
Base Unit Operating Weight with Buffer Tank (accounts for mass of water in unit)	—	9,165 (3,497)
Options—Additional Weight		
No Pumps, With Piping Specialties (Digit 12 = 1)	—	22 (10)
Single Standard Head Pump with Piping Specialties (Digit 12 = 2)	—	247 (110)
Single High Head Pump with Piping Specialties (Digit 12 = 3)	—	375 (170)
Dual Standard Head Pump with Piping Specialties (Digit 12 = 4)	—	450 (204)
Dual High Head Pump with Piping Specialties (Digit 12 = 5)	—	721 (327)
Single Inverter Driven Pump with Piping Specialties (Digit 12 = 6)	—	450 (204)
Condenser Coil Filter Guard (Digit 17 = 1)	—	110 (50)

Figure 10.1 Dimensions and clearances for Liebert HPC-S model FG0052, no buffer tank

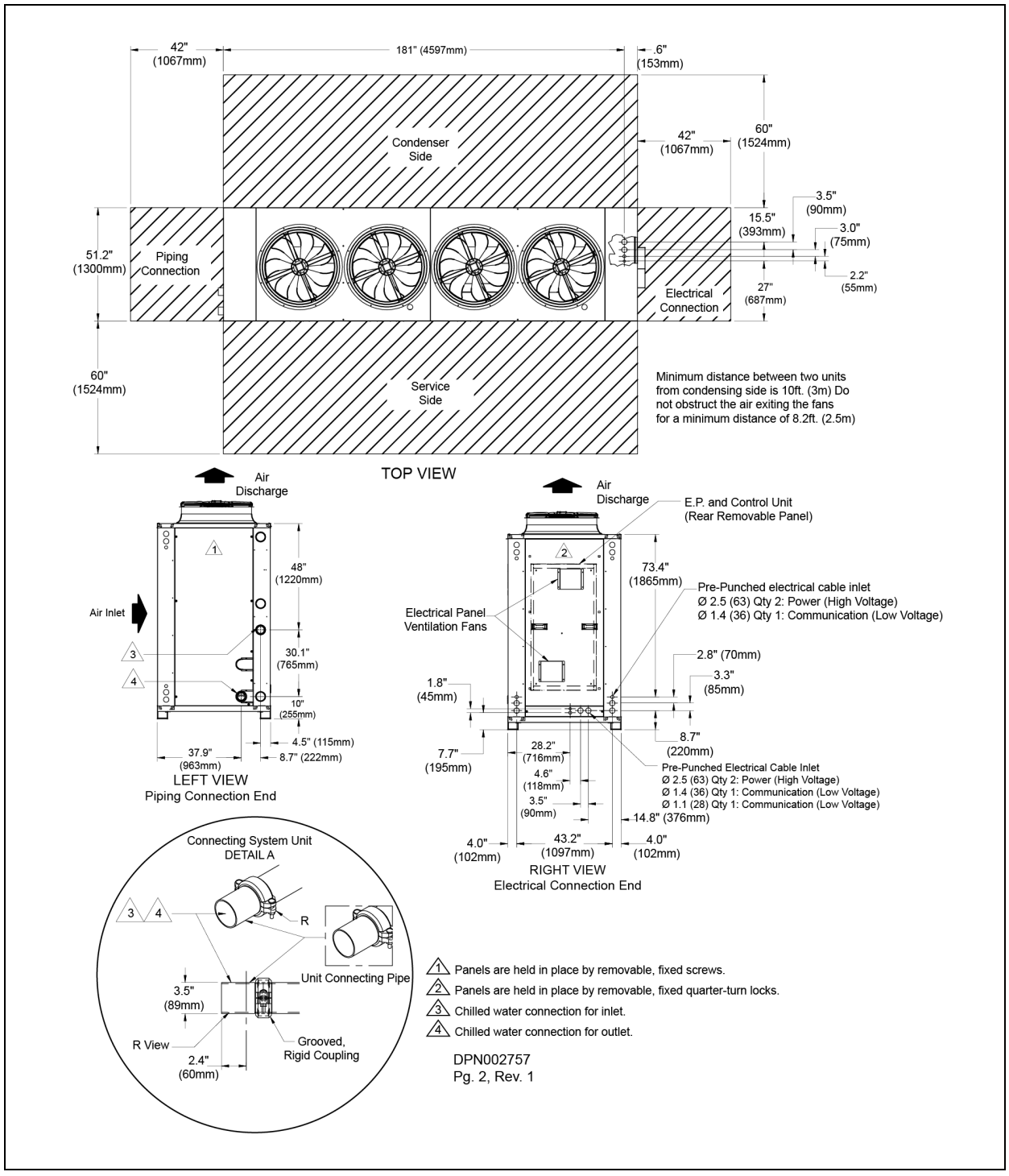


Figure 10.2 Dimensions and clearances for Liebert HPC-S model FG0052 with buffer tank

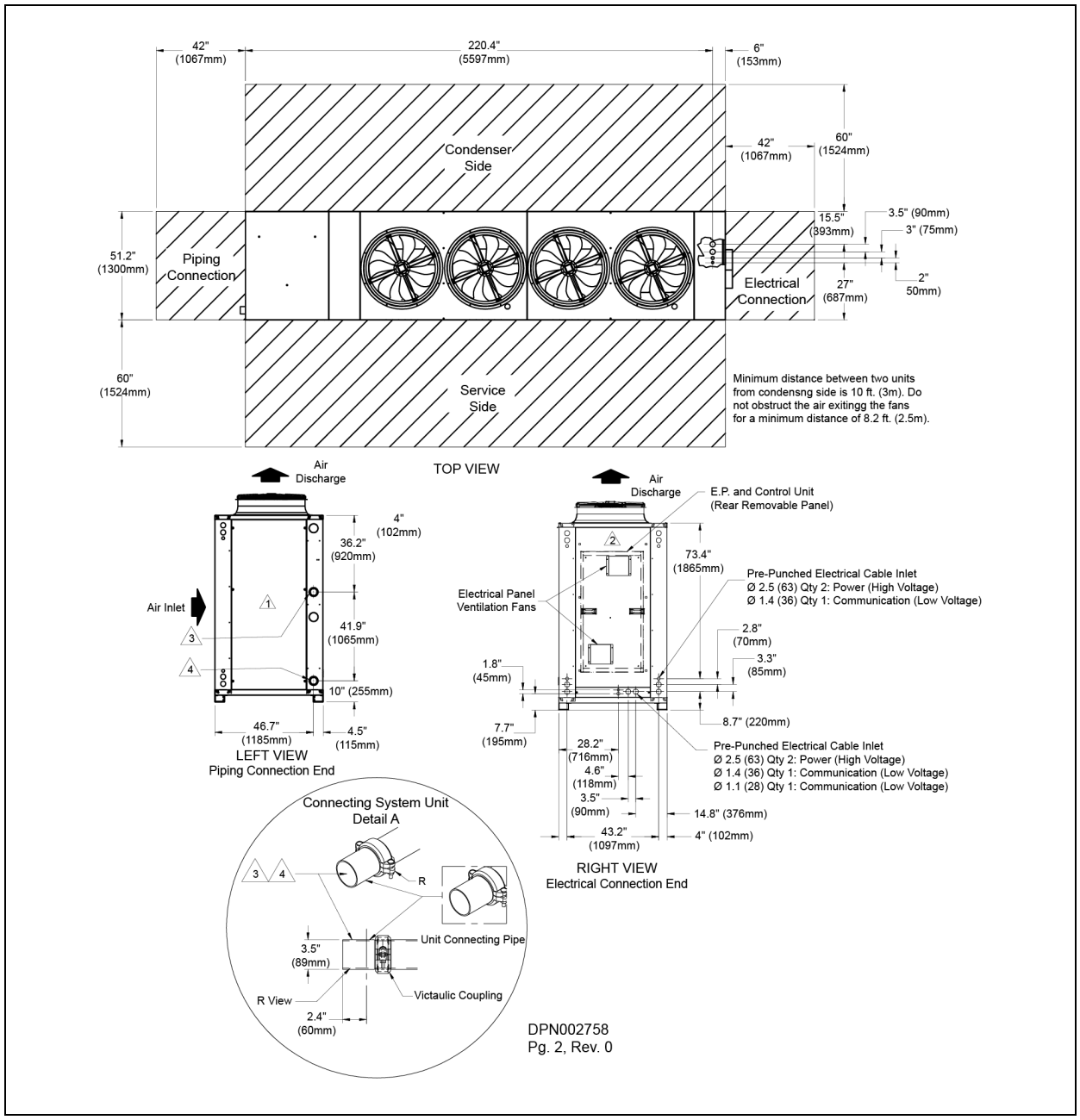


Figure 10.3 Dimensions and clearances for Liebert HPC-S models FG0080 and FB0110, no buffer tank

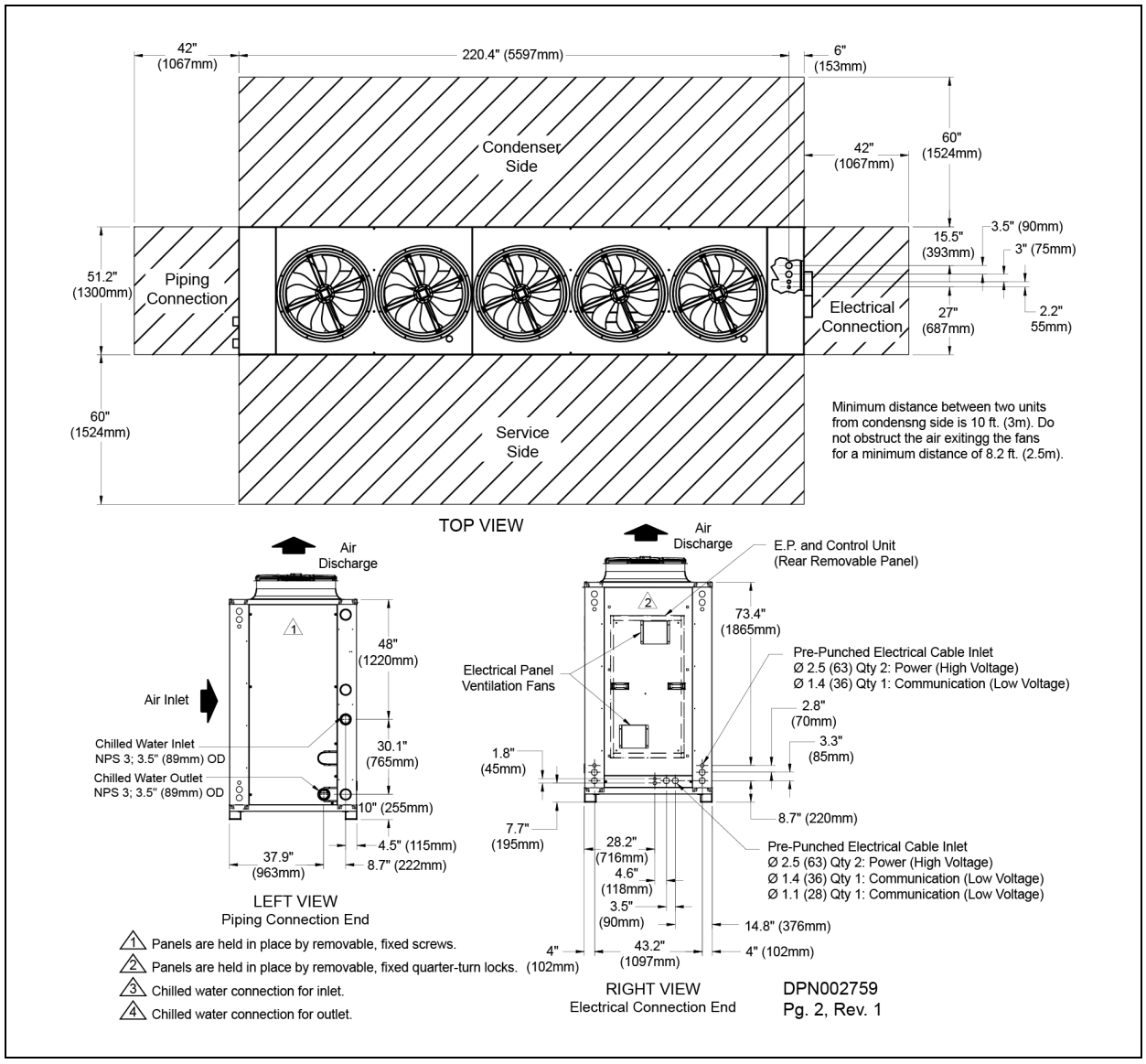


Figure 10.4 Dimensions and clearances for Liebert HPC-S models FG0080 and FB0110 with integral free-cooling and buffer tank

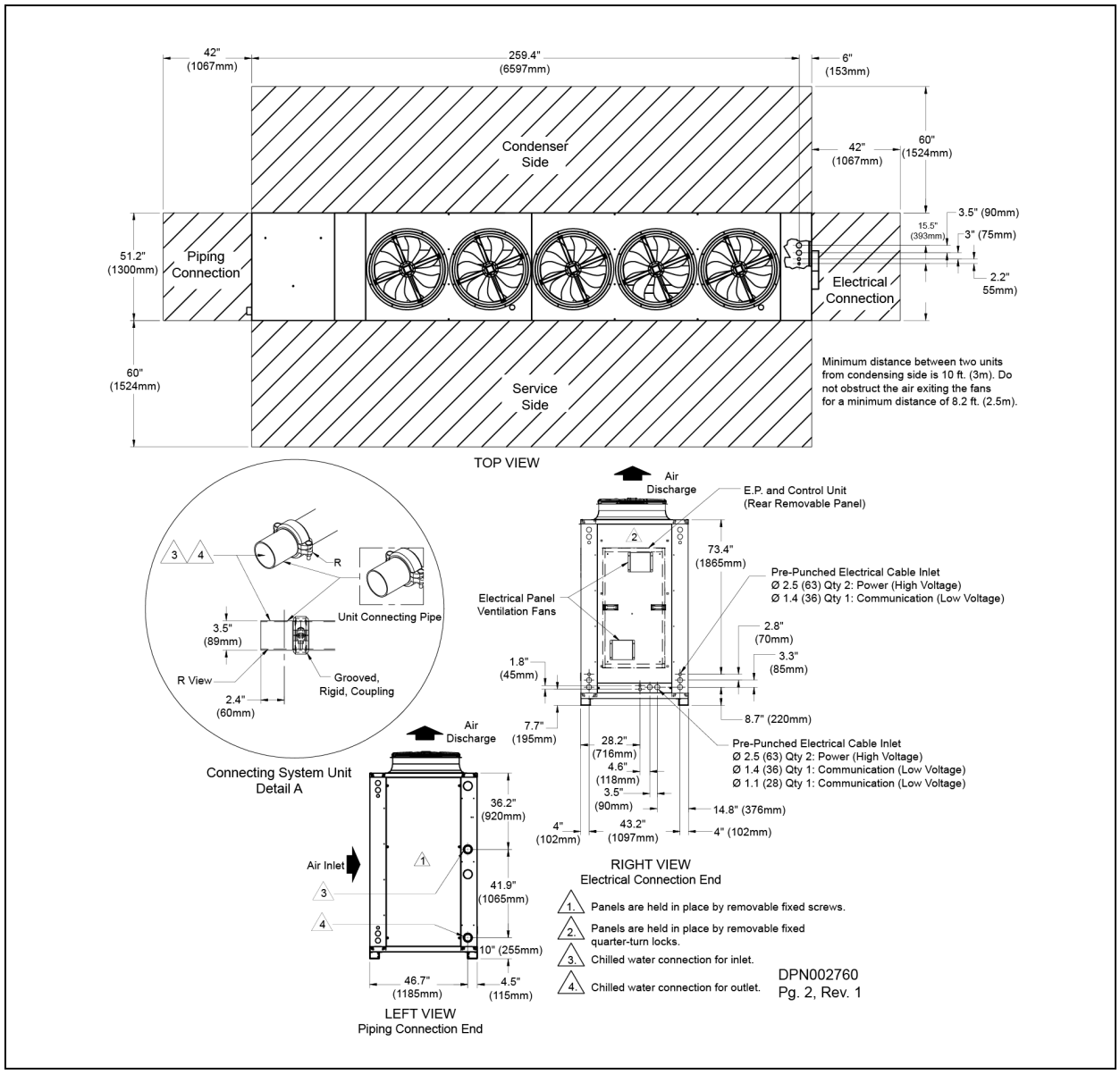


Figure 10.5 Grooved, rigid coupling connection system

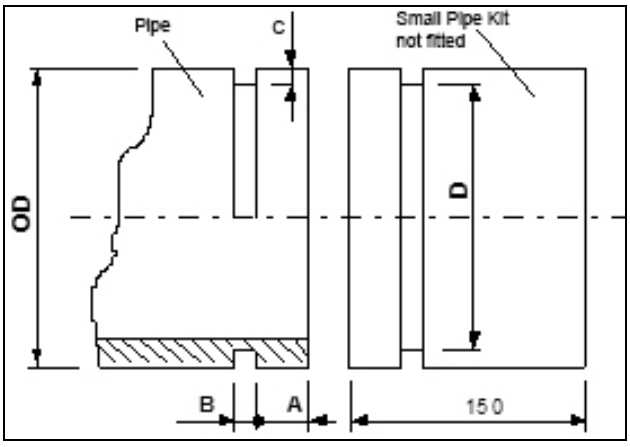


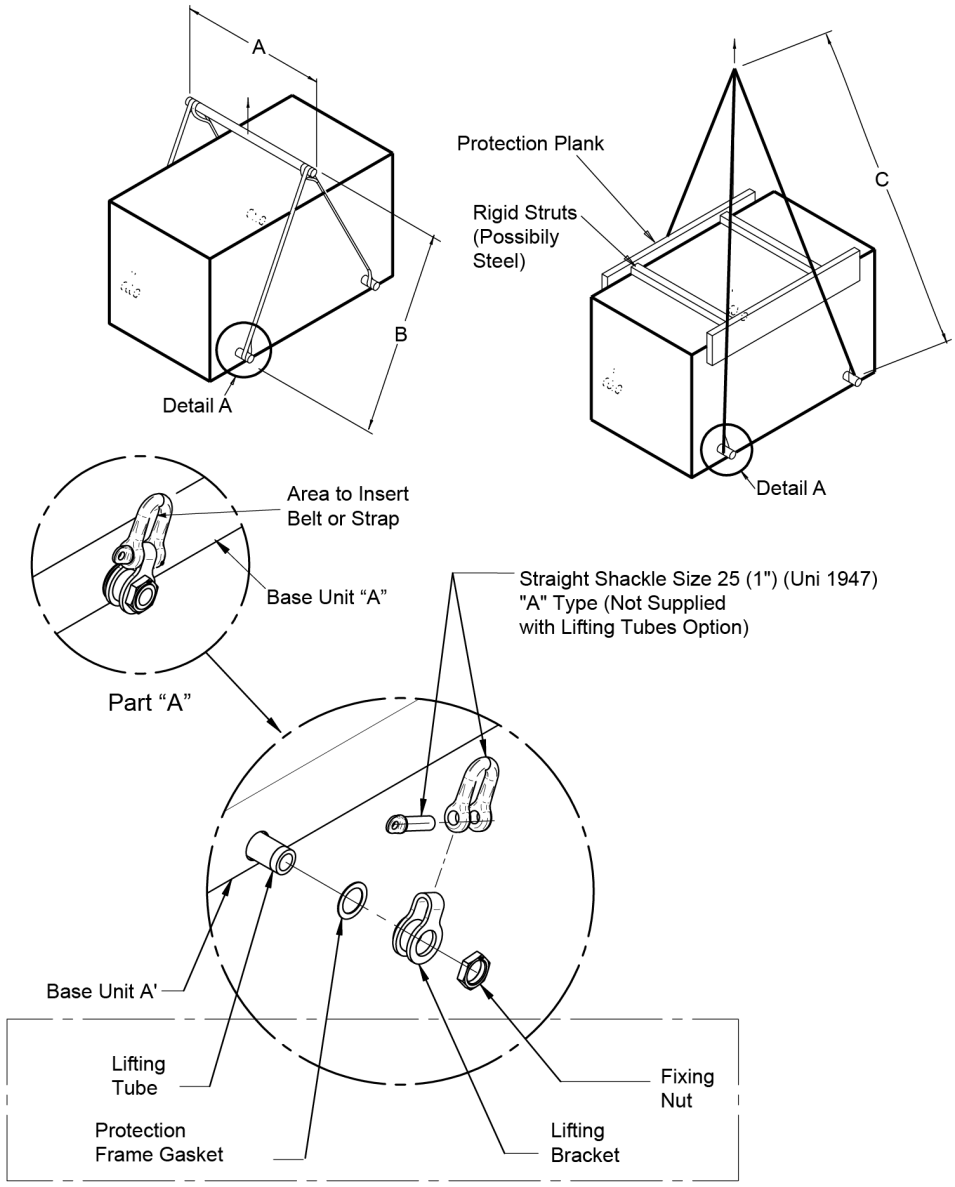
Table 10.9 Grooved, rigid coupling connection system dimensions

Dimensions						
OD	Ø inch	3"	4"	5"	6"	8"
A Tolerance	inch inch	0.625 ±0.030	0.625 ±0.030	0.625 ±0.030	0.625 ±0.030	0.750 ±0.030
B Tolerance	inch inch	0.313 ±0.030	0.375 ±0.030	0.375 ±0.030	0.375 ±0.030	0.438 ±0.030
C	inch	0.078	0.083	0.084	0.085	0.092
D Tolerance	Ø inch inch in	3.344 -0.020 +0.000	4.334 -0.020 +0.000	5.335 -0.022 +0.000	6.455 -0.022 +0.000	8.441 -0.025 +0.000

For welded hydraulic connection use the “line sections” supplied, otherwise directly connect grooved lines with the unit’s grooved, rigid couplings, taking care to suitably grease the joint gaskets.

WARNING! Risk of very heavy unit falling. Improper handling can cause equipment and building damage, injury or death.
Use extreme caution and lift and move the Liebert HPC-S chiller only as described in these instructions.
Installers must wear OSHA approved safety headgear, eye protection, gloves and shoes when moving, lifting and installing the unit.
Equipment used in moving, lifting and installing the chiller must meet OSHA requirements and be rated for the weight of the chiller unit. See Operating weight distribution - Unit without tank on page 55 andTable 10.15 on page 56 for chiller unit weights.
Read and follow the lifting equipment and/or ladder manufacturer's operating instructions and safety requirements.

Figure 10.6 Lifting instructions with tubes



Lifting Tubes Hardware Arrangement

1. Place the lifting tubes in the holes in the base indicated by the word 'LIFT HERE'.
2. Lock the ends of the tubes in position with the locking pins and split pins as shown above. The capacity of the lifting gear must be adequate to lift the load in question.
3. Check the weight of the units, the capacity of the lifting gear and ropes and the condition and suitability of the aforementioned equipment.
4. Lift the unit with a speed suitable for the load to be moved, so as not to damage the Liebert HPC-S 052-110 structure.

Table 10.10 Lifting

A (inch)	B (inch)	C (inch)
71	≈197	≈354

Figure 10.7 Lifting center of gravity axis

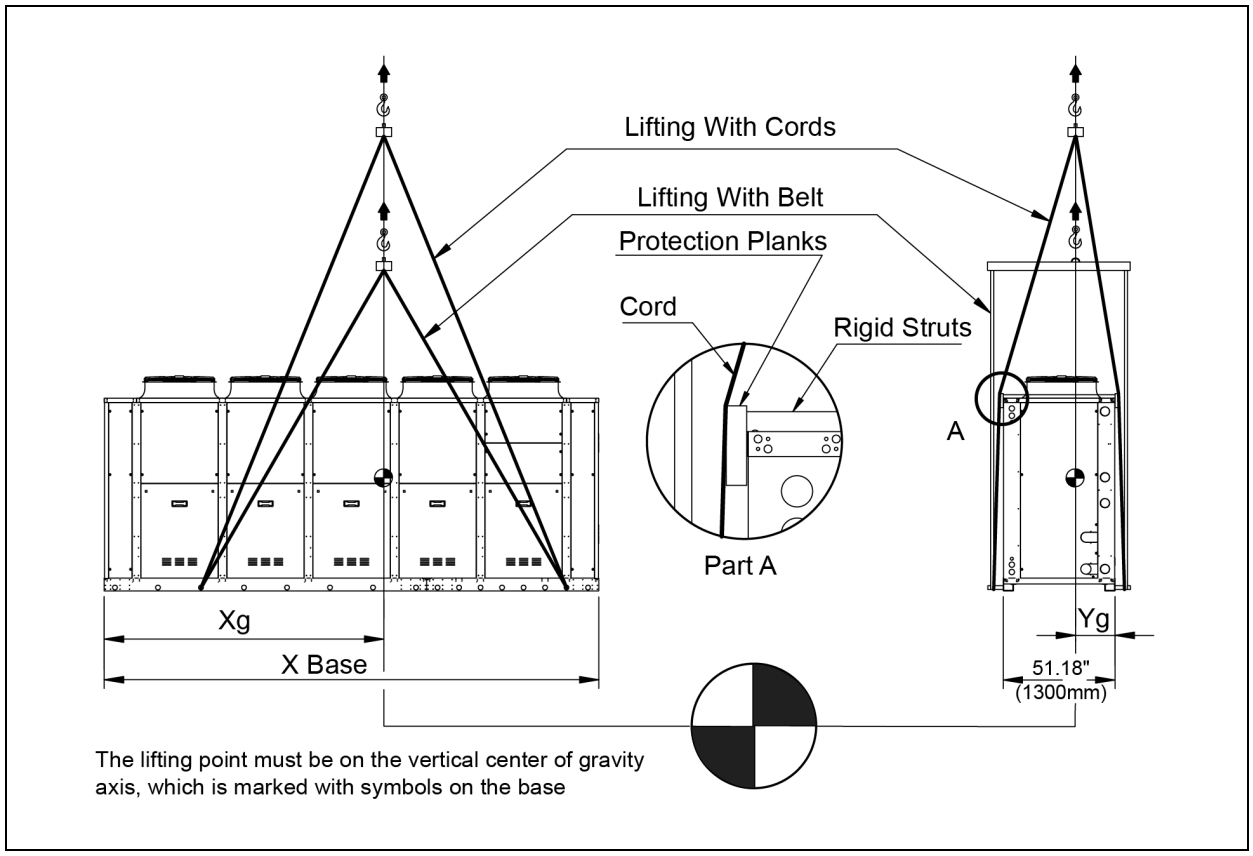


Table 10.11 Shipping weight and unit center of gravity position - Unit without tank

Models	X Base ft (m)	"Xg" ft (m)	Unit without pumps "Yg", ft (m)	Shipping Weight, lb (kg)
FG0052	15.58 (4.7)	8.48 (2.6)	2.10 (0.6)	5320 (2413)
FG0080	18.86 (5.7)	10.48 (3.2)	2.10 (0.6)	6619 (3002)
FB0110	18.86 (5.7)	10.48 (3.2)	2.10 (0.6)	6724 (3050)

Table 10.12 Shipping weight and unit center of gravity position - Unit with tank

Models	X Base ft (m)	"Xg" ft (m)	Unit without pumps "Yg", ft (m)	Shipping Weight, lb (kg)
FG0052	18.83 (5.7)	10.19 (3.1)	2.10 (0.6)	6292 (2854)
FG0080	22.15 (6.8)	12.22 (3.7)	2.10 (0.6)	7591 (3443)
FB0110	22.15 (6.8)	12.19 (3.7)	2.10 (0.6)	7697 (3491)

Figure 10.8 Support positions and loads

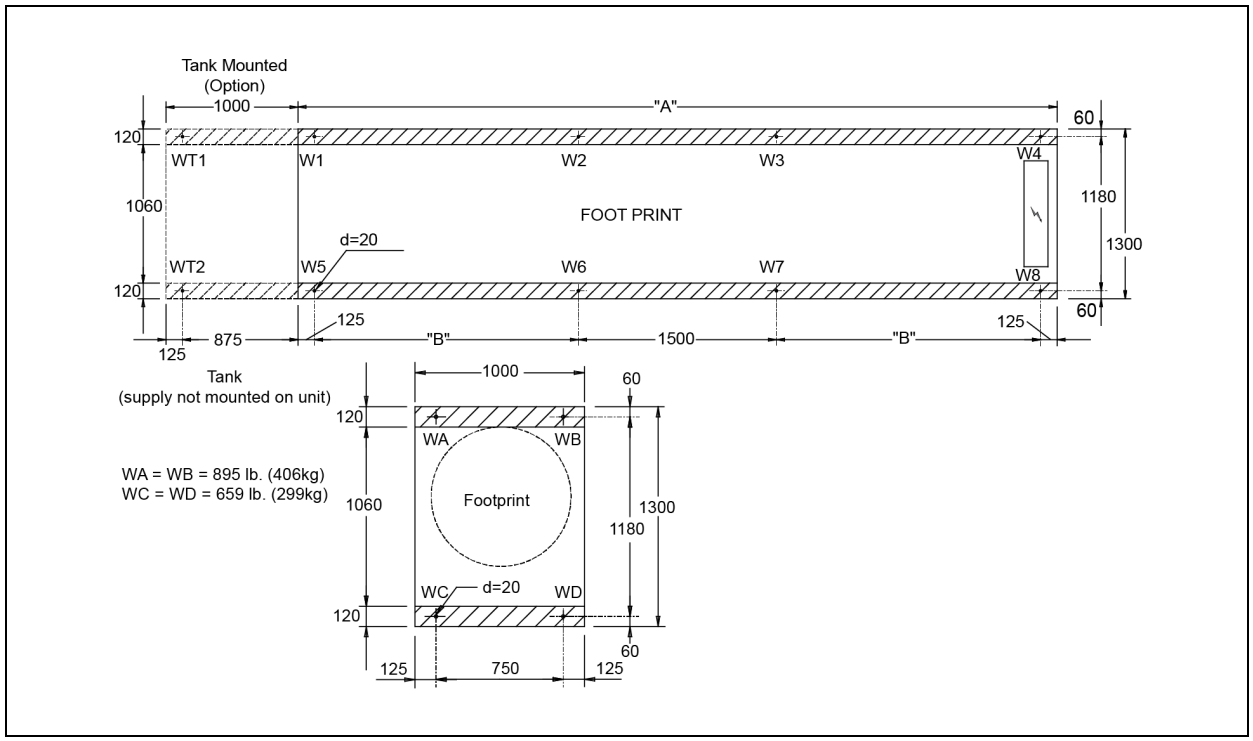


Table 10.13 Dimensions

Models	Dimensions, ft (m)	
	A	B
FG0052	15.58 (4.7)	4.92 (1.5)
FG0080	18.86 (5.7)	6.56 (1.9)
FB0110	18.86 (5.7)	6.56 (1.9)

Table 10.14 Operating weight distribution - Unit without tank

Models	Weight distribution, lb (kg)								Total lb (kg)
	W1	W2	W3	W4	W5	W6	W7	W8	
FG005	608 (275.8)	608 (275.8)	794 (360.2)	794 ()	606 (274.8)	606 (274.8)	791 (358.8)	791 (358.8)	5598 (2539.2)
FG0080	714 (323.8)	714 (323.8)	1021 (463.1)	1021 (463.1)	714 (323.8)	714 (323.8)	1023 (464.0)	1023 (464.0)	6943 (3149.3)
FB0110	732 (332.0)	732 (332.0)	1025 (464.9)	1025 (464.9)	739 (335.2)	739 (335.2)	1032 (468.1)	1032 (468.1)	7053 (3199.1)

Table 10.15 Operating weight distribution - Unit with tank

Size	Weight distribution, lb (kg)										Total lb (kg)
	W1	W1	W2	W3	W4	WT2	W5	W6	W7	W8	
FG0052	1093 (495.7)	1093 (495.7)	805 (365.1)	805 (365.1)	805 (365.1)	992 (449.9)	992 (449.9)	730 (331.1)	730 (331.1)	730 (331.1)	8775 (3980.3)
FG0080	1113 (504.8)	1113 (504.8)	1012 (459.0)	1012 (459.0)	1012 (459.0)	1027 (465.8)	1027 (465.8)	933 (423.2)	933 (423.2)	933 (423.2)	10,116 (4588.5)
FB0110	1124 (509.8)	1124 (509.8)	1021 (508.4)	1021 (508.4)	1021 (508.4)	1041 (472.2)	1041 (472.2)	946 (429.1)	946 (429.1)	946 (429.1)	10,231 (4640.7)

Figure 10.9 Rubber anti-vibration support + 264.17 gal US tank

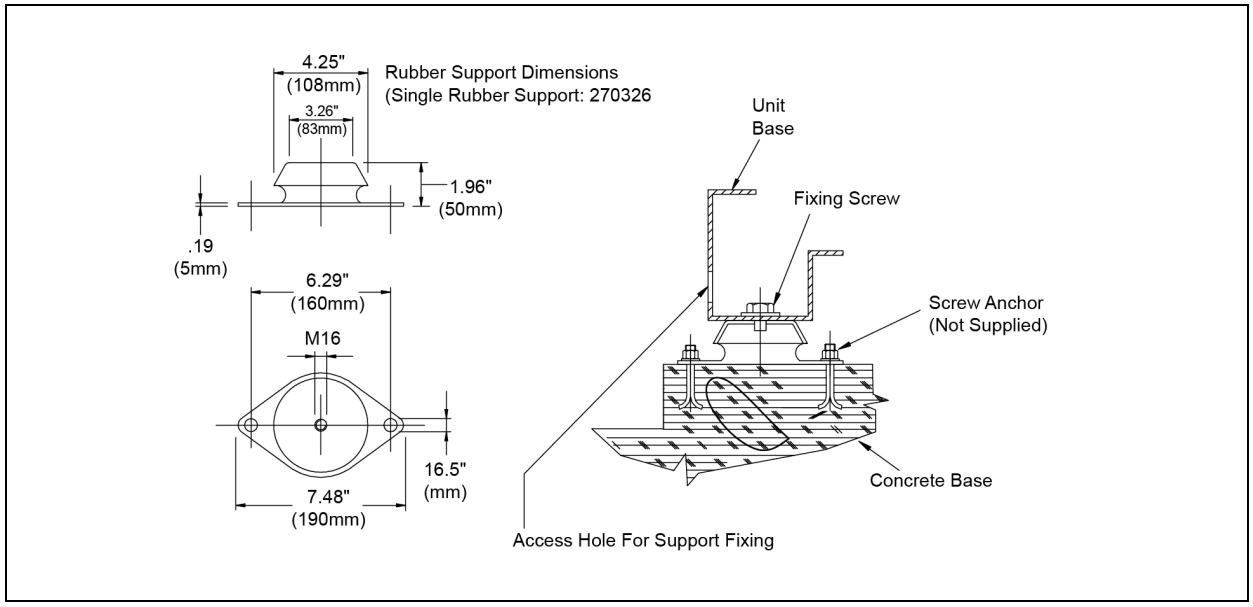
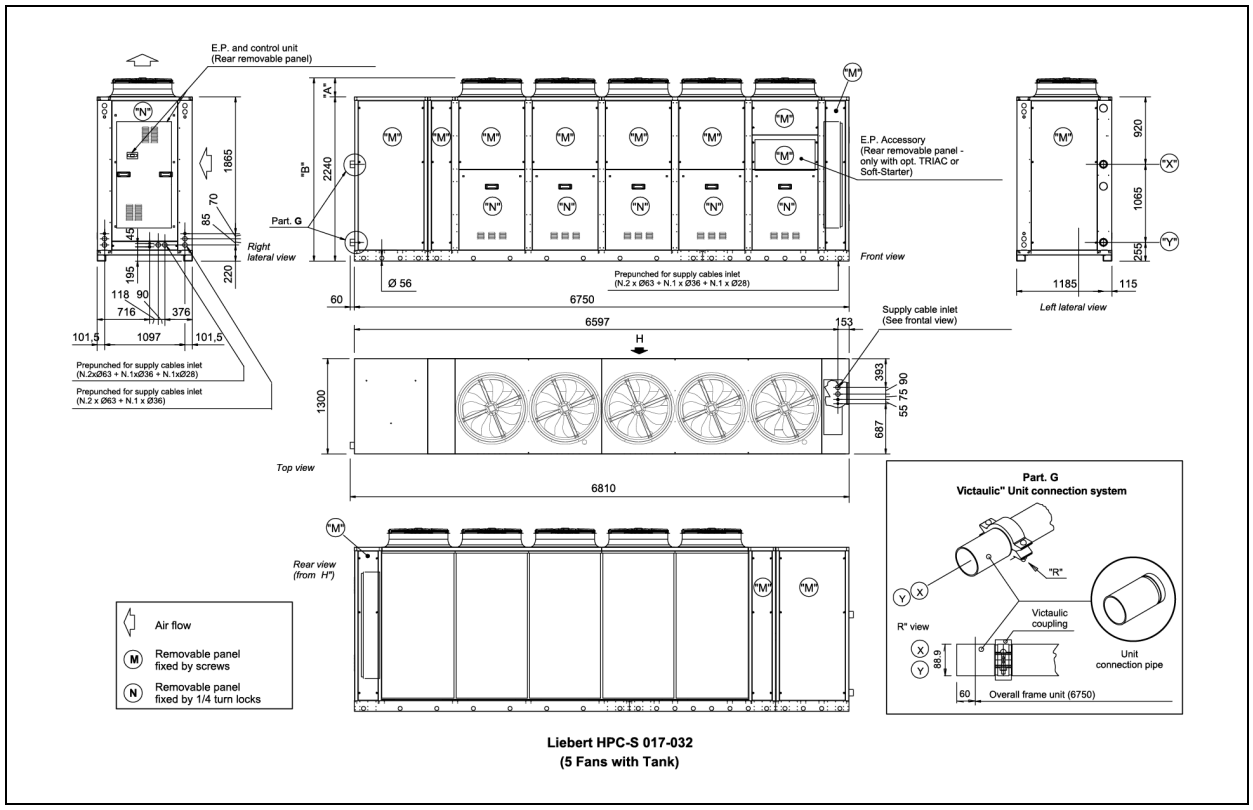


Table 10.16 Rubber supports + 264.17 gal US tank

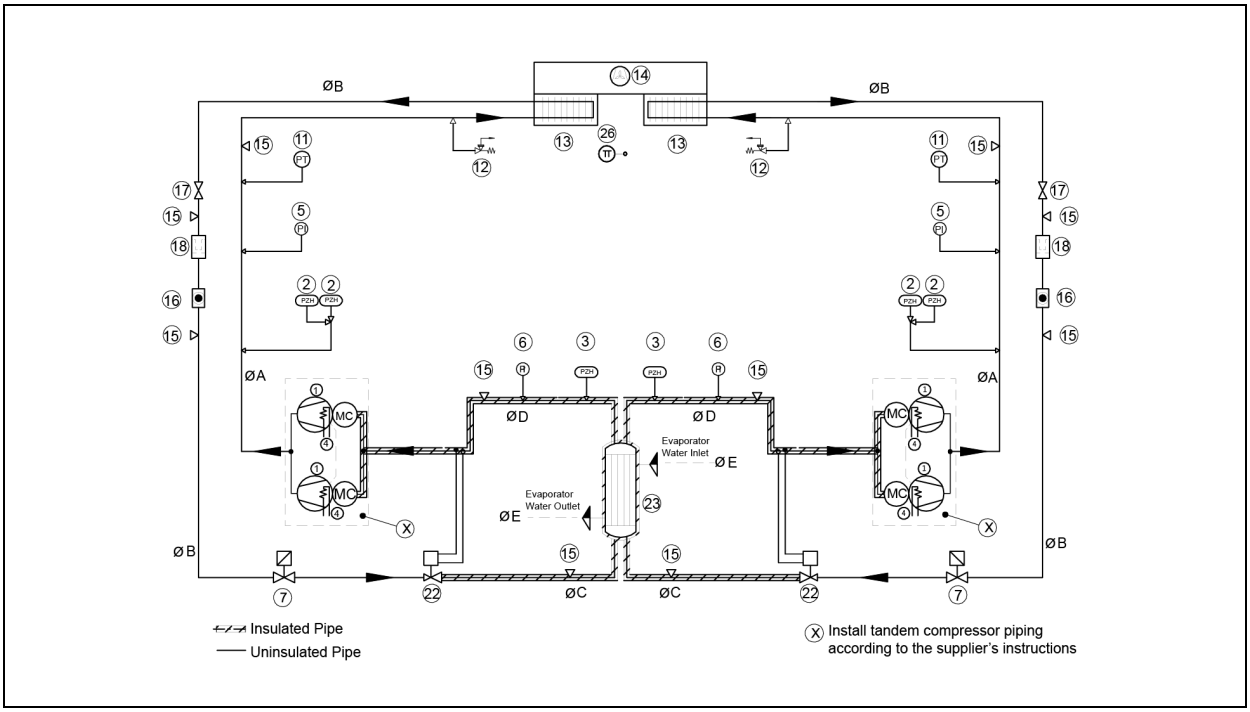
Unit	Configuration	Support Kit Code	Single Support Code	Kit Support Pieces
FG0052 FG0080 FB0110	Without tank	485625	270326	8
FG0052 FG0080 FB0110	With tank	485626	270326	10
264.17 gal US tank	Loose supplied	485649	270326	4
Each kit is complete with stainless steel fixing screws and plain washers for unit assembly.				

Figure 10.10 Overall dimensions



"A" (ft)	"B" (ft)	Chilled water connections	
0.95	8.3	"X" Inlet	"Y" Outlet
		Grooved, Rigid Coupling, 3"	

Figure 10.11 Refrigerant circuit



N.	Description	N.	Description
1	Compressor	13	Condenser
2	High-pressure Switch	14	Condenser Fans
3	Low-pressure Switch	15	Service Connection
4	Crankcase Heater	16	Sight Glass
5	High-pressure Manometer	17	Shutoff Valve
6	Low-pressure Manometer	18	Filter Dryer
7	Shutoff Solenoid Valve	22	Thermostatic Expansion Valve
11	Transducer Press. Sensor/hp Control	23	Evaporator
12	Safety Valve	26	External Air Sensor

NOTES

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