Liebert® CRV™
Row-based Cooling System

600-mm and 300-mm Wide

Installer/User Guide

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. For additional assistance, visit https://www.VertivCo.com/en-us/support/

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1 IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

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

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

Adhere to all warnings, cautions, notices and installation, operating and safety instructions on the unit and in this manual. Follow all installation, operation and maintenance instructions and all applicable national and local building, electrical and plumbing codes.

Any operation that requires opening doors or equipment panels must be carried out only by properly-trained and qualified personnel.

To identify the unit model and serial number for assistance or spare parts, locate the identification label on the unit. The label is inside the door on 600 mm (24 in.) units and at the electrical box on 300 mm (12 in.) units.

A warning label on the front and back panels reminds users that:

- the Liebert CRV restarts automatically
- the main switch must be opened before opening the internal compartments for any operation.

WARNING! Arc flash and electric shock hazard. Open all local and remote electric power disconnect switches, verify with a voltmeter that power is Off and wear personal protective equipment (PPE) 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 controller 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 the controller. 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.

WARNING! Risk of explosive discharge from high-pressure refrigerant. Can cause loss of refrigerant, environmental pollution, injury or death. This unit contains fluids and gases under high pressure. Relieve pressure before working with piping.

WARNING! Risk of refrigerant system rupture or explosion from overpressurization. Can cause equipment damage, injury or death. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.

WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit.

WARNING! Risk of top-heavy unit falling over. Improper handling can cause equipment damage, injury or death. Read all of the following instructions and verify that all lifting and moving equipment is rated for the weight of the unit before attempting to move, lift, remove packaging from or prepare the unit for installation.

WARNING! Risk of unsecured unit rolling off skid. Can cause equipment damage, injury or death. The 300-mm (12-in.) DX unit is on casters. Ensure that the unit/skid is located on a flat surface before loosening the hardware securing the to its shipping pallet.

WARNING! Risk of hair, clothing and jewelry entanglement with high speed rotating fan blades. Can cause equipment damage, serious injury or death. Keep hair, jewelry and loose clothing secured and away from rotating fan blades during unit operation.

WARNING! Risk of contact with extremely hot and/or cold surfaces. Can cause equipment damage, injury and death. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is Off, and verify that all components have reached a temperature that is safe for human contact or wear appropriate, OSHA-approved PPE before working within the electric connection enclosures or unit cabinet. Perform maintenance only when the system is de-energized and component temperatures have become safe for human contact.

CAUTION: Risk of contact with sharp edges, splinters, and exposed fasteners. Can cause injury. Only properly trained and qualified personnel wearing appropriate, OSHA-approved PPE should attempt to move, lift, remove packaging from or prepare the unit for installation.

NOTICE

Risk of oil contamination with water. Can cause equipment damage.

Liebert systems require the use of POE (polyolester) oil. POE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the POE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. POE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

NOTICE

Risk of improper refrigerant charging. Can cause equipment damage.

Refrigerant charge must be weighed into air-cooled compressorized systems before they are started. Starting scroll and digital scroll compressors without proper refrigerant charging can cause the compressors to operate at less than 5°F (–15°C) evaporator temperature and at less than 20 psig (138 kPa). Operation for extended periods at less than 20 psig (138 kPa) can cause premature compressor failure.

NOTICE

Risk of clogged or leaking drain lines. Can cause equipment and building damage.

This unit requires a water drain connection. Drain lines must be inspected at start-up and periodically, and maintenance must be performed to ensure that drain water runs freely through the drain system and that lines are clear and free of obstructions and in good condition with no visible sign of damage or leaks. This unit may also require an external water supply to operate.

Improper installation, application and service practices can result in water leakage from the unit. Water leakage can result in catastrophic and expensive building and equipment damage and loss of critical data center equipment.

Do not locate unit directly above any equipment that could sustain water damage.

We recommend installing a monitored fluid-detection system to immediately discover and report coolant-fluid system and condensate drain-line leaks.

NOTICE

Risk of piping-system corrosion and freezing fluids. Can cause leaks resulting in equipment and very expensive building damage. Cooling coils, heat exchangers and piping systems are at high risk of freezing and premature corrosion. Fluids in these systems must contain the proper antifreeze and inhibitors to prevent freezing and premature coil, piping and heat exchanger corrosion. The water or water/glycol solution must be analyzed by a competent local water treatment specialist before start up to establish the inhibitor and antifreeze solution requirement and at regularly scheduled intervals throughout the life of the system to determine the pattern of inhibitor depletion.

The complexity of water/glycol solution condition problems and the variations of required treatment programs make it extremely important to obtain the advice of a competent and experienced water treatment specialist and follow a regularly scheduled coolant fluid system maintenance program.

Water chemistry varies greatly by location, as do the required additives, called inhibitors, that reduce the corrosive effect of the fluids on the piping systems and components. The chemistry of the water used must be considered, because water from some sources may contain corrosive elements that reduce the effectiveness of the inhibited formulation. Sediment deposits prevent the formation of a protective oxide layer on the inside of the coolant system components and piping. The water/coolant fluid must be treated and circulating through the system continuously to prevent the buildup of sediment deposits and or growth of sulfate reducing bacteria.

Proper inhibitor maintenance must be performed in order to prevent corrosion of the system. Consult glycol manufacturer for testing and maintenance of inhibitors.

Commercial ethylene glycol, when pure, is generally less corrosive to the common metals of construction than water itself. It will, however, assume the corrosivity of the water from which it is prepared and may become increasingly corrosive with use if not properly inhibited.

We recommend installing a monitored fluid-detection system that is wired to activate the automatic-closure of field-installed coolant-fluid supply and return shut-off valves to reduce the amount of coolant-fluid leakage and consequential equipment and building damage. The shut-off valves must be sized to close-off against the maximum coolant-fluid system pressure in case of a catastrophic fluid leak.

NOTICE

Risk of frozen pipes and corrosion from improper coolant mixture. Can cause equipment damage and building.

When piping or the cooling unit may be exposed to freezing temperatures, charge the system with the proper percentage of glycol and water for the coldest design ambient temperature. Automotive antifreeze is unacceptable and must NOT be used in any glycol fluid system. Use only HVAC glycol solution that has been prepared by industry practices.

NOTICE

Risk of no-flow condition. Can cause equipment damage. Do not leave the water/coolant fluid-supply circuit in a no-flow condition. Idle fluid allows the collection of sediment that prevents the formation of a protective oxide layer on the inside of tubes. Keep unit switched On and water/coolant fluid-supply circuit system operating continuously.

NOTICE

Risk of improper water supply. Can reduce humidifier efficiency or obstruct humidifier plumbing.

Do not use completely demineralized water with this unit. The water must contain minerals for the electrode principle to work.

Do not use a hot water source. It will cause deposits that will eventually block the fill-valve opening.

NOTICE

Risk of water backing up in the drain line. Leaking and overflowing water can cause equipment and building damage.

Do not install an external trap in the drain line. This line already has a factory-installed trap inside the cabinet (Except for 300-mm (12-in.) Chilled-water models).

This line may contain boiling water. Use copper or other suitable material for the drain line. Sagging condensate drain lines may inadvertently create an external trap.

NOTICE

Risk of doorway/hallway interference. Can cause unit and/or structure damage. The unit may be too large to fit through a doorway or hallway while on the skid. Measure the unit and passageway dimensions, and refer to the installation plans prior to moving the unit to verify clearances.

NOTICE

Risk of damage from forklift. Can cause unit damage. Keep tines of the forklift level and at a height suitable to fit below the skid and/or unit to prevent exterior and/or underside damage.

NOTICE

Risk of improper storage. Can cause unit damage.

Keep the unit upright, indoors and protected from dampness, freezing temperatures and contact damage.

NOTICE

Risk of release of hazardous substances into the environment. Can cause environmental pollution and violation of environmental regulations.

The Liebert CRV contains substances and components hazardous for the environment (electronic components, refrigerating gases and oils). At the end of its useful life, the Liebert CRV must be dismantled by specialized refrigerating technicians. The unit must be delivered to suitable centers specializing in the collection and disposal of equipment containing hazardous substances.

NOTE: The Liebert indoor cooling unit has a factory-installed high pressure safety switch in the high-side refrigerant circuit. A pressure relief valve is provided with Liebert Lee-Temp™ condensers. Consult your local building code to determine whether the Liebert MC condensers will require field-provided pressure-relief devices.

Agency Listed

Standard 60-Hz units are CSA certified to the harmonized U.S. and Canadian product safety standard CSA C22.2 No 236/UL 1995 for Heating and Cooling Equipment and are marked with the CSA c-us logo.

2 NOMENCLATURE AND COMPONENTS

This section describes the model-number configuration for Liebert CRV units and components.

2.1 Model-number Nomenclature

The tables describe the 25-digit configuration number. The 14-digit model number consists of the first 10 digits and last 4 digits of the configuration number.

For the full description of configuration and model number refer to Model-number Nomenclature Detail on page 153.

MODEL NUMBER DIGITS 1 TO 10										MODEL DETAILS											MODEL NUMBER DIGITS 11 TO 14			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	R	0	2	0	R	A	1	C	7	S	H	1	8	1	1	E	L	1	0	P	A	–	–	–

Digits 1-2 - Unit Family	Digit 14 - Air Filter
Digits 3-5 - Nominal Capacity, kW	Digit 15 - Water/Glycol Valve Type
Digit 6 - Row-Based, Unit Depth	Digit 16 - Enclosure
Digit 7 - System Type	Digit 17 - High-Voltage Options
Digit 8 - Fan Type	Digit 18 - Option Package
Digit 9 - Power Supply	Digit 19 - Liebert IntelliSlot™ Housing
Digit 10 - Cooling System	Digit 20 - Future Options
Digit 11 - Humidifier	Digit 21 - Packaging With Ramp
Digit 12 - Control System	Digit 22 - Special Features
Digit 13 - Reheat	Digits 23-25 - Factory Configuration Number

2.2 Component Location

The unit component locations are described in the submittal documents included in the Submittal Drawings on page 156.

The following table lists the relevant documents by number and title.

Table 2.1 Component-location Drawings

DOCUMENT NUMBER	TITLE
DPN003738	Component Locations, 600mm (24in.) Models
DPN003583	Component Location, 300mm (12in.) Air Cooled Models
DPN003585	Component Location, 300mm (12in.) Water Glycol Cooled Models
DPN003584	Component Location, 300mm (12in.) Chilled Water Models

2.3 Liebert CRV Description

The Liebert CRV is a precision cooling unit available in compressorized (air-, water- or glycol-cooled) and chilled-water configurations to be installed within a row of high-density computing racks in a “hot aisle-cold aisle” configuration.

Air enters the rear of the CRV from the hot aisle, is filtered, cooled and conditioned, then discharged into the cold aisle. The CRV provides all the necessary functions of a standard Thermal Management unit, including cooling, heating, humidification, dehumidification, air filtration, condensate management, temperature control, alarm monitoring and data communication. (The 300 mm [12 in.] models do not provide heating, humidification or dehumidification.) The CRV is optimized for maximum cooling capacity in a minimal footprint.

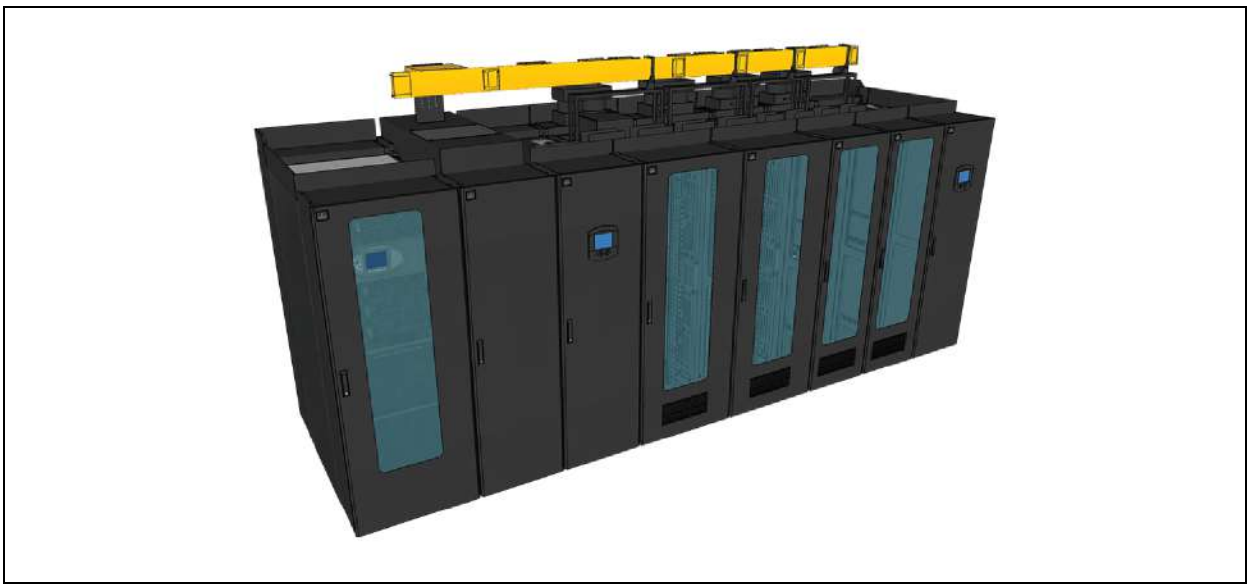
Figure 2.1 Liebert CRV, front and rear views

ITEM	DESCRIPTION
1	Front view
2	Rear view
3	600-mm (24-in.) DX and CW models
4	300-mm (12-in,) DX models
5	300-mm (12-in.) CW models

2.4 Vertiv SmartRow Micro-Data Center Solution

The Vertiv™ SmartRow DCX is a comprehensive, micro-data center in a row. Starting with the IT requirements, all of the associated remote management, monitoring and infrastructure are configured to address the initial and future needs of the rack-mount equipment. This approach simplifies the entire process, from selection through to deployment, reducing the time, complexity and costs associated with alternative approaches. The factory-engineered SmartRow platform leverages the Liebert CRV as part of its thermal-management system. For more information visit, www.VertivCo.com/SmartRowDCX.

Figure 2.2 SmartRow DCX



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3 PRE-INSTALLATION PREPARATION AND GUIDELINES

NOTE: Before installing unit, determine whether any building alterations are required to run piping, wiring and duct work. Follow all unit dimensional drawings and refer to the submittal engineering dimensional drawings of individual units for proper clearances.

Refer to Model-number Nomenclature on page 13 and the appropriate submittal drawings, to determine the type of system being installed and anticipate building alterations, piping and duct work needed.

The unit dimensions, pipe-connection locations, and piping schematics are described in the submittal documents included in the Submittal Drawings on page 156.

- Verify that the floor is level, solid and sufficient to support the unit. See Table 3.2 below. for unit weights.
- Confirm that the room is properly insulated and has a sealed vapor barrier.
- For proper humidity control, keep outside or fresh air to an absolute minimum (less than 5% of total air circulated in the room).
- Do not install a Liebert CRV in an alcove or at the end of a long, narrow room.
- Install the units as close as possible to the largest heat load.
- Allow at least the minimum recommended clearances for maintenance and service. See the appropriate submittal drawings for dimensions.
- We recommend installing an under-floor water detection system. Contact your Vertiv™ representative for information.

3.1 Planning Dimensions

The unit, floor stand, and plenum dimensions are described in the submittal documents included in the Submittal Drawings on page 156.

The following table lists the relevant documents by number and title.

Table 3.1 Dimension Planning Drawings

DOCUMENT NUMBER	TITLE
DPN001791	Cabinet and Floor Planning Dimensional Data, 600 mm (24 in.)
DPN002807	Cabinet and Floor Planning Dimensional Data, 300 mm (12 in.)

3.2 Unit Weights

Table 3.2 Weights without packaging

MODEL NO.	UNIT WIDTH	WEIGHT ± 5%, LB (KG)		
		AIR-COOLED	WATER/GLYCOL-COOLED	CHILLED WATER
CR019	300 mm (12 in.)	507 (230)	545 (247)	–
CR032		–	–	418 (190)
CR020	600 mm (24 in.)	739 (335)	772 (350)	–
CR035		805 (365)	849 (385)	–
CR040		–	–	728 (330)

Table 3.3 Shipping weights

MODEL NO.	DOMESTIC PACKAGING, LB (KG)			EXPORT PACKAGING, LB (KG)		
	AIR	WATER/GLYCOL	CHILLED WATER	AIR	WATER/GLYCOL	CHILLED WATER
CR019	649 (294)	687 (311)	–	721 (327)	782 (355)	–
CR032	–	–	560 (254.0)	–	–	683 (309.8)
CR020	846 (384)	879 (399)	–	953 (432)	986 (447)	–
CR035	912 (414)	956 (434)	–	1019 (462)	1063 (482)	–
CR040	–	–	835 (379)	–	–	942 (427)

4 EQUIPMENT INSPECTION AND HANDLING

SAFETY INFORMATION

WARNING! Risk of top-heavy unit falling over. Improper handling can cause equipment damage, injury or death. Read all of the following instructions and verify that all lifting and moving equipment is rated for the weight of the unit before attempting to move, lift, remove packaging from or prepare the unit for installation. Unit weights are specified in Table 3.2 on page 17 and Table 3.3 on page 18.

CAUTION: Risk of contact with sharp edges, splinters, and exposed fasteners. Can cause injury. Only properly trained and qualified personnel wearing appropriate, OSHA-approved PPE should attempt to move, lift, remove packaging from or prepare the unit for installation.

NOTICE

Risk of doorway/hallway interference. Can cause unit and/or structure damage. The unit may be too large to fit through a doorway or hallway while on the skid. Measure the unit and passageway dimensions, and refer to the installation plans prior to moving the unit to verify clearances.

NOTICE

Risk of damage from forklift. Can cause unit damage. Keep tines of the forklift level and at a height suitable to fit below the skid and/or unit to prevent exterior and/or underside damage.

NOTICE

Risk of improper storage. Keep the unit upright, indoors and protected from dampness, freezing temperatures and contact damage.

Upon arrival of the unit and before unpacking:

- Verify that the labeled equipment matches the bill of lading.
- Carefully inspect all items for visible or concealed damage.
- Report damage immediately to the carrier and file a damage claim with a copy sent to Vertiv™ or to your sales representative.
- For initial access use a 7/32-in. Allen wrench for panel removal.

Equipment Recommended for Handling the Unit:

- Forklift
- Pallet jack
- Piano jacks
- Slings
- Spreader bars

4.1 Packaging Material

All material used to package this unit is recyclable. Please save for future use or dispose of the material appropriately.

4.2 Handling the Unit while Packaged

Transport the unit with a forklift or pallet jack. See Moving 600-mm (24-in.) Models Using Rigging below for additional handling option for the 600-mm (24-in) unit.

When using a forklift or pallet jack:

- Make sure that the forks (if adjustable) are spread to the widest allowable distance that will fit under the skid.
- Make sure the fork length is suitable for the skid length. Skid length for 600-mm (24-in.) model is 60 in (1524 mm). Skid length for 300-mm (12-in.) model is 54 in. (1372 mm)
- Do not lift the packaged unit any higher than 4 in. (102 mm). All personnel except those moving the unit must be kept 12 ft (3.7 m) or more from the unit while it is being moved.
- If the unit must be lifted higher than 4 in. (102 mm), all personnel not directly involved in moving the unit must be 20 ft (5 m) or more from the unit.
- Always refer to the location of the center-of-gravity indicators when lifting the unit, see Figure 4.1 below.

Figure 4.1 Center-of-gravity indicator

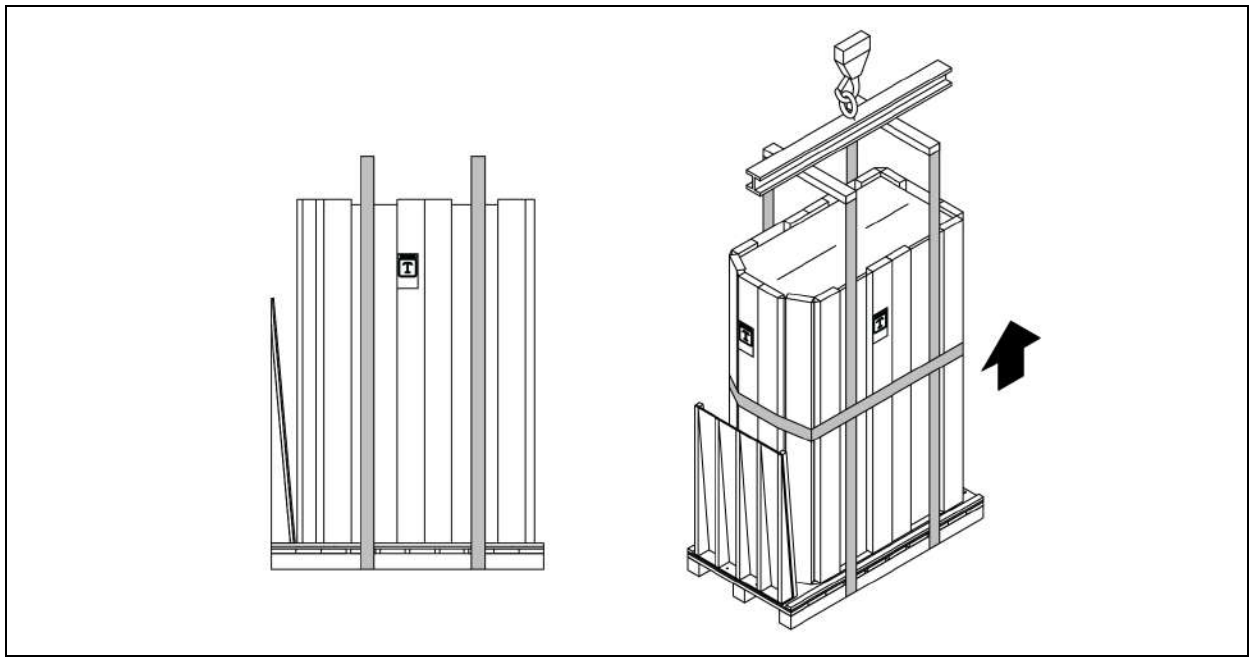
4.2.1 Moving 600-mm (24-in.) Models Using Rigging

1. Use a pallet jack or forklift to raise the packaged unit.
2. Place slings under the skid runners, equally spacing the slings to make sure the unit is balanced, see Figure 4.2 on the facing page.
3. Lower the unit and remove the pallet jack or forklift.
4. Connect the slings to the lifting device, using spreader bars or similar equipment to protect the unit, see Figure 4.2 on the facing page.

NOTE: Wrapping one or two more straps around the middle of the unit will improve stability when it is lifted.

5. Move the unit to its installation location. Two or more properly trained and qualified personnel are required to move the unit to its installation location.
6. Lower the unit and remove the slings.

Figure 4.2 Moving using rigging—600 mm (24 in.)



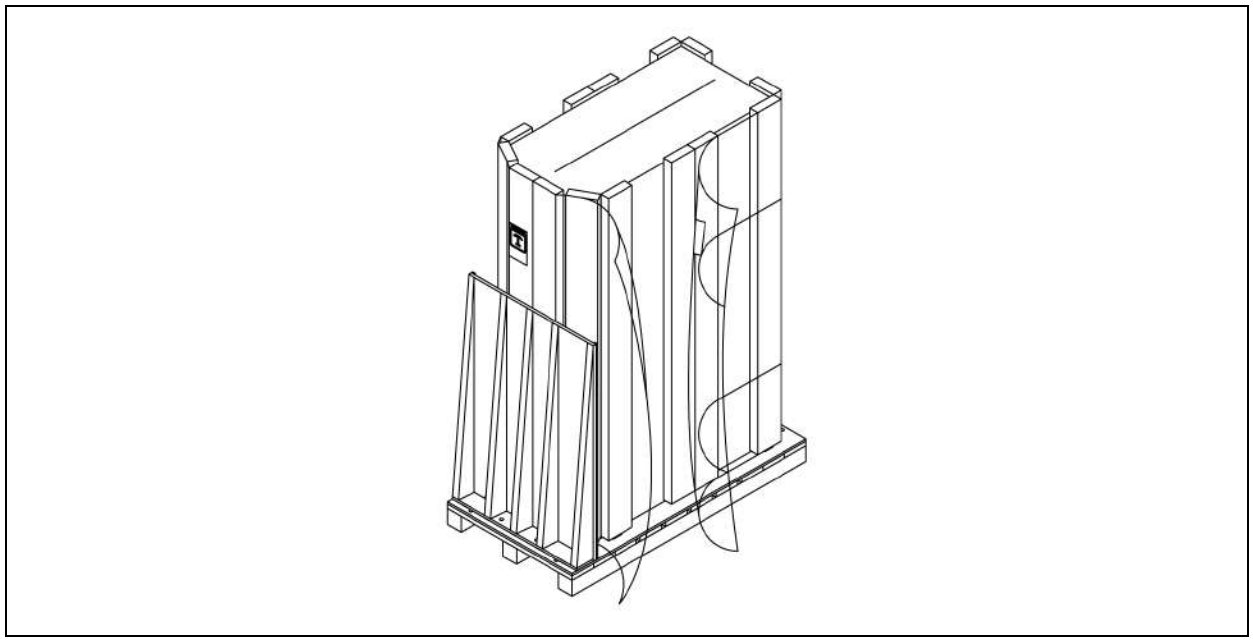
4.3 Removing Packaging from 600-mm (24-in.) Unit

1. Remove the lag bolts securing the ramp to the skid.
2. Remove the exterior stretch wrap packaging from around the unit and any planks tightened with the stretch wrap, exposing the protective corner and side packaging planks, as shown in Figure 4.3 on the next page.
3. Remove the corner and side packaging planks from the unit, exposing the bag over the unit.

NOTE: The bag may remain in place to protect from dust and to protect the unit panels, or it may be removed for immediate installation.

4. Remove the bag from the unit when ready to remove the skid and install the unit.

Figure 4.3 Unpacking the 600-mm (24-in.) Unit

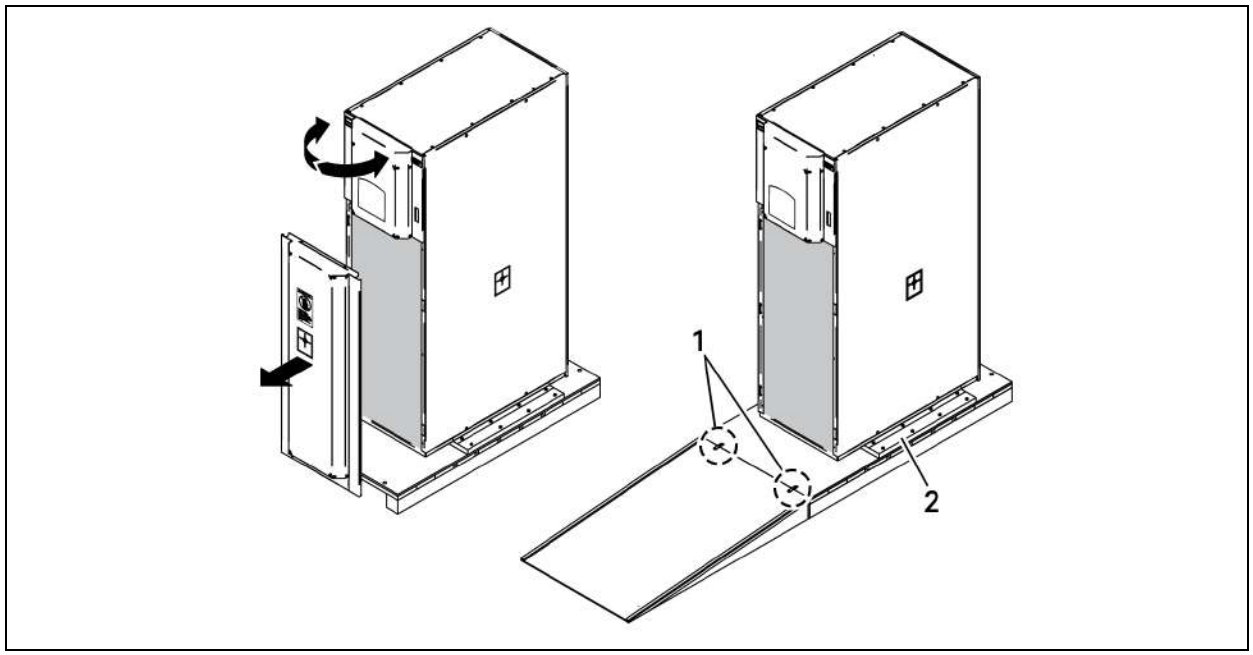


4.4 Removing 600-mm (24-in.) Models from the Skid

1. Remove, baffle panel from the front of the unit:
   - Open the top-panel door (with iCOM display) as shown Figure 4.4 on the facing page.
   - Using a T30 Torx screwdriver, remove the bottom baffle panel assembly, and set aside until needed for reattachment.
   - Close and latch the top panel door.

2. Install the ramp on the skid:
   - Place the ramp against the skid as shown in Figure 4.4 below.
   - Remove the orange clips from the plastic bag, and insert the clips into holes on the skid and ramp.
3. Using a 17-mm socket wrench, open-end wrench, or pliers, remove the 8 bolts (4 on each side) that secure side tie-down brackets to skid, shown in Figure 4.4 below.

Figure 4.4 Removing the unit from the skid



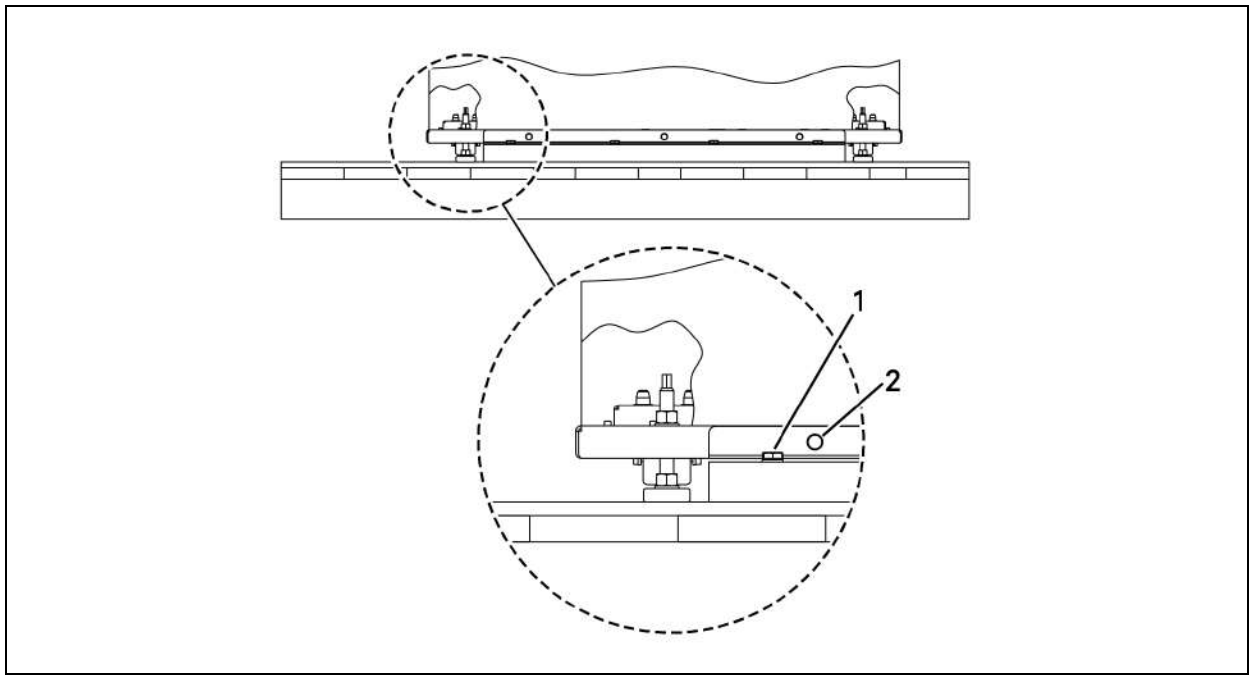
ITEM	DESCRIPTION
1	Orange clips inserted into holes.
2	Bolts in tie-down brackets (4 each side)

4. Lower the four stabilizer feet until the side tie-down brackets no longer contact the skid.
5. Using a 13-mm socket wrench, see Figure 4.5 on the next page, open-end wrench, or pliers, remove the 6 bolts (3 on each side) that secure the side tie-down brackets to the unit base, and remove the side tie-down brackets.
6. Using a 17-mm socket wrench, see Figure 4.5 on the next page, open-end wrench, or pliers, remove the 8 bolts (4 on each side) that secure the lift block to the skid, and remove the lift blocks from the skid.

7. Using the stabilizer feet, lower the unit to the skid. Make sure that the stabilizer feet are all the way in the "up" position.
8. Move the unit to its installation location.

IMPORTANT! Two or more properly trained and qualified personnel are required to move the unit to its installation location.

Figure 4.5 Stabilizer feet, 13-mm bolt and 17-mm bolt locations



ITEM	DESCRIPTION
1	M17 socket
2	M13 socket

4.4.1 Reattaching Baffle Panel—600 mm (24 in.)

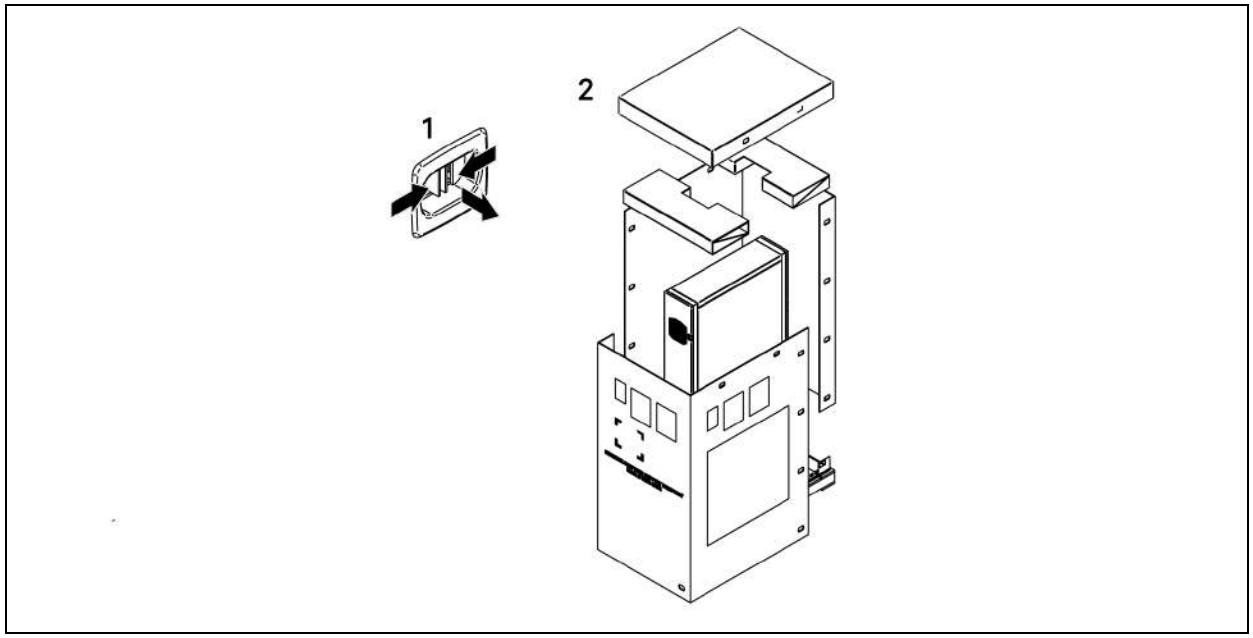
Once the unit is moved to where it will be installed, the baffle panel can be reattached.

1. Open top panel door (with iCOM display), see Figure 4.4 on the previous page.
2. Reattach the bottom baffle panel assembly with screws, using a T30 Torx drive.
3. Close and latch top panel door.

4.5 Removing Packaging from 300-mm (12-in.) Unit

1. To remove the packaging, release the retaining clips along the seams in the corrugated packaging around the unit.
2. Remove all exterior packaging from around the unit.
3. Remove the bag from the unit when ready to remove the skid and install the unit.

Figure 4.6 Removing packaging from unit



ITEM	DESCRIPTION
1	Retaining clip
2	Packaging removal

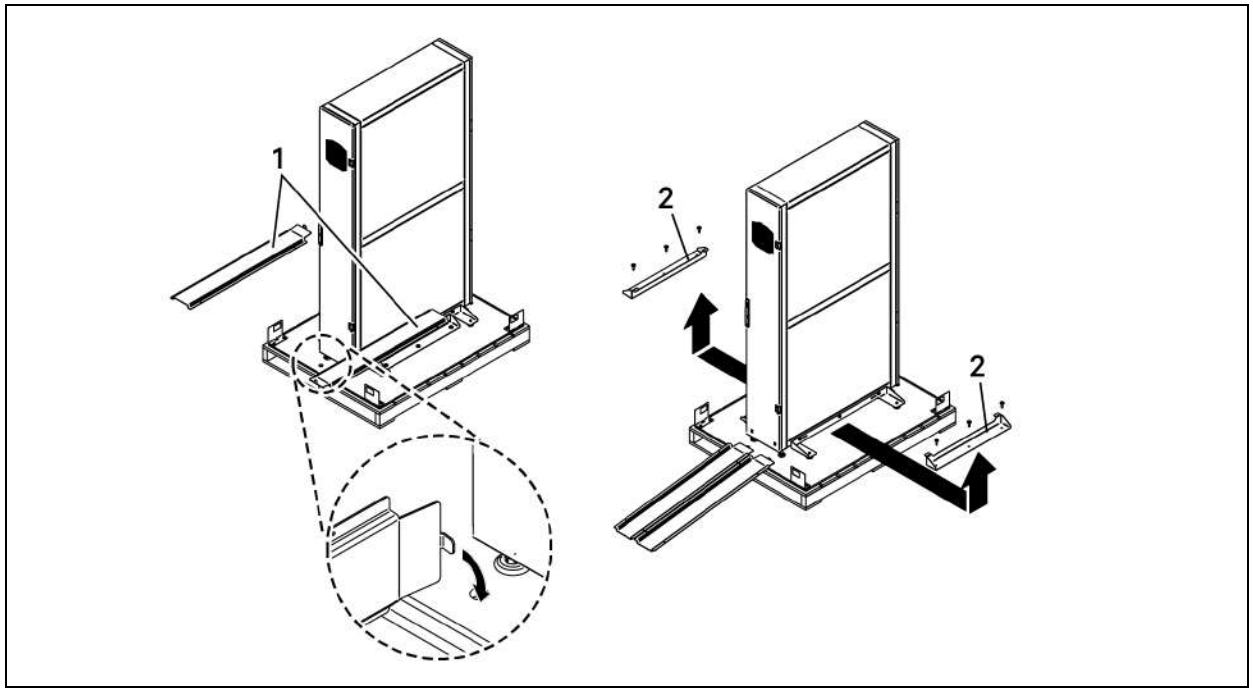
4.6 Removing 300-mm (12-in.) Models from the Pallet

WARNING! Risk of unsecured unit rolling off skid. Can cause equipment damage, injury or death. The 300-mm (12-in.) DX unit is on casters. Ensure that the unit/skid is located on a flat surface before loosening the hardware securing the to its shipping pallet.

1. Install the ramp:
   - Remove the (2) 1/4-in. hex-head bolts that secure each ramp the skid.
   - Refer to Figure 4.7 below, and fit the tab on each ramp into a hole on the shipping pallet.
2. Remove the (3) 9/16-in. hex-head bolts that secure the shipping brackets, one bracket on each side of the unit.
3. Roll the unit down the ramp and off the pallet onto a flat surface.

IMPORTANT! Two or more properly trained and qualified personnel are required to move the unit to its installation location.

Figure 4.7 Installing ramps and removing shipping brackets



ITEM	DESCRIPTION
1	Ramp
2	Shipping bracket

5 INSTALLING IN ENCLOSURE ROW

Built-in casters let you roll the Liebert CRV into position for installation. Stabilizers reduce the likelihood of the module tipping over. These stabilizers, shown in Figure 5.1 on the next page, must be removed before the unit is positioned in the row. Adjustable leveling feet prevent it from moving after positioning, See Adjusting Base Supports/Leveling Feet below.

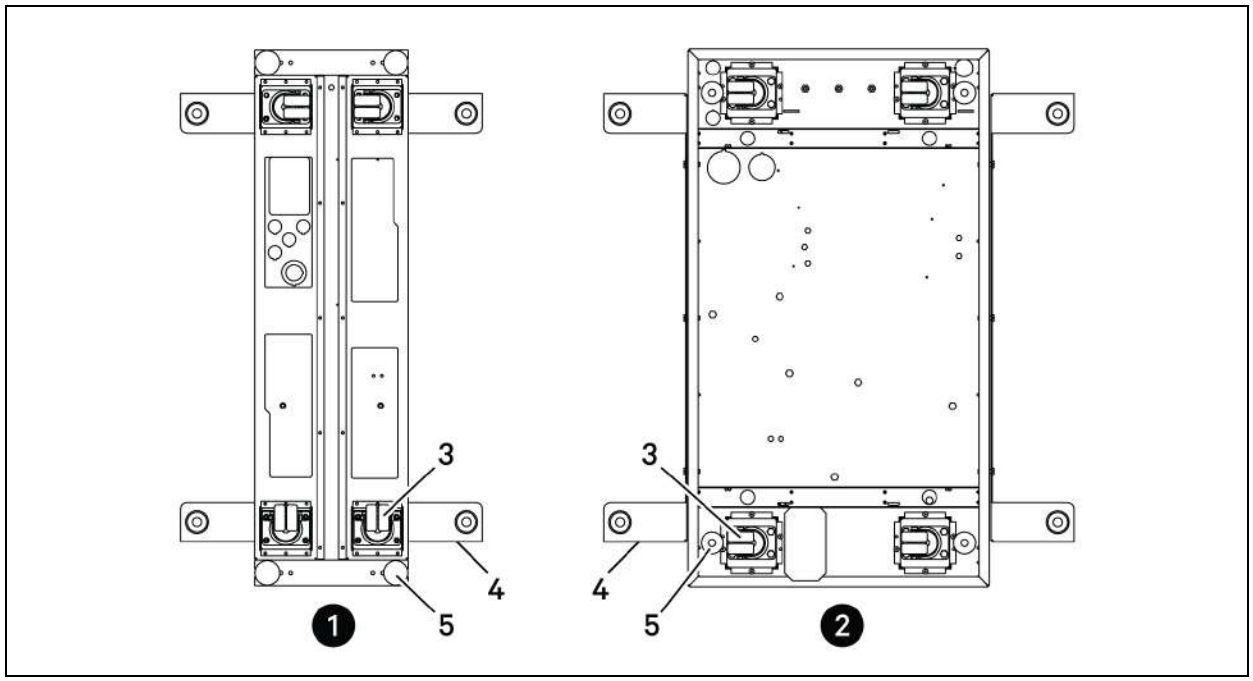
Once positioned, secure the unit to the floor or to an adjacent cabinet.

Adjustable brackets for attaching the unit to an adjacent cabinet are included with each unit. A bracket to attach the unit to the floor is available from your Vertiv™ representative.

5.1 Adjusting Base Supports/Leveling Feet

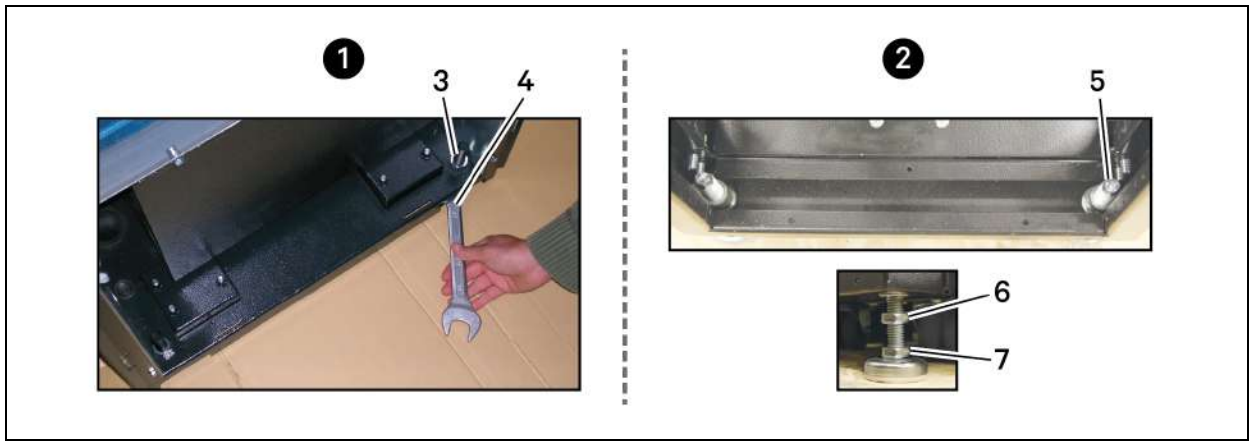
1. After the unit is in its final installation position, open the display door and remove the lower front baffle panel using a 10-mm nut-driver or T30 Torx Bit to prepare for installation.
2. Open the rear panel.
3. Using an adjustable wrench, adjust the four base supports, or feet, shown in Figure 5.1 on the next page. Ensure that the unit is level to avoid corrosion or health hazards caused by condensate accumulation.
    a. Turning the base supports (leveling feet) clockwise, extends them, and lifts the unit one corner at a time.
    b. Tighten the nut on the top of each foot to lock the feet. The nut on 600-mm (24-in.) units is inside the cabinet. The nut on 300-mm (24-in.) units is under the cabinet, as shown in Figure 5.2 on page 29.

Figure 5.1 Caster locations



ITEM	DESCRIPTION
1	Rear of 300-mm (12-in.) unit, bottom view
2	Rear of 600-mm (24-in.) unit, bottom view
3	Caster, 1 at each corner
4	Stabilizer, 1 at each corner
5	Adjustable leveling foot, 1 at each corner

Figure 5.2 Adjust leveling feet



ITEM	DESCRIPTION
1	600-mm (24-in.) unit
2	300-mm (12-in.) unit
3	Nut on top of foot.
4	Adjust foot with wrench
5	Adjust foot with wrench
6	Jam nut, secures foot and final height
7	Nut to raise/lower foot.

5.2 Optional Tie-down Brackets for 300-mm (12-in.) Units

An optional tie-down bracket may be installed on the unit to secure it in the row. The bracket keeps the space between the cooling unit and adjacent equipment constant, preventing noise from vibration.

WARNING! Risk of electric shock and/or improper drilling. Can cause equipment damage, injury or death. Open all local and remote electric power disconnect switches, verify that power is off with a voltmeter and verify that no servers or other equipment is located in the intended area for drilling or use of mounting screws. Verify that there are no electric wires or equipment that may be damaged by the drill or by the resulting shavings and debris.

5.2.1 What's Included

- Brackets: 4 (2-piece, L-shaped components; for cabinets of different heights)
- Bracket tie-downs: 2 (flat brackets; for cabinets of same height)
- M6 bolts: 2
- M6 nuts: 2
- Washers: 2
- Self-tapping screws: 16

5.2.2 Tools Required

- Screwdriver, Phillips #2 Bit
- Drill
- Drill bit: 1/8" diameter
- 10 mm wrench or adjustable wrench

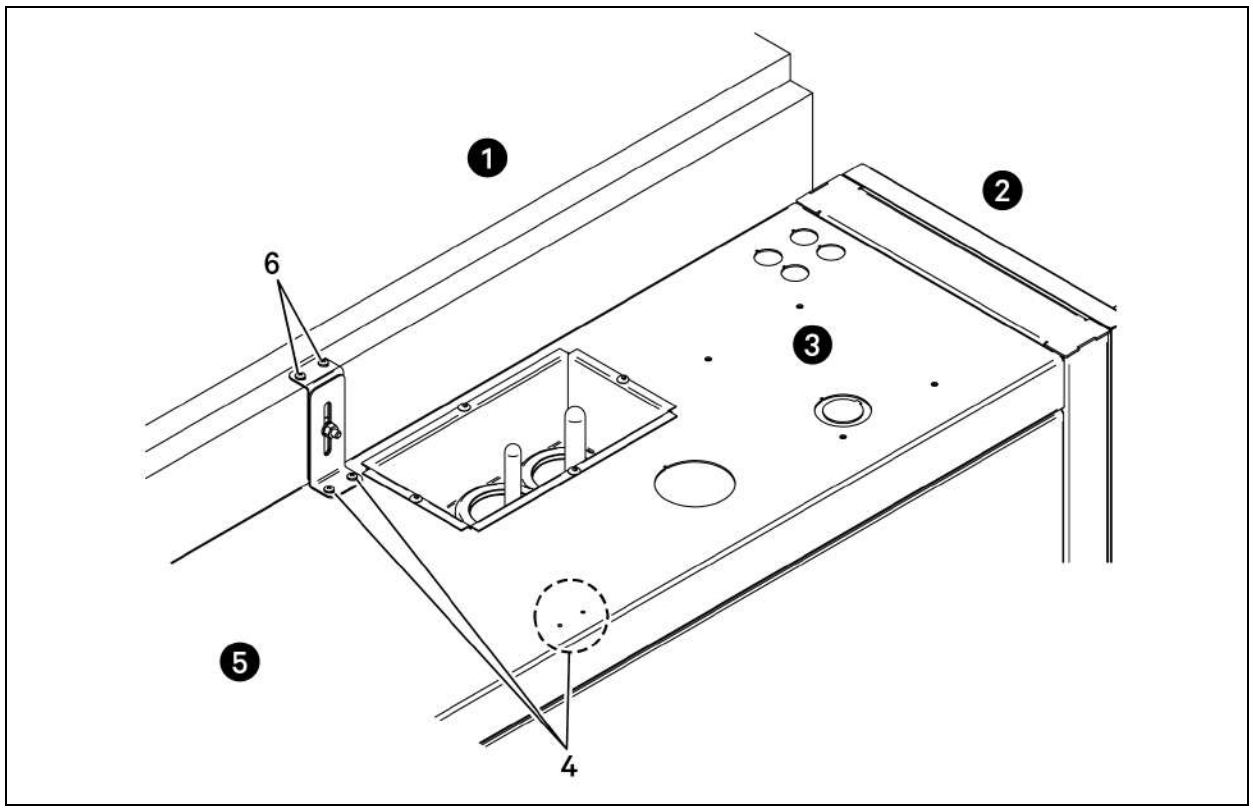
5.2.3 Installing Tie-down Brackets on 300-mm (12-in.) and on Cabinets of Different Heights

To install the tie-down bracket:

1. Insert the M6 bolt through the longest slot in the two-piece tie-down bracket as shown in Figure 5.3 on the facing page.
2. Secure the tie-down bracket loosely with the washer and M6 nut.
3. Position the tie-down bracket over the factory-fabricated holes on the top of the Liebert CRV and over the top of the adjacent cabinet as shown in Figure 5.3 on the facing page.
4. Mark where the self-tapping screws will attach the tie-down bracket to the adjacent cabinet.
5. Taking proper precautions to collect the metal shavings and protect equipment, drill holes in the adjacent cabinet for the two screws.
6. Use a vacuum cleaner or other method to remove all metal particles.
7. Position the bracket over the holes in the Liebert CRV and the adjacent cabinet.

8. Insert and tighten the four screws.
9. Tighten the M6 nut installed in step 2 securely.

Figure 5.3 Tie-down bracket on cabinets of different heights—300 mm (12 in.)



ITEM	DESCRIPTION
1	Top of adjacent cabinet
2	Rear of unit
3	Top of unit
4	Screw holes for tie-down brackets
5	Front of unit
6	Screws in drilled holes.

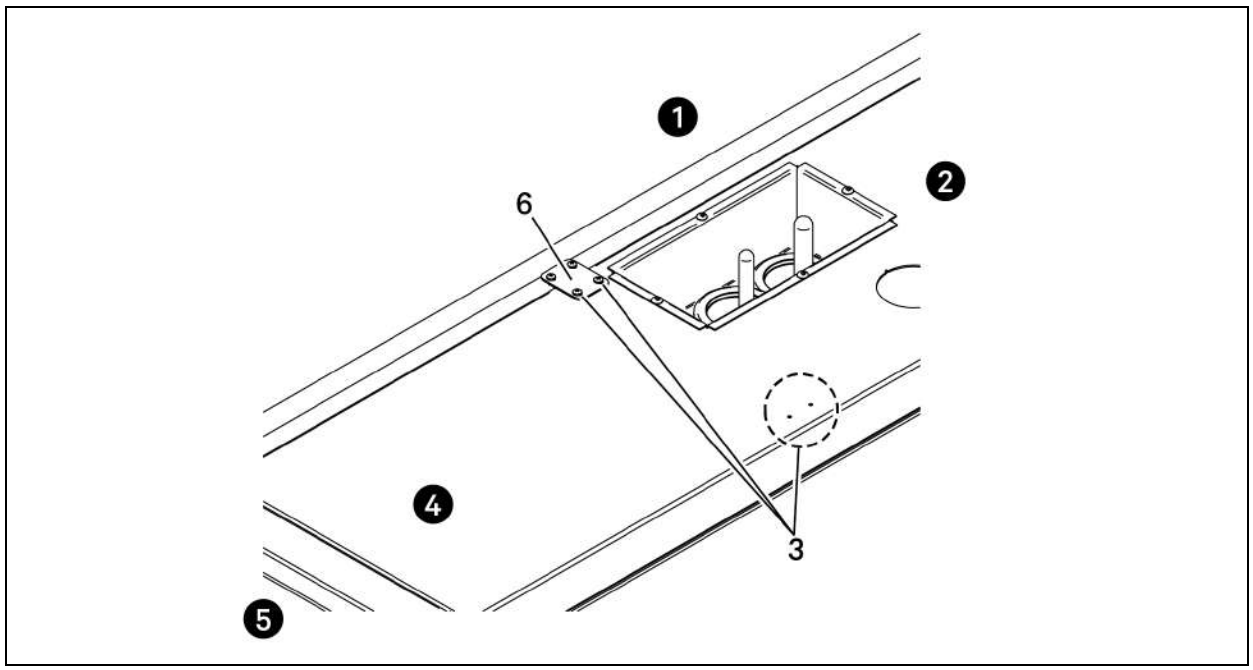
5.2.4 Installing Tie-down Brackets on 300-mm (12-in.) and on Cabinets of the Same Height

To install the tie-down bracket:

1. Position the tie-down bracket over the factory-fabricated holes on the top of the Liebert CRV and over the top of the adjacent cabinet of the same height as shown in Figure 5.4 on the next page.
2. Mark where the self-tapping screws will attach the tie-down bracket to the adjacent cabinet.
3. Taking proper precautions to collect the metal shavings and protect equipment, drill holes in the adjacent cabinet for the two screws.
4. Use a vacuum cleaner or other method to remove all metal particles.

5. Position the bracket over the holes in the Liebert CRV and the adjacent cabinet.
6. Insert and tighten the four screws.

Figure 5.4 Tie-down bracket on cabinets of the same height—300 mm (12 in.)



ITEM	DESCRIPTION
1	Top of adjacent cabinet
2	Rear of unit
3	Screw holes for tie-down brackets
4	Top of the unit
5	Front of the unit
6	Bracket

6 PIPING AND REFRIGERANT REQUIREMENTS

The chilled water and water/glycol piping use threaded connections. The air-cooled unit and internal refrigeration connections are sweat copper. The humidifier and condensate supply are threaded connections. Factory-installed piping brackets must not be removed. Field-installed piping must be installed in accordance with local codes and must be properly assembled, supported, isolated and insulated. Avoid piping runs through noise-sensitive areas, such as office walls and conference rooms.

Refer to specific text and detailed diagrams in this manual for other unit-specific piping requirements.

All piping below the elevated floor must be arranged so that it offers the least resistance to airflow. Careful planning of the piping layout under the raised floor is required to prevent the airflow from being blocked. When installing piping on the subfloor, we recommend installing the pipes in a horizontal plane rather than stacked one above the other. Whenever possible, the pipes should be run parallel to the airflow.

The pipe connection locations, piping general arrangement and schematics are described in the submittal documents included in the Submittal Drawings on page 156.

The following tables list the relevant documents by number and title.

Table 6.1 Piping General-arrangement Drawings

DOCUMENT NUMBER	TITLE
	Air-cooled Systems
DPN002858	Piping Arrangement, 600mm (24in.) Air Cooled w/ Liebert MC Condenser Models
DPN002808	Liebert Piping Arrangement, 300mm (12in.) Air Cooled w/ Liebert MC Condenser Models
	Water/Glycol-cooled Systems
DPN001985	Piping Arrangement, 600mm Water/Glycol Cooled Models
DPN003039	Piping Arrangement, 300mm (12in) Water/Glycol Cooled Models
	Chilled-water Systems
DPN001986	Piping Arrangement, 600mm (24in.) Chilled Water Models
DPN002976	Piping Arrangement, 300mm (12in.) Chilled Water Models

Table 6.2 Piping Connection Drawings

DOCUMENT NUMBER	TITLE
	Air-cooled Systems
DPN001792	Connection Locations, CR020R & CR035R Air Cooled Models
DPN002813	Connection Locations, 300-mm (12-in.) Air Cooled Models
	Water/Glycol-cooled Systems
DPN001793	Connection Locations, CR020R & CR035R Water/Glycol Models
DPN003040	Connection Locations, 300mm (12in.) Water/Glycol Cooled Models
	Chilled-water Systems
DPN001794	Connection Locations, CR040R Chilled Water Models
DPN002814	Connection Locations 300mm (12in.) Air Cooled Models
DPN002815	Connection Locations, 300mm (12in.) Chilled Water Models

6.1 Refrigerant Piping and Charging

WARNING! Risk of explosive discharge from high-pressure refrigerant. Can cause injury or death. This unit contains fluids and gases under high pressure. Relieve pressure before working with piping.

WARNING! Risk of refrigerant system rupture or explosion from overpressurization. Can cause equipment damage, injury or death. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.

CAUTION: Risk of excessive refrigerant line pressure. Can cause tubing and component rupture resulting in equipment damage and personal injury. Do not close off the refrigerant-line isolation valve for repairs unless a pressure-relief valve is field- installed in the line between the isolation valve and the check valve. The pressure-relief valve must rated 5% to 10% higher than the system-design pressure. An increase in ambient temperature can cause the pressure of the isolated refrigerant to rise and exceed the system-design pressure rating (marked on the unit nameplate).

Consult local building and plumbing codes for installation requirements of additional pressure-relief devices when isolation valves are field installed as shown in DPN002858 and DPN002808 (see Submittal Drawings on page 156). Do not isolate any refrigerant circuits from over-pressurization protection.

NOTE: The Liebert indoor cooling unit has a factory-installed high pressure safety switch in the high-side refrigerant circuit. A pressure relief valve is provided with Liebert Lee-Temp™ condensers. Consult your local building code to determine whether the Liebert MC or Liebert VFD condensers will require field-provided pressure-relief devices. A fusible plug kit for Liebert VFD condensers is available for field installation.

NOTICE

Risk of oil contamination with water. Can cause equipment damage.

Liebert systems require the use of POE (polyolester) oil. POE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the POE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. POE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

NOTICE

Risk of improper refrigerant charging. Can cause equipment damage.

Refrigerant charge must be weighed into air-cooled compressorized systems before they are started. Starting scroll and digital scroll compressors without proper refrigerant charging can cause the compressors to operate at less than 5°F (–15°C) evaporator temperature and at less than 20 psig (138 kPa). Operation for extended periods at less than 20 psig (138 kPa) can cause premature compressor failure.

6.1.1 Refrigerant Piping Guidelines for Air-cooled Systems

- Indoor unit ships with a nitrogen holding charge. Do not vent the evaporator until all refrigerant piping is in place, ready for connection to the unit and condenser.
- Use copper piping with high-temperature brazed joints.
- Isolate piping from building using vibration-isolating supports.
- Refer to Heat-rejection Line Sizes and Equivalent Lengths on page 39, for piping sizes.
- Refer to Refrigerant Charge Requirements for Air-cooled Systems on page 40, for refrigerant-charge amounts.
- Refer to condenser installation manual for charging information.
- Install traps on hot gas (discharge) lines at the base of vertical risers and every 15 ft (4.6 m) of vertical rise.
- See Piping Layout and Condenser Positioning on page 37, for the allowable elevation difference between the condenser and the Liebert CRV.
- Consult Vertiv™ technical support if piping run exceeds 300 feet (91 m) equivalent length.
- Keep piping clean and dry, especially on units with R-410A refrigerant.
- Avoid piping runs through noise-sensitive areas.
- Do not run piping directly in front of air stream of any air conditioner.
- Refrigerant oil – do not mix oil types.

Refer to ASHRAE Refrigeration Handbook for general, good-practice refrigeration piping.

6.2 Piping Guidelines for Liebert MC Condensers

The following operations must be carried out by an experienced refrigeration technician.

NOTICE

Risk of oil contamination with water. Can cause equipment damage.

Liebert systems require the use of POE (polyolester) oil. POE oil absorbs water at a much faster rate when exposed to air than previously used oils. Because water is the enemy of a reliable refrigeration system, extreme care must be used when opening systems during installation or service. If water is absorbed into the POE oil, it will not be easily removed and will not be removed through the normal evacuation process. If the oil is too wet, it may require an oil change. POE oils also have a property that makes them act as a solvent in a refrigeration system. Maintaining system cleanliness is extremely important because the oil will tend to bring any foreign matter back to the compressor.

1. When installing the refrigerant piping, note the following:

   Brazing:

   - All joints must be brazed.
   - Avoid butt brazes by using couplings or swaging one of the pipes with a swaging tool.
   - Ensure that all brazed joints are leak-free.
   - Flow dry nitrogen through the pipes during brazing.

   Always use large-radius curves (bending radius at least equal to pipe diameter). Bend the pipes as follows:

   - soft copper: bend by hand or use bending device;
   - hard copper: use preformed curves.
   - To minimize oxidation, avoid overheating the pipes when brazing.
2. Connect the pipes to the condenser:
   - Condensers with butt-brazed pipe connections: Cut the pipe, enlarge it, and braze it to the pipeline.
   - Respect the direction of refrigerant flow. (See labels on refrigerant.)
3. Wash out the pipelines as follows:
   a. Plug up the free ends of the pipes.
   b. Connect a helium or nitrogen cylinder, fitted with a reducer (maximum pressure 10 bar), to the 1/4" SAE Schrader valve of the condenser.
   c. Pressurize the pipes with helium or nitrogen.
   d. Unplug the pipes instantaneously.
   e. Repeat steps a through d several times.

      This operation is especially important when hard copper piping is used.
4. Open all the shut-off valves on the room unit.
5. Discharge the room unit pressurized with helium (at 1 bar) by opening the charge valves so that all the branches of the circuit are discharged (for example, on the receiver, on the low-pressure side, and on the compressor delivery).
6. Cut the spun-closed ends off the hot-gas and liquid-line connections on the Liebert CRV.

7. Fix (braze) the pipes to the connections on the air conditioner.
8. Air-cooled Units—Connect the refrigerant-safety pressure-relief valve to the outdoors with a 5/8-in. (16-mm) copper pipe if hot-gas and liquid-isolation valves are installed in the field.

NOTE: Not required on water/glycol units, which have an indoor relief valve.

6.2.1 Piping Layout and Condenser Positioning

The piping layout and condenser positioning is detailed in the submittal documents included in the Submittal Drawings on page 156.

The following table lists the relevant documents by number and title along with recommended insulation guidelines for the piping.

Table 6.3 Air-cooled Piping-layout and Condenser-positioning Drawings

CONDENSER POSITION:		CONDENSER ABOVE INDOOR UNIT	CONDENSER AND INDOOR UNIT AT SAME LEVEL	CONDENSER BELOW INDOOR UNIT
Insulation:				
Discharge line:	Indoor	Necessary	Necessary	Necessary
	Outdoor	Only for aesthetic reasons	Only for aesthetic reasons	Only for aesthetic reasons
Liquid line:	Indoor	Only for aesthetic reasons	Only for aesthetic reasons	No, expose to under-floor air
	Outdoor		Only if exposed to sunlight	Only if exposed to sunlight
Document Number: (see Submittal Drawings on page 156)		DPN003954, Pg. 1	DPN003954, Pg. 2	DPN003954, Pg. 3

Piping Guidelines:

1. Piping must be Type ACR copper tubing and sized per Table 6.5 on page 39 through Table 6.7 on page 40.

NOTE: All field-installed piping must comply with applicable national, state and local codes.

2. Use the shortest possible refrigeration pipelines to minimize the total charge of refrigerant and the number of pressure drops.
3. Minimize the number of bends and make the bends the largest radius practical to prevent constricting refrigerant flow.
4. Insulate the piping as specified in 6.2.1 above. If the pipes are installed next to electrical cables, they must be isolated from the building using vibration-isolating supports to avoid damage to cable insulation.
5. There must be at least 1 in. (25 mm) separation between the gas and liquid pipelines. If this is not possible, insulate both lines.
6. Support both horizontal and vertical pipes with vibration-damping clamps, which include rubber gaskets. Place these clamps every 5 to 7 ft (1.5 to 2 m).

Table 6.4 Cooling unit maximum distance from the remote condenser—Liebert MC Condenser with or without Liebert Lee-Temp

PARAMETER	MAXIMUM DISTANCES, FT. (M)	
From cooling unit to condenser	300 (91.4) equivalent length	
From cooling unit to VFD condenser	Above: 60 (18.3)	Below: 15 (4.5)
From cooling unit to Liebert Lee-Temp™ condenser	Above: 60 (18.3)	Below: 0 (0)

6.2.2 Top or Bottom Connection for Refrigerant Piping on Air-cooled Units

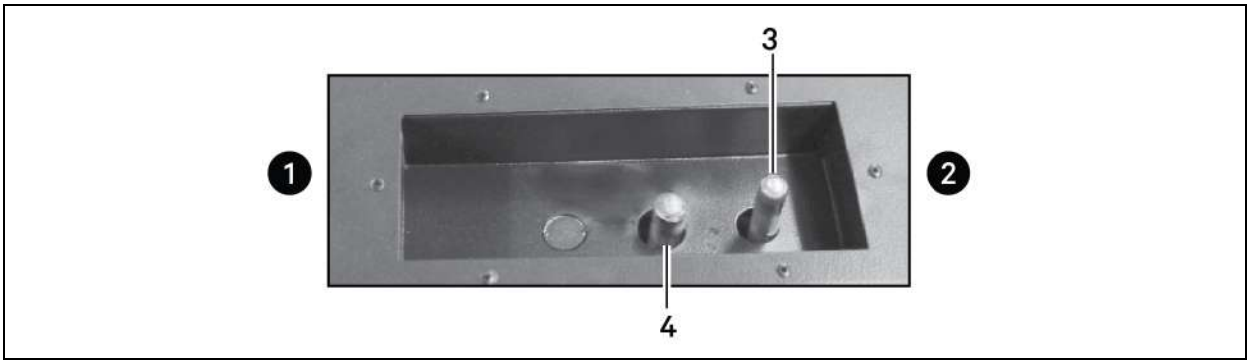
The Liebert CRV can be connected to a condenser through either the top or bottom of the unit. The unit is piped for connections at the top of the unit, shown in Figure 6.1 below, with provisions for connection through the bottom.

Connecting through the bottom of the unit requires cutting the liquid and discharge lines as shown in Figure 6.2 on the facing page. Cutting these lines just below the pipe clamps disconnects the top connections from the rest of the refrigeration system.

NOTE: Clearances require using a smaller tubing cutter to make the refrigerant piping connections on the top or bottom of the unit.

Air-cooled units are shipped with a holding charge of nitrogen.

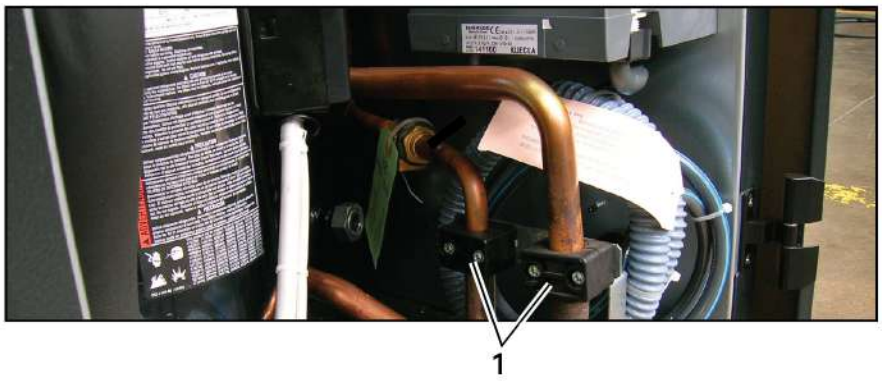
Figure 6.1 Top refrigerant-piping connection on all unit models



ITEM	DESCRIPTION
1	Toward front of unit
2	Toward rear of unit
3	Discharge connection
4	Liquid-line connection

NOTE: Figure 6.2 on the facing page shows the pipe clamps in an Air-cooled, 600-mm model

Figure 6.2 Pipe-clamps for cuts to make bottom refrigerant-piping connections



ITEM	DESCRIPTION
1	Pipe clamps (make cuts just below clamps for bottom connections)

6.2.3 Heat-rejection Line Sizes and Equivalent Lengths

Table 6.5 Liebert CRV Recommended Refrigerant-line Sizes, O.D. CU for Liebert MC Condensers with and without Liebert Lee-Temp™

LIEBERT CRV MODEL NUMBER	TOTAL EQUIVALENT LENGTH, FT (M)	HOT-GAS LINE, IN. (MM)	LIQUID LINE, IN. (MM)
CR019RA/CR020RA	50 (15)	3/4 (19.1)	5/8 (15.9)
	100 (30)	3/4 (19.1)	5/8 (15.9)
	150 (45)	3/4 (19.1)	5/8 (15.9)
	300 (91)	7/8 (22.2)*	3/4 (19.1)
CR035RA	50 (15)	7/8 (22.2)	3/4 (19.1)
	100 (30)	7/8 (22.2)	3/4 (19.1)
	150 (45)	7/8 (22.2)	3/4 (19.1)
	300 (91)	1-1/8 (28.6)*	7/8 (22.2)

Contact your Vertiv™ representative for line sizing for runs longer than 300 ft. (91.4 m) equivalent length.

*Must down-size vertical riser one trade size (1-1/8" to 7/8", 7/8" to 3/4", 3/4" to 5/8", 5/8" to 1/2").

Source: DPN000788, Rev. 5

Table 6.6 Liebert MC Condenser piping sizes for 600-mm (24-in.) and 300-mm (12-in.) units

MODEL NO.	NUMBER OF FANS	CONNECTION SIZES, OD, IN. (MM)	
		HOT GAS LINE	LIQUID LINE
MCS028	1	7/8	5/8
MCM040	1	7/8	5/8
MCM080	2	1-1/8	7/8
MCL055	1	1-1/8	7/8
MCL 110	2	1-3/8	1-1/8

Table 6.7 Single-circuit Liebert MC condenser piping connection sizes with Liebert Lee-Temp for all models of Liebert CRV

MODEL #	CONDENSER CONNECTIONS, OD. IN		LIEBERT LEE-TEMP CONNECTIONS		
	HOT GAS	LIQUID	HOT GAS TEE IDS IN.	LIQUID LINE TO LEE-TEMP VALVE, ODS, IN.	RECEIVER OUT, IDS IN.
MCS028	7/8	5/8	7/8	5/8	5/8
MCM040	7/8	5/8	7/8	5/8	5/8
MCM080	1-1/8	7/8	1-1/8	7/8	1-1/8
MCL055	1-1/8	7/8	1-1/8	7/8	7/8
MCL110	1-3/8	1-1/8	1-3/8	1-1/8	1-1/8

Source: DPN002167, Rev. 7

6.2.4 Refrigerant Charge Requirements for Air-cooled Systems

The following tables provide the refrigerant charge requirements for the Liebert CRV, connected piping and condenser options.

Table 6.8 R410-A refrigerant charge and oil charge for air-cooled Liebert CRV

MODEL	BASE REFRIGERANT CHARGE, LB (KG)	BASE OIL CHARGE		MAXIMUM SYSTEM REFRIGERANT CHARGE BEFORE OIL ADDITION, LB (KG)	FLUID OUNCES OF OIL TO ADD FOR EVERY 10 LB. (4.5KG) OF REFRIGERANT OVER MAXIMUM SYSTEM CHARGE, OZ (ML)
		INITIAL OIL CHARGE, OZ (KG)	MAXIMUM TOPPING UP, OZ (KG)		
CR019RA	5 (2.7)	60 (1.68)	56 (1.57)	38 (17.1)	1.6 (48)
CR020RA	7 (3.2)	60 (1.68)	56 (1.57)	38 (17.1)	1.6 (48)
CR035RA	10 (4.5)	110 (3.08)	106 (2.97)	28 (12.6)	4 (120)

The recommended oil is EMKARATE RL 32-3MA.

Table 6.9 Interconnecting piping refrigerant charge for R-410A, lb per 100 ft (kg per 30 m)

LINE SIZE, O.D., IN.	HOT GAS	LIQUID
3/8	–	3.2 (1.4)
1/2	0.7 (0.3)	5.9 (2.7)
5/8	1.1 (0.5)	9.6 (4.3)
3/4	1.6 (0.7)	14.3 (6.4)
7/5	2.3 (1.0)	19.8 (8.8)
1-1/8	3.9 (1.7)	33.8 (15.1)
1-3/8	5.9 (2.6)	51.5 (23.0)
1-5/8	8.4 (3.7)	–

Data based on 50°F Evap 15°F superheat 125°F SCT 10°F sub-cooling

Source: DPN003099 Rev. 0

Table 6.10 Liebert MC condenser refrigerant charge approximate R-410A with and without Liebert Lee-Temp

	SINGLE CIRCUIT, LB/CIRCUIT (KG/CIRCUIT)	
CONDENSER MODELS	CONDENSERS WITHOUT LIEBERT LEE-TEMP	CONDENSERS WITH LIEBERT LEE-TEMP
MCS028	2.5 (1.2)	21.7 (9.8)
MCM040	3.5 (1.6)	22.7 (10.3)
MCM080	8.5 (3.8)	39.8 (18.1)
MCL055	5.0 (2.3)	24.2 (11.0)
MCL110	10.7 (4.9)	49.1 (22.3)

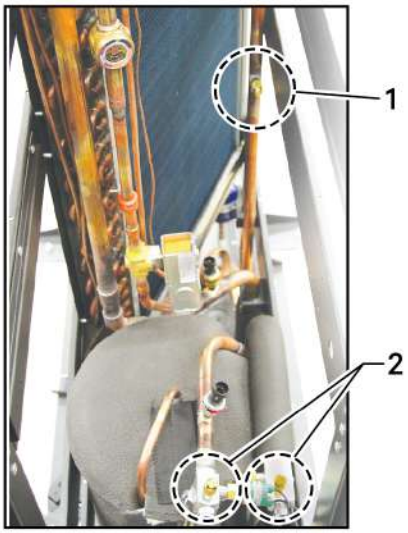
Vacuum Refrigerant-charge Connection Locations

Figure 6.3 below, and Figure 6.4 on the facing page, show the various connection locations for refrigerant charging.

Figure 6.3 Connections for vacuum creation and refrigerant charge—Air-cooled, 600 mm (24 in.)

ITEM	DESCRIPTION
1	Suction, liquid, and discharge service connections
2	Liquid-line service connection (close-up view of the center callout in Item 1)
3	High-pressure switch
4	Pressure transducer

Figure 6.4 Connections for vacuum creation and refrigerant charge—Air-cooled, 300 mm (12 in.)



ITEM	DESCRIPTION
1	Service discharge connections for vacuum charging
2	Service suction and discharge connections for vacuum charging

6.2.5 Evacuation, Leak-testing, and Charging Air-cooled Systems without Receivers

A discharge line and liquid line must be field-installed between the indoor unit and the outdoor condenser. See the appropriate piping schematic, listed in Table 6.1 on page 33.

Evacuation and Leak-testing Air-cooled Systems without Liebert Lee-Temp™

For proper leak-check and evacuation, you must open all system valves and account for all check valves.

NOTE: The system includes a factory-installed check valve and an additional downstream Schrader valve with core in the compressor discharge line. Proper evacuation of the condenser side of the compressor can be accomplished only using the downstream Schrader valve. See the appropriate piping schematic for your system in the submittal-drawings appendix.

1. If unit power is available, open the unit liquid-line solenoid valves using the evacuation function for System #1 in the diagnostic section of the Liebert iCOM® control.
   – or –
   If unit power is not available, connect a field-supplied 24-VAC/75-VA power source directly to the unit solenoid valve.
2. Connect refrigerant gauges to the suction rotalock valves and discharge-line Schrader valves.
3. Open the service valves and place a 150 PSIG (1034 kPa) of dry nitrogen with a tracer of refrigerant. Check system for leaks with a suitable leak detector.

4. After completion of leak testing, release the test pressure, (observe local code) and pull an initial deep vacuum of 500 microns on the system with a suitable pump.
5. After 4 hours, check the pressure readings and, if they have not changed, break vacuum with dry nitrogen. Pull a second and third vacuum to 500 microns or less. Re-check the pressure after 2 hours.
   When the 3 checks are complete, proceed to Charging Air-cooled Systems without Liebert Lee-Temp below.

Charging Air-cooled Systems without Liebert Lee-Temp

Source: DPN002411, Rev. 8

NOTICE

Risk of improper refrigerant charging. Can cause equipment damage.

R-410A is a blended refrigerant and must be introduced and charged from the cylinder only as a liquid.

When adding liquid refrigerant to an operating system, it may be necessary to add the refrigerant through the compressor suction service valve. Care must be exercised to avoid damage to the compressor. We recommend connecting a sight glass between the charging hose and the compressor suction service valve. This will permit adjustment of the cylinder hand valve so that liquid can leave the cylinder while allowing vapor to enter the compressor.

NOTICE

Risk of refrigerant overcharge. Can cause equipment damage.

Do not use the sight glass as an indicator when charging Liebert MC condenser systems.

The system must be fully piped and evacuated before it can be charged. See Evacuation and Leak-testing Air-cooled Systems without Liebert Lee-Temp™ on the previous page.

Liebert MC condensers are charge-sensitive and require accurate calculation of the system charge to avoid overcharging. To avoid overcharge, the following additional guidelines are recommended to ensure trouble-free operation.

- When charging system in an outdoor ambient below 50°F (10°C), recheck the subcooling against Table 6.11 on page 46 when the ambient is above 60°F (15.6°C)
- The indoor space should be maintained at 70 to 80°F (21 to 26.7°C) return air before final charge adjustments are made.
- Charging unit at greater than 80°F (26.7°C) return air and low outdoor ambient temperature may result in the unit being overcharged.
- Charge by subcooling measurement at the indoor unit. See Table 6.11 on page 46 for target subcooling temperatures.
- Pressure and temperature measuring instruments should be capable of measuring to ±10 psig (68.9 kPa) and ± 2°F (1.1°C) for best subcooling measurement.

To calculate the charge for the system:

1. Check the nameplate on the indoor unit for refrigerant type to be used. Unit control configurations differ depending on refrigerant type.
2. The unit must be operating. Refer to the following if necessary:
   - Checks to Perform after Start-up on page 112 to operate the system.
   - The operating manual for the Liebert MC Condenser.

   Manuals are available at https://www.vertivco.com/en-us/support/.
3. Calculate the amount of charge for the system. See Refrigerant Charge Requirements for Air-cooled Systems on page 40.
4. Accurately weigh in as much of the system charge as possible before starting the unit. Do not exceed the calculated charge by more than 0.5 lb (.23 kg).
5. Turn on the Liebert MC disconnect switch.
6. Turn on the Liebert CRV disconnect switch, and operate the unit for 30 minutes using the charging function for each circuit of the system.
   - You must operate the indoor fan using the "Diagnostic" menu of the Liebert iCOM control.
   - A minimum 20 psig (138 kPa) must be established and maintained for the compressor to operate.
   - The charging function operates the compressor at full capacity and energizes the liquid-line solenoid valve. The reheat and humidifier are disabled.
   - The charging function can be reset as many times as required to complete unit charging.
7. Attach pressure and temperature instruments to the liquid-line of the indoor unit, measure the initial subcooling, and continue to add charge until the recommended subcooling for the current outdoor ambient temperature is reached. See Table 6.11 on the next page. Read the outdoor ambient temperature from the Liebert MC condenser control menu ID F02.

NOTE: To determine subcooling measurement, you must measure the liquid-line pressure reading (at the factory-installed Schrader tap) and obtain a temperature reading on the liquid line. Convert the liquid-line pressure reading into a liquid temperature using a Pressure-Temperature Guide or Table 6.12 on page 47. Subtract the measured temperature from the saturated-liquid temperature. The difference is subcooling. Make sure to use the saturated liquid temperature to calculate subcooling.

8. As head pressure builds, the variable-fan-speed controlled condenser fan begins rotating. The fan will run at full speed when sufficient head pressure is developed.

Table 6.11 Target subcooling for ambient outdoor temperature

AMBIENT TEMP, °F (°C)	SUBCOOLING, °F (°C)
0 (-17.8)	22 (12.0)
10 (-12.2)	22 (12.0)
20 (-6.7)	22 (12.0)
30 (-1.1)	22 (12.0)
40 (4.4)	22 (12.0)
50 (10.0)	21 (11.7)
60 (15.6)	19 (10.8)
70 (21.1)	17 (9.3)
80 (26.7)	13 (7.2)
90 (32.2)	9 (5.0)
95 (35.0)	7 (3.9)
100 (37.8)	5 (2.9)
105 (40.6)	3 (1.8)
110 (43.3)	1 (0.7)
125 (51.7)	0

DPN002411, Rev. 8

Table 6.12 Liquid pressure and temperature chart

PRESSURE		TEMPERATURE*	
PSIG	BARG	°F	°C
170	11.7	59.8	15.4
180	12.4	63.1	17.3
190	13.1	66.3	19.1
200	13.8	69.5	20.8
210	14.5	72.5	22.5
220	15.2	75.4	24.1
230	15.9	78.2	25.7
240	16.6	80.9	27.2
250	17.2	83.6	28.7
260	17.9	86.2	30.1
270	18.6	88.7	31.5
280	19.3	91.1	32.8
290	20.0	93.5	34.2
300	20.7	95.8	35.5
310	21.4	98.1	36.7
320	22.1	100.3	38.0
330	22.8	102.5	39.2
340	23.4	104.6	40.3
350	24.1	106.7	41.5
360	24.8	108.7	42.6
370	25.5	110.7	43.7
380	26.2	112.7	44.8
390	26.9	114.5	45.9
400	27.6	116.4	46.9
500	34.5	133.5	56.4
600	41.4	148.1	64.5

* Values are for saturated liquid

Source: DPN002411, Rev. 8

6.2.6 Evacuation, Leak-testing, and Charging Air-cooled Systems with Liebert Lee-Temp "Flooded-condenser" Head-pressure Control System

The Liebert Lee-Temp system consists of a modulating-type head-pressure control valve and insulated receiver with heater pad to ensure operation at ambient temperatures as low as -30°F (-34.4°C). The Liebert Lee-Temp system can be used with any compressor or expansion-valve choice.

A discharge line and liquid line must be field-installed between the indoor unit and the outdoor condenser. See the appropriate piping schematic, listed in Table 6.1 on page 33.

Liebert Lee-Temp-controlled Materials Supplied

- Built-in, pre-wired condenser control box
- Air-cooled condenser
- Piping access cover
- Bolts—4 per leg (3/8 in. x 5/8 in.)
- Terminal block for 2-wire, 24-V interlock connection between unit and condenser
- Terminal blocks for shielded, CANbus-cable connection between unit and condenser
- Condenser legs—4 with 1-fan units and 5 on 2-fan units
- Bolts—6 per receiver (3/8 in. x 1 in.)
- Liebert Lee-Temp system:
  - Insulated storage receiver with (2) liquid-level sight glasses—1
  - Head-pressure control-valve piping assembly with (2) integral check valves—1
  - Service valve—1
  - Pressure-relief valve—1

NOTE: The Lee-Temp heater pad requires a separate, continuous electrical source. See nameplate on unit for proper voltage.

Evacuation and Leak-testing Air-cooled Systems with Liebert Lee-Temp Receiver

For proper leak-check and evacuation, you must open all system valves and account for all check valves.

NOTE: The system includes a factory-installed check valve and an additional downstream Schrader valve with core in the compressor discharge line. Proper evacuation of the condenser side of the compressor can be accomplished only using the downstream Schrader valve. See the appropriate piping schematic for your system in the submittal-drawings appendix.

1. If unit power is available, open the unit liquid-line solenoid valve or electronic-expansion valve (EEV) using the evacuation function in the diagnostic section of the Liebert iCOM® control.
   – or –
   If unit power is not available, connect a field-supplied 24-VAC/75-VA power source directly to the unit solenoid valve.
2. Connect a jumper hose from the service-valve fitting on the outlet of the receiver and the Schrader fitting on the discharge header of the condenser. Seat the service valve approximately two (2) turns from the fully back-seated position.
3. At the compressor, connect refrigerant gauges to the suction rotalock valves and discharge-line Schrader valves.
4. Open the service valves and place a 150 PSIG (1034 kPa) of dry nitrogen with a tracer of refrigerant. Check system for leaks with a suitable leak detector.
5. After completion of leak testing, release the test pressure, (observe local code) and pull an initial deep vacuum of 500 microns on the system with a suitable pump.
6. After 4 hours, check the pressure readings and, if they have not changed, break vacuum with dry nitrogen. Pull a second and third vacuum to 500 microns or less. Re-check the pressure after 2 hours.
   When the 3 checks are complete, remove the jumper hose from the service valve fitting and the condenser, and proceed to Charging Air-cooled Systems with Liebert Lee-Temp Receiver on the facing page.

Charging Air-cooled Systems with Liebert Lee-Temp Receiver

NOTICE

Risk of improper refrigerant charging. Can cause equipment damage.

R-410A is a blended refrigerant and must be introduced and charged from the cylinder only as a liquid.

When adding liquid refrigerant to an operating system, it may be necessary to add the refrigerant through the compressor suction service valve. Care must be exercised to avoid damage to the compressor. We recommend connecting a sight glass between the charging hose and the compressor suction service valve. This will permit adjustment of the cylinder hand valve so that liquid can leave the cylinder while allowing vapor to enter the compressor.

To calculate the charge for the system:

1. Check the nameplate on the indoor unit for refrigerant type to be used. Unit control configurations differ depending on refrigerant type.
2. The unit must be operating, refer to Checks to Perform after Start-up on page 112.
3. Calculate the amount of charge for the system. See Refrigerant Charge Requirements for Air-cooled Systems on page 40.
4. Accurately weigh in as much of the system charge as possible before starting the unit.
5. Turn on unit disconnect switch, and operate the unit for 30 minutes using the charging function in the "Diagnostic" menu of the Liebert iCOM control.
   - A minimum 20 psig (138 kPa) must be established and maintained for the compressor to operate.
   - The charging function operates the compressor at full capacity and energizes the liquid-line solenoid valve. The reheat and humidifier are disabled.
   - The charging function can be reset as many times as required to complete unit charging.
6. Charge the unit until the liquid-line sight glass becomes clear. Then add an additional 1 lb (0.45 kg) of refrigerant.

NOTE: A digital scroll compressor will have a clear sight glass only when operating at 100% capacity. When operating below 100%, the sight glass may show bubbles with each 15-second unloading cycle.

Refrigerant-level Sight Glasses on the Liebert Lee-Temp Receiver

On the receiver at the condenser are 2 refrigerant-level sight glasses. Refrigerant level will vary with outside temperature. Check refrigerant level after the unit has been on for at least 15 minutes.

Sight Glass Levels at Outdoor Temperatures

- 40°F (4.5°C) and lower—bottom sight glass is 3/4 full
- 40 to 60°F (4.5 to 15.5°C)—bottom sight glass is full
- 60°F (15.5°C) and higher—top sight glass is 3/4 full

6.2.7 Superheat and Refrigerant Charge Optimization

Superheat on All Units

Compressor suction superheat for all unit types should be checked and adjusted per Table 6.14 on the facing page. See Determining Suction Superheat on page 136 and Adjusting Superheat Setting with the TXV on page 136 for superheat measurement and adjustment methods.

Optimizing Refrigerant Charge on Water/Glycol Units

Liebert CRV water/glycol systems are factory-charged with R-410A refrigerant and will operate without refrigerant-charge adjustment at a wide range of return-air temperatures and water/glycol entering temperatures. Adjusting the factory refrigerant charge while operating the unit at full-load room conditions and at typical water/glycol temperatures can maximize the cooling capacity and unit efficiency.

Table 6.13 below, describes the factory charge for the unit.

Table 6.13 R410-A refrigerant factory charge and oil charge for water-cooled Liebert CRV

MODEL	R-410A REFRIGERANT CHARGE, LB (KG)	INITIAL OIL CHARGE, OZ. (KG)*
CR019RW	6.5 (2.9)	60 (1.68)
CR020RW	13.0 (5.9)	60 (1.68)
CR035RW	17.0 (7.7)	110 (3.12)

1. The recommended oil is EMKARATE RL 32-3MA.

To optimize the refrigerant charge:

1. Operate the unit at full heat load, normal room conditions and normal water/glycol fluid temperatures for a minimum of 30 minutes before measuring stable unit superheat and subcooling temperatures and adjusting charge levels.
   - Condensing temperatures should be in range of 100 to 130°F (38 to 54°C) depending on fluid type and fluid temperature.
   - Full heat load is required to stabilize the system and prevent digital scroll-compressors from modulating.
2. Attach pressure and temperature instruments to the liquid line of the indoor unit. Use the factory-installed Schrader valve located in the liquid line downstream of the condenser. Measure the initial subcooling.

NOTE: To determine subcooling measurement, a liquid-line pressure reading (at the factory-installed Schrader tap) must be measured along with the temperature reading on the liquid line. Convert the liquid-line pressure reading into a liquid temperature by utilizing a Pressure-temperature Guide or Liquid pressure and temperature chart on page 47. Subtract the measured temperature from the liquid-saturation temperature. The difference is subcooling.

3. Adjust refrigerant charge levels as needed to achieve subcooling and superheat ranges shown for your model in Table 6.14 on the facing page, while maintaining full load conditions.

Table 6.14 Target Superheat and Subcooling Ranges by Model Number

MODEL NO.	MODEL WIDTH	SYSTEM TYPE	SUPERHEAT	SUBCOOLING
CR019	12 in. (300 mm)	Air-cooled	10 - 20°F (5.6 - 11.1°C)	See Table 6.11 on page 46.
		Water/Glycol-cooled	15 - 25°F (8.3 - 13.9°C)	1 - 5°F (0.6 - 2.7°C)
CR020 CR035	24 in. (600 mm)	Air-cooled	10 - 20°F (5.6 - 11.1°C)	See Table 6.11 on page 46.
		Water/Glycol-cooled	10 - 20°F (5.6 - 11.1°C)	1 - 5°F (0.6 - 2.7°C)

6.3 Fluid Piping for Air-cooled, Water/Glycol-cooled and Chilled-water Piping Applications

NOTICE

Risk of water leakage. Can cause severe property damage and loss of critical data center equipment.

The Liebert CRV requires a water drain connection. The 600-mm (24-in.) model may require an external water supply to operate the humidifier. Improper installation, application and service practices can result in water leakage from the unit.

Do not locate the unit directly above any equipment that could sustain water damage.

We recommend installing monitored leak detection equipment for the water supply lines and the internal unit water lines.

The following pipe connections are required:

- A drain line from the evaporator coil drain pan.
- A water-supply line to the optional humidifier (if applicable).
- On air, water, or glycol systems: refrigerant piping connections between the evaporator unit and the condensing unit.
- On chilled-water systems: connections to the building chilled-water source.
- On water-glycol systems: connections to a water or glycol loop.

6.3.1 Water/Glycol Loop Piping Guidelines

NOTICE

Risk of frozen pipes and corrosion from improper coolant mixture. Can cause equipment damage and building.

When piping or the cooling unit may be exposed to freezing temperatures, charge the system with the proper percentage of glycol and water for the coldest design ambient temperature. Automotive antifreeze is unacceptable and must NOT be used in any glycol fluid system. Use only HVAC glycol solution that has been prepared by industry practices.

NOTICE

Risk of piping-system corrosion and freezing fluids. Can cause leaks resulting in equipment and very expensive building damage. Cooling coils, heat exchangers and piping systems are at high risk of freezing and premature corrosion. Fluids in these systems must contain the proper antifreeze and inhibitors to prevent freezing and premature coil, piping and heat exchanger corrosion. The water or water/glycol solution must be analyzed by a competent local water treatment specialist before start up to establish the inhibitor and antifreeze solution requirement and at regularly scheduled intervals throughout the life of the system to determine the pattern of inhibitor depletion.

The complexity of water/glycol solution condition problems and the variations of required treatment programs make it extremely important to obtain the advice of a competent and experienced water treatment specialist and follow a regularly scheduled coolant fluid system maintenance program.

Water chemistry varies greatly by location, as do the required additives, called inhibitors, that reduce the corrosive effect of the fluids on the piping systems and components. The chemistry of the water used must be considered, because water from some sources may contain corrosive elements that reduce the effectiveness of the inhibited formulation. Sediment deposits prevent the formation of a protective oxide layer on the inside of the coolant system components and piping. The water/coolant fluid must be treated and circulating through the system continuously to prevent the buildup of sediment deposits and or growth of sulfate reducing bacteria.

Proper inhibitor maintenance must be performed in order to prevent corrosion of the system. Consult glycol manufacturer for testing and maintenance of inhibitors.

Commercial ethylene glycol, when pure, is generally less corrosive to the common metals of construction than water itself. It will, however, assume the corrosivity of the water from which it is prepared and may become increasingly corrosive with use if not properly inhibited.

We recommend installing a monitored fluid-detection system that is wired to activate the automatic-closure of field-installed coolant-fluid supply and return shut-off valves to reduce the amount of coolant-fluid leakage and consequential equipment and building damage. The shut-off valves must be sized to close-off against the maximum coolant-fluid system pressure in case of a catastrophic fluid leak.

NOTICE

Risk of no-flow condition. Can cause equipment damage.

Do not leave the water/coolant fluid-supply circuit in a no-flow condition. Idle fluid allows the collection of sediment that prevents the formation of a protective oxide layer on the inside of tubes. Keep unit switched On and water/coolant fluid-supply circuit system operating continuously.

Refer to the appropriate piping general-arrangement schematics for your system for the recommended, field-installed hardware such as shut-off valves. See Table 6.1 on page 33.

- Equipment damage and personal injury can result from improper piping installation, leak checking, fluid chemistry and fluid maintenance.
- Follow local piping codes, safety codes.
- Qualified personnel must install and inspect system piping.
- Contact a local water consultant regarding water quality, corrosion protection and freeze-protection requirements.
- Install manual shut-off valves at the supply and return line to each indoor unit and drycooler to permit routine service and emergency isolation of the unit.
- Install a monitored, fluid-detection system that is wired to activate the automatic closure of field-installed coolant-fluid supply and return shut-off valves to reduce the amount of coolant fluid leakage and consequential equipment and building damage. The shut-off valves must be sized to close-off against the maximum coolant-fluid system pressure in case of a catastrophic fluid leak.

Glycol Mixture

Add ethylene glycol or propylene glycol to the circuit in the percentages shown in the following table.

Table 6.15 Glycol mixtures

GLYCOL PERCENTAGE * BY VOLUME	ETHYLENE GLYCOL - FREEZING TEMPERATURE, °F (°C)	PROPYLENE GLYCOL - FREEZING TEMPERATURE, °F (°C)
0%	32 (0)	32 (0)
10%	25.3 (-3.7)	28.9 (-1.7)
20%	16 (-8.9)	18.7 (-7.4)
30%	3.7 (-15.7)	8.4 (-13.1)
40%	-12.6 (-24.8)	-6.7 (-21.5)

* Freezing temperatures may vary slightly among commercially available glycol products; refer to manufacturer's specifications.

Water/Glycol-cooled Piping Connections

- The unit must receive cooling water via:
  - open circuit, see Open-circuit Applications on the next page, for additional requirements.

    – or –

  - closed circuit, see Closed-circuit Applications on the next page, for additional requirements.
- Connect the refrigerant piping as described in Piping and Refrigerant Requirements on page 33.
- Use hoses connected with 3-piece joints to the condenser water inlet and outlet couplings.
- Install a field-supplied, 16-20 mesh strainer on the water/glycol supply to the indoor unit. The strainer prevents particles in the water from entering the unit's heat exchanger.
- Place shut-off ball valves at the indoor unit inlet and outlet to allow easy maintenance.
- Install a water drain system at the lowest point in the circuit.
- Fully-drain the piping before connecting it to the cooling unit.

Open-circuit Applications

The cooling unit receives cooling water in an open circuit from an external cooling water source. For open-circuit applications note the following:

- Use the unit with mains or well water. Do not use water from an evaporative cooling tower unless the water hardness is controlled.
- The water pressure must be 29 to 145 psi (2 to 10 bar). If water pressure is outside this range, contact Vertiv™ for technical support.
- The required water flow at different temperatures is available from Vertiv™ technical support.
- If water temperature is very low, insulate both pipes.

Closed-circuit Applications

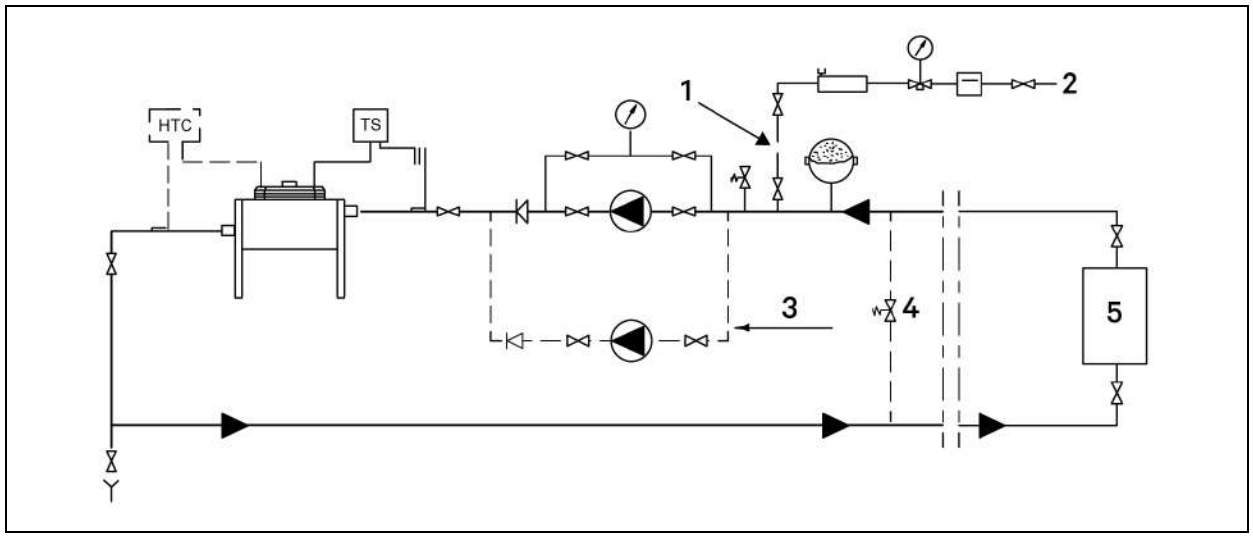
The cooling unit receives cooling water in a closed circuit using a drycooler. For closed-circuit applications, note the following:

- Install a pump system calculated on the basis of the flow and total head of the system (see site plan data) and controlled by the compressor running (see label on the unit).
- Insulate both pipes.

IMPORTANT! Add water and ethylene glycol to the circuit when the ambient temperature is below 32°F (0°C). Refer to the Liebert CRV System Design Manual, SL-11978). Do not exceed the nominal operating pressure of the circuit components.

- Bleed air out of the circuit.
- The following figure shows the recommended installation of a drycooler.

Figure 6.5 Recommended drycooler installation



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Disconnect after charge.		Expansion tank
2	Fill water		Filling meter
3	Stand-by pump (optional)		Gauge
4	Pressure-operated bypass		Pump
5	Thermal-management unit		Safety valve
	Air separator		Shut-off valve
	Charge group (filter, reducer, check valve)	TS	Thermostat
	Check valve	HTC	Variex
	Drain (at lowest point)		

6.3.2 Chilled-water Loop Piping

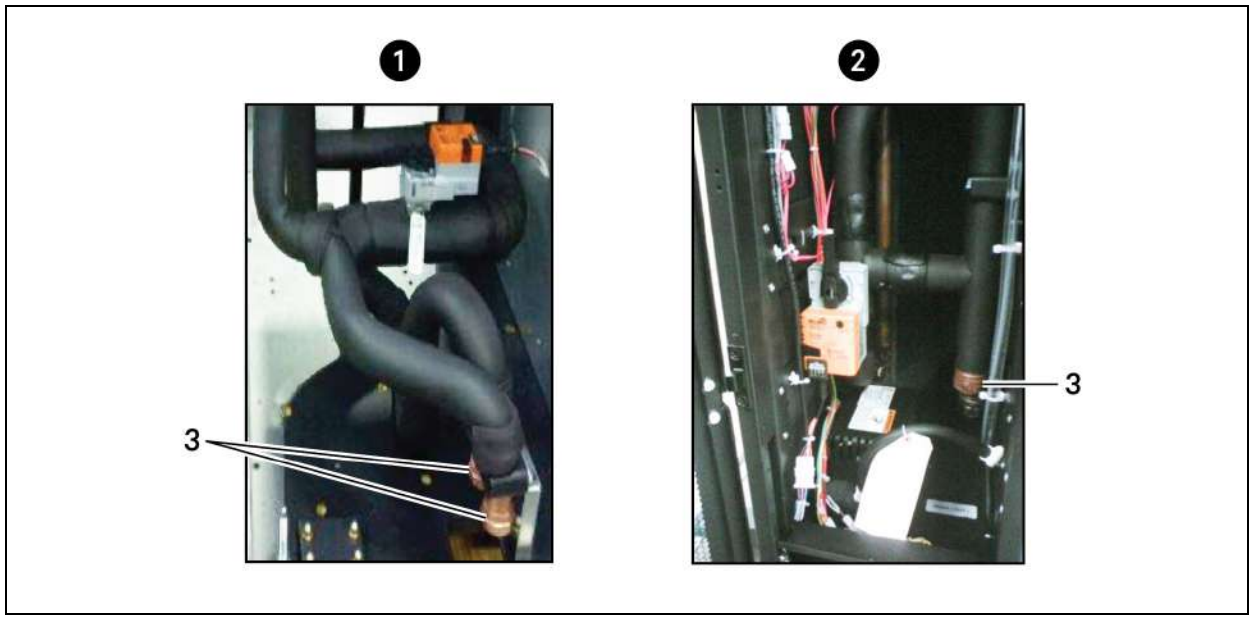
For the top connection locations the, refer to the appropriate submittal documents included in the Submittal Drawings on page 156. Figure 6.6 below shows the bottom connection locations for the chilled-water units. Figure 6.7 on the facing page diagrams the chilled-water circuit.

- Use copper tubing or steel pipe.

NOTE: A dielectric fitting is required when using steel pipe.

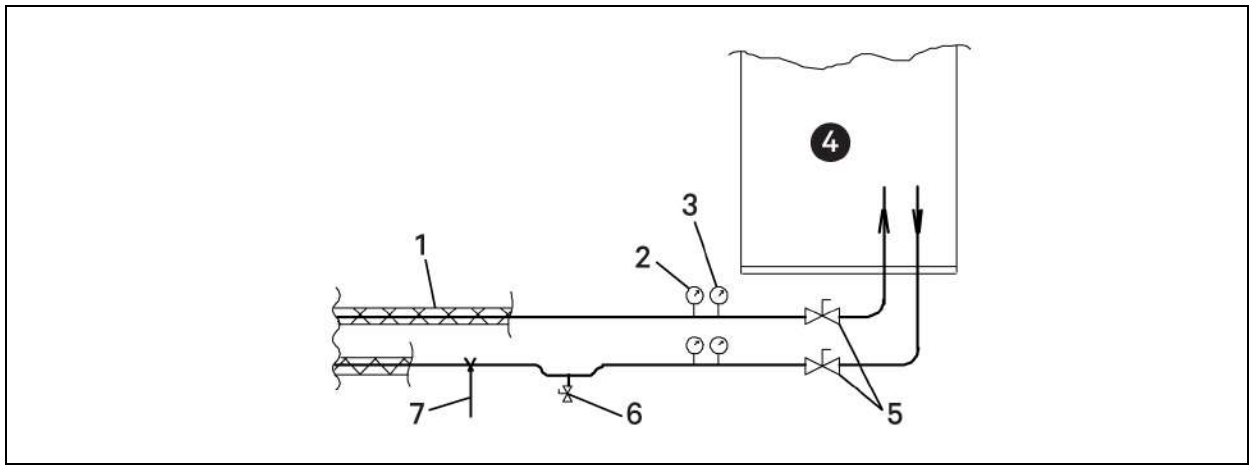
- Place the tubing on supporting saddles.
- Insulate both tubes.
- Install shut-off ball valves on the inlet and outlet pipes to ease maintenance.
- Install optional thermostats and pressure gauges on the inlet and outlet pipes.
- Install a water drain tap at the lowest point in the circuit.
- Fill the circuit with water or glycol.
- Locate air vents at tops of all risers and any intermediate system high points.

Figure 6.6 Bottom connections on chilled water units



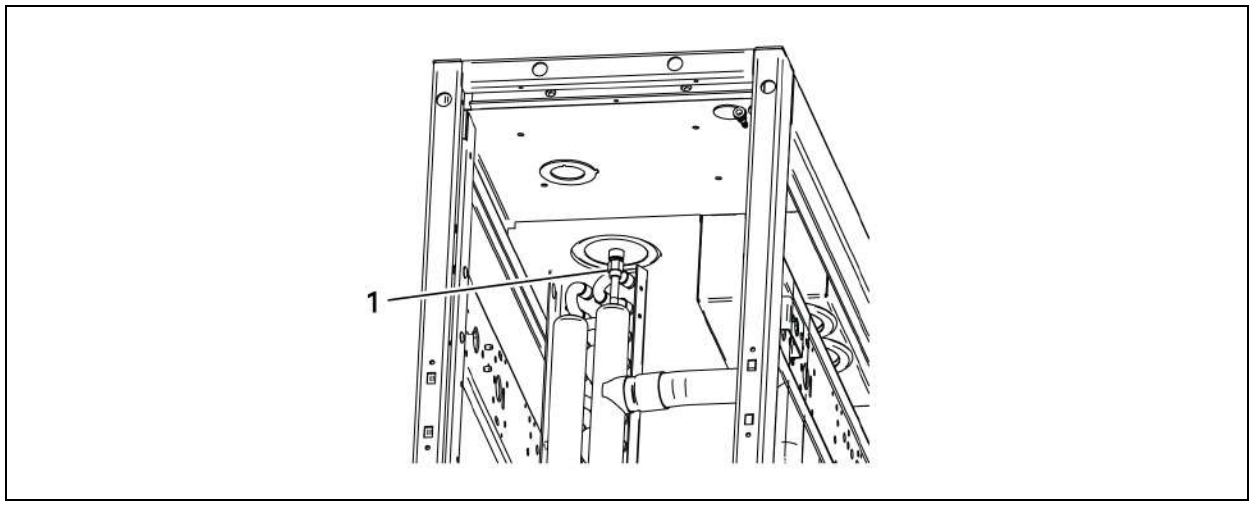
ITEM	DESCRIPTION
1	600 mm (24 in.) unit
2	300 mm (12 in.) unit
3	Chilled-water connections

Figure 6.7 Chilled-water circuit



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Insulation	5	Ball valve
2	Thermostat	6	Water drain trap
3	Pressure gauge	7	Tubing support
4	Liebert CRV		

Figure 6.8 Venting air trapped in a chilled-water unit



ITEM	DESCRIPTION
1	Schrader valve on core

6.3.3 Humidifier Water-supply Line requirements

NOTE: The humidifier is an option on 600-mm (24-in.) units only.

The fill valve is sized for an extended water pressure range of 30 to 80 psi.

For installations where water pressure is less than 15 psi, add a pressure-boost pump and notify your Vertiv™ representative. A fill valve with an oversized opening will be supplied.

For installations where water pressure is greater than 80 psi, install a pressure-reducing valve in the water-feed line to the unit.

With dirty or muddy water sources (for example, some well sources), ensure proper filtration by adding an external filter to the water line entering the unit. (Consult your Vertiv™ for accessories such as filters.)

NOTICE

Risk of improper water supply. Can reduce humidifier efficiency or obstruct humidifier plumbing.

Do not use completely demineralized water with this unit. The water must contain minerals for the electrode principle to work.

Do not use a hot water source. It will cause deposits that will eventually block the fill-valve opening.

See Connecting Water Supply to the Humidifier on page 82 to connect the humidifier.

6.3.4 Leak Checking for Unit and Field-installed Fluid Piping

The fluid systems in the Liebert CRV are factory-checked for leaks and may be shipped with a nitrogen holding charge. At installation, check all fluid circuits for leaks.

NOTE: We recommend isolating the unit with field-installed shutoff valves during leak checking of field-installed piping. When the units are included in a leak test, use of fluid for pressure testing is recommended. When pressurized gas is used for leak testing the unit, the maximum recommended pressure is 30 psig (207 kPa) and tightness of the unit should be verified by pressure decay over time, (<2 psig/hour [13.8 kPa/hour]) or sensing a tracer gas with suitable instrumentation. Dry seals in fluid valves and pumps may not hold a high gas pressure.

LIEBERT CRV OPTION	CONDENSATE PUMP AND HUMIDIFIER		CONDENSATE PUMP AND NO HUMIDIFIER		NO CONDENSATE PUMP AND NO HUMIDIFIER	
MODEL	600 MM	300 MM	600 MM	300 MM	600 MM	300 MM
Top Connections	Available	Not Available	Available	Available	Not Available	Available
Bottom Connections	Available	Not Available	Available	Available	Available	Available

Table 6.16 Volume of internal water circuits—600-mm (24-in.) and 300-mm (12-in.)

MODEL	VOLUME, GAL., (L)
CR019RW	1.0 (3.78)
CR020RW	1.50 (5.7)
CR035RW	1.51 (5.7)

6.3.5 Condensate-pump Drain Line Requirements

NOTICE

Risk of water backing up in the drain line. Leaking and overflowing water can cause equipment and building damage.

Do not install an external trap in the drain line. This line already has a factory-installed trap inside the cabinet (Except for 300-mm (12-in.) Chilled-water models).

This line may contain boiling water. Use copper or other suitable material for the drain line. Sagging condensate drain lines may inadvertently create an external trap.

Observe the following requirements when installing and routing the drain line:

- The drain line must be located so it will not be exposed to freezing temperatures.
- The drain should be the full size of the drain connection.
- The drain line must slope continuously away from the unit. Pitch drain line toward drain a minimum of 1/8 in. (3 mm) per 1 ft (305 mm) of length.
- Drain is trapped internally. Do not externally-trap the drain line.
- The drain line must be rigid enough that it does not sag between supports, which unintentionally creates traps.
- Use copper or other material suitable for draining water that can reach temperatures up to 212°F (100°C).
- We recommend installing monitored, under-floor leak-detection equipment.

When your unit includes the factory-installed, optional condensate pump, refer to the additional details and specific installation instructions depending on the configuration of your unit:

- Condensate-pump Drain Piping for 600-mm (24-in.) Models below
- Bottom Connection for Humidifier Supply and Condensate Drain Water on 600-mm (24-in.) Water/Glycol Systems below
- Condensate-pump Drain Piping for 300-mm (12-in.) Models on the facing page

Condensate-pump Drain Piping for 600-mm (24-in.) Models

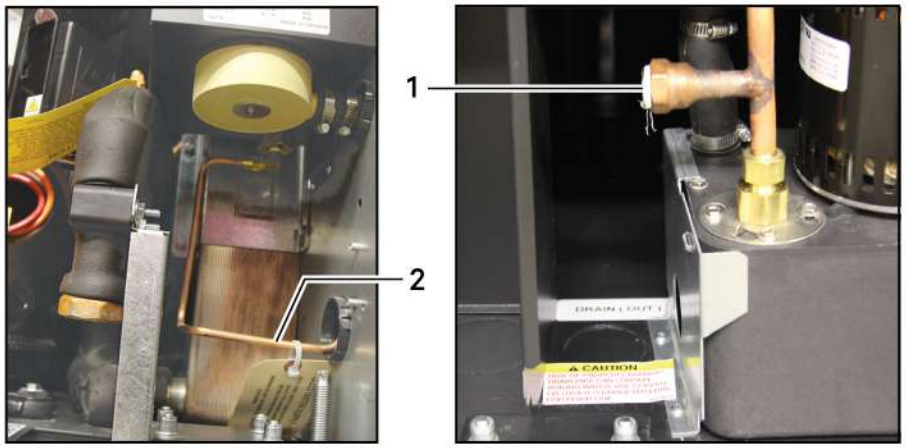
- 1/2-in. FPT connection is provided on units with top and bottom connections for optional factory-installed condensate pump.
- Condensate pump is rated for approximately 6 GPM at 30 ft (22.7 l/m) at 9 m total head.
- Size piping based on available condensate head.

Bottom Connection for Humidifier Supply and Condensate Drain Water on 600-mm (24-in.) Water/Glycol Systems

NOTE: A humidifier is optional: See Humidifier—600-mm (24-in.) Units Only on page 81.

Units with a condensate pump and humidifier are preset to be connected from the top. If floor connections are used, the water lines can be intercepted at the following points shown in Figure 6.9 on the facing page.

Figure 6.9 Water connection points, bottom entry, 600 mm (24 in.) models



ITEM	DESCRIPTION
1	Condensate-pump drain
2	Humidifier water supply

6.3.6 Condcondensate-pump Drain Piping for 300-mm (12-in.) Models

- Condensate pump is rated for approximately 4.6 GPH at 17 feet (0.28l/m at 5.18 m) total head. Maximum coil condensate design flow rate is 4.6 GPH.
- Size piping based on available condensate head.

Before connecting the drain line, refer to the appropriate instructions to the discharge hose to the drain-line opening based on the cooling type of the unit:

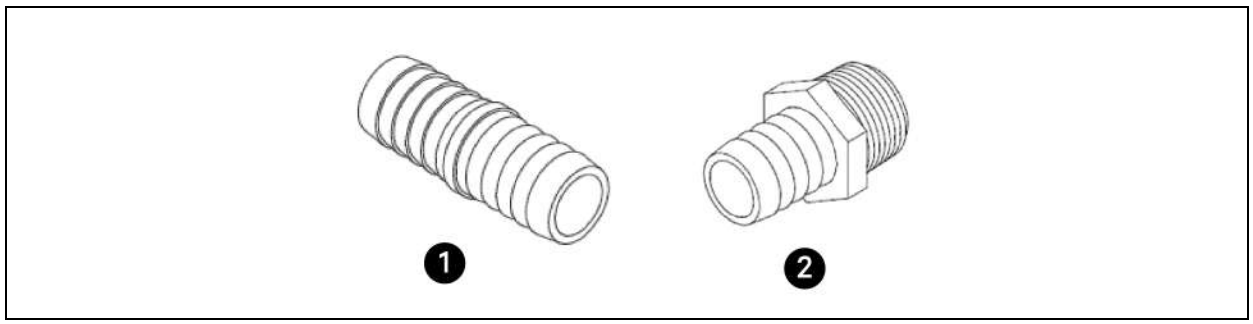
- Connecting Discharge Hose on Air-cooled, 300-mm (12-in.) Models on the next page
- Connecting Discharge Hose on Water/Glycol-cooled, 300-mm (12-in.) Models on page 63
- Connecting Discharge Hose on Chilled-water, 300-mm (12-in.) models on page 65

Connecting Discharge Hose on Air-cooled, 300-mm (12-in.) Models

The unit has a 3/8-in. ID x 5/8-in. OD vinyl hose on the condensate discharge with a factory-installed 3/8-in hose barb. Refer to Figure 6.11 on the facing page for the condensate-pump components.

For field-connection to the drain piping, a factory-supplied 1/2-in. MPT x 3/8-in. hose-barb threaded adapter is included.

Figure 6.10 Condensate-pump piping adapters, Air-cooled, 300-mm (12-in.)



ITEM	DESCRIPTION
1	3/8-in. Nylon adapter hose (factory-supplied, installed on the condensate pump.
2	1/2-in. MPT X 3/8-in. Hose-barb threaded adapter (factory-supplied)

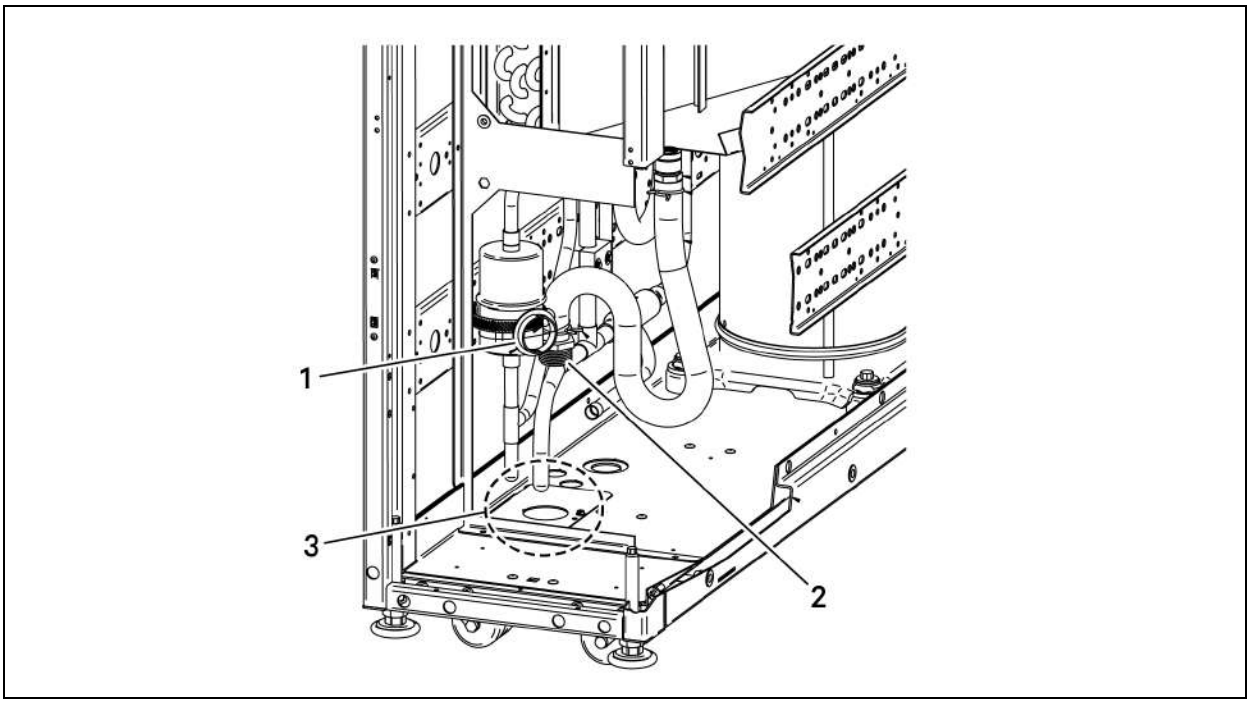
For top discharge:

Connect the discharge tubing to the tubing exiting the top of the unit.

For bottom discharge:

Run the tubing out the bottom of the unit.

Figure 6.11 Condensate-pump drain piping, Air-cooled, 300-mm (12-in.)



ITEM	DESCRIPTION
1	Bushing for bottom condensate exit (field-installed in drain-line knockout hole)
2	Hose barb (field installed)
3	Drain-line knockout

Connecting Discharge Hose on Water/Glycol-cooled, 300-mm (12-in.) Models

The 300-mm (12-in.) water/glycol-cooled units have separate models for top and bottom fluid connections. Both have a factory-installed top discharge for the condensate-pump drain connection. The discharge can be changed to the bottom of the unit in the field.

The unit has a 3/8-in. ID x 5/8-in. OD vinyl, drain hose on the condensate discharge with a factory-installed 3/8-in hose barb. Refer to the figure for the condensate-pump components.

For field-connection to the drain piping, a factory-supplied 1/2-in. MPT x 3/8-in. hose-barb threaded adapter is included.

For top discharge:

Connect the discharge tubing to the tubing exiting the top of the unit.

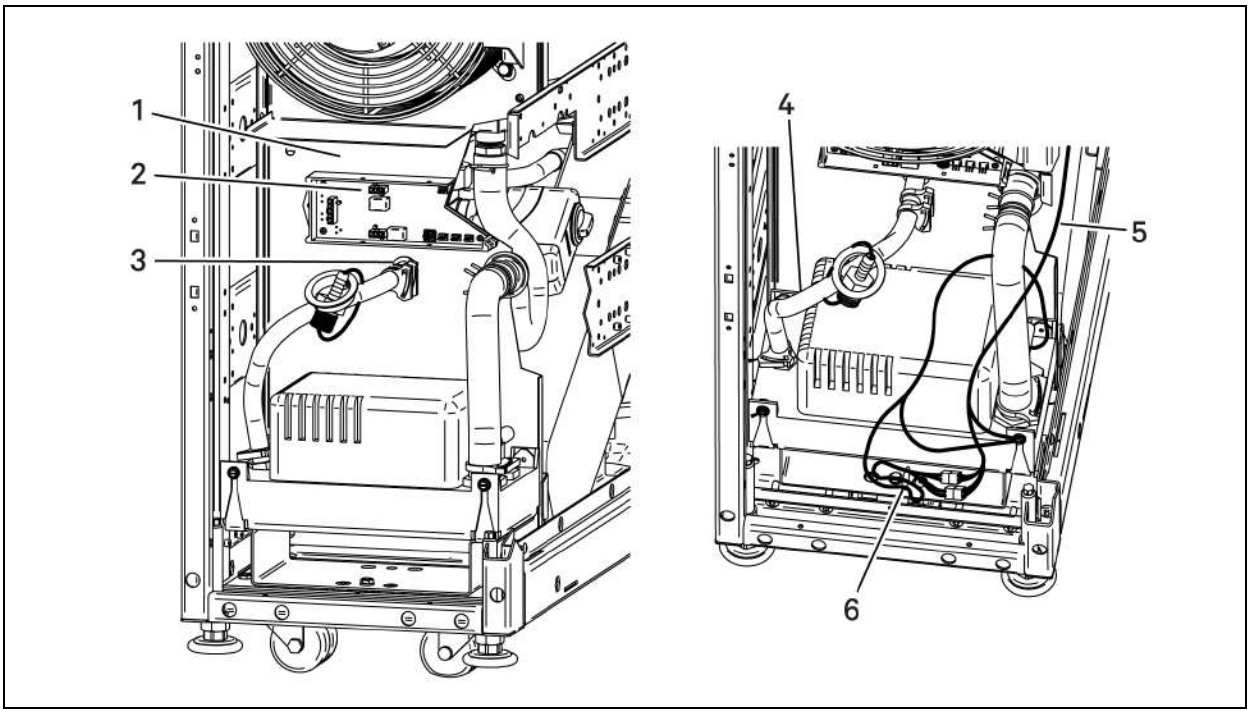
For bottom discharge, run the condensate drain through the bottom of the unit:

Refer to the following figure and:

1. Unbolt the fasteners that hold the condensate pump in the unit.
2. Unplug the fan wiring pin connectors from the fan control board and remove the fan control board.

3. Loosen the hose barb and hole bushing from the condensate pump.
4. Remove the drain line from the evaporator coil and pump discharge line.
5. Remove the condensate pump.
6. Remove the wire ties that secure the wire harness inside the corner post to get slack in the wires.
7. Remove the vertical access plate behind the pump and fan control board.
8. Remove the access plate beside the brazed plate exchange so that unit the condensate drain line can be run under the unit.

Figure 6.12 Condensate-pump drain piping, Water/Glycol-cooled, 300-mm (12-in.)



ITEM	DESCRIPTION
1	Back panel
2	Fan control board
3	Bushing for bottom condensate exit (field-installed in drain-line knockout hole)
4	Drain hose
5	Wiring from electrical panel
6	Wire tires on wiring routed inside frame

Connecting Discharge Hose on Chilled-water, 300-mm (12-in.) models

The unit has a 3/8-in. ID x 5/8-in. OD vinyl hose on the condensate discharge with a factory-installed 3/8-in hose barb. Refer to the figure for the condensate-pump components.

For field-connection to the drain piping, a factory-supplied 1/2-in. MPT x 3/8-in. hose-barb threaded adapter is included.

For top discharge:

Refer to the following figure and:

1. Remove the factory-supplied adapter that is tied to the condensate line inside the unit.
2. Insert the adapter into the factory-installed condensate line at the top of the unit.
3. Insert the barbed connection of the condensate pump line into the factory-installed condensate line.
4. Connect field-supplied drain line to the connection at the top of the unit.
5. Using field-supplied clamps, clamp all connections as needed.

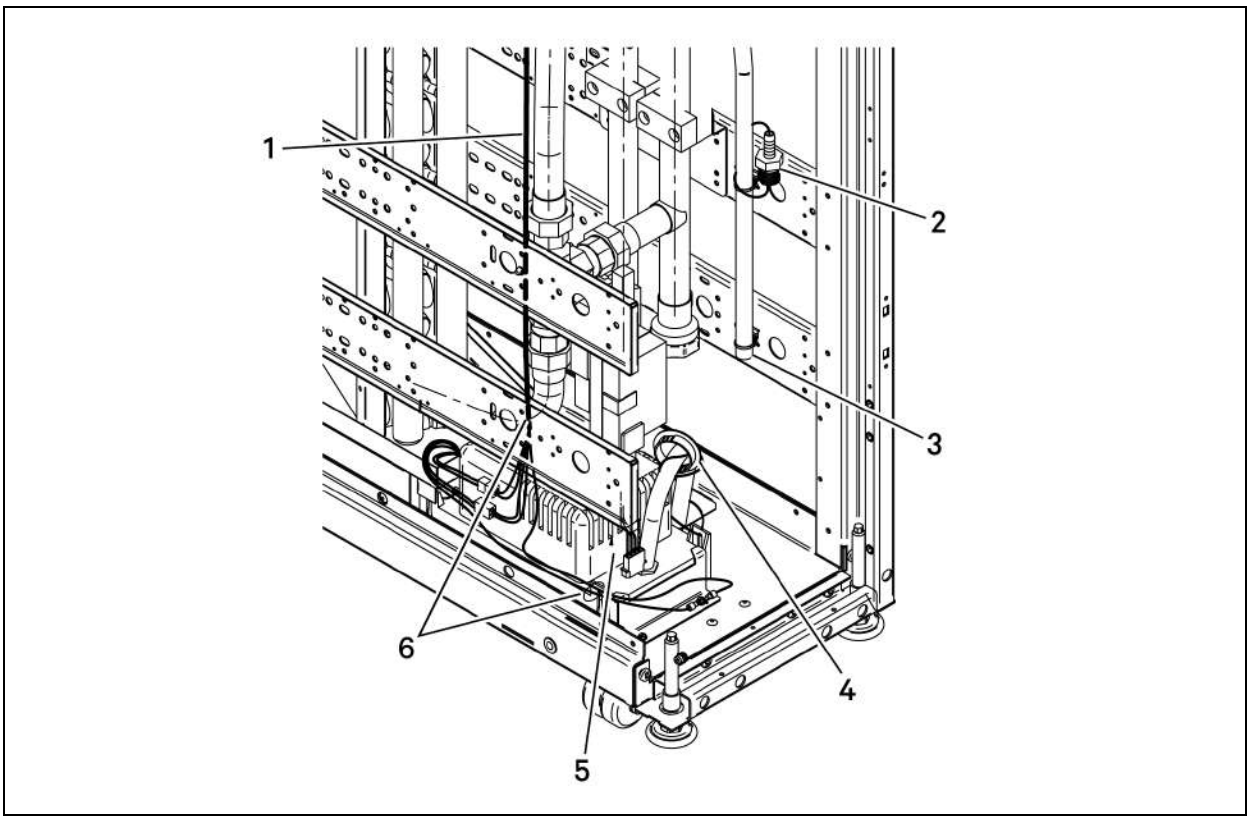
For bottom discharge:

Refer to the following figure and:

1. Remove the factory-supplied adapter and bushing that are tied to the condensate line inside the unit.
2. Remove the barbed adapter from the condensate pump discharge hose.
3. Insert the adapter into the condensate pump discharge hose.
4. Remove the knockout in the plate inside the bottom of the unit, and insert the bushing into the knockout.
5. Run the condensate-pump discharge hose through the bushing in the bottom of the unit.

6. Connect field-installed drain line to the connection under the unit.
7. Using field-supplied clamps, clamp all connections as needed.

Figure 6.13 Condensate-pump drain piping, Chilled-water, 300-mm (12-in.)



ITEM	DESCRIPTION
1	Wiring harness from electrical panel to condensate pump
2	Adapter (field-installed)
3	Condensate-drain tubing, top exit
4	Bushing for bottom condensate exit (field-installed in drain-line knockout hole)
5	Condensate pump
6	Service loop of high- and low-voltage wiring for condensate-pump removal. Make sure the service loop remains, and coil as necessary.

6.3.7 Field-installed, Gravity-fed Drain Line Requirements

Units without the optional, factory-installed condensate pump include an FPT drain connection that is sized based on your unit's model and humidifier options.

- A 3/4-in. FPT connection is provided on models with an infrared humidifier and on models no humidifier.
- A 1/4-in. FPT connections is provided on models with a steam-generating humidifier.

NOTICE

Risk of water backing up in the drain line. Leaking and overflowing water can cause equipment and building damage.

Do not install an external trap in the drain line. This line already has a factory-installed trap inside the cabinet (Except for 300-mm (12-in.) Chilled-water models).

This line may contain boiling water. Use copper or other suitable material for the drain line. Sagging condensate drain lines may inadvertently create an external trap.

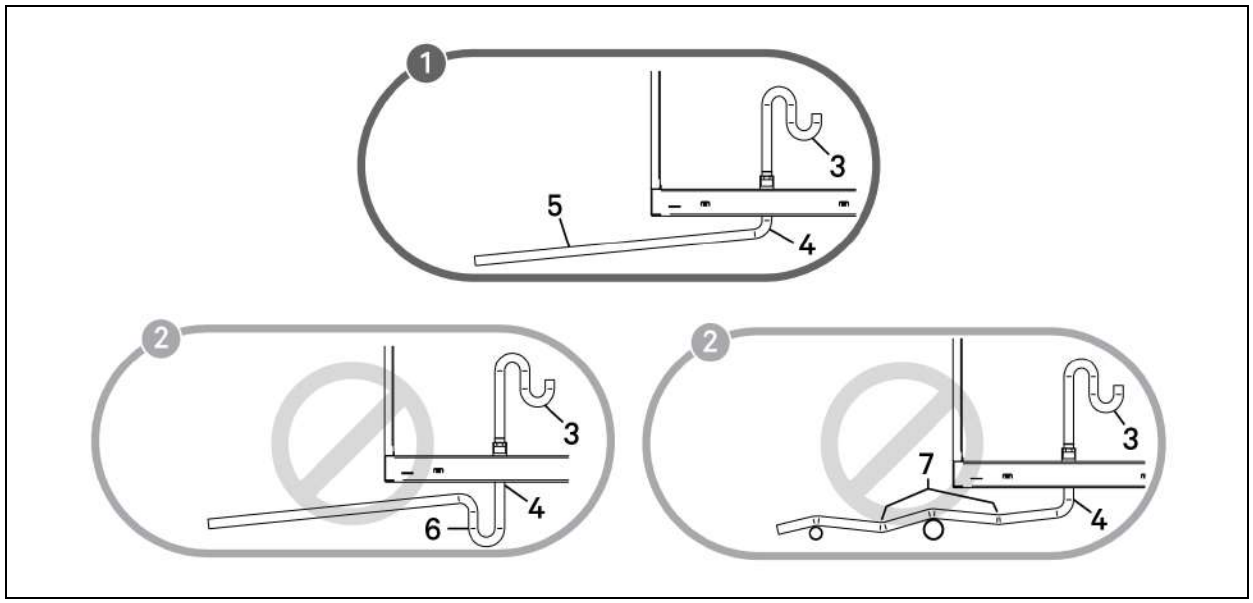
Observe the following requirements when installing and routing the drain line:

- Drain line must be sized for 2 gpm (7.6 l/m) flow.
- The drain line must be located so it will not be exposed to freezing temperatures.
- The drain should be the full size of the drain connection.
- The drain line must slope continuously away from the unit. Pitch drain line toward drain a minimum of 1/8 in. (3 mm) per 1 ft (305 mm) of length.
- Drain is trapped internally. Do not externally-trap the drain line.
- The drain line must be rigid enough that it does not sag between supports, which unintentionally creates traps.
- Use copper or other material suitable for draining water that can reach temperatures up to 212°F (100°C).
- When the evaporator is installed below the level of the gravity-fed drain line, the optional condensate pump is required. Refer to the appropriate section that follows, depending on the configuration of your unit. See Condensate-pump Drain Line Requirements on page 60.

Refer to the additional details and specific installation instructions depending on the configuration of your unit:

- Connecting Gravity-drain Line on All 600-mm (24-in.) models and on Air- and Water/Glycol-cooled, 300 mm (12 in.) models on the next page
- Connecting Gravity-drain Line on Water/Glycol-cooled, 300-mm (12-in.) Models on page 70
- Connecting Gravity-drain Line on Chilled-water, 300-mm (12-in.) Models on page 71

Figure 6.14 Correct and Incorrect gravity-drain piping on all 600-mm 24-in.) and water/glycol-cooled 300-mm (12-in.) models

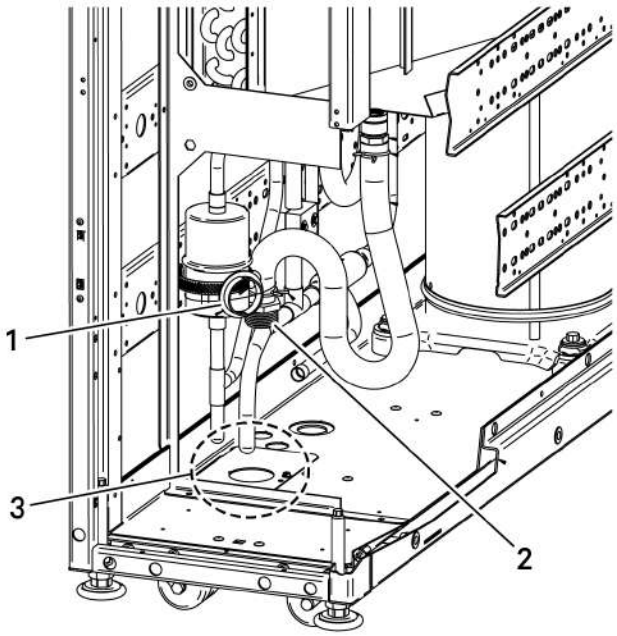


ITEM	DESCRIPTION
1	Correct drain installation
2	Incorrect drain installation
3	Internal drain
4	External drain
5	Continuous downward slope
6	External trap
7	Unintentional traps from bowing of line. Lines must be rigid enough not to bow, creating a trap.

Connecting Gravity-drain Line on All 600-mm (24-in.) models and on Air- and Water/Glycol-cooled, 300 mm (12 in.) models

1. Remove the factory-supplied adapter and bushing that are tied to the condensate line inside the unit.
2. Remove the knockout in the plate inside the bottom of the unit, and insert the bushing into the knockout.
3. Run the evaporator drain line through the bushing in the bottom of the unit.
4. Connect field-installed drain line to the discharge hose.
5. Using field-supplied clamps, clamp all connections as needed.

Figure 6.15 Gravity drain-line connection shown on Air-cooled, 300-mm (12-in.) unit

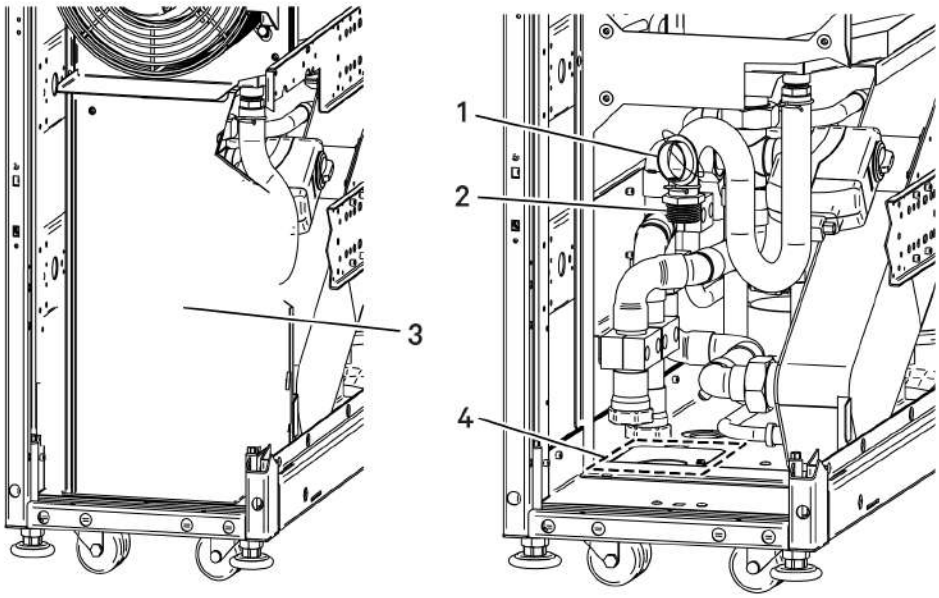


ITEM	DESCRIPTION
1	Bushing for installation after knockout is removed
2	Adapter, 1-in. NPT Male - 3/4-in. barb
3	When coolant supply/return is top-entry, remove this plate, remove the knockout for the drain, and then re-install the plate.

Connecting Gravity-drain Line on Water/Glycol-cooled, 300-mm (12-in.) Models

1. Remove the access plate, shown in Figure 6.16 below.
2. Route the evaporator drain line through the bottom of the unit at unit bottom access plate.
3. Fill the drain trap with tap water.

Figure 6.16 Gravity drain-line connection on Water/Glycol-cooled, 300-mm (12-in.) unit

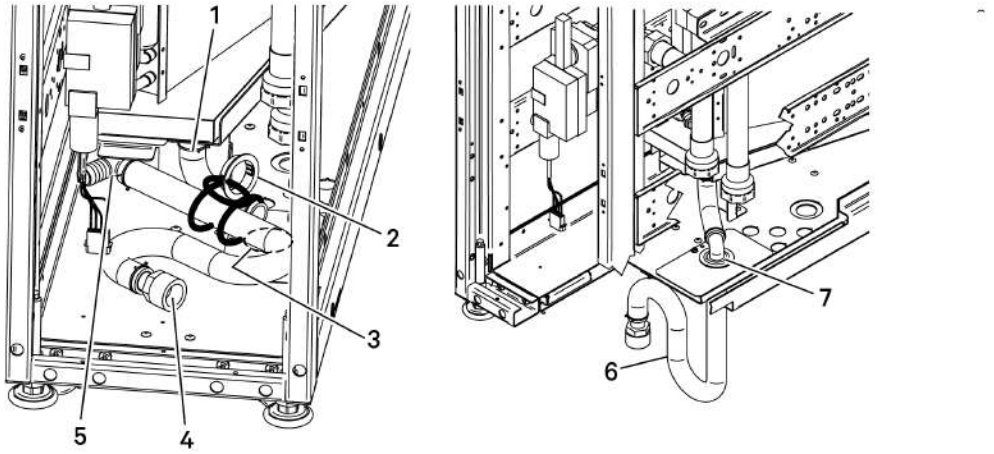


ITEM	DESCRIPTION
1	Bushing (field-installed after knockout removed)
2	Adapter, 1-in. NPT Male - 3/4-in. barb
3	Access plate
4	When coolant supply/return is top-entry, remove this plate, remove the knockout for the drain, and then re-install the plate.

Connecting Gravity-drain Line on Chilled-water, 300-mm (12-in.) Models

1. Remove the factory-supplied hose barb, bushing and trap that are tied to piping inside the unit.
2. Remove the knockout in the plate in the bottom of the unit, and insert the bushing into the knockout.
3. Insert factory-supplied drain trap through bushing with 90-degree barb inside the unit and the trap beneath the unit.
4. Connect the barb to the factory-installed condensate line.

Figure 6.17 Gravity drain-line connection on Chilled-water, 300-mm (12-in.) units



ITEM	DESCRIPTION
1	Condensate drain (factory-installed)
2	Bushing (field-installed after knockout removed)
3	Knockout location below drain tubing (not visible in figure)
4	Connect to field-supplied drain line
5	90-degree hose barb
6	Condensate drain and trap under units without a condensate-drain pump
7	Condensate drain tubing routed through bushing/knockout

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7 ELECTRICAL CONNECTIONS

WARNING! Arc flash and electric shock hazard. Open all local and remote electric power disconnect switches, verify with a voltmeter that power is Off and wear personal protective equipment (PPE) 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 controller 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 the controller. 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.

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

Before proceeding with the electrical connections, ensure that:

- all electrical components are undamaged
- all terminal screws are tight
- the supply voltage and frequency are as indicated on the unit

NOTE: The serial tag on the 600 mm (24 in.) unit will be found on the inside of the display panel. The serial tag on the 300 mm (12 in.) units will be on the narrow side of the electric panel, nearest the filters.

7.1 Power-supply Cable-connection Guidelines

- Connect the cable to the line inlet terminal board.
- Use the appropriate cable size for the current draw, supply voltage and installation type.
- Protect the supply using a backup fuse or circuit breaker.
- Do not fit the supply cable in the raceways inside the unit's electric board—600 mm (24 in.) units.
- Use only multi-polar cables with sheath (CEI20-22).

7.2 Wiring Connections

- Remote On/Off connections must be provided by the installer.
- The General Alarm terminals allow remote alarm signaling.

In case of short circuit, check the affected switch for sticking and replace it if necessary.

7.3 Electrical Field-connection Descriptions

The electrical connections are described in the submittal documents included in the Submittal Drawings on page 156.

The following tables list the relevant documents by number and title.

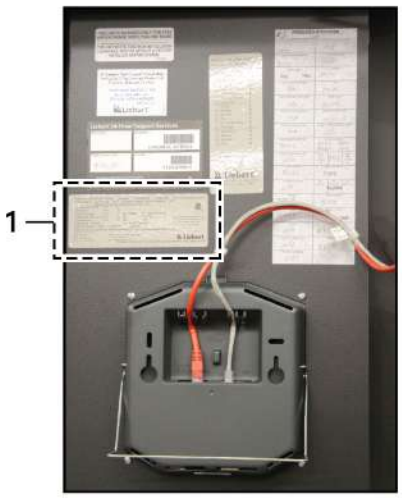
Table 7.1 Electrical Field-connection Drawings

DOCUMENT NUMBER	TITLE
	600-mm (24-in.) Models
DPN001884	Electrical Field Connections Descriptions, 600mm (24in.) Models
DPN002841	CANbus & Interlock Connections between 600mm (24in.) Unit & Liebert MC Condenser
	300-mm (12-in.) Models
DPN002810	Electrical Field Connections Descriptions, 300mm (12in.) Models
DPN003036	CANbus & Interlock Connections between 300mm (12in.) Unit & Liebert MC Condenser
DPN003588	Low Voltage Field Wiring Routing, 300mm (12in.) All Models
DPN003589	Power Cable Routing Bottom Entry, 300mm (12in.) Air Cooled & Water Glycol Cooled Models
DPN003590	Power Cable Routing Bottom Entry 300mm (12in.) Chilled Water Models

7.3.1 Locating the Serial Tag and Removing the Electrical Panel on 600-mm (24-in.) Units

This serial tag on the 600-mm (24-in.) unit is inside the display panel as shown in Figure 7.1 below.

Figure 7.1 Serial tag location—600 mm (24 in.)

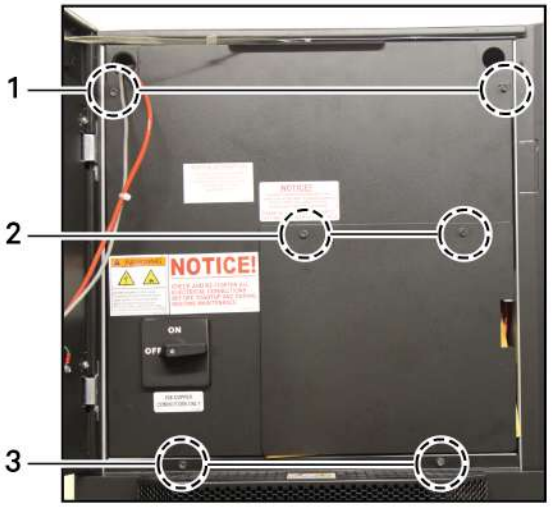


ITEM	DESCRIPTION
1	Serial tag

To access the electrical panels:

Refer to Figure 7.2 on the facing page, and remove the bolts indicated.

Figure 7.2 Remove electrical panel and lower front panel—600 mm (24 in.)

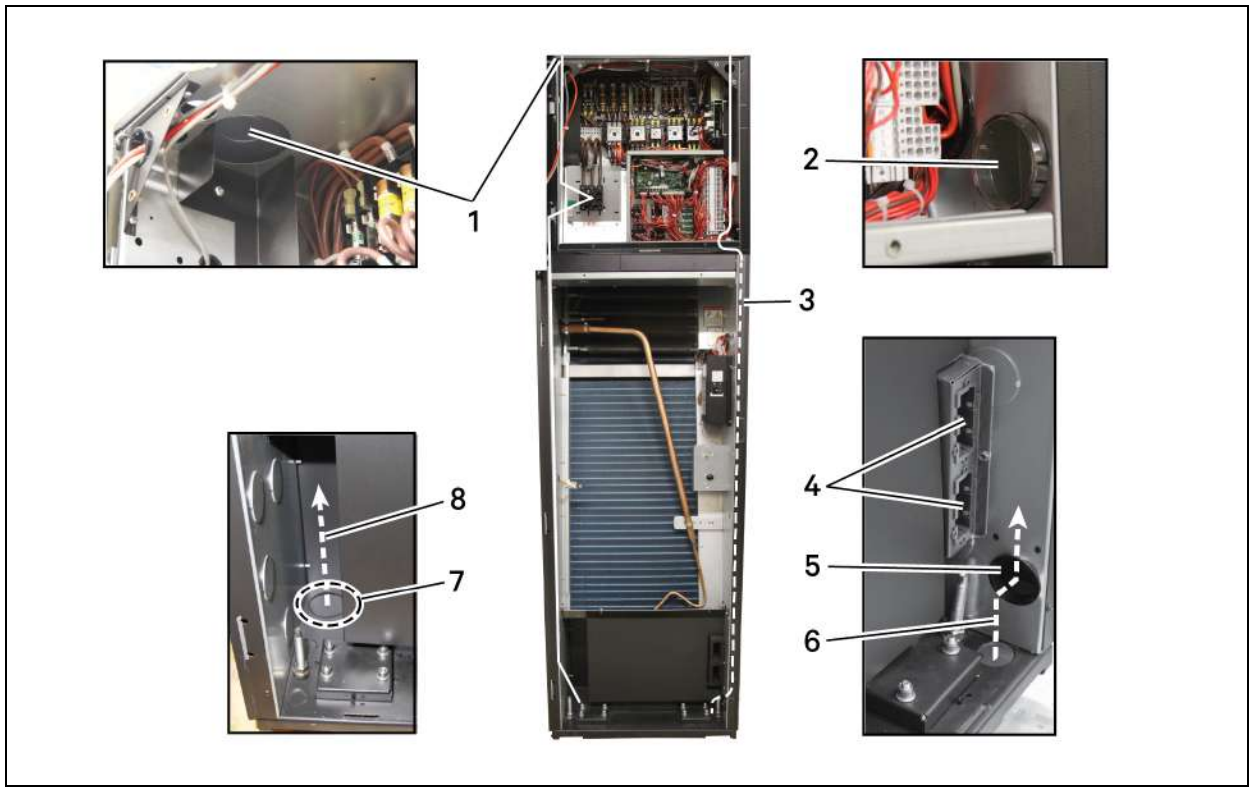


ITEM	DESCRIPTION
1	Bolts to remove for access to high-voltage electrical panel
2	Bolts to remove for access to low-voltage electrical panel
3	Bolts to remove to open lower front-baffle panel

7.3.2 Cable-entry Points on 600-mm (24-in.) Units

Figure 7.3 below shows the high- and low-voltage cable-entry points.

Figure 7.3 Power and control cable entry points and routing—600 mm (24 in.)



ITEM	DESCRIPTION
1	High-voltage top-entry point
2	Low-voltage channel opening in side panel
3	Low-voltage cables route from top entry, through the channel opening in the side panel, and connect bottom of the unit to the electrical panel.
4	IntelliSlot bays
5	Low-voltage bottom port entry
6	Low-voltage cable path to electrical panel
7	High-voltage bottom-entry knockout
8	High-voltage cable path

7.3.3 Protective Features of Electrical Heaters—600-mm (24-in.) Units

Figure 7.4 below shows the temperature-sensor protection on the electrical heaters.

Figure 7.4 Electrical heating with temperature sensor protection

ITEM	DESCRIPTION
1	Temperature sensor protection

7.3.4 Accessing the Electrical Panel on 300-mm (12-in.) Units

The electrical panel is located on the rear of the unit behind the filters. Figure 7.5 on the next page shows the details to pull-out the panel.

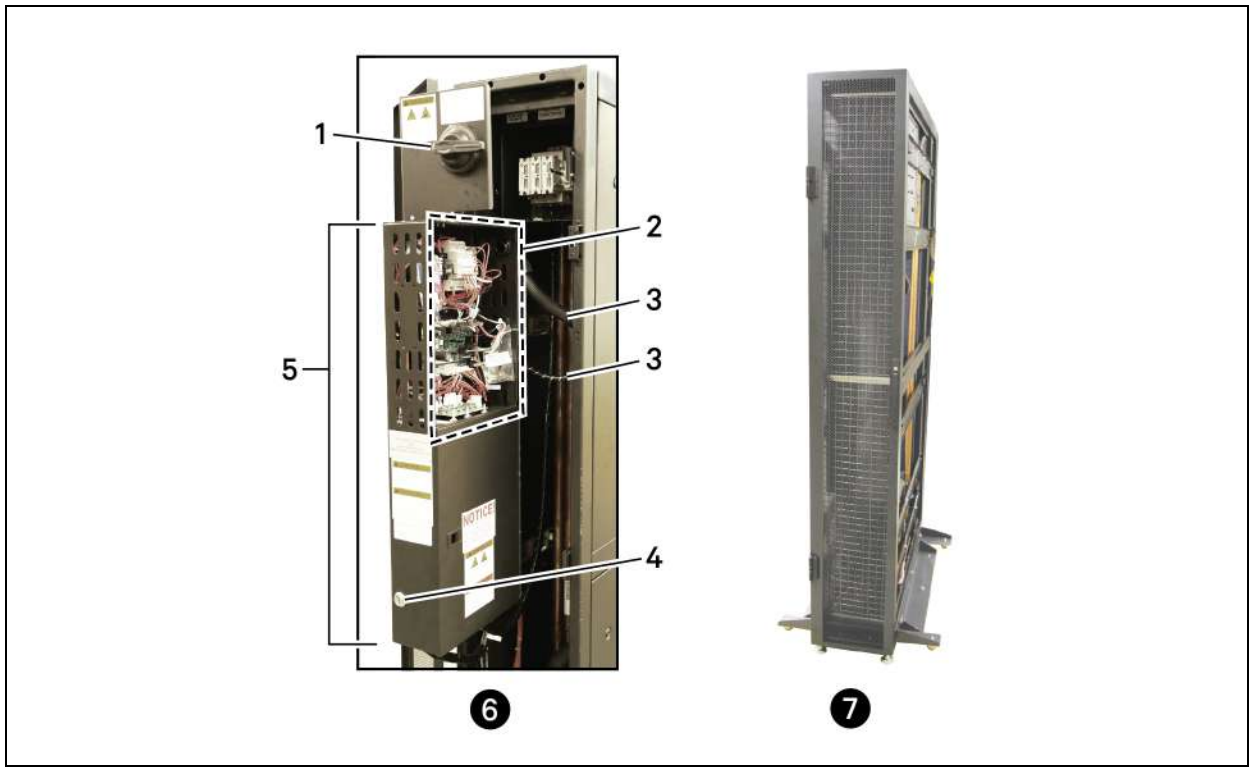
To access the electrical panel:

1. Remove the filters.
2. Turn the main disconnect "Off" and release the quarter-turn latch.

NOTE: The main-disconnect switch must be Off before the electrical panel will slide out, and it will not switch to On until the panel is fully inside the unit.

3. Slide the electrical panel out of the unit until the slides on the panel locking.
   See Releasing the Electric-panel Lock on the next page to slide the electrical panel into the unit.

Figure 7.5 Pulling out the electric panel—300 mm (12 in.)



ITEM	DESCRIPTION
1	Main disconnect switch
2	Low-voltage electrical panel
3	Low-voltage electrical-wiring conduit (the lower conduit carries factory wiring)
4	Quarter-turn latch
5	Electrical panel, slides out
6	Rear of unit, filters removed and electrical panel accessible
7	Rear of unit, filters installed

7.3.5 Releasing the Electric-panel Lock

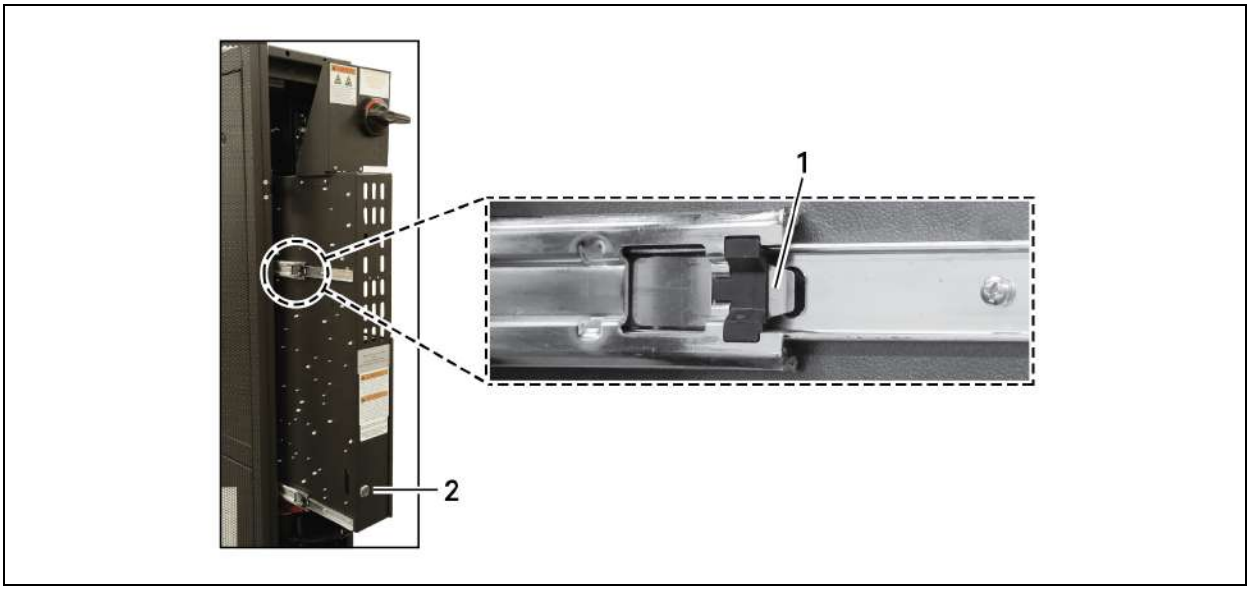
When the electrical panel is pulled-out, the slides on the panel lock.

To release the lock and push the electric panel in:

1. Press the tab in the center of the bottom slide, shown in Figure 7.6 on the facing page.
2. Then press the tab on the top slide while pushing the panel into the unit.
3. Lock the panel in place with the quarter-turn latch.

NOTE: The main-disconnect switch will not switch to On until the panel is fully inside the unit.

Figure 7.6 Electric panel lock



ITEM	DESCRIPTION
1	Slide-lock latch, press to release.
2	Quarter-turn latch

7.4 Protective Features of the Electronically-commutated (EC) Fans—All Models

The EC fans are protected against:

- Overtemperature of electronics
- Overtemperature of motor
- Locked rotor protection
- Short circuit at the motor output

When any of these failures occurs, the motor stops, electronically, with no potential for separation, and the status relay is released.

The unit does not restart automatically. To reset the alarm, the power supply must be switched Off for 20 minutes once motor is at standstill.

- Input power undervoltage detection:

  If the utility power falls below 3ph/290VAC (typical value) for 5 seconds or longer, the motor is switched Off, electronically, with no potential for separation, and the status relay is released.

  When the utility voltage returns to a correct value, the motor restarts automatically.

- Phase failure recognition:

  If one phase fails for 5 seconds or longer, the motor is switched Off, electronically, with no potential for separation, and the status relay is released.

  When all three phases return to correct values, the motor restarts automatically in 10 to 40 seconds.

The power supply for an external speed-setting potentiometer is protected against short-circuiting.

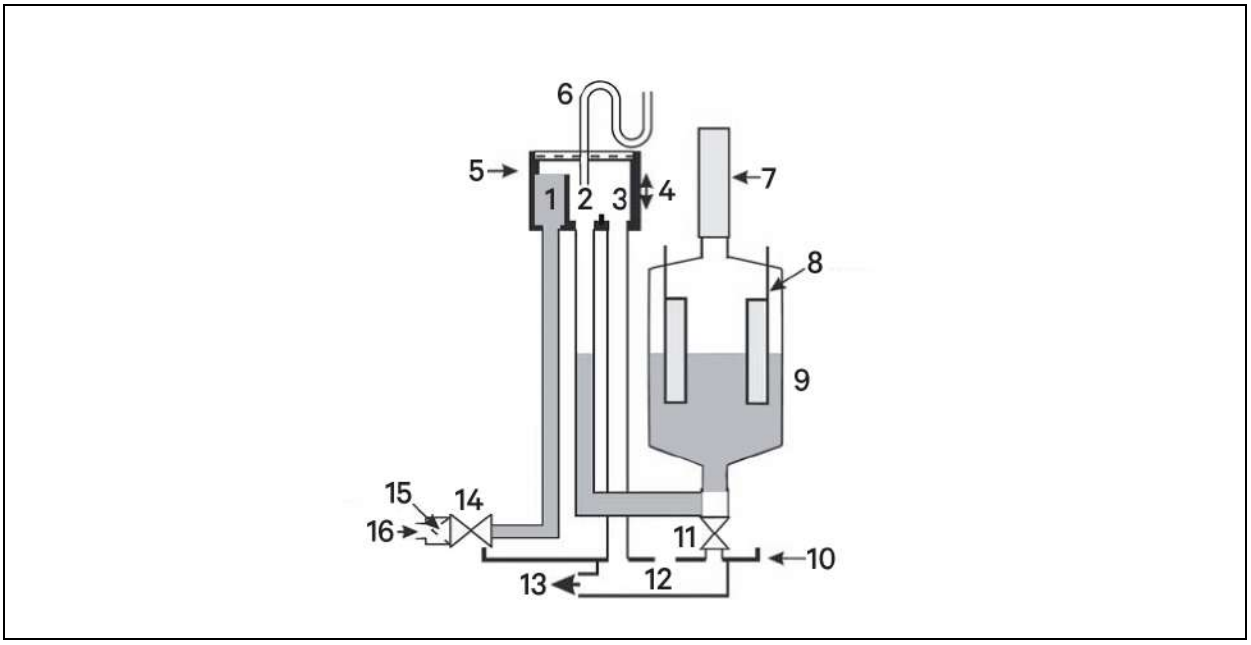
The motor is overload-protected via motor current limitation.

8 HUMIDIFIER—600-MM (24-IN.) UNITS ONLY

8.1 Principal of Operation

When the Liebert iCOM calls, the cylinder fills to 100% of the Full Load Amperage (FLA) or to the top of the cylinder, whichever comes first. See Figure 8.1 below. If it reaches 100% FLA, the water heats and boils away to a level giving 80% FLA. An electronic timer uses the rate of amp fall to determine the water level. The objective is to concentrate current carrying minerals in the cylinder so that a smaller volume of water is required to produce the rated steam output. This extends the life of the disposable cylinder by minimizing electrode coverage and reducing energy use because the high concentration allows a minimal drain rate. When 80% FLA is reached, the fill valve will open, refilling the cylinder to 100% FLA. On occasion, the drain valve will also come on if the water level is too low, indicating too high a concentration and the need to dilute the water in the cylinder. If the water reaches the top of the cylinder before 100% FLA, the fill valve shuts Off via the sensor, and the fill-boil-fill-boil cycle continues, cycling Off the red high water sensor light until the concentration becomes high enough to reach 100% FLA. The above-described control process will then take over.

Figure 8.1 General diagram—humidifier operation



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Inlet chamber	9	Cylinder
2	Fill chamber	10	Drain pan
3	Water over-flow chamber (safety drain in case of fill-valve/control-board failure)	11	Drain valve
4	1-in. air gap	12	Drain canal (open to atmosphere)
5	Fill cup	13	Drain connection
6	Condensate return (optional)	14	Fill valve
7	Steam hose	15	Strainer
8	Electrodes	16	Tap-water supply

NOTE: The Liebert iCOM control monitors the condition of the air discharging from the unit to protect neighboring electronic equipment. The Liebert iCOM will prevent the humidifier from activating if the discharge air is near its saturation point. This protects against discharging fog from the unit or condensation forming on the unit's supply air baffles. This protection mode is activated when the supply air leaving the unit is below 64°F (17.8°C) or above 55% relative humidity. The Liebert iCOM screen will display "Humidifier Suspended." The screen will display "Humidifier Resumed" when the protection mode resets at 67°F (19.4°C).

8.2 Connecting Water Supply to the Humidifier

A copper compression olive type coupling for 1/4" O.D. soft copper tubing is provided with the unit and requires no soldering for the water connection to the unit.

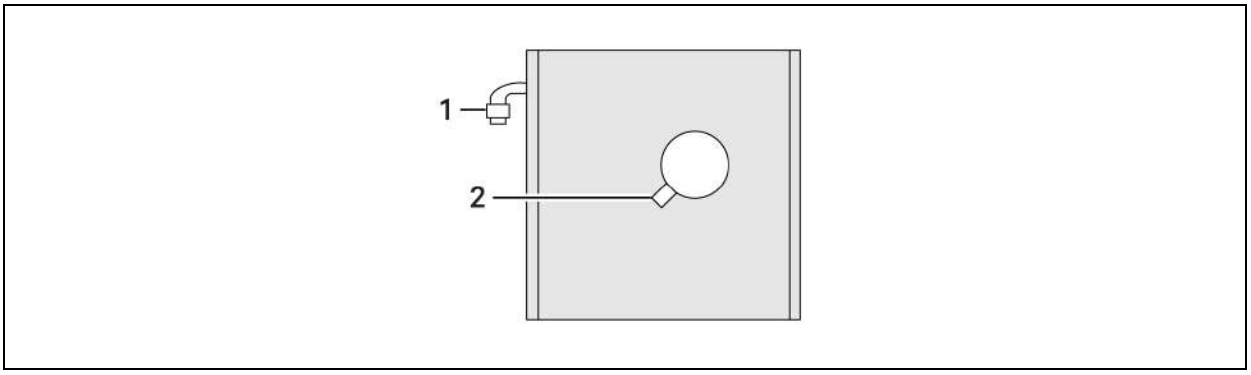
An isolating valve should ALWAYS be placed in the feed water line to allow service of the fill valve.

Each unit is fitted with a fill solenoid valve located on the base drain pan.

Flow openings are designed for water pressure from 30 to 80 psi and are protected by the built-in strainer.

For inlet water pressure outside this range, the factory should be contacted.

Figure 8.2 Water connection to humidifier



ITEM	DESCRIPTION
1	3/8-in. Cold-water olive connection
2	7/8-in. Drain connection Use factory-supplied 7/8-in ID hose.

8.3 Humidifier Start-up and Operation

- Ambient temperature location for humidifier: 41 - 104°F (5 - 40°C).
- Relative humidity location for humidifiers: 5 - 80% RH.

Check to see that the unit is securely mounted on a level surface with the proper drain and water supply. Check for correct voltage with appropriately sized service. Check that the steam distributor, steam supply hose and condensate line are correctly installed and routed back to the unit.

Check all electrical connections for wires that may have become loose in shipping. Components damaged because of loose connections are NOT under warranty.

Check electrode plugs to ensure they are pressed firmly onto the electrode pins. Important: Loose connections will cause overheating of the cylinder plugs, possibly melting the plugs and/or cylinder.

1. Open the isolating valve in the feed water line to the unit.
2. Make sure the Liebert iCOM is set high enough to call for humidification.
3. Turn on the main disconnect in the primary service feeding the unit and check that unit has power at the primary terminal block.
4. Push the auto On/Off/Drain Switch to “On.”

Water will start to enter the cylinder through its bottom port and rise in the cylinder to a point determined by the solid state control circuitry. It is not unusual upon initial start up for the water to fill the cylinder and cycle on the red high-water sensor light.

The red light simply acts as a safety to shut off the fill valve and prevent overfilling. With the red light on, the water in the cylinder will continue to heat and, after a few minutes, start to boil. After the boiling of the water has lowered the water level below the sensor at the top of the cylinder, the red light will go out and the fill solenoid will again open until the cylinder is again full. This cycling of the red light and fill valve will continue until the unit's full output capacity is reached, after which the water level will automatically lower itself in the cylinder. (The increased concentration allows for lower electrode coverage while maintaining the same output.) When a stabilized condition is reached, the water will be boiling close to the cylinder seam level. The solid state circuitry will maintain the proper concentration in the cylinder by introducing short drains only when necessary. If the cylinder is manually drained, the above process will repeat itself.

8.3.1 Low Water Conductivity

Should normalization of the unit be required immediately after start up, the installer may speed up the process by artificially increasing water conductivity. During a fill cycle, the installer should dissolve half a teaspoon of table salt (no more) in a cup of water and add it to the cylinder by means of the fill cup attached to the plumbing section. Open the plumbing compartment and add salt solution through cylinder outlet. Excessive amounts of salt will result in erratic operation of the unit; however, normalization of the unit will occur automatically through the solid-state control sequence.

8.4 Humidifier Canister Replacement

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

WARNING! Risk of humidifier canister meltdown, smoke and fire. Can cause fire suppression system activation, fire and smoke alarm activation, equipment and building damage, injury and death. The steam cylinder is disposable and must be replaced at the end of it's service life. A cylinder's service life depends on water supply conditions and humidifier usage. Using a humidifier canister that has reached the end of it's service life can be extremely hazardous. If the canister cannot be replaced immediately at the end of life condition, turn Off the power and water supply to the humidifier and remove the canister until a replacement canister can be installed.

CAUTION: Risk of contact with hot surfaces. Can cause injury. The refrigerant discharge lines, are extremely hot during unit operation. Allow sufficient time for them to cool before working within the unit cabinet. Use extreme caution and wear appropriate, OSHA-approved PPE when working on or near hot discharge lines.

After an extended period of operation, in accordance with life-expectancy information, the cylinder is completely used as indicated by the amber high-water sensor light illuminated on the cabinet. Then this condition is reached, a new replacement cylinder must be installed.

NOTE: The amber high-water sensor light may come on during initial start-up, but this instance does not indicate that the cylinder should be replaced.

The steam cylinder is disposable and must be replaced at the end of the cylinder's life. Cylinder life will vary according to water-supply conditions and humidifier use.

Contact your local Vertiv™ representative to obtain a replacement cylinder. To obtain the correct cylinder, supply the cylinder model from the white 3-digit label on the cylinder, or supply the model, voltage and serial number from the unit specification label.

8.4.1 Removing the Old Canister

To replace a used-up humidifier cylinder:

1. Turn Off the water supply to unit.
2. The old cylinder must be drained completely before removing. This is done by pushing the auto On/Off/drain switch to the "Drain" position.
3. When completely drained, push the auto On/Off/Drain switch to the Off position.
4. Open the main electrical disconnect during the entire cylinder change operation.

5. The power wires to the cylinder are attached by cylinder plugs to the electrode pins on top of the cylinder. Pull up to remove the plugs from the pins.
6. Use slotted screwdriver to loosen the steam hose clamp(s)
7. Disconnect the steam hose by pulling it straight up.
8. Loosen the reversible cylinder zip tie.
   The cylinder is now ready to be lifted out of the unit.

8.4.2 Mandatory Cleaning of the Drain Valve

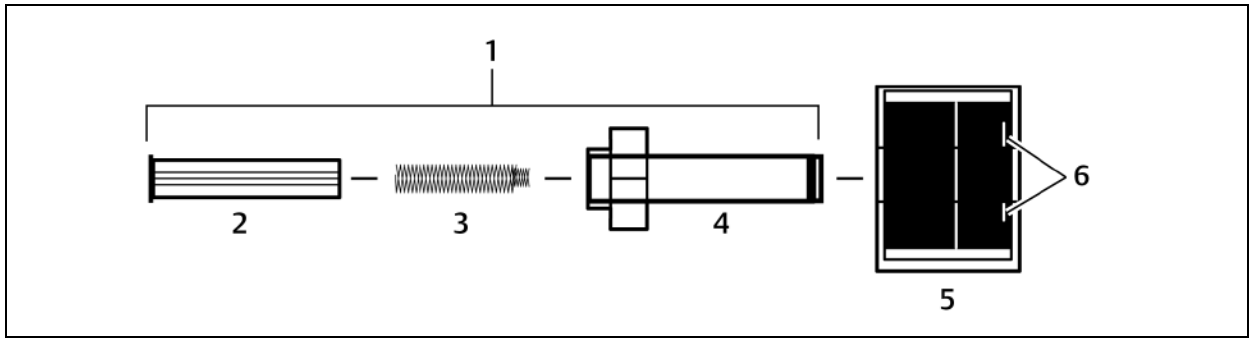
Always clean the drain valve before installing a new cylinder. Figure 8.3 below shows an exploded view of the drain valve for reference to clean it.

1. Remove old cylinder as described in Removing the Old Canister on the previous page.
2. Note that the ring terminal for the drain-valve green ground wire is sandwiched between the drain valve and the drain pan.
3. Remove the two screws securing the drain valve body to the drain pan.
4. Remove the hose clip and hose connection from the drain-valve body.
5. The drain-valve assembly is now free for disassembly and cleaning.
6. At a sink, remove the snap-fit red cap from the coil assembly and slide the coil off the actuator.
7. Loosen actuator using a wrench and unscrew from the plastic body.
8. Clean the exposed core, spring and plastic drain-valve pot
9. Reinstall in the reverse order.

NOTE: Be cautious when putting the spring back into the plunger, the taper end of the spring must be installed toward the solenoid.

10. Hand-tighten the actuator back into place, then secure it using a wrench to turn it a quarter of a turn.
11. Clean out the end of the hose, then reconnect it to the drain-valve body with the clamp.
12. Fit mounting screws back through the drain-valve body, one through ring terminal on the green wire.

Figure 8.3 Drain valve assembly



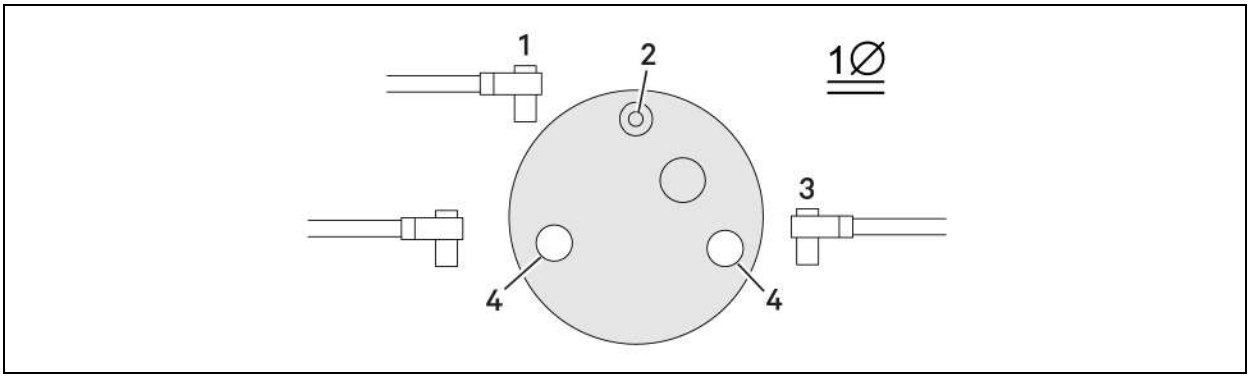
ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Actuator	4	Sleeve
2	Plunger	5	Holding coil
3	Spring	6	Male, slip-on connection tabs

8.4.3 Installing the New Canister

1. The reverse procedure should be followed to install a new cylinder. The main electrical disconnect is to be left open until the cylinder is completely installed and reconnected.
2. The blue sensor plug on all units is for the high water sensor pin, which always goes on the single pin with collar offset from the others. See Figure 8.4 below.
3. Ensure that cylinder plugs are snug on the pins. Replace any loose fitting plugs as these may result in hazardous operation.

WARNING! Risk of humidifier canister meltdown, smoke and fire. Can cause fire suppression system activation, fire and smoke alarm activation, building evacuation, dispatching of fire and rescue equipment and personnel and water leaks resulting in expensive equipment or building damage, injury or death. Check steam generating humidifier electrode plugs to ensure that they are pressed firmly onto pins. Loose connections will cause overheating of cylinder and plugs.

Figure 8.4 Sensor pins, cylinder plugs



ITEM	DESCRIPTION
1	White sensor plug
2	Sensor pin
3	Cylinder plug
4	Cylinder pin

8.5 Humidifier Maintenance during Extended Shutdown

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

Always drain the cylinder before disconnecting power to the humidifier for a period of extended shutdown. Otherwise, the electrodes are subject to harmful corrosion, which drastically shortens the cylinder life. Do not leave the switch in the DRAIN position indefinitely because the drain coil could burn out. Leave the switch in the Off position and open the main external fused disconnect to stop power to the humidifier. Close the shutoff valve in the water supply line feeding the humidifier.

8.5.1 Humidifier Troubleshooting

Terms Used in Humidifier Troubleshooting:

- FLA (Full Load Amps) are amps listed on the humidifier specification label.
- Short cycling occurs when the humidifier's "On time" is less than 10 minutes upon a call for humidity. To correct short cycling, all humidifiers have a capacity adjustment that allows the output of the humidifier to be reduced to as low as 20% of rated output, thus extending the "on time" required to maintain output.
- Foaming can occur when the impurities already in water reach an excess concentration as a result of boiling away water and continued boiling agitates the contained water. The humidifier electronics are designed to prevent foaming, although in extreme cases water will foam with little concentration, making it necessary to increase the drain time of the water contained in the cylinder. Foaming is normally caused by short cycling, a restricted drain or back pressure. The foam generated in these instances is conductive and may lead to false full-cylinder indication if the level of the foam approaches the top of the cylinder.
- Back pressure is the restriction of steam flow caused by long steam runs, improperly sloped steam lines, elbows changing the direction of steam flow from horizontal to vertical without a drain leg, any plumbing detail allowing the accumulation of condensate, undersized steam line, improper steam distributor, downward air flow onto the distributor causing excess static pressure at the steam outlets, or high static pressure ducts (not probable). To overcome excess static pressure in the duct, use a fill cup extension kit. In downflow applications, a downflow distributor should be used, but in some cases the fill cup extension will also be required.
- Reset unit (humidifier): To reset the humidifier, switch the auto On/Off/Drain switch at the front of the humidifier to the Off position for at least five seconds, then switch it back to the On position.
- Monitored leg is the primary wire to the cylinder that loops through the current sensing device of the main PCB. This wire ends at the red cylinder plug at the cylinder.

Table 8.1 Steam-generating Humidifier Status Lamps: Causes and Corrective Actions

UNIT STATUS LAMP		SYMPTOM	CORRECTIVE ACTIONS
YELLOW	GREEN		
On	On	Maximum water level inside cylinder.	This usually happens on initial start-up after replacing the cylinder (normal). Water is concentrated with minerals inside the cylinder. Let unit run; yellow light will disappear when the unit is at full output. This may take a day or two.
Off	Off	No power to the board.	Check for main power supply fault. Turn power switch to "Drain" position. If drain valve is activated (sound of solenoid), check connection to the board or board itself. When no sound is present, check fuse (replace with 3.0 A if needed), transformer (voltage should be present between fuse holder and ground screw).
1 flash sequence	Off	Excess current. Operating amperage exceeded 130% of rated amps. Water is drained from the cylinder (drain valve on for 10 minutes).	Check drain valve operation, drain time, possible drain restrictions. Check fill valve for leaks (not holding supply water). Back pressure may also cause very conductive water conditions. Check for short cycling. Water conductivity too high.
2 flashes in sequence	Off	No current detection for 30 minutes with continuous call for humidity.	Check water level in the cylinder - should be more than 1/4 full. If not, check fill rate, 24 VAC on fill valve terminals (unit must be on with call for humidity - green light on steadily). Verify fresh water supply to the humidifier. Leaking drain valve may be at fault (minerals blocking the plunger). If cylinder is more than 1/4 full, check primary power, connections to the cylinder, continuity of wires to cylinder. Are power wires connected to proper terminals on the cylinder? (Color coding.) Possibly wrong cylinder type. Low water conductivity.
4 flashes in sequence	Off	End of cylinder life - change cylinder.	Check water level in the cylinder; should be about 3/4 full. Check for foaming if water level is lower or cylinder life shorter than expected. Change cylinder, clean drain valve.

Table 8.2 Steam generating humidifier troubleshooting guide

SYMPTOM	POSSIBLE CAUSE	CHECK OR REMEDY
Unit in call for humidification, humidifier will not operate	Humidifier not receiving power	Verify ON/OFF/DRAIN switch is in ON position.
		Check fuses or CB's and replace or reset if necessary.
Humidifier Contactor pulled in, but no water enters canister	No water available to unit	Check external water shut-off valves.
	Clogged fill line strainer	Clean or replaced fill line strainer
Excessive arcing in canister	Drain valve clogged or defective	Verify that drain valve operates freely when activated. Clean valve and replace if defective. Flush canister several times and replace if arcing persists.
	Improper water supply	If water is commercially softened, reconnect humidifier to raw water supply, drain canister and restart. If connected to hot water supply, reconnect to cold water.
	Insufficient drain rate	Verify that drain valve operates freely when activated. Clean valve and replace if defective. Flush canister several times and replace if arcing persists.
	Excessive mineral content in water	Analyze mineral content of water. If mineral content is excessive contact Vertiv™ Technical Support.

8.5.2 Humidifier Troubleshooting Steps

Auto On/Off/Drain switch in On position—unit will not fill:

When the On/Off control circuit is made and the Auto On/Off/Drain switch is pushed to On, the 24V holding coil of the primary contactor should energize. The resulting magnetic pull closes the high-voltage contacts with a distinct and audible “clunk.” If the contactor will not make the connection, then inspect the following while referring to the wiring diagram:

- Check for 24V across terminals 18 and 26 on the PC board.
- The low-voltage 3A fuse located in the control box may be blown.
- The contactor holding coil may be open or shorted.
- The switch may be defective.

Recheck that the Auto On/Off/Drain switch is still On. If it is, shut off the main disconnect and check fuses or breaker of the main disconnect. If they are serviceable, turn power back on.

To test for a defective Auto On/Off/Drain switch, connect a wire from the fuse directly to Terminal 6 on the external controls strip. If the contactor activates, the On side of the switch is defective. If the contactor does not activate, the PC board could be defective.

If the 3A control fuse blows when the wire from the fuse touches Terminal 6 on the external controls strip, the contactor holding coil may be shorted. Replace contactor if necessary.

After the necessary components have been replaced and the contactor pulls in, there is line voltage to the cylinder and the control sequence can begin.

Approximately 30 seconds after the contactor pulls in, the fill valve coil should energize. There is also a visible fill relay on the printed circuit board. It is the one located farthest from the C.T. core. The points on this relay must be touching in order for the fill valve coil to be energized. If the points do not touch after the built-in time delay, the sensor input may be interfering. To confirm, remove the black and red sensor wires from terminals 6 and 10 on the PC board. Wait 30 seconds and, if the fill relay points do not touch, replace the sensor. If they still do not touch, the basic PC board may be faulty. To confirm, disconnect the red wire from terminal 18 and touch it to terminal 14. If the fill valve coil activates, the basic PC board should be replaced. If it still does not activate, the fill valve coil should be replaced. After the necessary components have been changed, water will start filling the cylinder and begin to submerge the electrodes. Because of the high-voltage across the electrodes, the water can now conduct electricity.

Red “Change Cylinder” light on—Water at top of cylinder:

This is a common occurrence on start up. See Start-up on page 111.

Water remains at high level and won't concentrate:

This is normal on cold start-up and can be accelerated by adding a maximum of 1/2 tsp. of dissolved salt to the cylinder on fill cycle through the plastic fill cup. See Low Water Conductivity on page 83.

If the unit has been operating extensively, observe for normal fill-boil-fill-boil cycle; no drainage should occur. If drainage occurs, check for leaking drain valve or back pressure.

Unit drains continually:

May be caused by foaming and/or back pressure or by a leaking drain valve.

If cylinder is almost empty, check for magnetic pull on drain solenoid indicating miswiring. If there is no pull, drain actuator is blocked open; remove, disassemble and clean.

If drain is occurring through activated drain valve, valve is miswired or electronics are faulty; consult factory.

If drain is occurring through the overflow on the fill cup, this is due to abnormal restriction on the steam line and back pressure forcing water out of the cylinder so water cannot concentrate and level remains high. Review installation of steam line to ensure there are no blockages or excessive static pressure in the air system.

9 LIEBERT ICOM HARDWARE INSTALLATION

Your unit includes the Liebert iCOM controller. This section describes the installation of connections and cabling to fully utilize the iCOM features.

9.1 Installing Wired Remote Sensors

Up to 10 remote-sensor modules, installed in the monitored racks and connected to the cooling unit, provide control and reference input to iCOM and building-management systems. Using remote, rack sensors combats cooling problems related to recirculation air, uneven rack loading, and air distribution.

Each Liebert CRV comes with 3 2T sensors standard. Although using and adding additional remote sensors is optional, we recommend attaching one remote sensor to each rack that the unit is intended to cool because they allow more efficient and effective operation of the cooling unit.

The sensor array consists of 2T sensors that each have two temperature probes on a 6-ft (1.8-m) probe-connection cable, Figure 9.1 below, and requires several steps to prepare, connect, and begin monitoring the racks:

- Set DIP switches in each sensor.
- Terminate final sensor on CANbus link.
- Install sensors on racks.
- Install CANbus cabling between sensors.
- Connect CANbus cable to the cooling unit.
- Configure the sensors in iCOM.

NOTE: The 2T sensor shown in Figure 9.1 below may differ slightly for your system, depending on equipment installed.

Figure 9.1 2T sensor for rack monitoring

9.1.1 Setting DIP switches and labeling 2T sensors

Tools required:

- Small, non-conductive tool to set switches
- Small, Phillips-head screw driver to open 2T housing.

Each sensor requires a unique address on the CANbus cable connected to the cooling unit. Although not required, we recommend that you set the DIP-switch sensor-number setting to correspond to the sensor's location on the CANbus run. If settings are incorrect, the control will not operate properly.

The DIP switches in 2T sensors included with each Liebert CRV are factory-set according to Table 9.1 below. If adding additional 2T sensors, use the steps that follow to set the DIP switches.

Table 9.1 DIP-switch settings for factory-supplied rack sensors

2T SENSOR NUMBER/ADDRESS	DIP-SWITCH POSITION								FACTORY TERMINATION SETTING
	1	2	3	4	5	6	7	8	
1	Off	Off	On	Off	On	Off	Off	Off	Unterminated
2	On	Off	On	Off	On	Off	Off	Off	Unterminated
3	Off	On	On	Off	On	Off	Off	Off	Terminated

NOTE: Sensors are connected in a daisy chain to the cooling-unit control board. You can extend the sensor network (up to 10) by adding sensors to the end of the chain and adjusting the termination settings. Do not run individual wires from the sensors to the cooling unit.

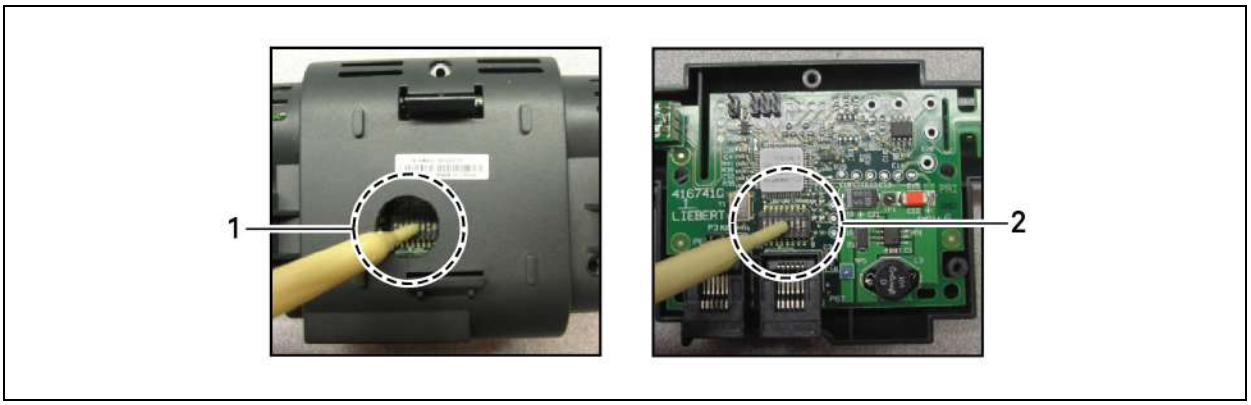
1. Apply numbered stickers to the sensor housing that corresponds to the sensor's position in the chain.
2. Locate the DIP-switch hole on the rear of the sensor housing, Figure 9.2 below.

   – or –

   If the hole is not present, or the settings are difficult to make through the hole, remove the cover, Figure 9.2 below, by removing the Phillips-head screws (typically 3).

NOTE: Use the non-conductive DIP-switch tool (included) or a similar tool to set switches. Do not insert any metal object into the sensor case.

Figure 9.2 DIP-switch opening/DIP switches inside of 2T sensor



ITEM	DESCRIPTION
1	Hole in sensor housing
2	Cover removed

3. Referring to 9.1.1 on page 91 and using the non-conductive tool, set the DIP switches for each sensor to its number in the chain (from sticker applied in step 1).
   Figure 9.3 below shows a representation of the DIP switches.
4. Confirm that the DIP switches are set correctly for each sensor, and replace the housing cover if necessary.

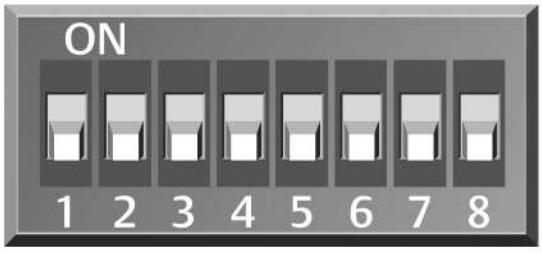
Table 9.2 DIP-switch settings for wired-remote sensors

2T SENSOR NUMBER/ADDRESS	DIP-SWITCH POSITION								FACTORY SETTING
	1	2	3	4	5	6	7	8	
Factory-supplied sensors									
1	Off	Off	On	Off	On	Off	Off	Off	Unterminated
2	On	Off	On	Off	On	Off	Off	Off	Unterminated
3	Off	On	On	Off	On	Off	Off	Off	Terminated
Optional added sensors									
4	On	On	On	Off	On	Off	Off	Off	Unterminated
5	Off	Off	Off	On	On	Off	Off	Off	Unterminated
6	On	Off	Off	On	On	Off	Off	Off	Unterminated
7	Off	On	Off	On	On	Off	Off	Off	Unterminated
8	On	On	Off	On	On	Off	Off	Off	Unterminated
9	Off	Off	On	On	On	Off	Off	Off	Unterminated
10	On	Off	On	On	On	Off	Off	Off	Unterminated

The last 2T sensor in the array must be terminated. If more than the 3 factory-supplied sensors are installed, sensor #3 must be unterminated and the last sensor must be terminated.

NOTE: Up is on, down is off on the DIP switch.

Figure 9.3 DIP switches in 2T sensor

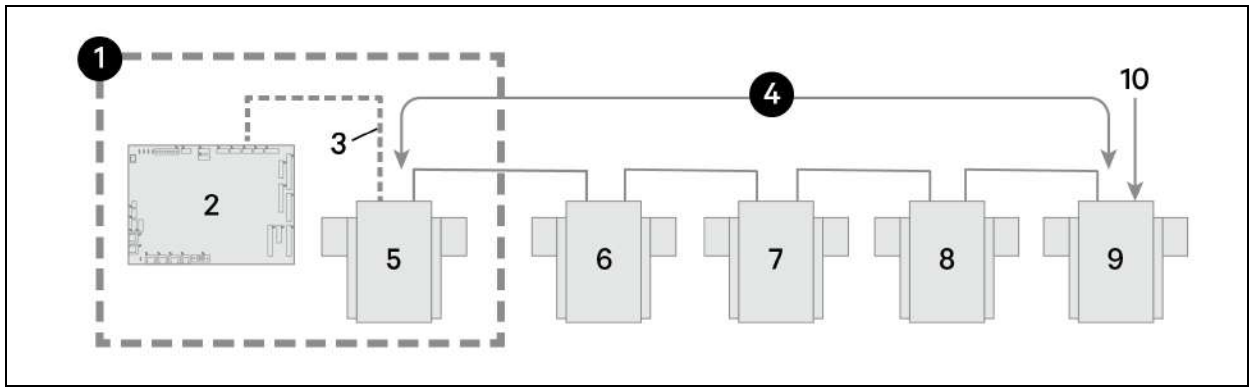


9.1.2 Terminating the last sensor on the CANbus link

The 2T sensor need not be installed in the numeric-order of their address/sensor number (although it may be easier for later maintenance). However, the last sensor in the chain must be terminated. All others must remain un-terminated. We also recommend that you make a record of the sensor numbers along with the name/number of the rack on which they are installed. Figure 9.4 below shows an example CANbus arrangement.

NOTE: To add sensors, un-terminate final sensor, add sensors to the chain, and terminate the new final sensor.

Figure 9.4 Sensor CANbus arrangement



ITEM	DESCRIPTION
1	Inside the CRV unit
2	iCOM control board
3	Factory wiring
4	CANbus communication link
5	Unit temperature/humidity sensor
6	2T sensor
7	2T sensor
8	2T sensor
9	2T sensor
10	Terminated sensor

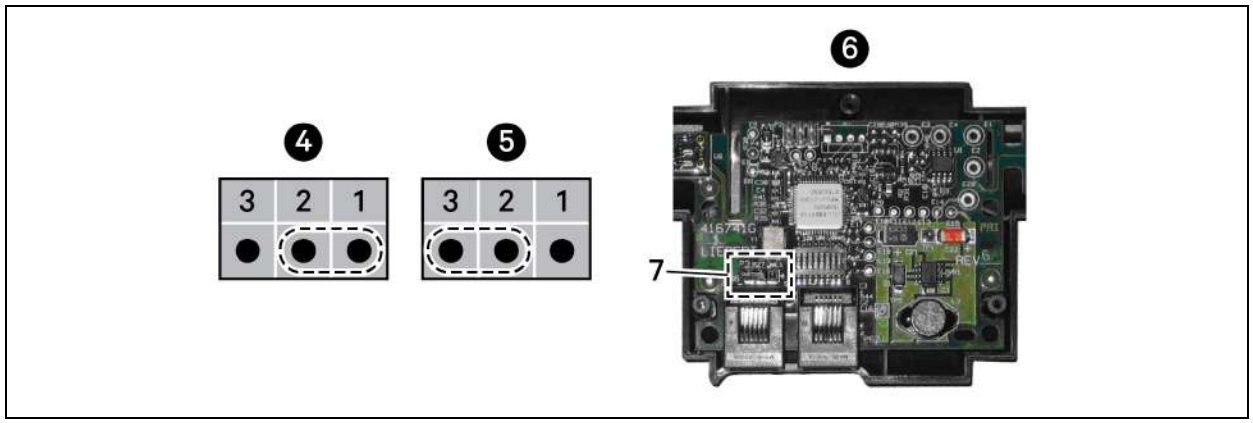
To terminate the last sensor:

1. Locate the sensor that will be last on the network.

NOTE: The last sensor on the network will be the sensor with only 1 CAN cable after all sensors are connected to the CANbus network. See Connecting the CANbus cable and ground on page 103.

2. Open the sensor's case by removing the Phillips-head screws (typically 3) one the rear of the housing to access the jumper used for terminating.
3. Remove the black jumper from pins 1 and 2, and install it on pins 2 and 3 as shown in Figure 9.5 on the facing page.
4. Replace the sensor cover.
   The 2T sensor is terminated in the CANbus link.

Figure 9.5 Termination-jumper on 2T circuit board



ITEM	DESCRIPTION
1	Jumper position
2	Jumper position
3	Jumper position
4	Unterminated
5	Terminated
6	Rear of sensor, cover removed
7	Termination jumper

9.1.3 Routing CANbus cable and preparing for sensor installation

Depending on the CRV model number, the CANbus cables may enter the cooling unit from differing locations to connect to the return-air temperature sensor.

- For 300-mm (24-in.): CR019 and CR032 models, the CANbus cable may enter through the top or bottom. See Preparing for sensor-cabling of CRV 300 -mm (12-in.) units—CR019 and CR032 on the next page.
- For 600-mm (12-in.): CR020, CR035, and CR040 models, the CANbus cable enters through the top of the unit. See Preparing for sensor cabling of CRV 600-mm (24-in.) units—CR020, CR035 and CR040 on page 98.

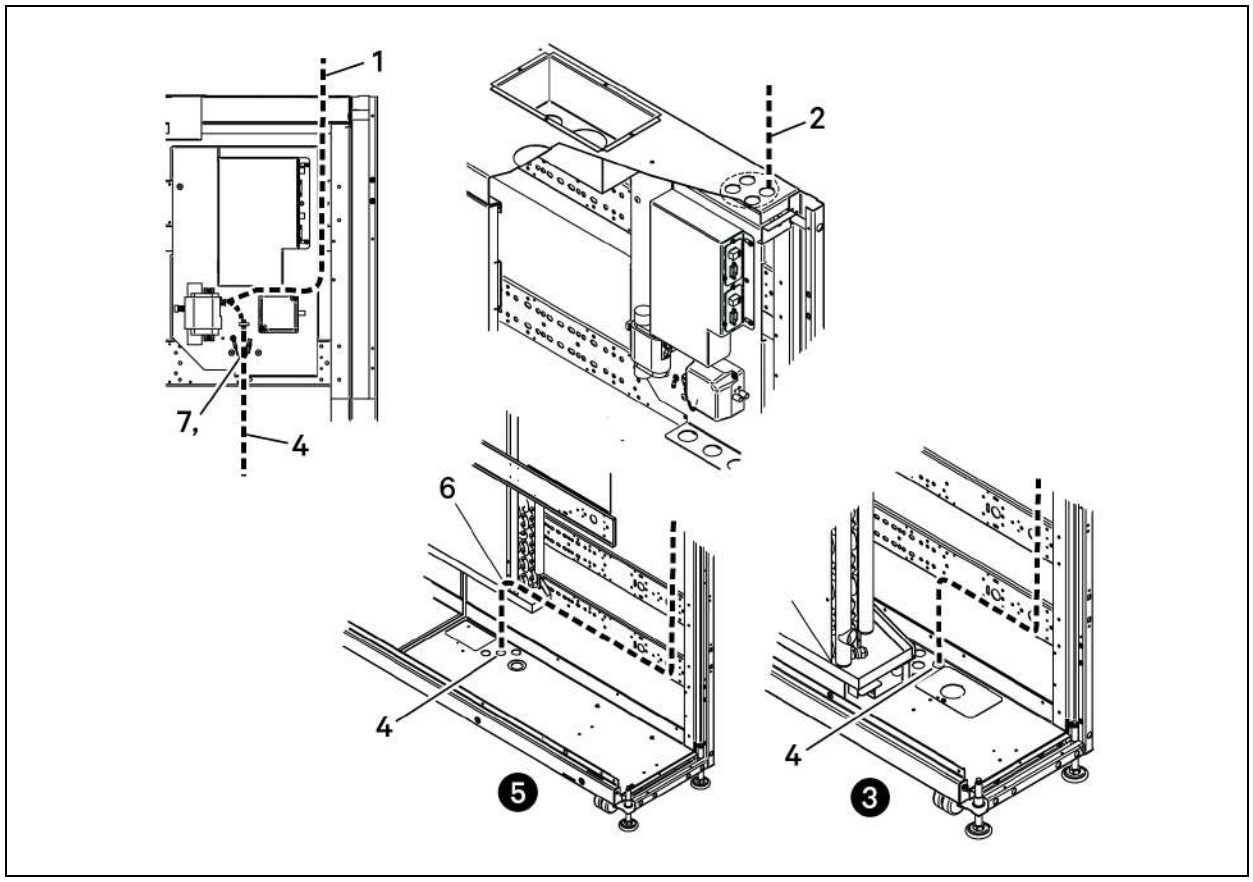
NOTE: Connecting the CANbus sensors requires entering the high-voltage electrical compartment in the unit. Consider hiring a certified electrician.

Preparing for sensor-cabling of CRV 300 -mm (12-in.) units—CR019 and CR032

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

1. Verify that all power entering the unit is disconnected.
2. Open the rear door on the back of the unit and remove the filters to access the unit-disconnect switch.
3. Turn the High Voltage disconnect switch to Off.
4. Locate the 10-ft (3 m) CANbus cable that shipped with the 2T sensors in the box on the unit skid.
5. Determine whether routing through top or bottom of unit, and locate low-voltage field wiring entry points, shown in Figure 9.6 on the facing page.
    - Route the cable through the low-voltage-access, 7/8-in. knockout using the proper strain relief.
    - Once inserted through knockout, route the cable to the IntelliSlot bracket inside the unit.

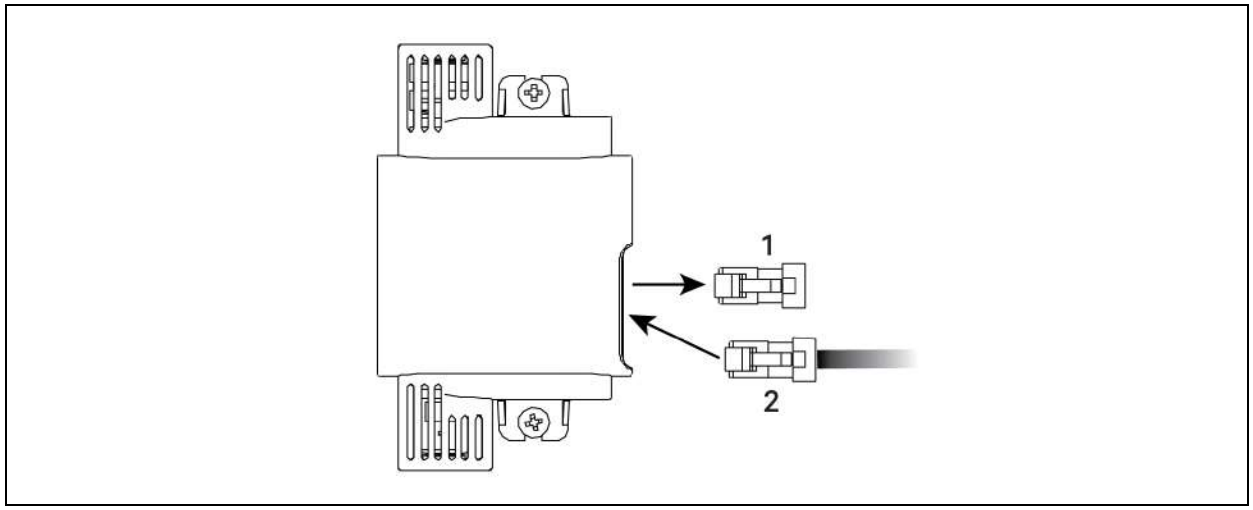
Figure 9.6 CANbus wire routing for CRV 300-mm (12-in.) units—CR019 and CR032



ITEM	DESCRIPTION
1	Top-entry field routing of CANbus wiring
2	Top-entry field routing of low-voltage wiring
3	CW unit
4	Bottom-entry field routing of low-voltage and CANbus
5	DX unit
6	CANbus and low-voltage wiring route in DX unit
7	Ground connector (factory installed)

6. Remove the termination plug from the temperature sensor (which is installed on the IntelliSlot bracket), and discard the plug, and connect the cable to the open CANbus port, Figure 9.7 below.
7. Connect the CANbus ground to the factory-supplied ground connector.

Figure 9.7 Remove Termination plug and insert CAN cable



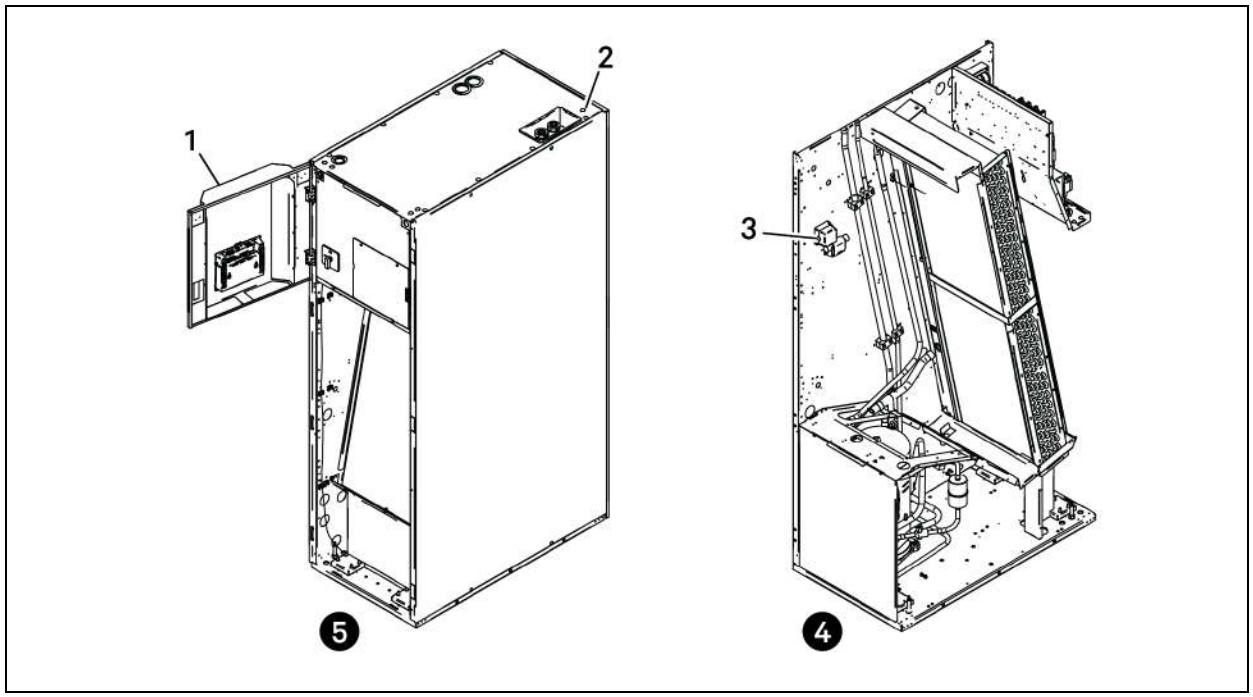
ITEM	DESCRIPTION
1	Termination plug
2	CAN cable

Preparing for sensor cabling of CRV 600-mm (24-in.) units—CR020, CR035 and CR040

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

1. Verify that all power entering the unit is disconnected.
2. Open the top, display door on the front of the unit, Figure 9.8 on the facing page.
3. Turn the High Voltage disconnect switch to Off.
4. Locate the 10-ft (3 m) CANbus cable that shipped with the 2T sensors in the box on the unit skid.
5. At the top of the cabinet, route the cable through the 7/8-in. knockout using the proper strain relief, then route the cable to the return-air temperature sensor inside the unit, Figure 9.8 on the facing page.

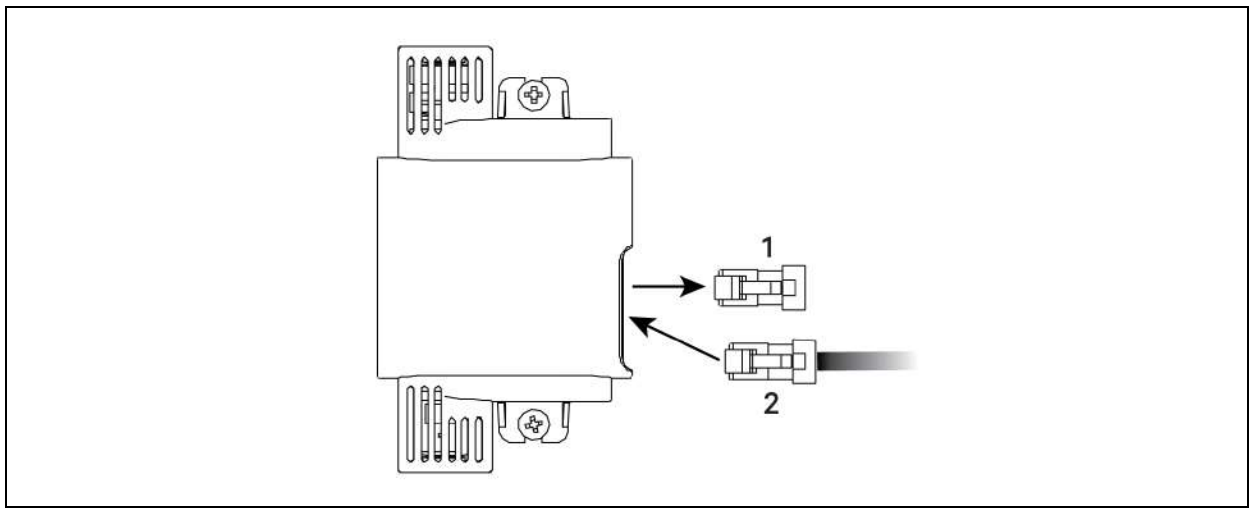
Figure 9.8 CANbus top-entry wiring for CRV 600-mm (24-in.) units—CR020, CR035, and CR040



ITEM	DESCRIPTION
1	Top/Display door
2	Cable-connection top entry
3	Temperature sensor
4	Rear view
5	Front view

6. Remove the termination plug from the temperature sensor, and discard the plug, and connect the cable to the open CANbus port, Figure 9.9 below.
7. Connect the CANbus ground to the factory-supplied ground connector.

Figure 9.9 Remove Termination plug and insert CAN cable



ITEM	DESCRIPTION
1	Termination plug
2	CAN cable

9.1.4 Installing 2T sensors in the racks to monitor

Tools required

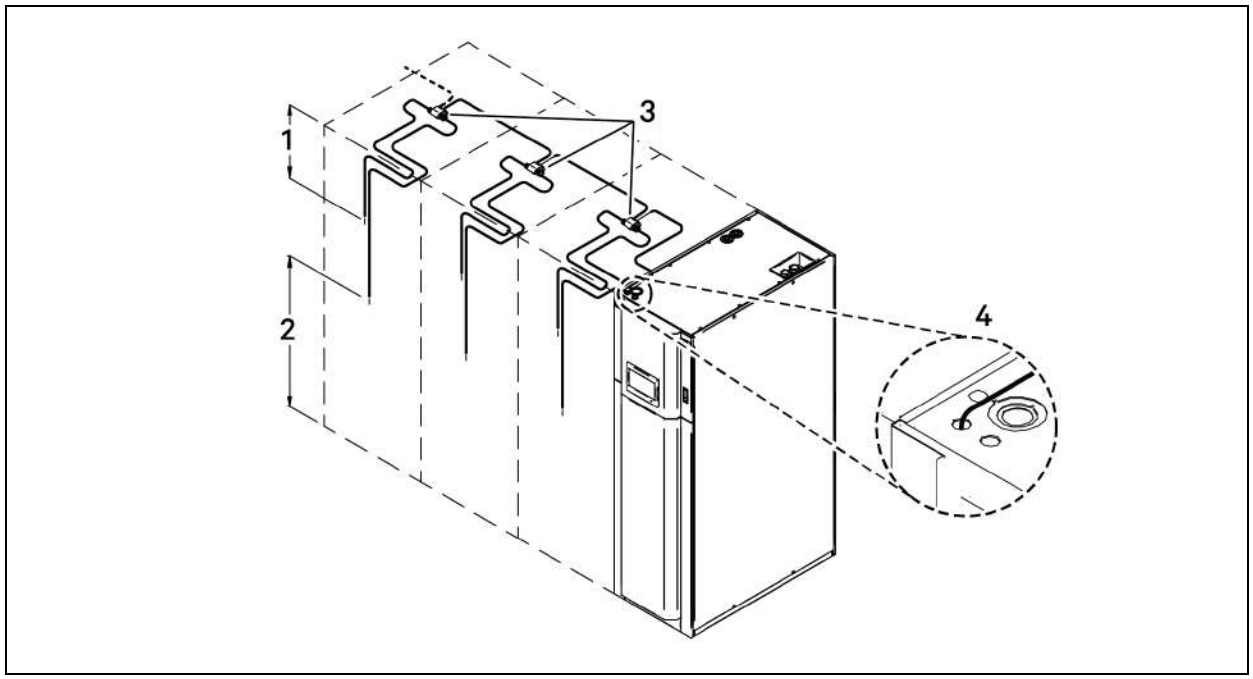
- Medium, flat-head screw driver to open electric-panel dead-front
- Cutting tool to trim cable ties

To install the sensors on the racks:

NOTE: Do not install a sensor in the hot aisle. Do not leave sensor probes coiled on top or coiled inside of a rack.

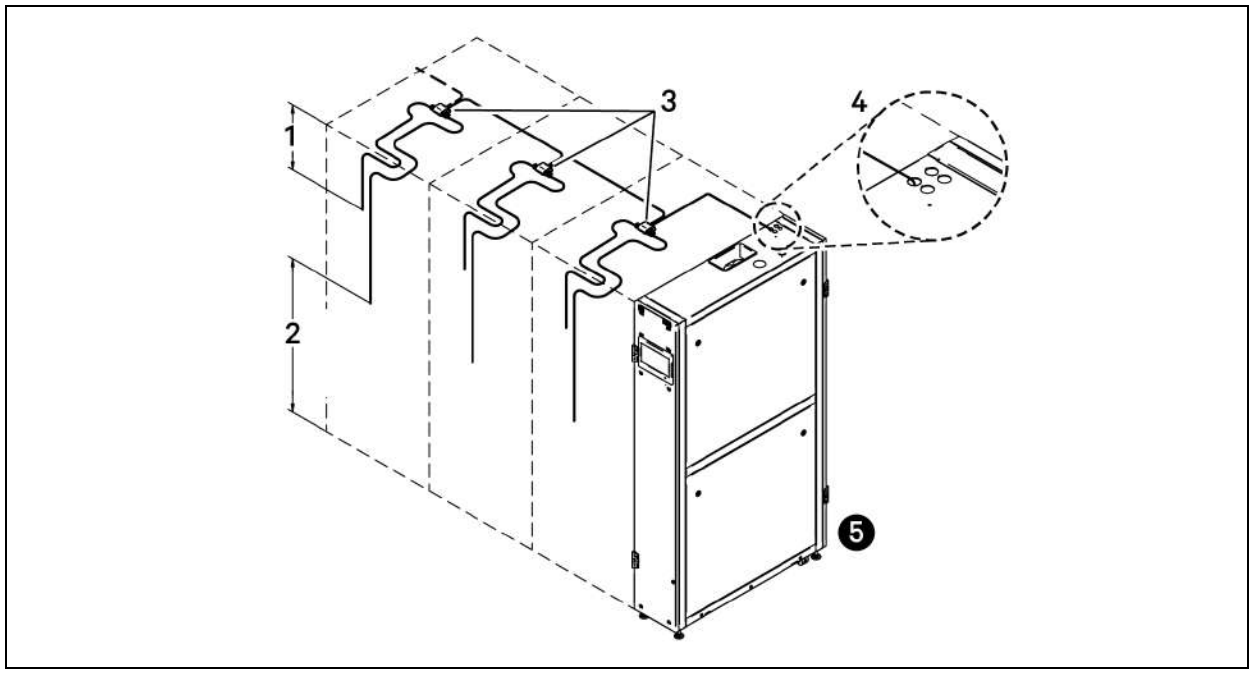
1. Install the rack temperature sensors on the rack adjacent to the CRV as shown in Figure 9.10 on the facing page or Figure 9.11 on page 102.

Figure 9.10 Rack sensor placement for 600-mm (24-in.) models



ITEM	DESCRIPTION
1	First probe, 12 in. (305 mm) from top
2	Second probe, in approximate center of rack and in front of the equipment
3	2T sensors with labels visible
4	Cable-connection top entry point (use a field-supplied and field-installed protective bushing)

Figure 9.11 Rack sensor placement for 300-mm (12-in.) models



ITEM	DESCRIPTION
1	First probe, 12 in. (305 mm) from top
2	Second probe, in approximate center of rack and in front of the equipment
3	2T sensors with labels visible
4	Cable-connection top entry point. Use a field-supplied and field-installed protective bushing.
5	Cable-connect bottom entry, refer to Preparing for sensor-cabling of CRV 300 -mm (12-in.) units–CR019 and CR032 on page 96, and use a field-supplied and field-installed protective bushing.

NOTE: Both probes on the 2T sensor must be installed on the same rack.

2. Install the 2T sensor probes the front door of the rack (inside or outside the door):
    a. Using a cable tie, secure the sensor wire so that a probe is approximately 12 in. (305 mm) from the top and in the center of the front door.
    This sensor monitors hot air coming over the top of the rack from the hot aisle.

NOTE: Do not wrap cable ties around the actual sensor probe. If the rack has no door, secure the probes to the rack at the side of the front opening.

    b. Use a cable tie to secure the sensor wire of the second probe to the front door so that it is centered in front of the heat-generating equipment drawing air.

    If the cabinet is completely-filled with equipment, determine the center based on cabinet width and height.

    c. With probes in place, use cable ties to route the wires neatly up the rack door and into the rack leaving enough slack in the wire so that the rack door opens and closes without binding or pinching the wire.
    d. Using the supplied, hook-and-loop fastener, connect the 2T-sensor housing to the rack in an easily-accessible location and with the sensor number visible.
3. Repeat step 2 until all sensors are installed.

9.1.5 Connecting the CANbus cable and ground

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

Cabling considerations:

- For cable up to 150-ft (45-m) long, no special considerations are needed.
- Cable 150 ft (45 m) to
- 300 ft (91 m), contact the factory.
- The CANbus cable network requires a ground wire.

To connect the cables:

1. Connect CANbus cable and a ground wire between each sensor for the cooling unit, Figure 9.12 below, taking the following precautions:

NOTE: Remember that the last sensor on the chain must be terminated as described in Terminating the last sensor on the CANbus link on page 94.

- Use only approved hangers, and do not secure cables in a way that could damage them.
- Limit bends to less-than 4-times the diameter of the cable.
- When securing and hanging, avoid deforming the cable.
- Keep cables away from devices that may cause interference such as high-voltage wires, machinery, fluorescent lights and electronics.

NOTE: High-voltage sources much be at-least 12 in. (305 mm) from CAN wires.

- Avoid stretching cables.
- Avoid using excess cable between sensors.
- Make sure that cables have the correct pin-out. Mismatched pins at the RJ2 connection will damage the CAN device.

2. Connect the ground connection between each sensor, Figure 9.12 below.

Figure 9.12 CANbus and ground connection on 2T sensor

9.2 U2U Network Installation

9.2.1 Required network equipment

Ethernet cable CAT5 or greater.

- Maximum cable length is 328 ft (100 m).
- An Ethernet repeater is required for cable lengths greater than 328 ft (100 m).

Network switch

- IEEE 802.3; IEEE 802.3u
- 10/100 Mbps speed
- Multiple 10/100 RJ-45 ports, one shared.
- RJ-45 up-link port

NOTE: Up to 32 cooling units may be connected in a U2U network.

9.2.2 Plan wiring runs

When planning the layout of the conditioned space, consider the following:

- Good wiring practices.
- An Ethernet repeater is required for cable lengths greater than 328 ft (100 m).
- A private network that only connects and manages the cooling units is required.
- Keep control and communication cables away from power cables to prevent electromagnetic interference.
- Keep cables away from noise-introducing devices such as machines, fluorescent lights and electronics.
- Do not bend cables to less than 4 times the diameter of the diameter of the cable.
- Do not deform cables when hanging or securing in bundles.
- Do not exceed 25 lb (11 kg) of tension when pulling cables to avoid stretching.
- Do not damage cables when securing them. Use only approve hangers, such as telephone wire/RG-6 coaxial-wire hangers.

9.2.3 U2U Wiring connection

NOTICE

Cooling units are factory-wired for stand-alone operation. Do not connect the U2U network cabling before setting the U2U network configuration/groups. Network communication conflicts and unreliable display readings will result.

Before you begin, refer to Preparing for U2U Group Set-up, and Configuring U2U Network Settings, in the “Liebert® iCOM™ User Manual,” included with your system documentation.

– or –

Contact Vertiv™ Technical Support at 1-800-543-2778 or https://www.vertivco.com/en-us/support/.

U2U Network Requirements

The network must be private:

- Isolated from other network traffic.
- Switches connecting the units must be dedicated to iCOM communication only.
- Do not connect the U2U network to the building or IT network. If the U2U network experiences a failure, the cooling units continue to operate independently.

iCOM supports up-to 64 nodes on the U2U network. The following are considered nodes:

- Input/Output board (1 in each cooling unit)
- Large wall-mount display

Small touchscreen displays on the cooling unit are not considered nodes because they are directly-connected to the input/output board in the unit, not the network.

Of the 64 nodes, up to 32 may be cooling-unit input/output boards. Table 9.3 below provides U2U network-configuration examples.

Table 9.3 Example iCOM U2U Network Configurations

CONFIGURATION EXAMPLE	NO. OF INPUT/OUTPUT BOARDS (COOLING UNITS)	NO. OF WALL-MOUNT DISPLAYS	PRIVATE SWITCH REQUIRED?
A	2	0	No
B	2	1	Yes
C	3	0	Yes
D	8	1	Yes
E	32	5	Yes
F	32	32	Yes

9.2.4 Wiring Cooling Units without Wall-mount Displays

NOTE: Cooling units are factory-wired for stand-alone operation. Do not connect the U2U network cabling before setting the U2U network configuration/groups. Network communication conflicts and unreliable display readings will result.

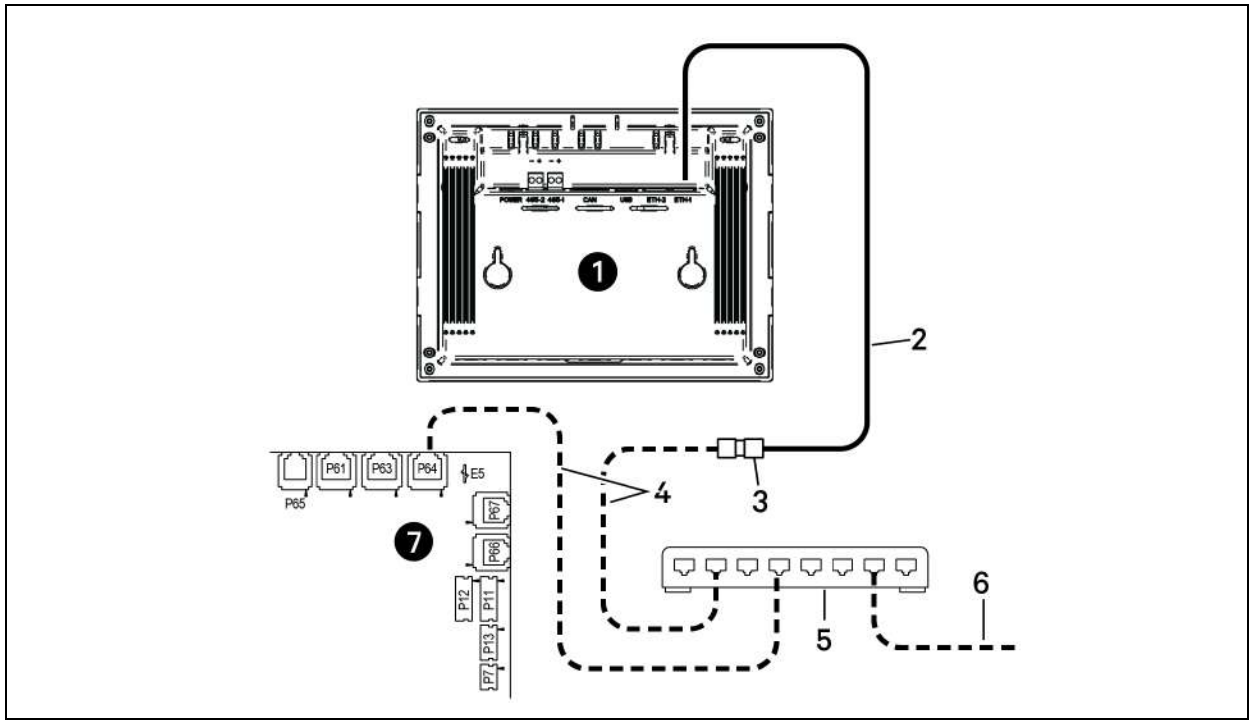
NOTE: Before you begin, refer to Preparing for U2U Group Set-up, and Configuring U2U Network Settings, in the "Liebert® iCOM™ User Manual," included with your system documentation.

To connect 300 mm (12 in.) units, see Figure 9.13 on the facing page, and:

1. Unplug the red cable from P64 at the I/O board, connect it to the crossover coupler provided.
2. Connect a field-supplied, straight-through Ethernet cable to the crossover coupler and the network switch.

3. Connect a second field-supplied, straight-through Ethernet cable to P64 and the network switch.

Figure 9.13 Connecting 300 mm (12 in.) units

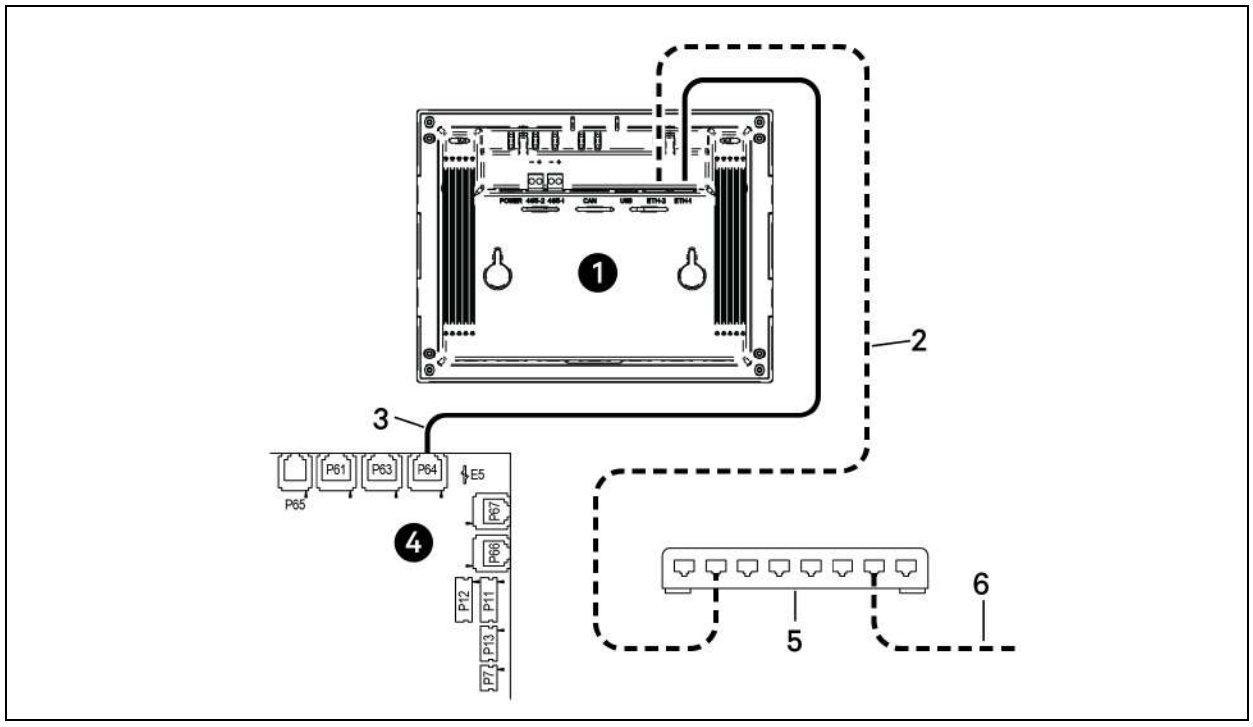


ITEM	DESCRIPTION
1	Touchscreen (rear view)
2	Ethernet cable
3	Coupler (factory-supplied)
4	Straight-through Ethernet cables
5	Network switch (field-supplied)
6	to ETH-2 on rear of other cooling-unit touchscreens
7	iCOM I/O board

To connect 600 mm (24 in.) units:

- On each unit, connect one plug on the CAT5 cable to ETH-2 on the rear of the display, and the other to the network switch, Figure 9.14 below.

Figure 9.14 Connecting 600 mm (24 in.) units



ITEM	DESCRIPTION
1	Touchscreen (rear view)
2	Ethernet cable (field-supplied)
3	Ethernet cable
4	iCOM I/O board
5	Network switch (field-supplied)
6	to ETH-2 on rear of other cooling-unit touchscreens

9.2.5 Wiring Cooling Units with Wall-mount Displays

NOTE: Cooling units are factory-wired for stand-alone operation. Do not connect the U2U network cabling before setting the U2U network configuration/groups. Network communication conflicts and unreliable display readings will result.

NOTE: Before you begin, refer to Preparing for U2U Group Set-up, and Configuring U2U Network Settings, in the "Liebert® iCOM™ User Manual," included with your system documentation.

Large, wall-mount displays may be used to remotely configure, control and monitor all cooling units connected on the U2U network.

- Each display requires 120 VAC or 230 VAC input power.
- An AC-adapter wall plug is factory-supplied.

To connect wiring:

1. On each wall-mount display (32 max.), connect one plug of a straight-through Ethernet cable to port P64 on the rear of the display.
2. Connect the other end to the U2U network switch.

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10 START-UP

WARNING! Risk of hair, clothing and jewelry entanglement with high speed rotating fan blades. Can cause equipment damage, serious injury or death. Keep hair, jewelry and loose clothing secured and away from rotating fan blades during unit operation.

WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit.

To start the Liebert CRV:

1. Open all valves in the refrigeration circuit according to the instruction label attached to the valve.
2. Water/Glycol-cooled Models Only: Open all valves in the water circuit according to the instruction label attached to the valve.
3. Ensure that the refrigerant charge is correct (see Refrigerant Charge Requirements for Air-cooled Systems on page 40).
4. Using a leak detector, verify that there are no refrigerant leaks. If any leaks are detected, repair them and recharge, depending on your system, as described in Charging Air-cooled Systems without Liebert Lee-Temp on page 44 or Charging Air-cooled Systems with Liebert Lee-Temp Receiver on page 49.
5. At least 4 hours before start up, close the main switch and the compressor switch on the electric panel.

NOTE: The default setting for the Liebert iCOM control is for stand-alone operation. The stand-alone mode lets you turn on the unit simply by rotating the main switch on the electrical panel. The yellow LED on the Liebert iCOM will light after the unit is turned on because electrical power is present.

If the LED does not light:

- Check the electrical panel power supply.
- Check the protection devices (for example, thermal switches).
- Check the fuses.

6. Verify that the crankcase heater is working.
7. Check to ensure that there are no water leaks.
8. If an external condenser or drycooler is installed, start it by supplying power to it.
9. Close all MCBs on the electrical panel.
10. Check the supply voltage on all phases.
11. Check the supply voltage on all phases for the external condenser or drycooler, if fitted.
12. Start the unit by pressing the On/Off switch.
13. Check the amp draw of all components (see Electrical Connections on page 73).
14. Check the amp draw of the external condenser/drycooler, if fitted.

15. If the compressor makes a loud, unusual noise, invert the electrical connections of the phases supplying the unit, which accepts only one direction of rotation.
16. Ensure that the fans rotate in the correct direction (see arrow on fan).
17. Ensure that all control system settings are correct and that there are no alarms (see Liebert iCOM Control).
18. Water/Glycol-cooled Models Only: Verify the water flow is adequate.
19. Water/Glycol-cooled Models Only: For closed circuit units, ensure that the water pump starts when the compressor starts.

10.1 Checks to Perform after Start-up

Once the system is operating under load, check the various components, as follows:

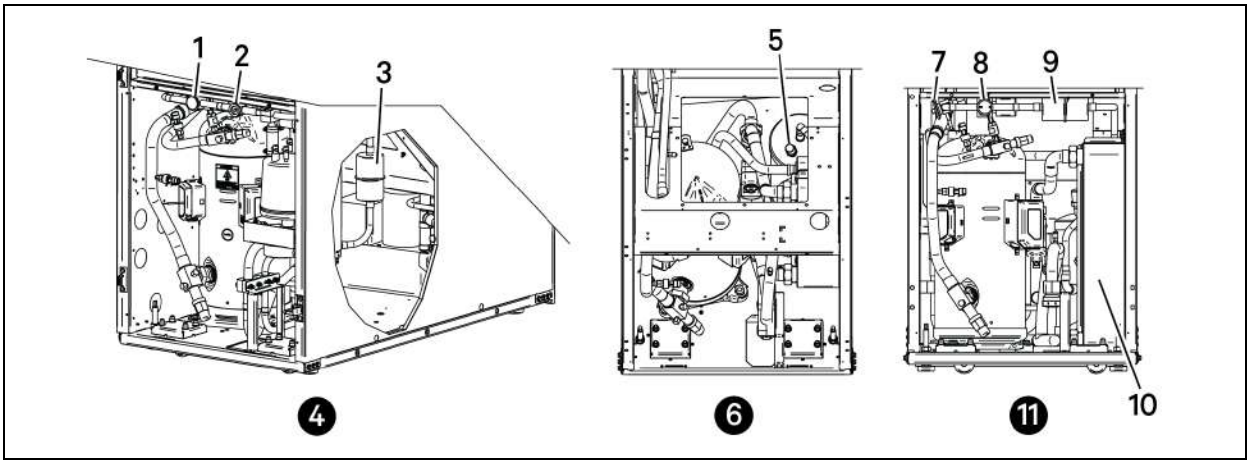
1. Verify that the fans are operating properly.
2. Ensure that the temperature and relative humidity are being controlled, and that the humidifier (optional) and heating steps (optional) operate when required.
3. Ensure that the compressor operates when required.
4. Ensure that the fan operation controller on the external condenser/drycooler (if fitted) is calibrated correctly, and that it controls the fan operation.
5. Record all of the following on the warranty inspection form:
    a. All component voltages and current draws
    b. All air / water temperatures indoor and outdoor
    c. All refrigerant and water / glycol pressures,
    d. All levels of refrigerant and oil in sight glasses
    e. Record refrigerant pressure switch settings and operating pressures
    f. Record superheat and subcooling.
6. Operate unit at full heat load, normal room conditions, and normal water/glycol fluid temperatures for a minimum of 30 minutes, and read/compare the superheat and subcooling values against Table 6.14 on page 51. Adjusting the refrigerant charge as described in Superheat and Refrigerant Charge Optimization on page 50 will maximize unit capacity and efficiency at full-load conditions.

10.2 Automatic Restart

The unit may be set to automatically restart on the return of power after a supply power interruption using the Liebert iCOM controller.

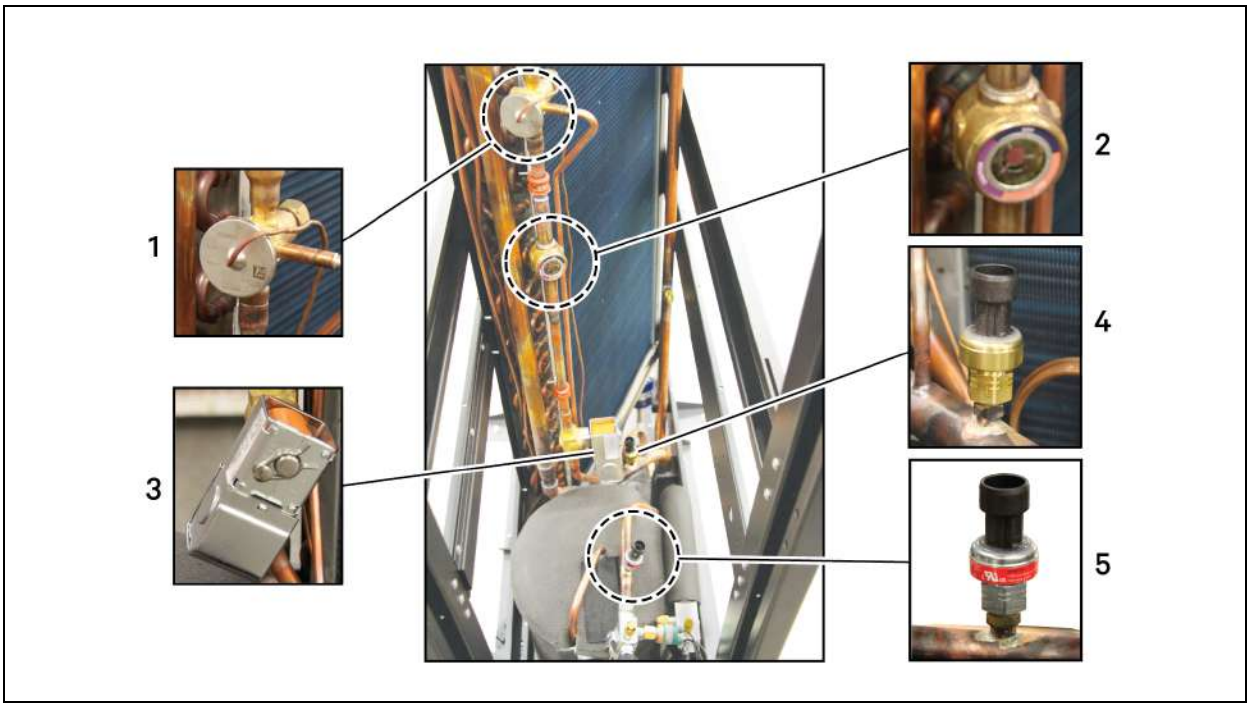
To avoid an automatic cold restart of the compressor if a power interruption of several hours is expected, stop the unit before the blackout. After power returns, allow the compressor to preheat before restarting the unit.

Figure 10.1 Refrigerant line components—All models, 600 mm (24 in.)



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	Solenoid valve	7	Thermostatic expansion valve
2	Sight glass	8	Solenoid valve
3	Filter dryer	9	Filter dryer
4	Air-cooled unit, rear view	10	Brazed-plate heat exchanger (Behind humidifier, humidifier not shown)
5	Liquid-receiver relief valve	11	Water-cooled unit, rear view
6	Water-cooled unit, top view		

Figure 10.2 Refrigerant line components—Air-cooled, 300 mm (12 in.)



ITEM	DESCRIPTION
1	Thermostatic expansion valve
2	Sight glass
3	Solenoid valve
4	Pressure transducer
5	Pressure transducer

10.3 Chilled Water Valve— All Chilled-water Models

The chilled-water units come with either a two-way or three-way valve, see Figure 10.3 on the facing page.

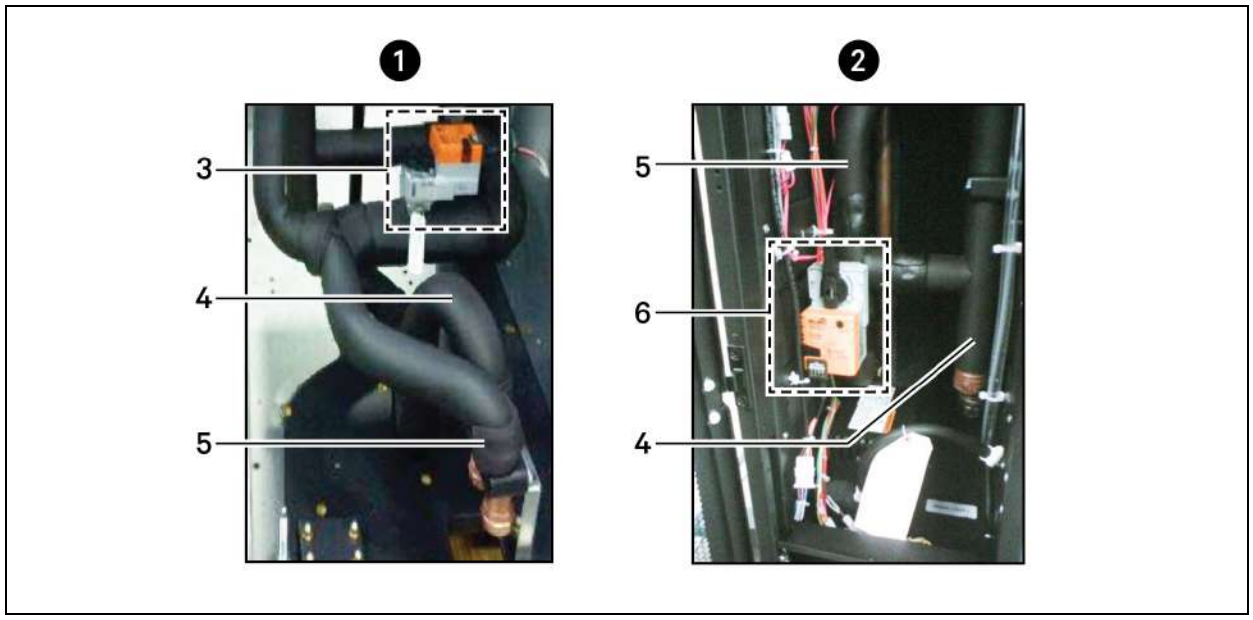
The valve controls the chilled water flow and operates as follows:

- When the valve is fully open (i.e., maximum chilled water flow/cooling), the actuator handle is set to the full CW position
- When the valve is closed (i.e., no chilled water flow/cooling), the actuator handle is set to the full CW position

The valve running time is set to the value specified in the control manual.

NOTE: In the event of control system failure, the valve can be manually controlled with the ball valve handle. It can be used to drive the actuator into any position between 0 and 1.

Figure 10.3 Position of the chilled-water valve actuator (for 2- or 3-way valve)—600 mm (24 in.) and 300 mm (12 in.) units



ITEM	DESCRIPTION
1	600-mm (24-in.) unit
2	300-mm (12-in.) unit
3	Chilled-water valve actuator, 2-way valve
4	Water return piping
5	Water supply piping
6	Chilled-water valve actuator, 3-way valve

10.4 Adjust Baffles to Direct Air Properly

WARNING! Risk of electric shock. Can cause equipment damage, injury or death. Open all local and remote electric power supply disconnect switches and verify with a voltmeter that power is off before working within any electric connection enclosures. Service and maintenance work must be performed only by properly trained and qualified personnel and in accordance with applicable regulations and manufacturers' specifications. Opening or removing the covers to any equipment may expose personnel to lethal voltages within the unit even when it is apparently not operating and the input wiring is disconnected from the electrical source.

WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit.

The Liebert CRV is equipped with an adjustable, modular, supply-air baffle system. Adjust the baffles prior to start up to direct air toward the racks that the cooling unit is intended to condition. Ideally, these should be the same racks from which the cooling unit is pulling hot air. The baffles can be readjusted at any time as cooling needs change.

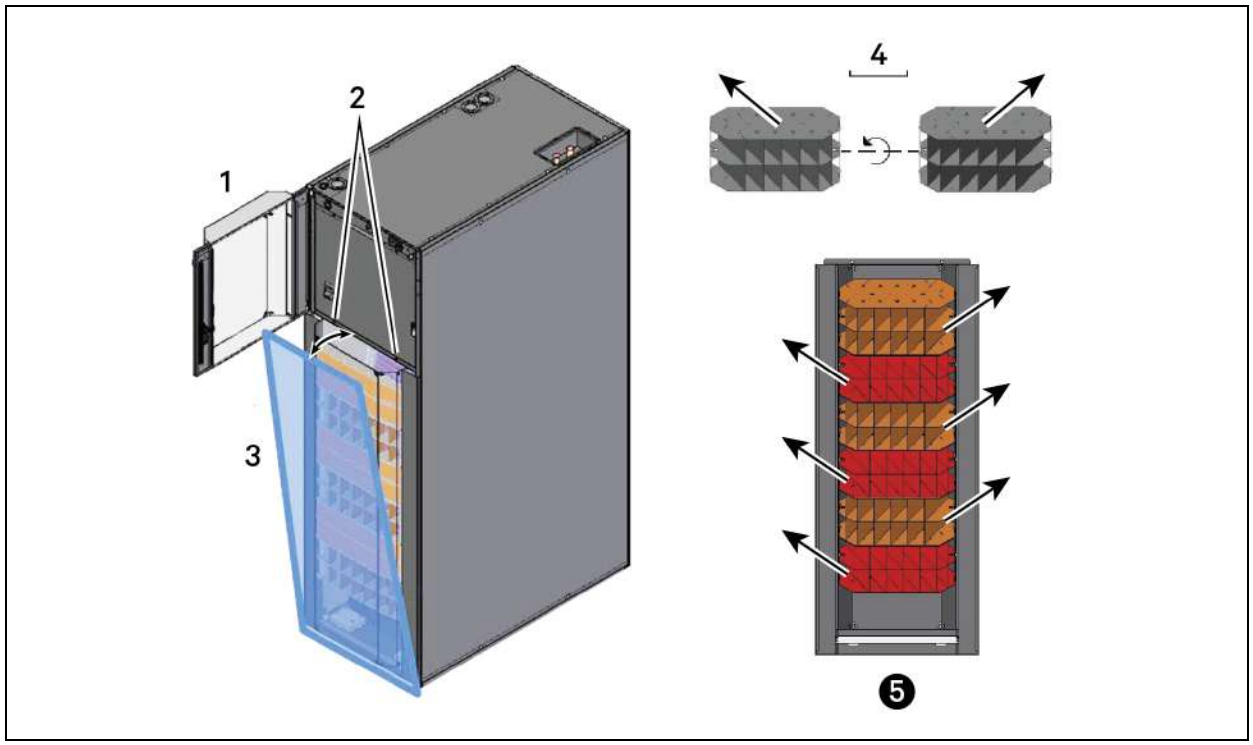
The unit ships with the baffles in an alternating pattern to direct cold air left and right. This configuration should be used when the cooling unit is located between racks. If cooling unit is installed at the end of a row, adjust all the baffles to blow air down the cold-aisle, toward the racks. The baffle segments at the top of the panel will direct more air than the segments at the bottom. The supply air will travel the furthest when all baffle segments are pointed in the same direction, left or right.

10.4.1 Adjusting Baffles—600-mm (24-in.)

To adjust the baffles on 600-mm (24-in.) models:

1. Open the door containing the Liebert iCOM display.
2. Remove the two bolts holding a baffle panel segment in place.
3. Slide out the baffle segment.
4. There is one screw on each side of the baffle, as shown in Figure 10.4 on the facing page. Remove the screws and rotate the baffle segment around its horizontal axis to change the airflow direction.
5. Reinsert the baffle segment and reinstall the screws.

Figure 10.4 Baffle adjustment for correct airflow direction—600-mm (24-in.)



ITEM	DESCRIPTION
1	Display door (open)
2	Bolts to remove
3	Tilt and lift-out baffle panel.
4	Changing baffle-panel direction
5	Baffles installed so that discharge air flows upward

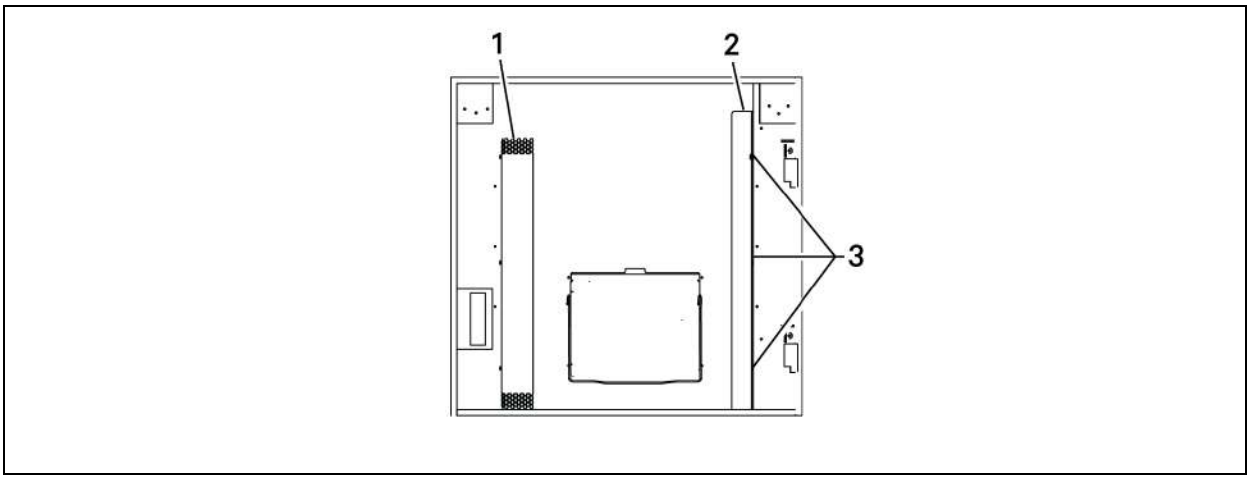
10.4.2 Adjusting Blocker Plate—600-mm (12-in.)

A blocker plate inside the display door should also be adjusted to direct air toward the racks that the cooling unit is intended to condition. The blocker plate can be installed on the left or right side of the display door, or it can be removed to discharge air left and right.

To adjust the blocker plate:

1. Remove the three screws that attach the blocker plate to the display door.
2. Reattach the blocker plate to the other side of the display door or to remove it.

Figure 10.5 Air-blocker plate adjustment on inside of top/display door



ITEM	DESCRIPTION
1	Perforated, supply-air opening (some perforations removed for clarity)
2	Air blocker over perforations.
3	Attachment screws

10.4.3 Adjusting Baffles—300-mm (12-in.)

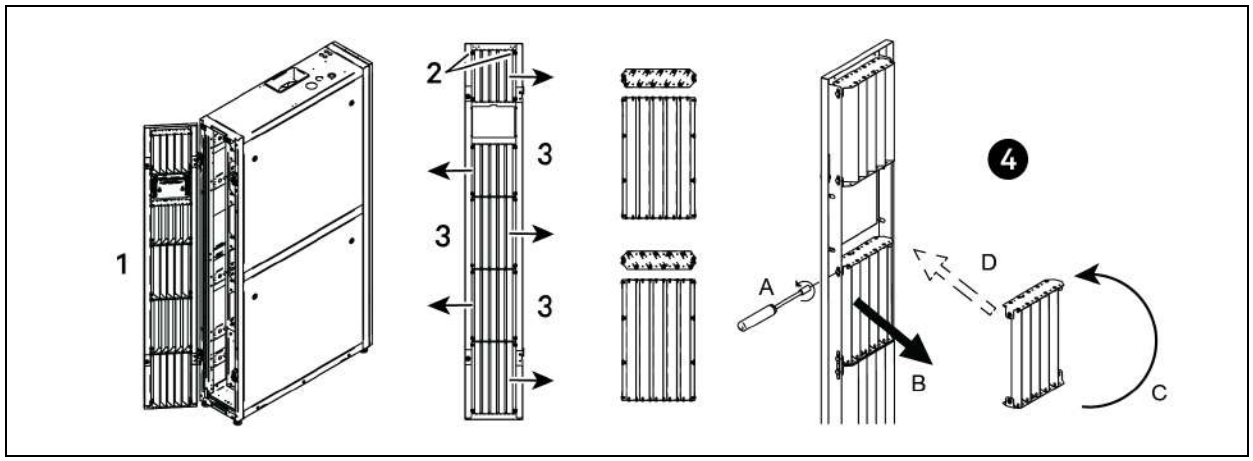
To adjust the baffles on 300-mm (12-in.) models:

NOTE: The air baffles on 300-mm (12-in.) units may be changed to direct air either right or left.

1. Shut down the Liebert CRV.
2. Open the door containing the Liebert iCOM display.
3. Remove the screws that secure the baffle panel in place.

   Each panel is secured with four screws, two on each side.
4. Slide out the baffle panel.
5. Rotate the baffle panel around its horizontal axis to change the airflow direction.
6. Reinsert the baffle panel.
7. Repeat for all baffles to be changed.
8. Reinstall the screws in the metal brace.

Figure 10.6 Baffle adjustment for correct airflow direction—300-mm (24-in.)



ITEM	DESCRIPTION
1	Open door
2	Screws securing baffle panel
3	Baffle panel (The arrows represent air-flow direction). When shipped, the baffles alternate as shown.)
4	Inside view of rotating baffle panels

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11 MONITORING AND MANAGING THE LIEBERT CRV WITH LIEBERT® ICOM™

NOTE: For detailed descriptions and operating instructions for using iCOM, refer to the "Liebert® iCOM™ User Manual" included with your system documentation.

11.1 Automatic restart after power failure

Set the cooling unit to return to the status at which it was operating when input power returns after a power failure. ("On" if it was powered-on and "Off" if it was powered-off before the failure.)

1. On the Service menu, touch *Options Setup*.
   The OPTIONS SETUP panel opens.
2. In the category column, touch *Misc Settings*.
   The MISC SETTINGS panel displays.
3. Set *Auto Restart Enable* to Yes, and use the slider to set the number of seconds to delay before restart, then click *Save*.
   Automatic restart is enabled.
   - Touch *Cancel* to discard the changes without saving.

11.2 Loss-of-power notification

When power is restored after an interruption, a Loss-of-power alarm lets you know that the interruption occurred. Once acknowledged, the alarm resets after 30 minutes. You can disable the event notification, set the notification delay and change event type.

1. On the Service menu, touch *Alarm/Event Setup*.
2. On the ALARMS & EVENTS panel, touch *Misc Events* to expand it, then touch *LOSS OF POWER*.
3. On the EDIT panel, touch *Notifications*.
   The EDIT panel displays the notification properties.
4. Adjust the notification properties, then touch *Save*.
   The notification is updated.
   - Touch *Cancel* to discard the changes without saving.

11.3 Variable-speed Fan Control

Air flow is adjustable via iCOM manually using a building-management system (BMS) or automatically using locally-installed temperature sensors.

NOTE: The cooling units ship with the factory setting "Return Sensor" for the temperature-control sensor and the fan-speed-control sensor.

11.3.1 Manual fan-speed control

In Manual fan-control mode, the speed of the motor can be set in one of the following ways:

- The manual (fixed) fan speed may be set via iCOM.
- Remotely using a Liebert IntelliSlot® card.

Setting remote fan-speed control

NOTE: For more details about using a Liebert IntelliSlot® card for fan-speed control, refer to the "Building Management Systems" section of the "Liebert® iCOM® User Manual" included with your system documentation.

1. On the Service menu, touch *Setpoints* > *Fan Control*, set *Fan Control Type* to Manual, then touch *Save*.
2. On the Service menu, touch *BMS & Teamwork Setup* > *BMS Setup*.
3. On BMS SETUP, touch *Control Settings*.
   The CONTROL SETTINGS secondary panel displays:
   - In *Fan Control Sensor*, select Manual.
   - Touch *Save*.
     BMS control of fan speed is set, and the BMS-set fan speed is displayed on the Fan Speed slider.

NOTE: Set the fan speed via BMS by writing to the Fan Speed Maximum Set Point monitoring point. For details, see SL-28170 IntelliSlot Reference Guide found at *https://www.vertivco.com/en-us/support/*.

NOTE: Local adjustments to fan speed are overridden when remote/BMS fan-speed control is set.

11.3.2 Automatic fan-speed control

Liebert iCOM on the CRV is factory-set for supply-air sensor control of fan speed and cooling capacity to ensure that the CRV is delivering precise cooling to the cold aisle.

Remote rack sensors allows decoupling of fan speed and cooling capacity for the preferred operating method of CRV(s) in a hot/cold-aisle configuration. Decoupling modulates cooling capacity based on supply-sensor readings and relies on readings from the remote rack sensors for fan control to ensure that cool air is delivered to the rack inlets on the cold aisle.

In the Setpoint screen, the controlling temperature sensor (S102) can be set to either Supply, Return or Remote. As the selection is changed from one sensor to another, the setpoint is displayed next to the corresponding sensor on the illustration, showing the sensors placement in relation to the Liebert CRV.

Temperature sensors can control fan-speed using one of three modes based on the type of sensor selected as the fan-control sensor: supply, return, or remote, see Table 11.1 below. Control is based on the selected sensor for both fan control and temperature control and their setpoints as follows:

- Coupled—the fan-control and temperature-control sensor selection is the same. When coupled, fan speed is determined by the temperature setpoints.
- Decoupled—the fan-control and temperature-control sensor selection is different. When decoupled, fan speed is determined by the fan setpoints.

Table 11.1 Fan-speed controlling sensor options

		TEMPERATURE CONTROL SENSOR SELECTED		
		SUPPLY SENSOR	REMOTE SENSOR	RETURN SENSOR
Fan Control Sensor selected	Supply Sensor	Coupled	N/A	N/A
	Remote Sensor	Decoupled (Recommended)	Coupled	N/A
	Return Sensor	Decoupled	Decoupled	Coupled

To set parameters for automatic fan-speed control:

1. On the Service menu, touch *Setpoints*.
   The SETPOINTS panel opens.
2. Touch *Fan Control* in the Options list,
   - Set Fan Control Type to *Manual*
   - Select a *Fan Control Sensor*.
   - Adjust the setpoint options, then touch *Save*.

   Sensor-based fan-speed control is set.
3. Touch *Temperature Control* in the Options list.
4. On the TEMPERATURE CONTROL secondary panel:
   - Select a *Temperature Control Sensor*.
   - Adjust the setpoint options, then touch *Save*.

11.3.3 Minimum Fan Speed

The minimum fan speed is design-specific for Liebert CRV operation, is factory-set, and cannot be modified.

NOTE: Contact your local Vertiv™ representative if minimum fan speed must be lowered.

NOTE: For more details about fan-speed settings , refer to the "Configuring Fan Setpoints" section of the "Liebert® iCOM™ User Manual" included with your system documentation.

11.4 Compressor Protection

11.4.1 Advanced DX Freeze Protection

Advanced, DX freeze protection automatically prevents freezing condensate on the coil when fan speed is below 100% by predicting freeze conditions and adjusting fan speed and compressor capacity.

A pressure transducer is installed in your Liebert CRV so that the advanced, low-pressure routine is automatically used.

11.4.2 Advanced DX High-pressure Protection

Advanced DX high-pressure protection automatically prevents total loss of cooling from high-pressure lock-outs by adjusting compressor capacity when pressure fluctuations are detected.

11.4.3 High-pressure Lock-off

At compressor start-up, iCOM monitors for high-pressure conditions, and if detected during the first 10 minutes of operation, the cooling unit attempts to correct the problem without an event notification. If the problem is not corrected, an alarm notification occurs and the affected compressor is locked "off." After the initial 10-minute period, a high-pressure situation immediately prompts an alarm and locks the compressor "off" without attempting correction.

NOTE: If the cooling unit is equipped with manual-reset high-head-pressure switches or if the auto-reset high-head-pressure switches do not reset, there is 30-second delay between the occurrence of high head-pressure and the alarm notification.

If a high-head-pressure alarm event trips 3 times in a rolling 12-hour period, the affected compressor is locked “off.” Once locked-off, the compressor remains locked-off even if pressure drops below the alarm threshold.

Unlock the compressor in one of the following ways:

- Cycle main power of the cooling unit.

  – or –

- Reset the high-pressure alarm code via iCOM Diagnostics.

To unlock the compressor:

1. On the Service menu, touch *Diagnostic/Service* > *Diagnostics*.
   The DIAGNOSTICS panel opens.
2. On the COMPRESSOR CIRCUIT panel, touch *Set to Zero* next to High Pressure Alarm Code, then touch *Save*.
   The code is reset and the compressor can now operate.

11.4.4 High-temperature Lock-off for Digital-scroll compressors

Cooling units equipped with digital-scroll compressors with a thermistor provide protection via a maximum operating temperature for the compressor(s). A high-temperature situation prompts an alarm notification and locks the compressor “off” for at least 30 minutes. The compressor will resume operation if the temperature has cooled to safely operate after 30 minutes.

If a high-temperature alarm event occurs 5 times in a rolling 5-hour period, the compress is locked-out. Once locked-off, a compressor can be unlocked in one of the following ways:

- Cycle main power of the cooling unit.

  – or –

- Reset the high-temperature alarm counter via iCOM Diagnostics.

To unlock the compressor:

1. On the Service menu, touch *Diagnostic/Service* > *Diagnostics*.
   The DIAGNOSTICS panel opens.
2. Touch *Compressor Circuit N* in the Category list (where N is the circuit number of the locked-off compressor).
3. On the COMPRESSOR CIRCUIT panel, touch *Set to Zero* next to High Temperature Alarm Counter, then touch *Save*.
   The code is reset and the compressor can now operate.

11.4.5 Short-cycle Protection

A start-to-next-start delay is applied to each compressor in a unit. The 3-minutes-on/3-minutes-off delay helps maximize compressor life.

A short-cycle occurs when the compressor cycles on and off 10 times withing an hour. The start-to-next-start delay may cause a short cycle if there is a very-light room load or if control settings are too tight.

NOTE: For details about compressor control settings, refer to the "Control Methods" section of the "Liebert® iCOM™ User Manual" included with your system documentation.

NOTE: If short-cycling continues after adjusting the control settings, contact technical support at 1-800-543-2778 to adjust the minimum compressor off delay.

11.4.6 Motorized Ball Valves for Water/Glycol-cooled Units with Digital-scroll Compressors

Because a conventional water-regulating valve opens and closes excessively from the rapid pressure changes during un-loaded operation, water/glycol-cooled units with digital-scroll compressors monitor liquid-line transducers and regulate fluid flow through the heat exchanger with a motorized ball valve (MBV).

The MBV reduces the number of times the valve opens and closes based on a pressure-threshold setpoint in iCOM's compressor-settings options. The pressure-offset adds psi to increase valve sensitivity and cause the valve to open further the higher the added pressure. The ball-valve setting is specific to the cooling unit to maintain system pressure.

NOTE: Only a properly-trained and qualified technician should modify the motorized ball valve setting. For the steps to adjust the motorized ball-valve control, refer to "Adjusting Ball-valve Pressure Offset" in the "Service Operation" section of the "Liebert® iCOM™ User Manual" included with your system documentation.

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12 TROUBLESHOOTING

Table 12.1 on the next page lists possible issues and their cause and corrective steps.

Table 12.1 Unit diagnostics

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Rack temperature is too high	Dirty filters	Replace filters
	Filter clog sensor failure	Call Vertiv™ technical support.
	Incorrect positioning of remote temperature sensor(s)	Verify that remote temperature sensors are correctly positioned
	Remote temperature sensor(s) issue	Verify CANbus cable connections and CANbus termination are correct.
		Adjust remote sensor mode (max/average) and number of sensors calculated in average.
		Contact your local Vertiv™ representative
	Chilled water units: inlet water temperature is too high	Check cooling water temperature
	Refrigerating circuit charge issue	Contact your local Vertiv™ representative
	Cold air short-cycling issues	Verify unit positioning/room configuration
		Verify unit air baffles set-up
		Verify cold aisle containment seals (if applicable)
	Insufficient room-cooling capacity	Reduce rack heat load or add cooling units
	Chilled water-regulating valve issue	Contact your local Vertiv™ representative
	Unit safety device tripped	Contact your local Vertiv™ representative
	Compressor will not load	Verify air temperature setpoint and temperature control sensor reading
		Verify suction pressure in the service menus, diagnostic service icon with the compressor loaded to 100%. If the suction drops below 109 psi (7.5 bar), the compressor capacity will decrease to help build suction. Verify suction transducer reading is correct compared with a manifold gauge.
Evaporator Fans will not modulate from 100%	Low pressure condition detected	Verify suction pressure in the service menus, diagnostic service icon with the compressor loaded to 100%. If the suction drops below 109 psi (7.5 bar), the fan speed will increase to help build suction. Verify suction transducer reading is correct compared with a manifold gauge.
		Contact your local Vertiv™ representative
	Fan control not properly set	Refer to the fan-settings descriptions in the "Liebert® iCOM™ User Manual" included with your system documentation.
		Contact your local Vertiv™ representative
Capacity Reduced due to HP Alarm (Comp Reduced by HP)	Condensing pressure (head pressure) has exceeded 493 psig (34 bar)	Air-cooled units: Verify that remote condenser fan(s) are running.
		Check accuracy of transducer by attaching a manifold gauge to discharge side of compressor. Compare gauge reading to what is shown in Service Menus, Diagnostic service mode.
		Water/glycol units: Check cooling water supply
		Water/glycol units: Check cooling water temp
		Contact Vertiv™.

Table 12.1 Unit diagnostics (continued)

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Digital Scroll Sensor Failure	Sensor disconnected	Verify sensor reading in User Menu, Sensor Data.
		Check plug connections
		Contact your local Vertiv™ representative
Low Supply Temperature Alarm/ Room Over-cooling	Low return temperature	Place a unit into standby (if applicable)
	Poor airflow	Install blanking panels in open areas of racks. Consult your local Vertiv™ representative.
		Direct discharge baffles to heat source
	Supply chilled water temperature too low.	Check cooling water temperature
Low Room Humidity	Humidifier Suspended message.	See Humidification in the “Liebert® iCOM™ User Manual” included with your system documentation.
	Humidifier problem alarm.	Check fault LED on humidifier PCB enclosure.
		See Humidifier Troubleshooting on page 87
	Room Humidity Problem	Room humidity has exceeded the humidity control band for 36 hours straight. Verify setpoints and confirm room is properly sealed.
High Room Humidity	Dehum Suspended message	The operated in dehumidification for excessive time. Dehumidification is suspended to prevent condensation for forming on accent panels and other areas.
	Room Humidity Problem	Room humidity has been below the humidity control band for 36 hours straight. Verify setpoints and confirm room is properly sealed.
Unit fan fails to start	Fan is faulty	Contact your local Vertiv™ representative
	Top or Bottom Fan Failure Alarm	Confirm rear door switches are made
		Confirm fan contactor is pulled in
		Confirm line voltage is present at the fan
		Contact your local Vertiv™ representative
Water drops carried by airflow	Room humidity is over acceptable limit	Check room condition
	Condensate pan drain is clogged	Contact your local Vertiv™ representative
	Problem with humidifier control	Contact your local Vertiv™ representative

Table 12.1 Unit diagnostics (continued)

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Water on the floor around the unit	Unit is not properly leveled	Adjust the leveling feet
	Unit condensate drain pipe is clogged	Remove pipe obstruction
	Chilled water and water/glycol units: leak in the water circuit	Locate and repair the leak
	Piping insulation broken/damaged	Restore insulation integrity
	Leak in the draining circuit	Contact your local Vertiv™ representative
	Condensate pump is faulty	Contact your local Vertiv™ representative
	Leak in the humidifier filling hose	Contact your local Vertiv™ representative
Unsteady air delivery temperature	Incorrect positioning of remote temperature sensor(s)	Verify correct positioning of temperature sensors
	Unbalanced heat load distribution	Redistribute rack heat load
	Remote temperature sensor(s) issue	Contact your local [[[Undefined variable crv_nomenclature_detail_appdx.CompanyShort]]] representative
	Faulty temperature sensor(s)	Contact your local Vertiv™ representative
	Unit controller issue	Contact your local [[[Undefined variable crv_nomenclature_detail_appdx.CompanyShort]]] representative
Local display is not operational but unit operates	Local display cable disconnected	Connect cable
	Local display cable damaged	Replace cable
	Local display configuration lost	Contact your local Vertiv™ representative
Local display is not operational and unit does not operate	Unit electrical supply is Off	Restore electrical supply
	Unit main switch is Off	Switch On the unit
	Control board supply issue	Contact your local Vertiv™ representative
	Control board issue	Contact your local Vertiv™ representative

Table 12.2 Liebert CRV medium control board DIP-switch settings

DIPSWITCH NUMBER	COMPRESSORIZED CRV MODELS CR019, CR020 AND CR035	CHILLED WATER MODEL-CR040
1	On	Off
2	Off	Off
3	On	Off
4	Off	Off
5	Off	Off
6	Off	Off
7	Off	On
8	On	On

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13 MAINTENANCE

13.1 Safety Instructions

All maintenance operations must strictly observe national, state and local accident prevention regulations, especially the regulations concerning electrical systems, refrigerators and manufacturing resources.

Air conditioning equipment maintenance may be performed only by authorized properly trained and qualified personnel.

To keep all warranties valid, the maintenance must adhere to the manufacturer's regulations.

WARNING! Arc flash and electric shock hazard. Open all local and remote electric power disconnect switches, verify with a voltmeter that power is Off and wear personal protective equipment (PPE) 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 controller 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 the controller. 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.

WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit.

WARNING! Risk of contact with extremely hot and/or cold surfaces. Can cause equipment damage, injury and death. Open all local and remote electric power supply disconnect switches, verify with a voltmeter that power is Off, and verify that all components have reached a temperature that is safe for human contact or wear appropriate, OSHA-approved PPE before working within the electric connection enclosures or unit cabinet. Perform maintenance only when the system is de-energized and component temperatures have become safe for human contact.

WARNING! Risk of hair, clothing and jewelry entanglement with high speed rotating fan blades. Can cause equipment damage, serious injury or death. Keep hair, jewelry and loose clothing secured and away from rotating fan blades during unit operation.

NOTICE

Risk of improper maintenance. Can cause equipment damage.

All maintenance must be performed only by authorized properly trained and qualified personnel.

Ignoring safety instructions is dangerous. Soiled parts cause a loss of performance and, for switch or control devices, can lead to the breakdown of the unit performance and operation.

13.2 Facility Fluid and Piping Maintenance for Water and Glycol Systems

Maintaining facility water and glycol quality is required throughout the life of the coolant fluid piping system. Fluid and piping system maintenance schedules must be established and performed. A coolant-fluid maintenance program must be established that will evaluate fluid chemistry and apply necessary treatment. The complexity of water/glycol solution condition problems and the variations of required treatment programs make it extremely important to obtain the advice of a competent and experienced water-treatment specialist and follow a regularly-scheduled coolant-fluid system-maintenance program.

Perform periodic inspections of the facility and the unit coil and/or heat exchanger and coolant-fluid piping system for leaks and visible damage.

13.3 Glycol Solution Maintenance

It is difficult to establish a specific schedule of inhibitor maintenance because the rate of inhibitor depletion depends upon local water conditions. Analysis of water samples at the time of installation and through a maintenance program should help to establish a pattern of depletion. A visual inspection of the solution and filter residue is often helpful in judging whether active corrosion is occurring.

The complexity of water/glycol solution condition problems and the variations of required treatment programs make it extremely important to obtain the advice of a competent and experienced water-treatment specialist and follow a regularly-scheduled coolant-fluid system-maintenance program. It is important to note that improper use of water treatment chemicals can cause problems more serious than using none. Proper inhibitor maintenance must be performed in order to prevent corrosion of the glycol system. Consult the glycol manufacturer for testing and maintenance of inhibitors. Do not mix products from different manufacturers.

13.4 Spare Parts

Only original spare parts made by Vertiv™ may be used. Using third-party material can invalidate the warranty. When making seeking technical assistance, always refer to the component list supplied with the equipment, and specify the model number, serial number and, if available, the part number.

NOTE: When replacing a faulty component, follow the relevant manufacturer instructions.

NOTE: When the spare parts must be brazed, be careful not to damage the internal parts (gaskets, seals, O-rings, etc.).

13.5 Maintenance Schedule

Conduct monthly, quarterly, biannual and annual checks according to the following guidelines.

All tasks and time periods listed here are the manufacturers' regulations and must be documented in an inspection report.

Table 13.1 Maintenance schedule

COMPONENT		MAINTENANCE PERIOD			
		MONTHLY BY USER	EVERY 3 MONTHS	EVERY 6 MONTHS	ANNUALLY
General	Check unit display for clogged-filter warning	X			
	Check for irregular noise from unit fans	X			
	Check for irregular noise from compressor (if applicable)	X			
	Check for irregular noise from remote condenser fan(s) (if applicable)	X			
Filters	Check state of filters		X		
	Replace air filter if necessary		X		
	Check filter switch functionality			X	
Blowers	Verify impellers move freely		X		
	Check bearings			X	
	Check motor mounts for tightness			X	
	Check fan safety switch				X
Electrical/Electronics	Check condition of contacts			X	
	Check electrical connections				X
	Check operation of controller			X	
	Check unit operation sequence			X	
Steam-Generating Humidifier	Check cylinder and pan		X		
	Check condition of steam hoses			X	
	Verify filling solenoid valve is operating properly			X	
Cooling Water Circuit (Water/Glycol and Chilled Water Units)	Check circuit for leakage/general condition		X		
	Check water (glycol) inlet temperature			X	
	Check water regulating valve operation			X	
	Check in/out water (glycol) Dt			X	
	Check mixture glycol level (if applicable)				X

Table 13.1 Maintenance schedule (continued)

COMPONENT		MAINTENANCE PERIOD			
		MONTHLY BY USER	EVERY 3 MONTHS	EVERY 6 MONTHS	ANNUALLY
Refrigerating Circuit	Check compressor noise/vibrations		X		
	Check oil level through compressor sight glass			X	
	Adjust/tighten compressor/functional elements			X	
	Check sight glass for problem detection			X	
	Check starting/running amps			X	
	Check refrigerating circuit main pressures			X	
	Check compressor suction superheat			X	
	Check discharge temperature			X	
	Check subcooling				X
Air-cooled Condenser/Drycooler (if applicable)	Check fan bearings		X		
	Check fan motor mounts for tightness			X	
	Check coil condition			X	
	Check pipeline supports			X	
	Check fan speed controller operation				X
Water/Glycol Pump	See manual for the pump				

13.5.1 Thermostatic Expansion Valve (TXV) Maintenance

The TXV performs one function: It keeps the evaporator supplied with enough refrigerant to satisfy load conditions. It does not affect compressor operation.

Proper valve operation can be determined by measuring superheat. The correct superheat setting is found in Superheat and Refrigerant Charge Optimization on page 50. If too little refrigerant is being fed to the evaporator, the superheat will be high; if too much refrigerant is being supplied, the superheat will be low.

13.5.2 Determining Suction Superheat

To determine superheat:

1. Measure the temperature of the suction line at the point the TXV bulb is clamped.
2. Obtain the gauge pressure at the compressor suction valve.
3. Add the estimated pressure drop between the bulb's location and the suction valve.
4. Convert the sum of the two pressures to the equivalent temperature.
5. Subtract this temperature from the actual suction line temperature. The difference is superheat.

13.5.3 Adjusting Superheat Setting with the TXV

To adjust the superheat setting:

1. Remove the valve cap at the bottom of the valve.

2. Turn the adjusting stem counterclockwise to lower the superheat.
3. Turn the adjusting stem clockwise to increase the superheat.

NOTE: Make no more than one turn of the stem at a time. Allow up to 15 minutes of fully loaded compressor operation before checking superheat or making additional stem adjustments.

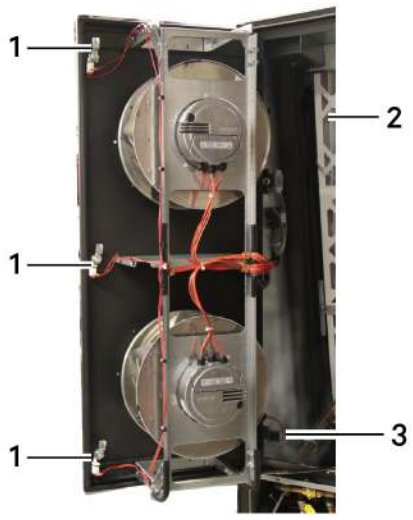
13.6 Inspect and Replace the Air Filters—600-mm (24-in.) Models

Check the air filter monthly to maintain efficient air distribution through the evaporator coil.

WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit.

1. Switch Off the Liebert CRV.
2. Open the rear panel by rotating the three locks with a screwdriver.
3. Wait until the fans stop rotating. When you open the first lock, you also open a safety switch that cuts the input power, see Figure 13.1 below.

Figure 13.1 Air filter location and input power safety switch—600-mm (24-in.) models



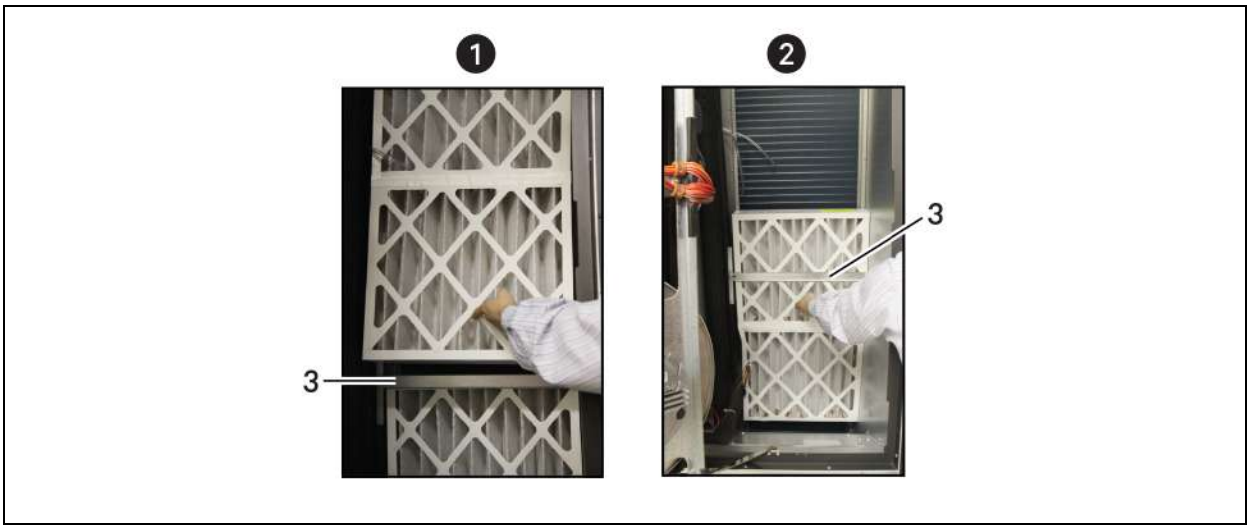
ITEM	DESCRIPTION
1	Safety switch
2	Air filter
3	Safety switch

To extract the filters, refer to Figure 13.2 on the next page:

1. Push up the upper filter.
2. Pull the bottom of the filter away from the unit.

3. Pull it out of the unit.
4. Lift the lower filter up
5. Pull the bottom of the filter away from the unit.
6. Pull it out of the unit.

Figure 13.2 Remove the air filters—600-mm (24-in.) models

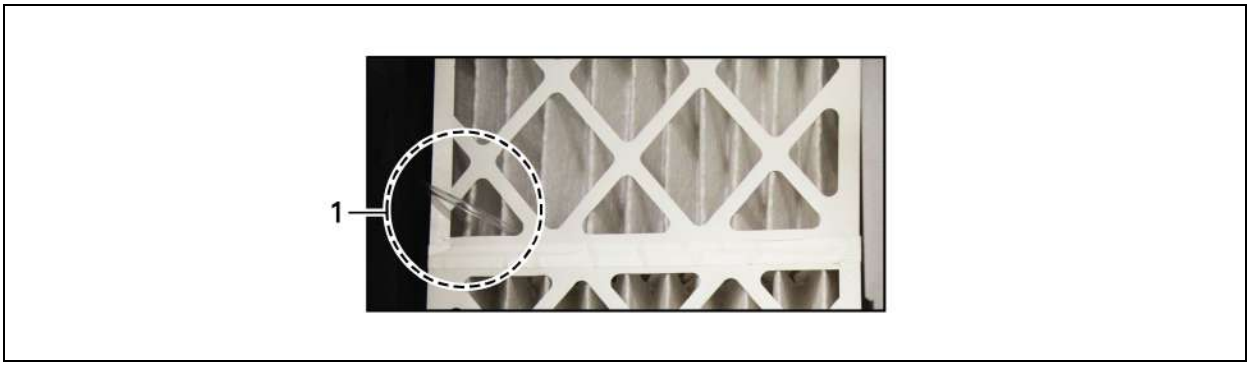


ITEM	DESCRIPTION
1	Upper filter removal
2	Lower filter removal
3	Support bar

After cleaning or replacing the filter and before reassembling the unit, check that the air differential pressure switch pipes (clogged filter alarm) are in the correct position and order. Check also that the drain trays are clean and the pipe secure.

NOTE: Before restarting the unit, be sure that the unit's door is properly closed. If it is ajar, the micro switches on the door will keep the unit in safety status.

Figure 13.3 Differential pressure switch tubes—600-mm (24-in.) models



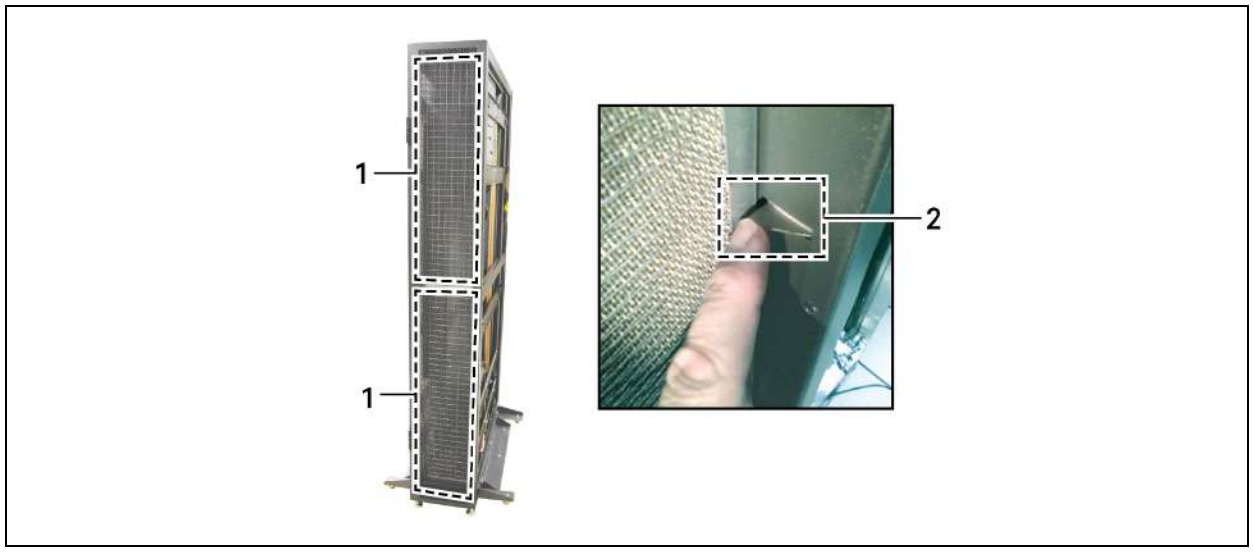
ITEM	DESCRIPTION
1	Differential-pressure switch tube

13.7 Inspect and Replace the Air Filters—300-mm (12-in.) Models

Check the air filter monthly to maintain efficient air distribution through the evaporator coil.

1. Switch Off the Liebert CRV.
2. Remove the rear door by unlatching the two quarter-turn fasteners and lifting the door off. The filters are just inside the door.
3. If the filters appear dirty, depress the tabs on the right side of the upper filter and remove the filter.
4. Repeat step 3 for the lower filter.
5. Replace the lower filter by inserting the left edge into the rail and pushing the right side in until the tabs snap back out to retain the filter.
6. Repeat step 5 for the upper filter.

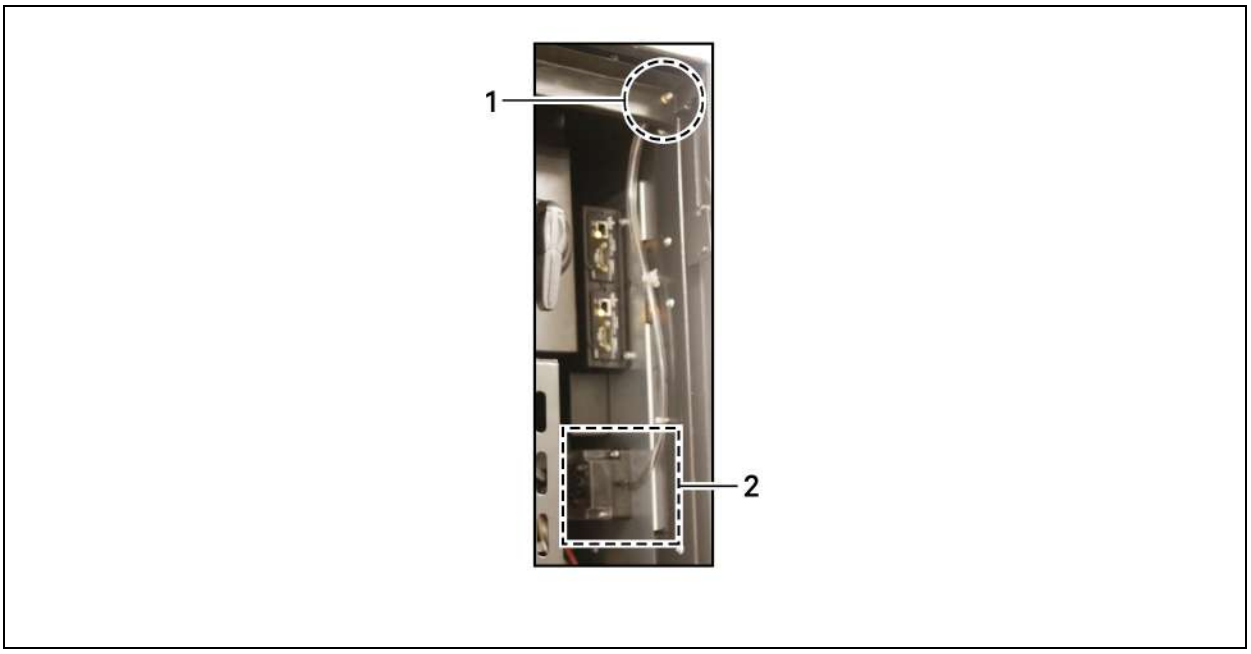
Figure 13.4 Remove the air filters 300-mm (12-in.) models



ITEM	DESCRIPTION
1	Air filter
2	Tab that secures filter in place

After cleaning or replacing the filter and before reassembling the unit, check that the air differential pressure switch tube (clogged filter alarm) are correctly installed. Also verify that the drain trays are clean and the pipe is secure.

Figure 13.5 Differential pressure switch components, 300-mm (12-in.) models



ITEM	DESCRIPTION
1	Differential-pressure sampling point
2	Differential-pressure switch

13.8 Condensate-drain and Condensate-pump System Maintenance

13.8.1 Condensate Drain

Check for and clear obstructions in tubing during routine maintenance.

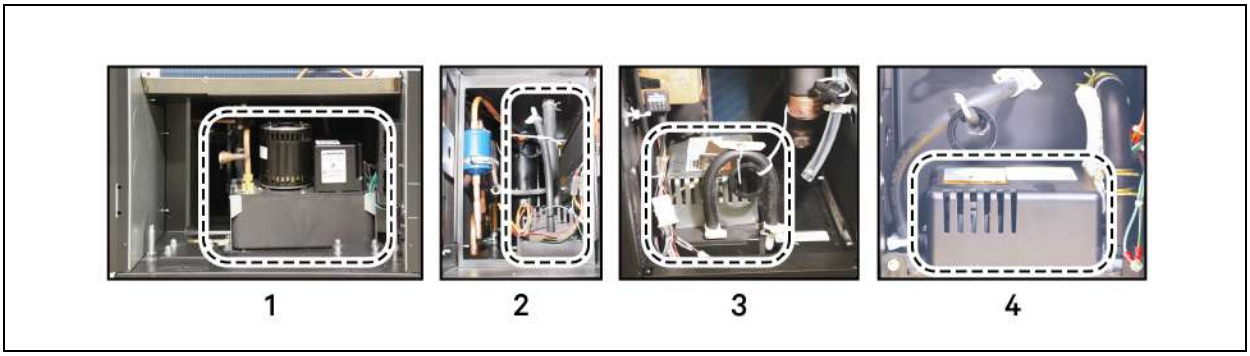
13.8.2 Condensate Pump, Dual-Float

WARNING! Risk of electric shock. Can cause injury or death. Open all local and remote electric power disconnect switches and verify that power is Off with a voltmeter before working within the condensate pump electrical connection enclosure. The Liebert iCOM™ 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 the Liebert iCOM.

To maintain the condensate pump:

1. Disconnect power to the unit using the disconnect switch.
2. Check for and clear obstructions in gravity lines leading to the condensate pump.
3. Remove the sump, clean with a stiff nylon brush and flush with water.
4. Inspect and clear clogs in the discharge check valve and float mechanism.
5. Reassemble and check for leaks.

Figure 13.6 Condensate pump



ITEM	DESCRIPTION
1	600-mm (24-in.) unit, near the front of the unit
2	300-mm (12-in.), air-cooled unit, near the front of the unit
3	300-mm (12-in.), chilled-water unit, near the rear of the unit
4	300-mm (12-in.), water/glycol-cooled unit, near the front of the unit

13.9 Air-Cooled Condenser and Drycooler Maintenance

- Clear coil surface of all debris that will inhibit airflow.
- Check for bent or damaged coil fins and correct.
- Do not permit snow to accumulate around or under outdoor unit.
- Periodically consider commercial cleaning of coil surface
- Inspect fans, motors and controls for proper operation.
- Check all piping and capillaries for proper support.
- Inspect for leaks.

13.10 Electric Reheat Maintenance

- Inspect and clean reheat elements.
- Inspect and tighten support hardware.

13.11 Fan Replacement

13.11.1 Replacing a Fan in 600-mm (24-in.) Models

WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit. or disconnecting the fan power wires.

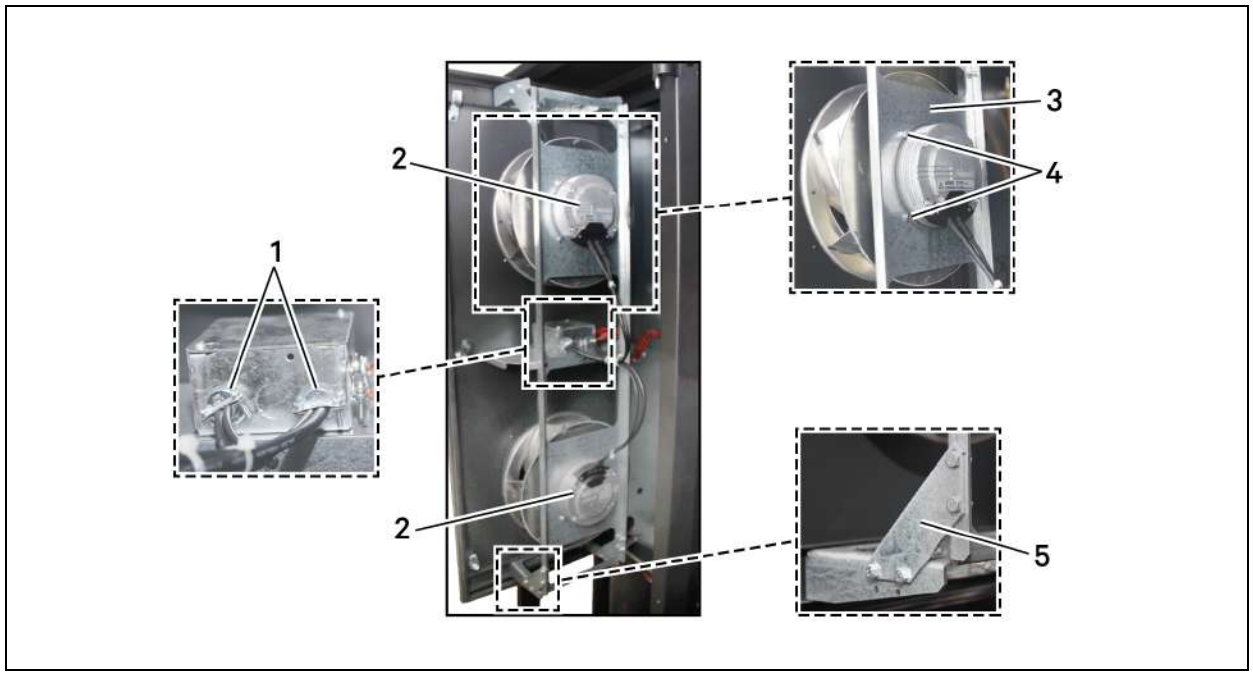
Refer to Figure 13.7 on the next page for the fan-assembly components.

To replace the fan:

1. Shut off all power to the unit by closing the main disconnect switch on the electrical panel on the rear of the Liebert CRV.Open the front door.
2. Open the panel assembly that contains the fans, using the quarter-turn latches.

3. Disconnect the fan's power connections in the electrical junction box.
4. Remove the fan frame assembly by removing the 4 bolts from the corner braces at each corner.
5. Set the fan assembly in a work area.
6. Remove the 4 bolts that attach the fan to be replaced to the frame assembly.
7. Reverse the steps to install the replacement fan.

Figure 13.7 Fan-assembly components—600-mm (24-in.) models



ITEM	DESCRIPTION
1	Wire entry into fan electrical-junction box
2	Fan
3	Mounting plate
4	Bolts, 2 on each side of fan, 4 total
5	Corner brace with 4 bolts

13.11.2 Replacing a Fan in 300-mm (12-in.) Models

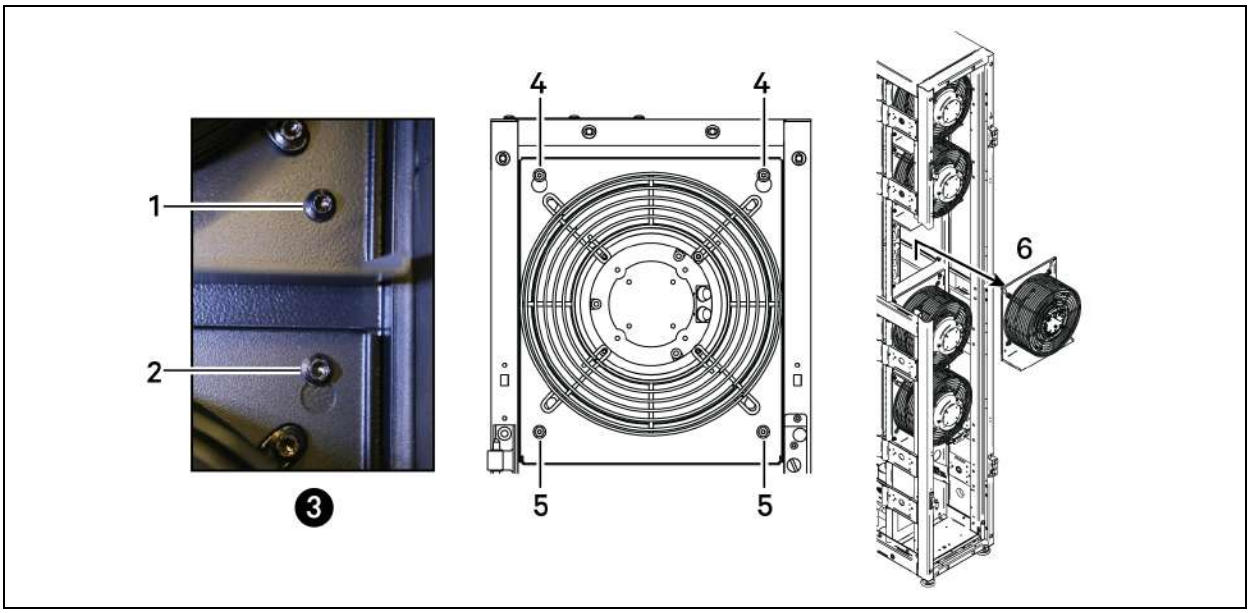
WARNING! Risk of contact with high-speed, rotating fan impeller blades. Can cause injury or death. Open all local and remote electrical-supply disconnect switches, verify with a voltmeter that power is off, and verify that all fan impellers have stopped rotating before working in the unit. or disconnecting the fan power wires.

Refer to Figure 13.8 on the facing page for the fan-assembly components.

1. Shut off all power to the unit by closing the main disconnect switch on the electrical panel on the rear of the Liebert CRV.
2. Open the front door.

3. Disconnect the fan high-voltage 3-pin connector and low-voltage 4-pin plug connector
4. Remove the 2 lower screws securing the fan assembly to the unit's frame. There is 1 screw in each corner.
5. Loosen the top screws on the fan assembly. There is 1 screw in each corner.
6. Lift the assembly up and out of the unit.
7. Set the fan assembly in a work area.
8. Reverse the steps to install the replacement fan.

Figure 13.8 Fan-assembly components—300-mm (12-in.) models



ITEM	DESCRIPTION
1	Screw in bottom half of upper fan assembly
2	Screw in keyhole slot in top half of lower fan assembly
3	Intersection of two fan assemblies
4	Upper screw in keyhole slot
5	Lower screws
6	Lift the fan assembly up and out of the unit.

13.12 Considerations when Dismantling the Unit

The Liebert CRV is designed and built to ensure continuous operation.

The working life of some of the main components, such as the fan and the compressor, depends on proper maintenance.

NOTICE

Risk of release of hazardous substances into the environment. Can cause environmental pollution and violation of environmental regulations.

The Liebert CRV contains substances and components hazardous for the environment (electronic components, refrigerating gases and oils). At the end of its useful life, the Liebert CRV must be dismantled by specialized refrigerating technicians. The unit must be delivered to suitable centers specializing in the collection and disposal of equipment containing hazardous substances.

The refrigerating fluid and the lubricating oil inside the circuit must be recovered according to the laws in the relevant country.

To recover the gas, use all the connections described in Vacuum Refrigerant-charge Connection Locations on page 42.

13.13 F-Gas Regulation (EC) No. 842/2006

Stationary air conditioning placed in the European Community market and operating with fluorinated greenhouse gases (F-gas), such as R-134A, R-407C and R-410A, must comply with the F-gas Regulation (applied since July 4, 2007).

Following considerations must be observed when operating with the above-mentioned equipment:

- Fluorinated greenhouse gases are covered by the Kyoto Protocol.
- The fluorinated greenhouse gases in this equipment should not be vented to the atmosphere.
- Referring to the value noted in Annex I of Regulation (EC) No 842/2006, the following list specifies the global warming potential (GWP) of some major F-gases:
  - R-134A: GWP 1300
  - R-407C: GWP 1610
  - R-410A: GWP 1890

- Operators of the above-mentioned applications, which contain fluorinated greenhouse gases, shall, using all measures that are technically feasible and do not entail disproportionate cost:
    a. prevent leakage of these gases and, as soon as possible, repair any detected leakage;
    b. ensure that they are checked for leakage by certified personnel;
    c. ensure arrangements are put in place for the proper recovery by certified personnel.
    d. In case of applications containing 3 kg (6 kg in case of hermetically sealed systems) or more of F-gases, certified personnel and companies (according to Reg. 303/2008) provide regular leak testing (according to Reg. 1516/2007 and Reg. 1497/2007) and maintain records of maintenance activities in a dedicated log book.
    e. Recovery for the purpose of recycling, reclamation or destruction of the fluorinated greenhouse gases, pursuant to Art. 4 (Recovery) of Reg.842/2006, shall take place before the final disposal of that equipment and, when appropriate, during its servicing and maintenance.
- Operator, according to Reg. 842/2006, Article 2, point 6, means the natural or legal person exercising actual power over the technical functioning of the equipment and system covered by the Regulation. The State may, in defined, specific situations, designate the owner as being responsible for the operator's obligations.
- Direct methods of leakage checking approved by the manufacturer (Reg. 1516/2007 and Reg. 1497/2007):
    a. gas detection device adapted to the refrigerant in the system; the sensitivity of portable gas detection devices (as a direct test method) shall be at least five grams per year.
    b. proprietary bubble solutions / soapsuds.
- Additional information located in a dedicated label of the unit (Reg. 1494/2007):
    a. Where fluorinated greenhouse gas is foreseen to be added to the equipment outside of the manufacturing site at the point of installation, a dedicated label accommodates notation of both the quantity (kg) pre-charged in the manufacturing plant and the quantity charged at the installation site, as well as the resulting total quantity of F-gas as a combination of the above-mentioned quantities, in a manner that conforms to legibility and indelibility.

       Our split units are usually not pre-charged at the factory; in this case, the total quantity of refrigerant charged in the unit must be written in the relevant label, during the commissioning operation at the installation site.

    b. Our packaged units (not split) operating with F-gas are usually fully charged at the factory, and the total amount of refrigerant charge is already reported on the label. In this case, the label has no need of further written information.
    c. In general, the above-mentioned information has been located in the main nameplate of the relevant unit.
    d. For equipment with double refrigeration circuits, in regards to different requirements based on the quantity of F-gas contained, the required information about refrigerant charge quantities must be listed separately for each individual circuit.

e. For equipment with separate indoor and outdoor sections connected by refrigerant piping, the label information will be on that part of the equipment that is initially charged with the refrigerant. In case of a split system (separate indoor and outdoor sections) without a factory pre-charge of refrigerant, the mandatory label information will be on that part of the product or equipment that contains the most suitable service points for charging or recovering the fluorinated greenhouse gas(es).

- Safety data sheets of F-gases used in the products are available on demand.

14 PREVENTIVE MAINTENANCE WORKSHEET

Source: DPN002954, Rev. 1

Inspection Date			Job Name	
Indoor Unit Model #			Indoor Unit Serial Number #	
Condenser/Drycooler Model #			Condenser/Drycooler Serial #	
Room Temperature/Humidity	°	%	Ambient Temperature	°

Not all units will have all components. To determine your unit's configuration, compare the Indoor Unit Model # above above and the information in the Components and Nomenclature section.

Good maintenance practices are essential to minimizing operation cost and maximizing product life. Read and follow all applicable maintenance checks listed below. At a minimum, these checks should be performed semi-annually. However, maintenance intervals may need to be more frequent based on site-specific conditions. Review the unit user manual for further information on unit operation. We recommend the use of trained and authorized service personnel, extended service contracts, and factory-certified replacement parts. Contact your local sales representative for more details.

Check all that apply:

Evaporator/Filters

1. Check/Replace filters
2. Grille area unrestricted
3. Wipe section clean
4. Coil clean
5. Clean condensate pan
6. Clean trap in condensate drain
7. Check/Test filter-clog switch operation (if equipped)

Reheat (if equipped)

1. Inspect elements
2. Check wire connections (inside reheat box)
3. Reheat amp draw

L1 _____ L2 _____ L3 _____

Steam Generating Humidifier (if equipped)

1. Check drain valve/drain lines/trap for damage/clogs/leaks
2. Check water fill valve and all supply lines/connection for leaks
3. Check condition of steam hose
4. Clean strainer
5. Replace humidifier bottle if necessary
6. Check operation of humidifier
7. Humidifier amp draw

L1 _____ L2 _____ L3 _____

Condensate Pump (if equipped)

1. Check for debris in sump
2. Check operation of float(s) (free movement)
3. Check/Clean discharge check valve

Electrical Panel

1. Check fuses
2. Check contactors for pitting (Replace if pitted)
3. Check/Re-torque wire connections

Controls

1. Check/Verify control operation (Sequence)
2. Check/Test changeover device(s) (if equipped)
3. Check/Test water-detection device(s) (if equipped)
4. Check/Test CAN connection between indoor and outdoor units (if equipped)

Refrigeration Piping

1. Check refrigerant lines (clamps secure/no rubbing/no leaks)
2. Check for moisture (sight glass)
3. Check for restriction temperature drop across filter drier

Compressor Section (if equipped)

1. Check oil level
2. Check for oil leaks
3. Check compressor mounts (springs/bushings)
4. Cap tubes (not rubbing)
5. Check/Re-torque wire connections (inside compressor box)
6. Compressor operation (vibration/noise)
7. Check crank-case heater fuses/operation (if equipped)
8. Check for refrigerant leaks

9. Suction pressure	Circuit #1
10. Discharge Pressure	Circuit #1
11. Superheat	Circuit #1
12. Low-pressure switch cut out	Circuit #1
13. Low pressure cut in	Circuit #1
14. High pressure cut out	Circuit #1

15. Amp draw

L1	L2	L3

Water-cooled Condensers (if equipped)

1. Verify proper water maintenance/treatment is being performed
2. Check water-regulating valve (motorized ball valve) operation
3. Verify water flow
4. Clean screen on Y strainer (if equipped)
5. Cap tubes (not rubbing)
6. Check condenser and supply/return lines/connections for water/glycol leaks
7. Entering water temperature _____°
8. Leaving water temperature _____°

Drycooler (if equipped)

1. Coil clean free of debris
2. Motor mounts tight
3. Bearings in good condition (motor)
4. Piping support/clamps secure
5. Check/Re-torque wire connections
6. Check contactors for pitting (replace if pitted)
7. Check fuses
8. Verify fan operation
9. Check surge-protection device status-indicator lights (if equipped)
10. Stat Settings _____ _____ _____ _____
11. Glycol level
12. Glycol solution ----_____%
13. Water/Glycol solution flowing continuously/clean and free of debris
14. Water-treatment plan established and followed for open cooling-tower application
15. Check refrigerant/glycol lines for signs of leaks/repair as found
16. Motor amp draw

#1	L1	L2	L3
#2	L1	L2	L3
#3	L1	L2	L3
#4	L1	L2	L3
#5	L1	L2	L3
#6	L1	L2	L3
#7	L1	L2	L3
#8	L1	L2	L3
#9	L1	L2	L3
#10	L1	L2	L3

Liebert MC Condenser (if equipped)

1. Coil clean
2. Fans free of debris
3. Fans securely mounted
4. Motor bearings in good condition
5. Check all refrigerant lines for vibration isolation. Support as necessary
6. Check for refrigerant leaks
7. Check surge-protection device (if installed) status-indicator lights
8. Check/Re-torque wire connections
9. Check contactors for pitting (replace if pitted)
10. Verify operation sequence/set points
11. Charge verification:
    a. Outdoor Ambient Temperature ------_____
    b. Subcooling ------_____
    c. Indoor-unit Return-air Temperature ------_____
    d. Sight-glass level (if Lee-Temp or pumped refrigerant) ------_____
12. Motor amp draw

#1	L1	L2	L3
#2	L1	L2	L3
#3	L1	L2	L3
#4	L1	L2	L3

Glycol Pump

1. Check pump rotation
2. Check pump and supply/return lines/connections for leaks
3. Pump pressures

#1	Suction	Discharge
#2	Suction	Discharge
#3	Suction	Discharge

4. Amp Draw

#1	L1	L2	L3
#2	L1	L2	L3
#3	L1	L2	L3

5. Verify pump changeover (if multiple pumps)

MAINTENANCE NOTES

Name

Signature

Company

Make photocopies for your records. Compare readings/information to previous maintenance worksheet.

To locate your local Vertiv™ representative for Vertiv™-engineered parts, check https://www.vertivco.com/en-us/support/ or Call 1-800-543-2778.

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APPENDICES

Appendix A: Model-number Nomenclature Detail

Table A.2 on the next page describes each digit of the 25-digit configuration number. The 14-digit model number consists of the first 10 digits and last four digits of the configuration number.

Table A.1 Liebert CRV 25-digit Configuration Number

MODEL # PART 1										MODEL DETAILS											MODEL # PART 2			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	R	0	2	0	R	A	1	C	7	S	H	1	8	1	1	E	L	1	0	P	A	–	–	–

Table A.2 CRV Model-number Digit Definitions

DIGIT	DESCRIPTION
Digits 1 and 2 = Unit Family	
	CR = Liebert CRV
Digits 3-5 - Nominal Capacity, kW	
	019 = DX (300 mm [12 in.] wide)
	020 = DX (600 mm [24 in.] wide)
	035 = DX (600 mm [24 in.] wide)
	032 = CW (300 mm [12 in.] wide)
	040 = CW (600 mm [24 in.] wide)
Digit 6 - Row-Based, Unit Depth	
	R = 1100 mm (43.4 in.)
Digit 7 - System Type	
	A = Air-Cooled
	W = Water/Glycol-Cooled
	C = Chilled Water-Cooled
Digit 8 - Fan Type	
	1 = Variable Speed EC fans
Digit 9 - Power Supply	
	A = 460V / 3ph / 60Hz (600 mm [24 in.])
	C = 208V / 3ph / 60Hz (600 mm [24V in.])
	Y = 208-230V / 3ph / 60Hz (300 mm [12 in.])
	P = 208-230V / 1ph / 60Hz (300 mm [12 in.] ; Control transformer can be tapped to provide 240V/1ph/60Hz)
	K = 120V / 1ph / 60Hz (300 mm [12 in.])
	3 = 460V / 3ph / 60Hz-Wye with Neutral required (300 mm [12 in.])
Digit 10 - Cooling System	
	2 = Two-Way Valve (CW Models Only)
	3 = Three-way Valve (CW Models Only)
	7 = R-410A Digital Scroll (Air-Cooled and 600 mm [24 in.] W/G)
	4 = Top Connections Only (300 mm [12 in.] W/G only)
	5 = Bottom Connections Only (300 mm [12 in.] W/G only)
Digit 11 - Humidifier	
	0 = None
	S = Steam Generating Canister (600 mm [24 in.] models only)
Digit 12 - Control System	
	H = Liebert iCOM (9-inch touch color screen display)
Digit 13 - Reheat	
	0 = None
	1 = Electric Reheat (600 mm [24 in.] models only)
Digit 14 - Air Filter	
	A = 2-in. MERV 8 (300 mm [12 in.] models only)
	C = 1/2-in. MERV 1 and Clog Filter Switch (300 mm [12 in.] models only)
	8 = 4-in. MERV 8 + Clogged Filter Switch (600 mm [24 in.] models only)
	9 = 4-in. MERV 11 + Clogged Filter Switch (600 mm [24 in.] models only)

Table A.2 CRV Model-number Digit Definitions (continued)

DIGIT	DESCRIPTION
Digit 15 - Water/Glycol Valve Type	
	1 = Two-Way Valve (W/G only) OR Default Air-Cooled Selection
	7 = Three-Way Valve (W/G only)
	H = Default CW Selection
Digit 16 - Enclosure	
	1 = No Certification; Standard Color (Z-7021 Black)
	3 = Seismic Certification Level 1 (Sd = 0.8); Standard Unit Without Internal Bracing; Standard Color (Z-7021 Black)
	4 = Seismic Certification Level 2 (Sd = 2.0/2.5) With Internal bracing; Standard Color (Z-7021 Black)
Digit 17 - High-Voltage Options	
	L = No condensate pump, 5k SCCR, 300 mm (12 in.) 120-V CW Only
	5 = Condensate pump, 5k SCCR, 300 mm (12 in.) 120-V CW Only
	M = No dual-float condensate pump (for units without humidifier), 65k SCCR
	P = Dual-float condensate Pump (for units with or without humidifier), 65k SCCR
Digit 18 - Option Package	
	0 = None
	H = Reheat and Humidifier Lockout Contact (600 mm [24 in.] Only)
	C = Reheat and Humidifier Lockout and Additional Alarm Contact (600 mm [24 in.] Only)
	D = Low Sound Package (600 mm [24 in.] DX Only)
	L = Low Sound Package and Reheat and Humidifier Lockout and Additional Alarm Contact (600 mm [24 in.] DX Only)
Digit 19 - Liebert IIntelliSlot™ Housing	
	0 = No Cards
	C = (1) Liebert SiteLink-E® Card
	U = (1) Liebert IntelliSlot Unity DP™ Card
	6 = (1) Liebert IntelliSlot Unity DP Card and (1) Liebert SiteLink-E™ Card
	7 = (2) Liebert IntelliSlot Unity DP Cards
Digit 20 - Future Options	
	0 = None
Digit 21 - Packaging With Ramp	
	P = Domestic
	S = Export (Seaworthy)
Digit 22 - Special Features	
	A = No SFAs, Standard Unit
	X = SFA Included
Digits 23-25 - Factory Configuration Number	

Appendix B: Submittal Drawings

The submittal drawings are in the order of document part number (DPN). Table A.3 below, groups the drawings by topic/application.

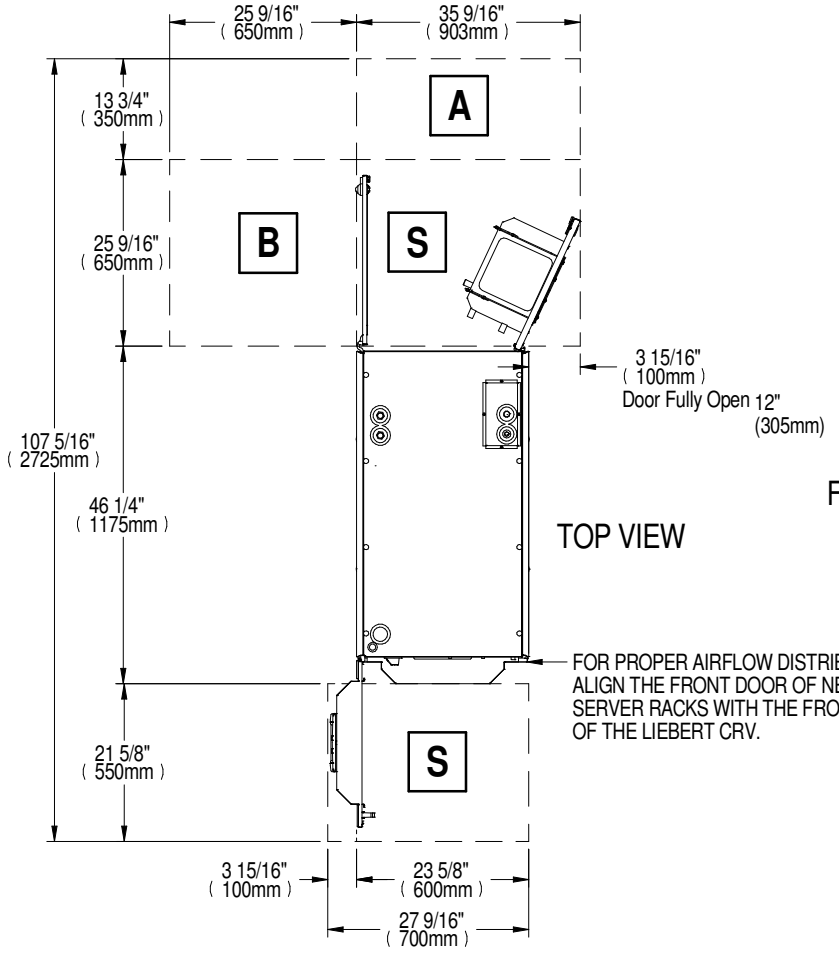
Table A.3 Submittal-drawings Contents

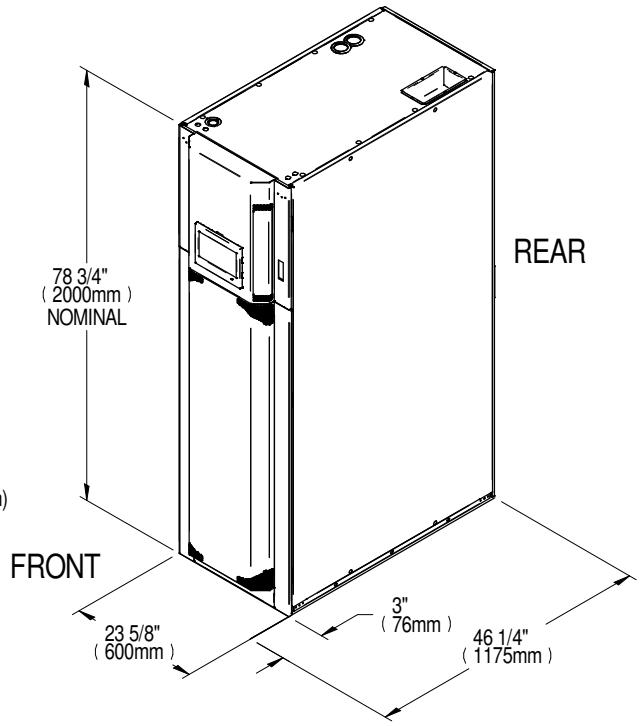
DOCUMENT NUMBER	TITLE
Component Locations	
DPN003738	Component Locations, 600mm (24in.) Models
DPN003583	Component Location, 300mm (12in.) Air Cooled Models
DPN003585	Component Location, 300mm (12in.) Water Glycol Cooled Models
DPN003584	Component Location, 300mm (12in.) Chilled Water Models
Planning Dimensions	
DPN001791	Cabinet and Floor Planning Dimensional Data, 600 mm (24 in.)
DPN002807	Cabinet and Floor Planning Dimensional Data, 300 mm (12 in.)
Piping Schematics and Connection Locations - Air-cooled Systems	
DPN002858	Piping Arrangement, 600mm (24in.) Air Cooled w/ Liebert MC Condenser Models
DPN002808	Piping Arrangement, 300mm (12in.) Air Cooled w/ Liebert MC Condenser Models
DPN003954	Piping Layout and Condenser Positioning
DPN001792	Connection Locations, CR020R & CR035R Air Cooled Models
DPN002813	Connection Locations, 300-mm (12-in.) Air Cooled Models
Piping Schematics and Connection Locations - Water/Glycol-cooled Systems	
DPN001985	Piping Arrangement, 600mm Water/Glycol Cooled Models
DPN003039	Piping Arrangement, 300mm (12in) Water/Glycol Cooled Models
DPN001793	Connection Locations, CR020R & CR035R Water/Glycol Models
DPN003040	Connection Locations, 300mm (12in.) Water/Glycol Cooled Models
Piping Schematics and Connection Locations - Chilled-water Systems	
DPN001986	Piping Arrangement, 600mm (24in.) Chilled Water Models
DPN002976	Piping Arrangement, 300mm (12in.) Chilled Water Models
DPN001794	Connection Locations, CR040R Chilled Water Models
DPN002814	Connection Locations 300mm (12in.) Air Cooled Models
DPN002815	Connection Locations, 300mm (12in.) Chilled Water Models
Electrical Field Connections - 600-mm (24-in.) Models	
DPN001884	Electrical Field Connections Descriptions, 600mm (24in.) Models
DPN002841	CANbus & Interlock Connections between 600mm (24in.) Unit & Liebert MC Condenser
Electrical Field Connections - 300-mm (12-in.) Models	
DPN002810	Electrical Field Connections Descriptions, 300mm (12in.) Models
DPN003036	CANbus & Interlock Connections between 300mm (12in.) Unit & Liebert MC Condenser
DPN003588	Low Voltage Field Wiring Routing, 300mm (12in.) All Models
DPN003589	Power Cable Routing Bottom Entry, 300mm (12in.) Air Cooled & Water Glycol Cooled Models
DPN003590	Power Cable Routing Bottom Entry 300mm (12in.) Chilled Water Models

LIEBERT CRV

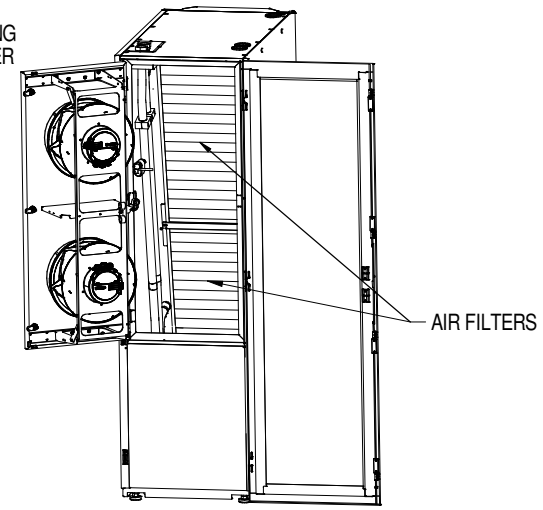
CABINET DIMENSIONAL DATA
600mm (24in.) MODELS

ACCESS REQUIRED TO SERVICE THE LIEBERT CRV UNIT WITHIN THE ROW
REAR SERVICE AREA IS S+B OR S+A WHEN B IS NOT AVAILABLE



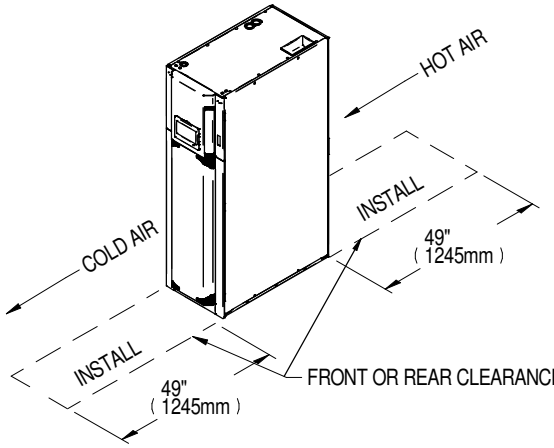


FOR PROPER AIRFLOW DISTRIBUTION: ALIGN THE FRONT DOOR OF NEIGHBORING SERVER RACKS WITH THE FRONT CORNER OF THE LIEBERT CRV.



REAR VIEW

ACCESS REQUIRED FOR INSTALLATION OF THE LIEBERT CRV UNIT WITHIN THE ROW.



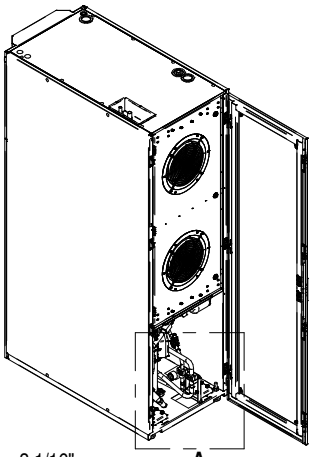
DRY WEIGHT ±5% - Lbs (kg)			
MODEL	AIR COOLED	WATER/GLYCOL	CHILLED WATER
CR020R	739 (335)	772 (350)	N/A
CR035R	805 (365)	849 (385)	
CR040R	N/A	N/A	728 (330)

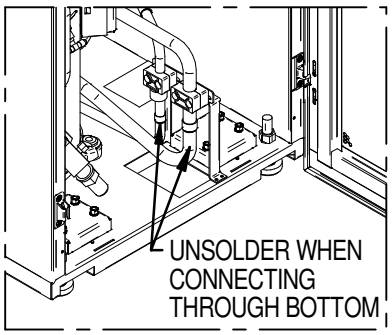
LIEBERT CRV

PRIMARY CONNECTION LOCATIONS
CR020R & CR035R AIR COOLED MODELS

PIPING AND ELECTRICAL CONNECTIONS AVAILABLE AT THE TOP AND BOTTOM OF UNIT.

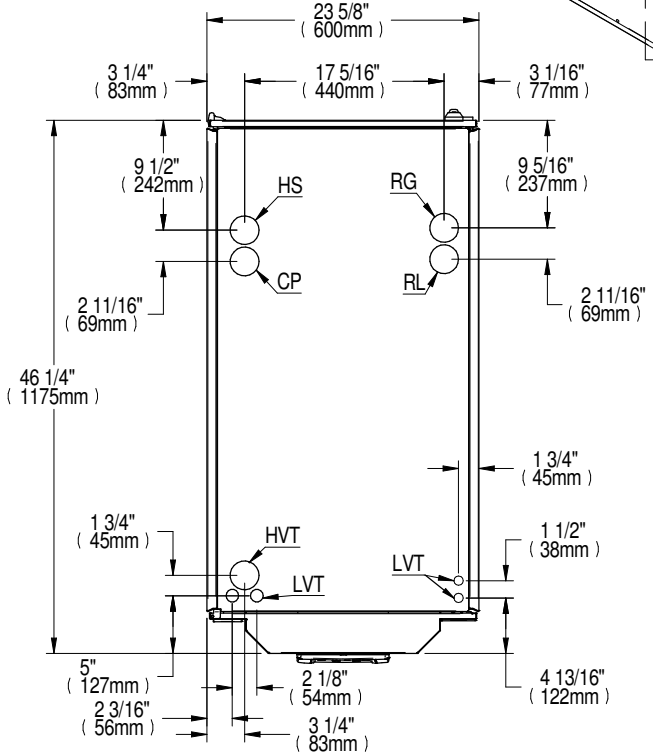
ATTENTION. AIR COOLED SYSTEMS MAY REQUIRE ADDITIONAL OIL TO BE ADDED IN THE FIELD IN ORDER TO ALLOW FOR SUFFICIENT COMPRESSOR LUBRICATION. PLEASE SEE THE USER MANUAL FOR DETAILS.

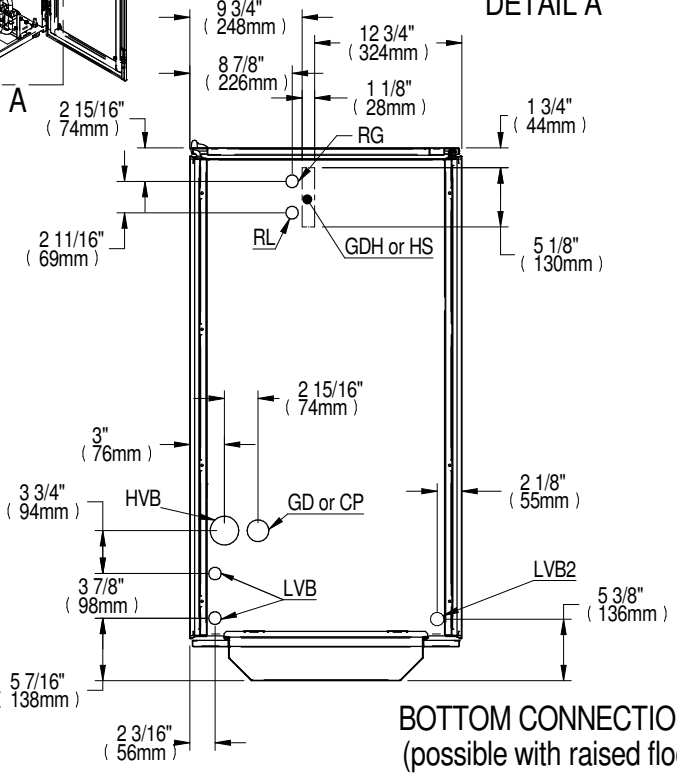




DETAIL A

TOP CONNECTIONS





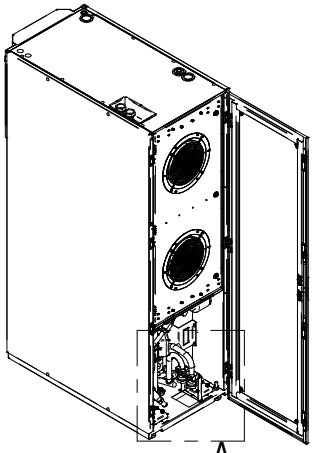
BOTTOM CONNECTIONS
(possible with raised floor)

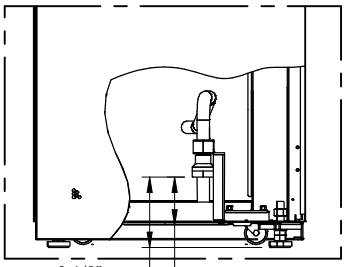
UNIT CONNECTIONS		CR20A (50Hz)	CR35A (50Hz)	CR20A (60Hz)	CR35A (60Hz)
RL	Refrigerant Liquid Line Inlet	12mm O.D. Copper Sweat	16mm O.D. Copper Sweat	1/2" O.D. Copper Sweat	5/8" O.D. Copper Sweat
RG	Refrigerant Gas Line Outlet	16mm O.D. Copper Sweat	22mm O.D. Copper Sweat	5/8" O.D. Copper Sweat	7/8" O.D. Copper Sweat
GD	Gravity Coil Pan Drain	20mm I.D.		1" MPT	
GDH	Gravity Humidifier Drain	22mm I.D.		N/A	
CP	Condensate Pump	1/2" GAS F		1/2" FPT	
HS	Humidifier Supply	1/2" GAS F (top connection), 3/4" GAS F (bottom connection)		1/2" FPT (top connection), 1/4" Compression Fitting (bottom connection)	
HVT	High Voltage Top Connection	Combination Knockout Hole Diameter 35mm (1-3/8"), 44.5mm (1-3/4") and 63.5mm (2-1/2")		Combination Knockout Hole Diameter 35mm (1-3/8"), 44.5mm (1-3/4") and 63.5mm (2-1/2")	
HVB	High Voltage Bottom Entrance (feed through the base of the unit)	Hole Diameter 63.5mm (2-1/2")		Knockout Hole Diameter 63.5mm (2-1/2")	
LVT	Low Voltage Top Connection	Hole Diameter 22mm (7/8") 2 places		Knockout Hole Diameter 22mm (7/8") 4 places	
LVB	Low Voltage Bottom Entrance (feed through the base of the unit)	Hole Diameter 28mm (1-7/64") 2 places		Knockout Hole Diameter 27.8mm (1-3/32") 2 places	
LVB2	Low Voltage Bottom Entrance (feed through the base of the unit)	------		Hole Diameter 44.5mm (1-3/4") 1 places	

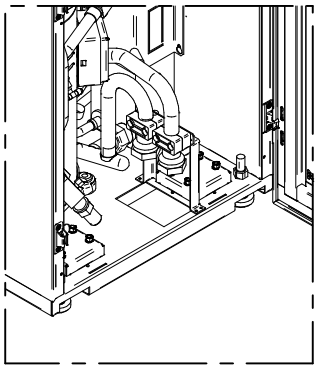
LIEBERT CRV

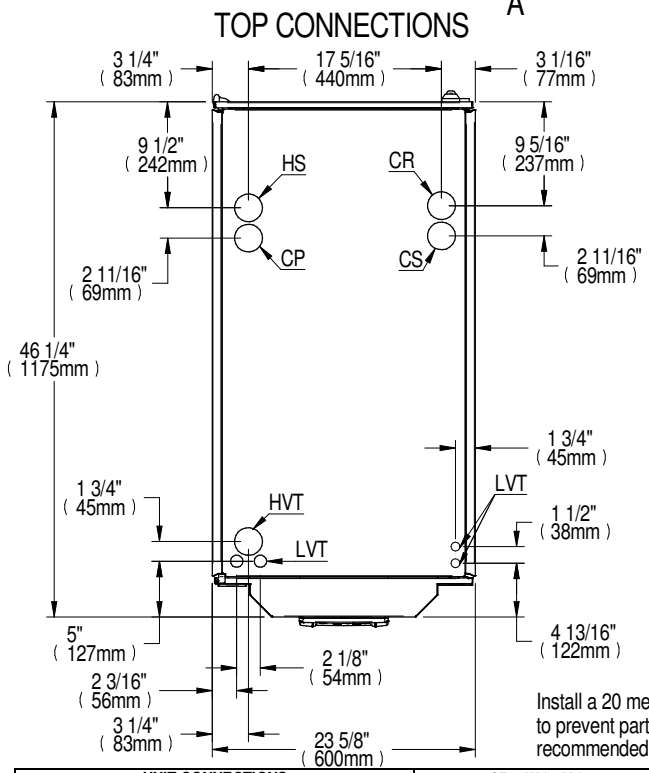
PRIMARY CONNECTION LOCATIONS
CR020R & CR035R WATER/GLYCOL MODELS

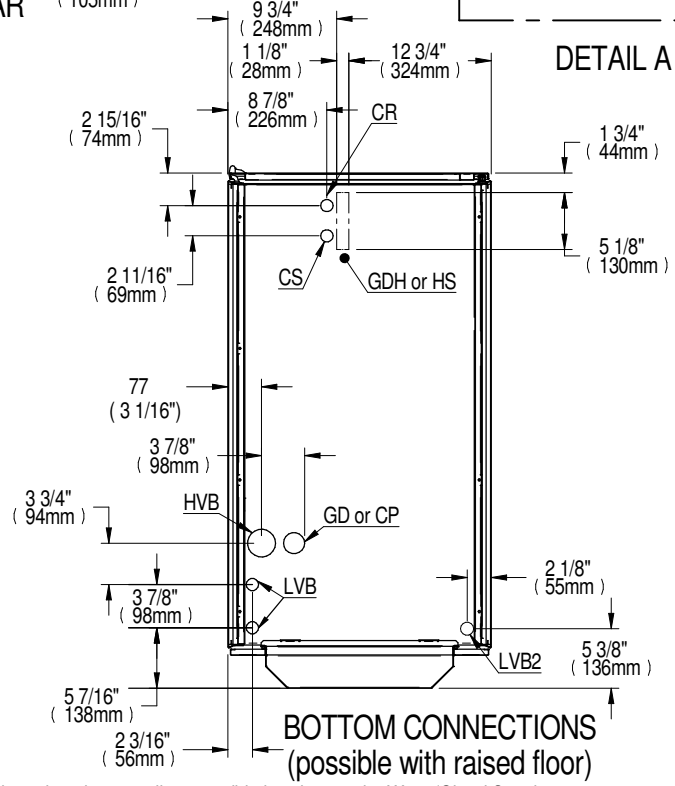
PIPING AND ELECTRICAL CONNECTIONS AVAILABLE AT THE TOP AND BOTTOM OF UNIT.











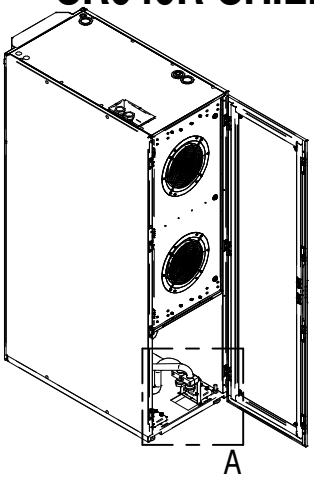
Install a 20 mesh strainer, in an easily accessible location, on the Water/Glycol Supply to prevent particles from entering the heat exchanger. Strainer bypass valves are recommended to allow the strainer to be cleaned while maintaining flow to the cooling unit.

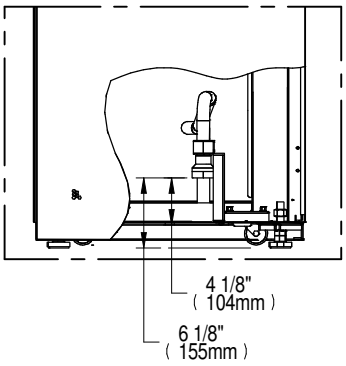
UNIT CONNECTIONS		CR20W (50Hz)	CR35W (50Hz)	CR20W (60Hz)	CR35W (60Hz)
CS	Water/Glycol Coolant Supply	32mm GAS F		1-1/4" FPT	
CR	Water/Glycol Coolant Return	32mm GAS F		1-1/4" FPT	
GD	Gravity Coil Pan Drain	20mm I.D.		1" MPT	
GDH	Gravity Humidifier Drain	22mm I.D.		N/A	
HS	Humidifier Supply	1/2" GAS F (top connection), 3/4" GAS F (bottom connection)		1/2" FPT (top connection), 1/4" Compression Fitting (bottom connection)	
CP	Condensate Pump	1/2" GAS F		1/2" FPT	
HVT	High Voltage Top Connection	Combination Knockout Hole Diameter 35mm (1-3/8"), 44.5mm (1-3/4") and 63.5mm (2-1/2")		Combination Knockout Hole Diameter 35mm (1-3/8"), 44.5mm (1-3/4") and 63.5mm (2-1/2")	
HVB	High Voltage Bottom Entrance (feed through the base of the unit)	Hole Diameter 63.5mm (2-1/2")		Knockout Hole Diameter 63.5mm (2-1/2")	
LVT	Low Voltage Top Connection	Hole Diameter 22mm (7/8") 2 places		Knockout Hole Diameter 22mm (7/8") 4 places	
LVB	Low Voltage Bottom Entrance (feed through the base of the unit)	Hole Diameter 28mm (1-7/64") 2 places		Knockout Hole Diameter 27.8mm (1-3/32") 2 places	
LVB2	Low Voltage Bottom Entrance (feed through the base of the unit)	----		Knockout Hole Diameter 44.5mm (1-3/4") 1 place	

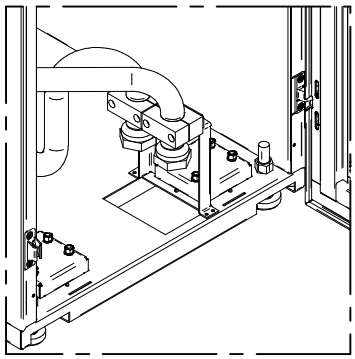
LIEBERT CRV

PRIMARY CONNECTION LOCATIONS
CR040R CHILLED WATER MODELS

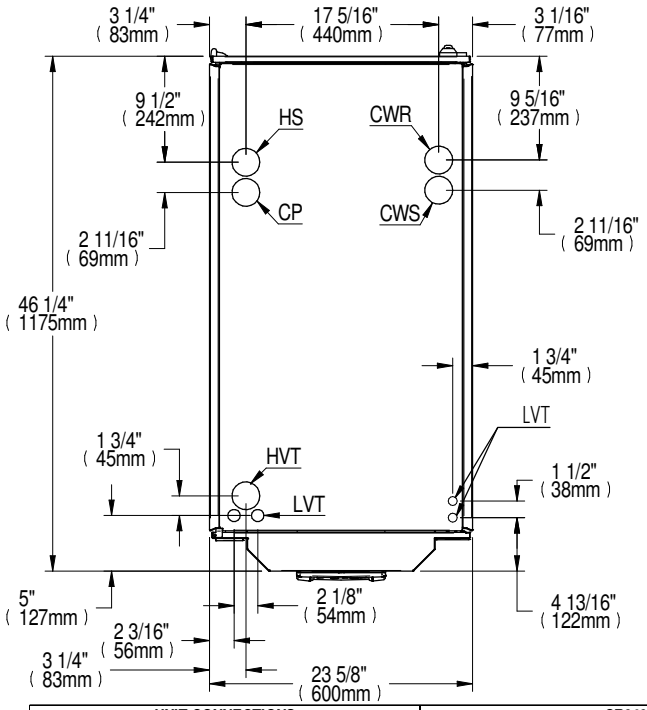
PIPING AND ELECTRICAL CONNECTIONS AVAILABLE AT THE TOP AND BOTTOM OF UNIT.

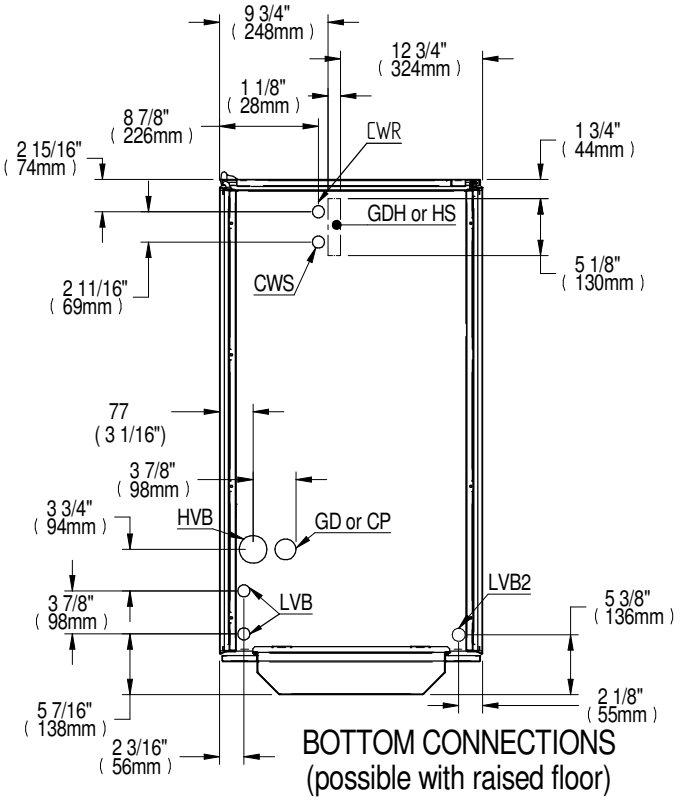






TOP CONNECTIONS





BOTTOM CONNECTIONS
(possible with raised floor)

UNIT CONNECTIONS		CR040C (50 Hz)	CR040C (60 Hz)
CWS	Chilled Water Supply	32mm GAS F	1-1/4" FPT
CWR	Chilled Water Return	32mm GAS F	1-1/4" FPT
GD	Gravity Coil Pan Drain	20mm I.D.	1" MPT
GDH	Gravity Humidifier Drain	22mm I.D.	N/A
HS	Humidifier Supply	1/2" GAS F (top connection), 3/4" GAS F (bottom connection)	1/2" FPT (top connection), 1/4" Compression Fitting (bottom connection)
CP	Condensate Pump	1/2" GAS F	1/2" FPT
HVT	High Voltage Top Connection	Combination Knockout Hole Diameter 35mm (1-3/8"), 44.5mm (1-3/4") and 63.5mm (2-1/2")	Combination Knockout Hole Diameter 35mm (1-3/8"), 44.5mm (1-3/4") and 63.5mm (2-1/2")
HVB	High Voltage Bottom Entrance (feed through the base of the unit)	Hole Diameter 63.5mm (2-1/2")	Knockout Hole Diameter 63.5mm (2-1/2")
LVT	Low Voltage Top Connection	Hole Diameter 22mm (7/8") 2 places	Knockout Hole Diameter 22mm (7/8") 4 places
LVB	Low Voltage Bottom Entrance (feed through the base of the unit)	Hole Diameter 28mm (1-7/64") 2 places	Knockout Hole Diameter 27.8mm (1-3/32") 2 places
LVB2	Low Voltage Bottom Entrance (feed through the base of the unit)	------	Knockout Hole Diameter 44.5mm (1-3/4") 1 place

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS
600mm (24in.) MODELS

STANDARD ELECTRICAL CONNECTIONS

1) **High voltage connection through the bottom of the electric panel –** 1-3/8" (34.9mm), 1-3/4" (44.5mm) & 2-1/2" (64mm) diameter concentric knockout.
2) **Low voltage connection through the bottom of the electric panel -** Quantity (2) 7/8" (22mm) diameter knockouts.
3) **High voltage connection through the top of the unit –** 1-3/8" (34.9mm), 1-3/4" (44.5mm) & 2-1/2" (64mm) diameter concentric knockout.
4) **Low voltage connection through the top of the unit -** Quantity (4) 7/8" (22mm) diameter knockouts.
5) **Three phase electrical service –** Connect to terminals on disconnect switch. Three phase service not by Liebert. (see page 2 for an important note regarding unit electrical service)
6) **Factory Installed locking Disconnect Switch**
7) **Earth ground -** Terminal for field supplied earth grounding wire.
8) **Remote unit shutdown -** Replace existing jumper between terminals 37 & 38 with field supplied normally closed switch having a minimum 75VA, 24VAC rating. Use field supplied Class 1 wiring.
9) **Customer alarm inputs -** Terminals for field supplied, normally closed contacts, having a minimum 75VA, 24VAC rating, between terminals 3 & 50, 2 & 51, 5 & 55, or 3 & 56. Use field supplied Class 1 wiring. Terminal 3 & 56 are used for humidifier alarm when a humidifier is installed. The remaining terminals are available for customer alarm inputs, such as; smoke sensors and building fire alarms.
10) **Common alarm -** On any alarm, normally open dry contact is closed across terminals 75 & 76 for remote indication. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.
11) **Heat rejection interlock -** On any call for compressor operation, normally open dry contact is closed across terminals 70 & 71 to heat rejection equipment. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.

STANDARD ELECTRICAL CONNECTIONS

12) **CANbus Connector** – Terminal block with terminals 49-1 (CAN-H) and 49-3 (CAN-L) + SH (shield connection). The terminals are used to connect the CANbus communication cable (provided by others) from the indoor unit to the Liebert MC Condenser.

13) **CANbus Cable** – CANbus cable provided by others to connect to the outdoor condenser. No special considerations are required when the total external cable connection between the indoor unit and outdoor unit(s) is less than 450FT (137M). For total external cable connections greater than 450FT (137M) but less than 800FT (243M) a CANbus isolator is required. Contact the Factory.
    Cable must have the following specifications:
    Braided shield or foil shield with drain wire
    - Shield must be wired to ground at indoor unit
    - 22-18AWG stranded tinned copper
    - Twisted pair (minimum 4 twists per foot)
    - Low Capacitance (15pF/FT or less)
    - Must be rated to meet local codes and conditions
    - EXAMPLES BELDEN 89207 (PLENUM RATED), OR ALPHA WIRE 6454 CATEGORY 5, 5E, OR HIGHER
14) Do not run in same conduit, raceway, or chase as high voltage wiring.
15) For CANbus network lengths greater than 450FT (137M) call Factory.

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS
600mm (24in.) MODELS

ELECTRICAL CONNECTIONS FOR OPTIONAL FEATURES

16) **Condensate pump high water alarm** (available when optional pump is installed) - On pump high water indication, normally open dry contact is closed across terminals 88 & 89 for remote indication. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.
17) **LiquiTect shutdown and dry contact** (available when optional LiquiTect sensor is installed) **–** On LiquiTect activation, normally open dry contact is closed across terminals 58 & 59 for remote indication. The LiquiTect sensor notifies iCOM of indication through terminals 60 & 61. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.
18) **Reheat and humidifier lockout** – Remote 24VAC required at terminals 82 & 83 for lockout of reheat and humidifier.
19) **Additional Common Alarm -** On any alarm, one additional normally open dry contact is closed across terminals 94 & 95 for remote indication. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.

NOTE: Refer to specification sheet for total unit full load amps, wire size amps and max overcurrent protective device size.

Important note for 460V rated Liebert CRV units (CR****A)**

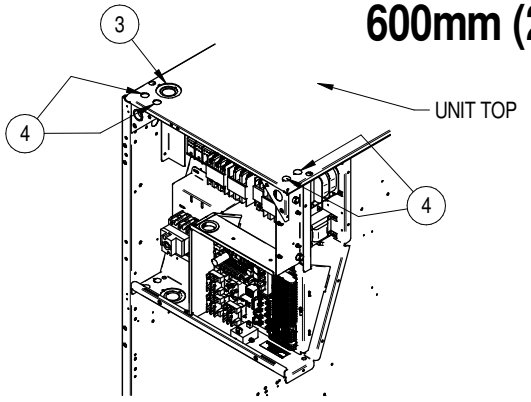
The electronically commutated (EC) motors included in the CRV unit are suitable for connection to an electrical service providing input power to the unit with 300V or less line to ground potential only.

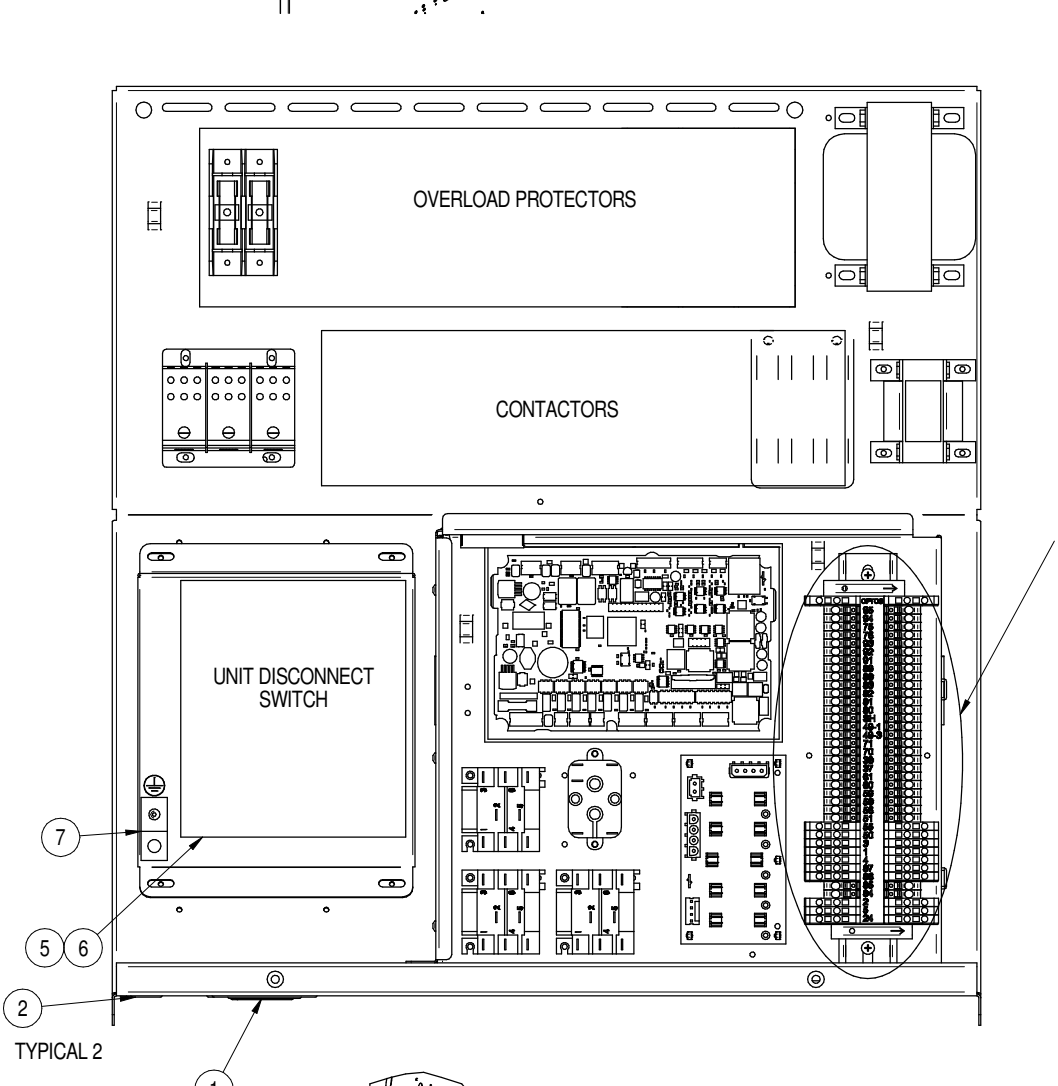
Acceptable unit input electrical service for 460V (480V) nominal units
- 480V wye with solidly grounded neutral and 277V line to ground

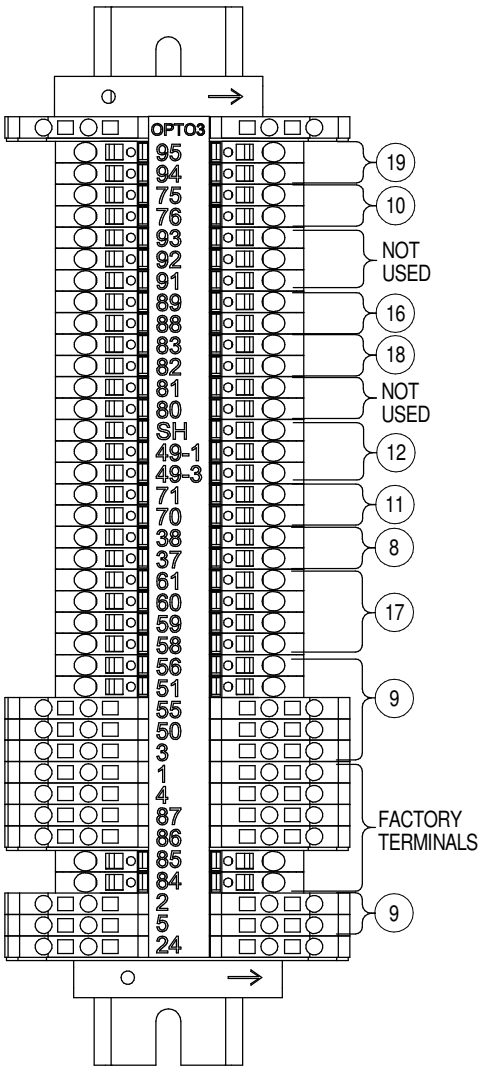
Un-acceptable unit input electrical service for 460V (480V) nominal units
- wye with high resistance (or impedance) ground
- delta without ground or with floating ground
- delta with corner ground
- delta with grounded center tap

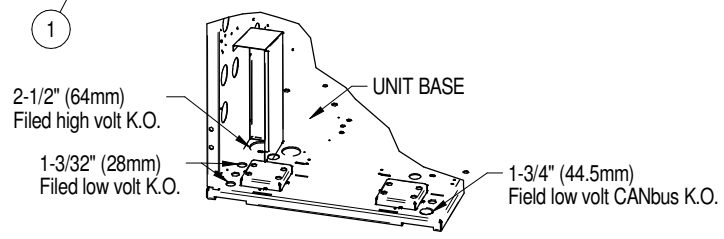
ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS

600mm (24in.) MODELS



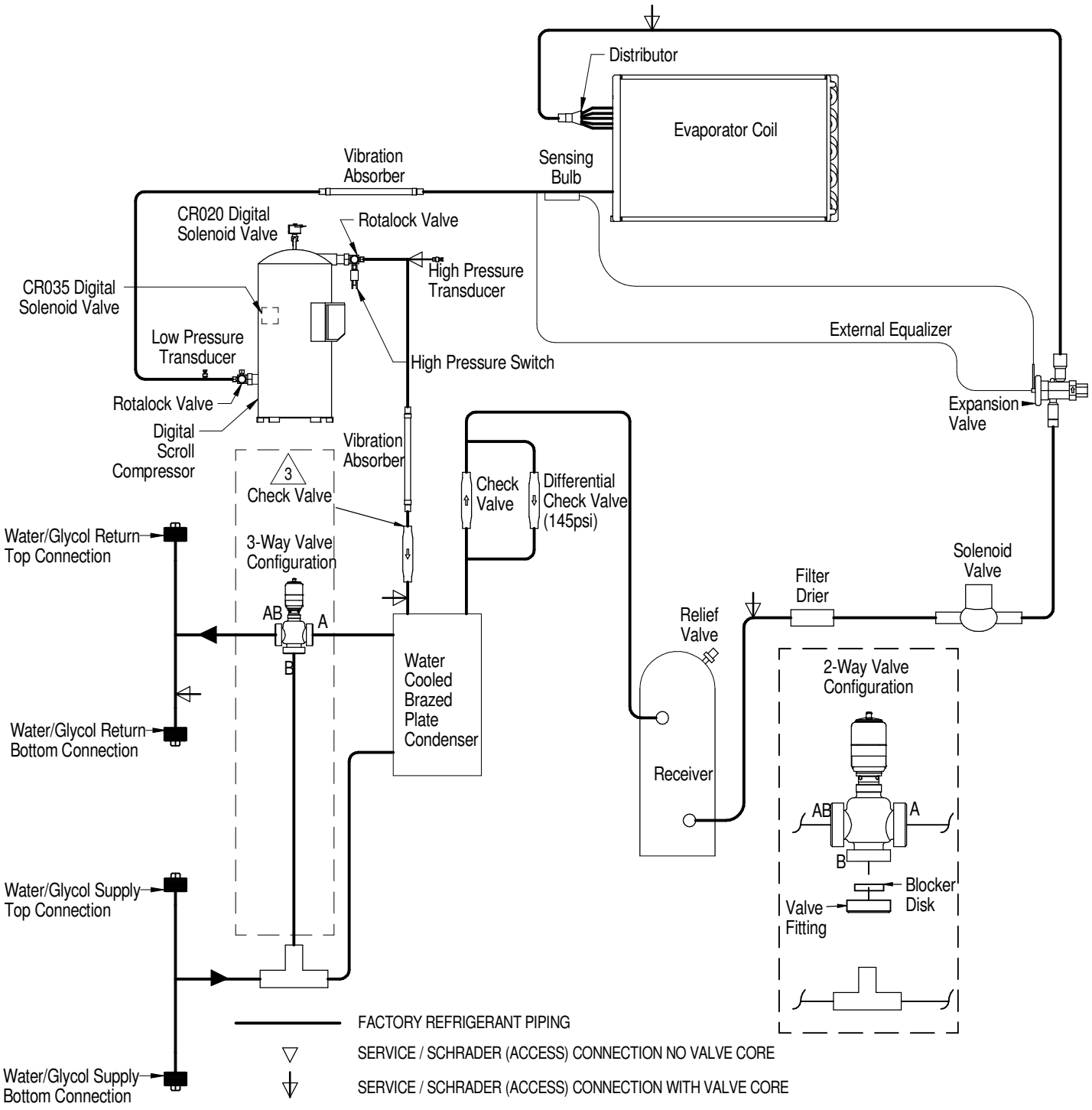






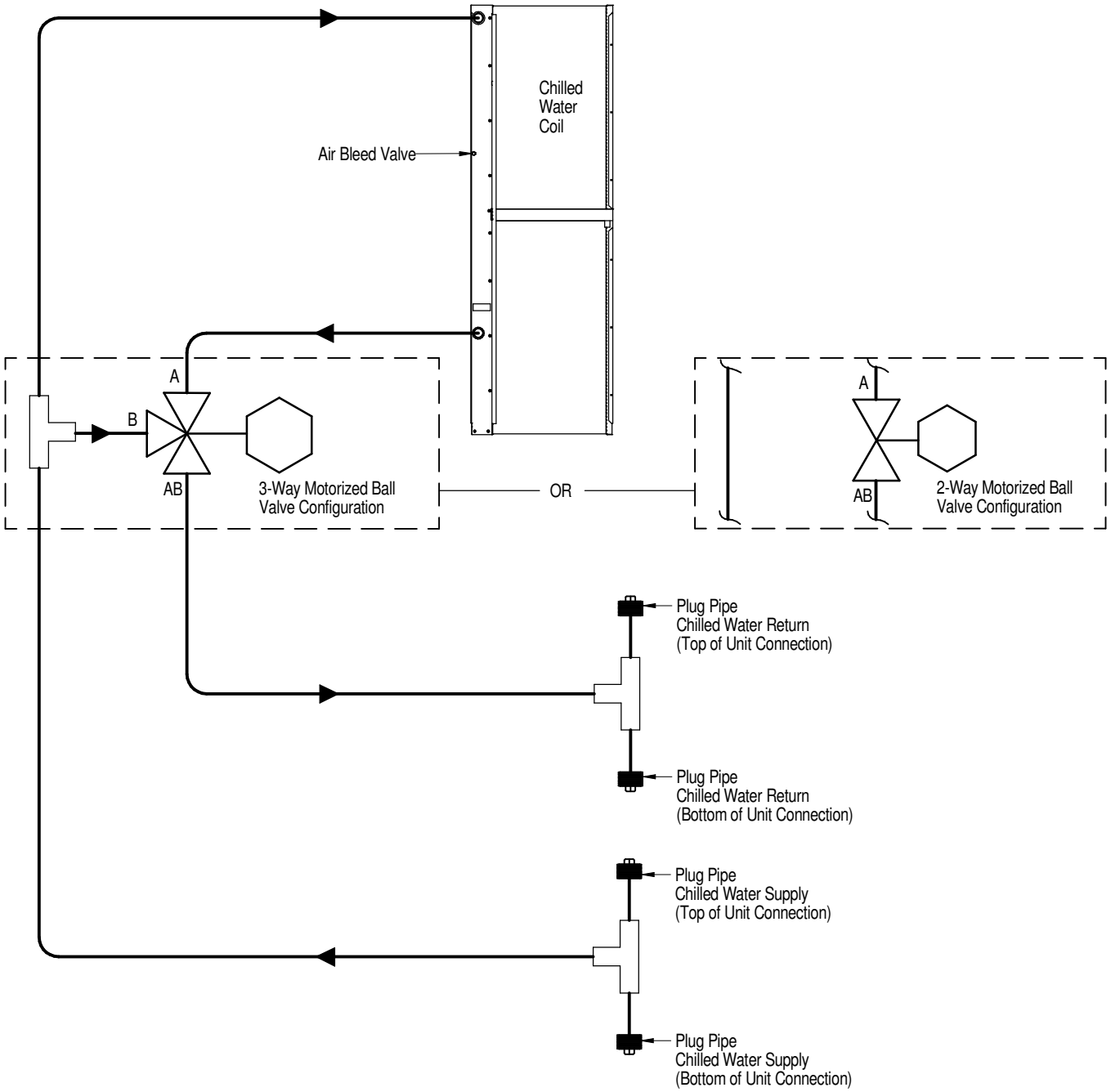
LIEBERT CRV

GENERAL ARRANGEMENT DIAGRAM
600mm WATER/GLYCOL COOLED MODELS



NOTES:
1. Schematic representation shown. Do not use for specific connection locations.
2. Install a 20 mesh strainer, in an easily accessible location, on the Water/Glycol Supply to prevent particles from entering the Heat Exchanger. Strainer Bypass Valves are recommended to allow the strainer to be cleaned while maintaining flow to the colling unit.
3. Check Valve supplied only on CR020RW units.

GENERAL ARRANGEMENT DIAGRAM
600mm (24in.) CHILLED WATER MODELS



FACTORY PIPING

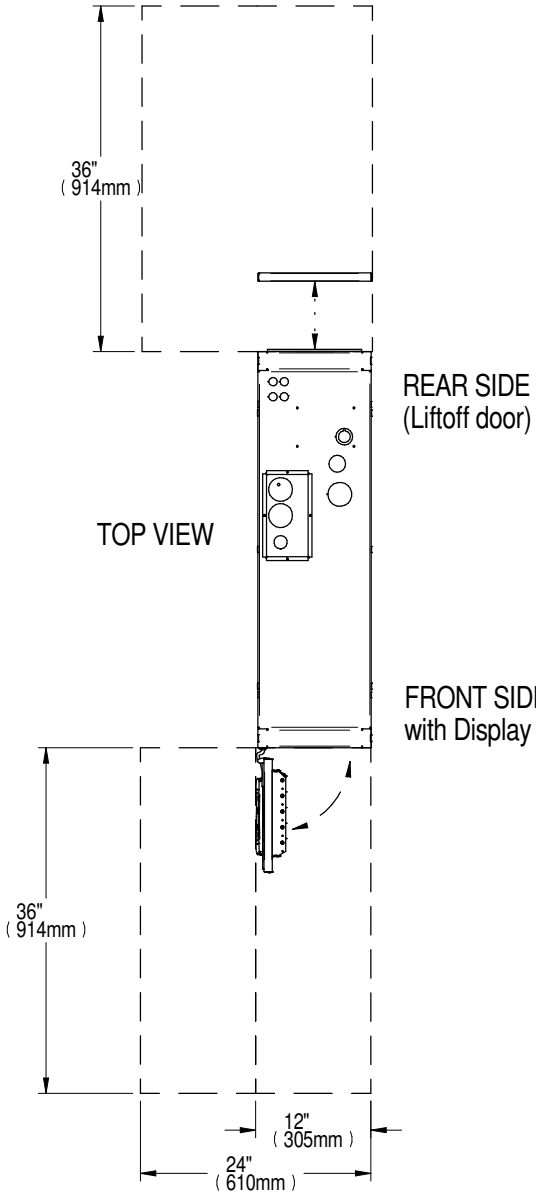
NOTE: SCHEMATIC REPRESENTATION SHOWN. DO NOT USE FOR SPECIFIC CONNECTION LOCATIONS.

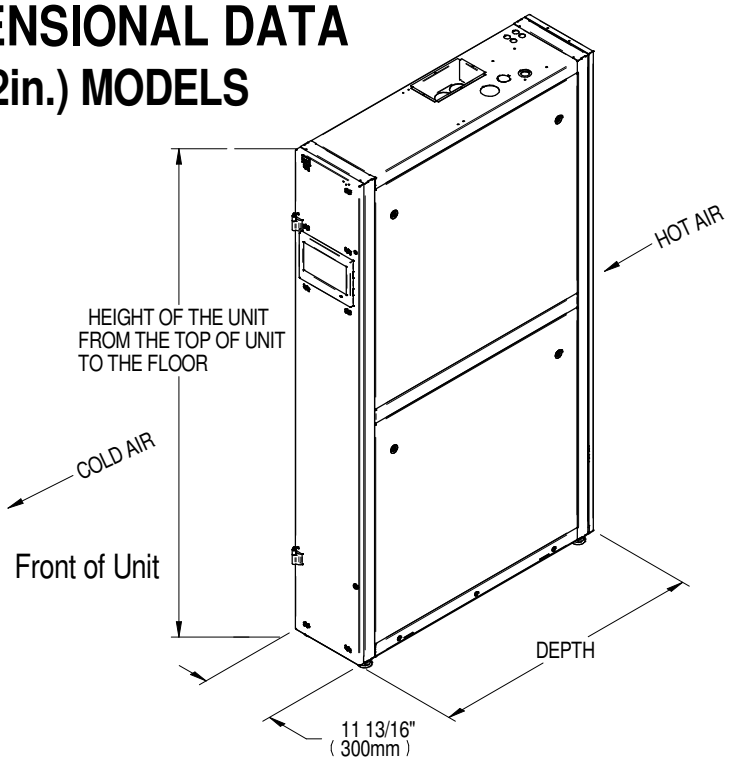
LIEBERT CRV

CABINET DIMENSIONAL DATA

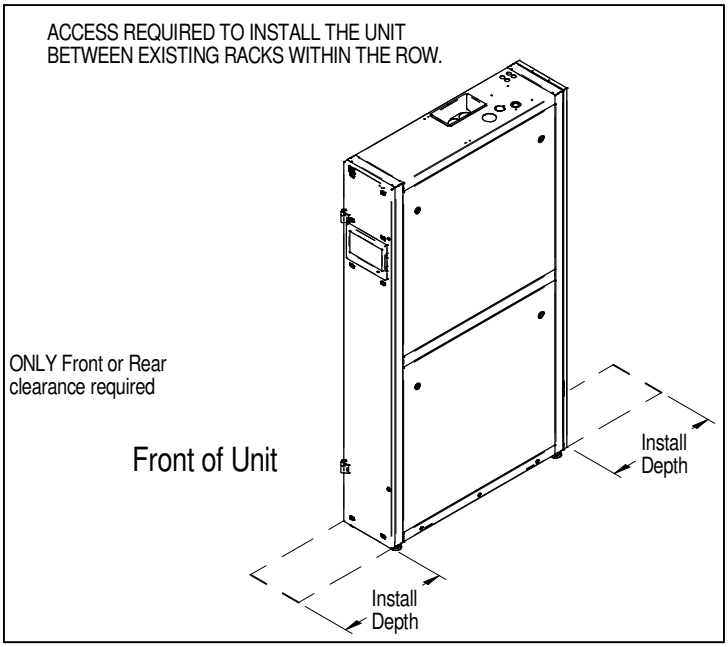
300mm (12in.) MODELS

ACCESS REQUIRED TO SERVICE THE UNIT
BETWEEN EXISTING RACKS WITHIN THE ROW





ACCESS REQUIRED TO INSTALL THE UNIT
BETWEEN EXISTING RACKS WITHIN THE ROW.

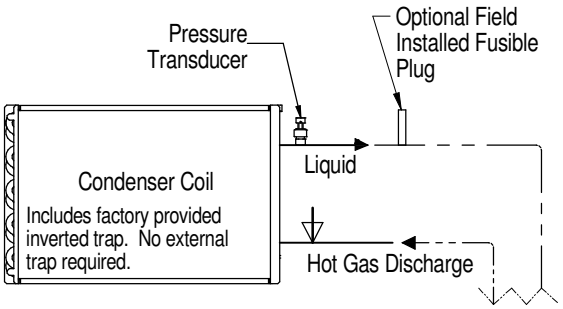


Cooling System	Height in. (mm)	Depth in. (mm)	Install Depth in. (mm)	Dry Weight, +/- 5% lbs (kg)
AIR	78-3/4 (2000)	43-5/16 (1100)	49-3/16 (1250	507 (230)
WTR/GLY				545 (247)
CW				418 (190)

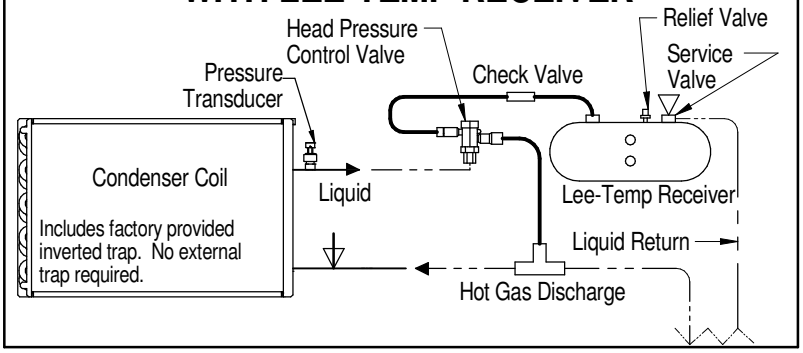
LIEBERT CRV

GENERAL ARRANGEMENT DIAGRAM
300mm (12in.) AIR COOLED W/ LIEBERT MC CONDENSER MODELS

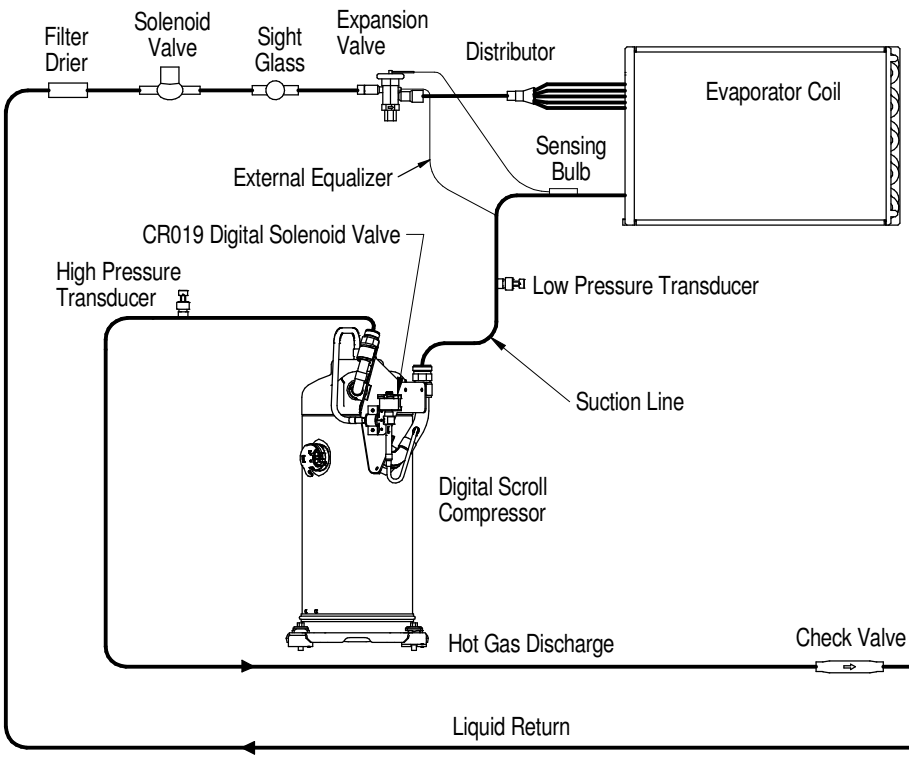
LIEBERT MC CONDENSER

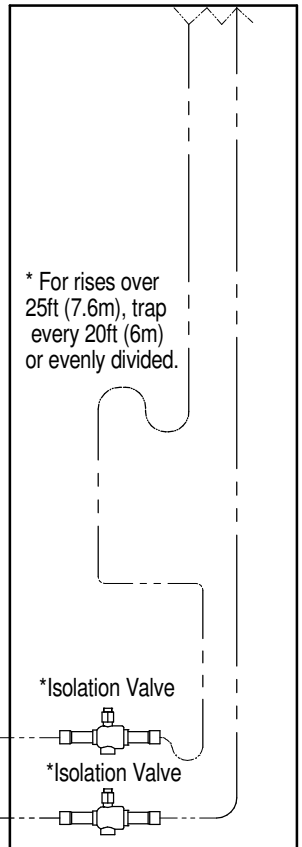


LIEBERT MC CONDENSER WITH LEE-TEMP RECEIVER



LIEBERT CRV UNIT AND ASSOCIATED PIPING





FACTORY REFRIGERANT PIPING

FIELD PIPING

SERVICE / SCHRADER (ACCESS) CONNECTION WITH VALVE CORE

NOTES:
1. SCHEMATIC REPRESENTATION SHOWN. DO NOT USE FOR SPECIFIC CONNECTION LOCATIONS.
2. ONE OR MORE ADDITIONAL PRESSURE RELIEF VALVES ARE REQUIRED DOWNSTREAM OF ANY AND ALL FIELD-INSTALLED ISOLATION. DO NOT ISOLATE ANY REFRIGERANT CIRCUITS FROM OVERPRESSURIZATION PROTECTION.
3. REFER TO OUTDOOR CONDENSER DOCUMENTS ABOVE FOR PROPER TRAP PLACEMENT.

* Components are not supplied by Liebert but are required for proper circuit operation and maintenance. Isolation valves should be located near the indoor Liebert CRV unit.

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS
300mm (12in.) MODELS

SAFETY INSTRUCTIONS: READ ALL SAFETY MESSAGES IN USER MANUAL BEFORE STARTING ELECTRICAL CONNECTIONS

STANDARD ELECTRICAL CONNECTIONS (See unit views for item callouts)

1) **High voltage connection through the rear of the disconnect switch box –** 1-1/8" (28.6mm) & 1-3/4" (44.5mm) diameter concentric knockout.
2) **High voltage connection through the top of the unit –** 1-1/4" (32mm) & 1-3/4" (44mm) diameter concentric knockout.
3) **Electrical service (hard wired) –** Refer to serial tag information for unit electrical service requirement.
   Three phase – 208/230V 60Hz
   Three phase with Neutral – 460V 60Hz Wye (5 wire: 3 phase + neutral + ground).
   Single phase – 208/230V 60Hz (Chilled Water only).
   Connect to terminals on disconnect switch. Electrical service not by Liebert. Use copper conductors only, Wire per local codes. Refer to specification sheet for total unit full load amps, wire size amps and max over current protective device size.
4) **Electrical service (cord connected) –** Refer to serial tag information for unit electrical service requirement.
   Single phase – 120V 60Hz (Chilled Water only). 1-3/4" (44mm) diameter knockout provided in the top and bottom of the unit for the power cord to exit the unit. The power cord is Liebert supplied with a L5-20 plug.
5) **Factory installed locking Disconnect Switch**
6) **Earth ground -** Terminal for field supplied earth grounding wire.
7) **Low voltage connection through the bottom of the unit -** Quantity (2) 7/8" (22mm) diameter knockouts, not shown.
8) **Low voltage connection through the top of the unit -** Quantity (2) 7/8" (22mm) diameter knockouts.
9) **Remote unit shutdown -** Replace existing jumper between terminals 37 & 38 with field supplied normally closed switch having a minimum 75VA, 24VAC rating. Use field supplied Class 1 wiring.
10) **Customer alarm inputs -** Terminals for field supplied, normally closed contacts, having a minimum 75VA, 24VAC rating, between terminals 3 & 50, 2 & 51, 5 & 55, or 3 & 56. Use field supplied Class 1 wiring. Terminals 5 & 55 not available when optional Condensate Pump is installed.
11) **Common alarm -** On any alarm, normally open dry contact is closed across terminals 75 & 76 for remote indication. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.
12) **Heat rejection interlock -** On any call for compressor operation, normally open dry contact is closed across terminals 70 & 71 to heat rejection equipment. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.

CANbus ELECTRICAL CONNECTIONS

13) **CANbus connector** – Terminal block with terminals 49-1 (CAN-H) and 49-3 (CAN-L) + SH (shield connection). The terminals are used to connect the CANbus communication cable (provided by others) from the indoor unit to the Liebert MC Condenser.
14) **CANbus cable** – CANbus cable provided by others to connect to the outdoor condenser. No special considerations are required when the total external cable connection between the indoor unit and outdoor unit(s) is less than 450FT (137M). For total external cable connections greater than 450FT (137M) but less than 800FT (243M) a CANbus isolator is required. Contact the Factory.
    Cable must have the following specifications:
    - Braided shield or foil shield with drain wire
    - Shield must be wired to ground at indoor unit
    - 22-18AWG stranded tinned copper
    - Twisted pair (minimum 4 twists per foot)
    - Low Capacitance (15pF/FT or less)
    - Must be rated to meet local codes and conditions
    - EXAMPLES BELDEN 89207 (PLENUM RATED), OR ALPHA WIRE 6454 CATEGORY 5, 5E, OR HIGHER
15) Do not run in same conduit, raceway, or chase as high voltage wiring.
16) For CANbus network lengths greater than 450FT (137M) call Factory.

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS

300mm (12in.) MODELS

SAFETY INSTRUCTIONS: READ ALL SAFETY MESSAGES IN USER MANUAL BEFORE STARTING ELECTRICAL CONNECTIONS

ELECTRICAL CONNECTIONS FOR OPTIONAL FEATURES (See unit views for item callouts)

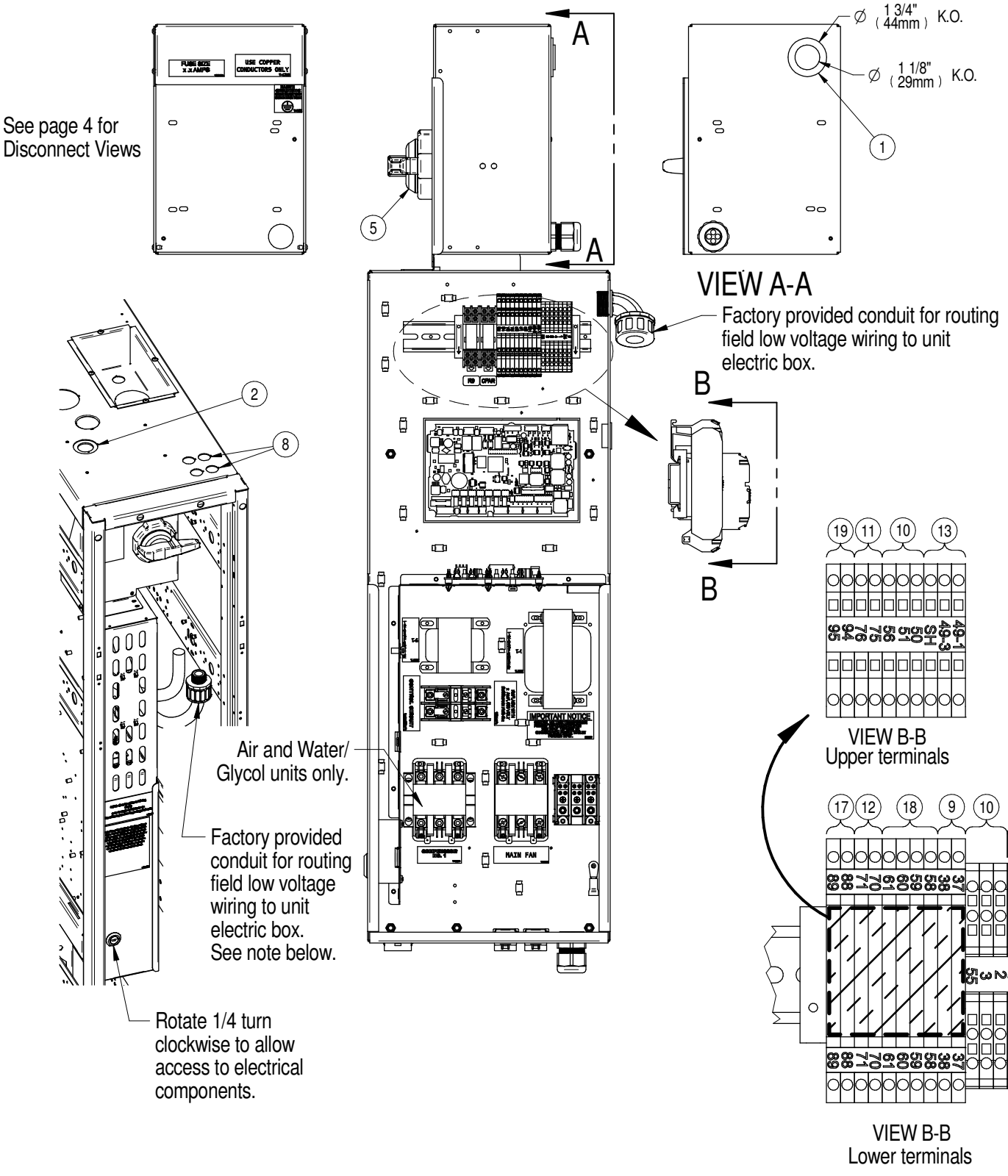
17) **Condensate pump high water alarm** (available when optional pump is installed) - On pump high water indication, normally open dry contact is closed across terminals 88 & 89 for remote indication. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.

18) **LiquiTect shutdown and dry contact** (available when optional LiquiTect sensor is installed) **–** On LiquiTect activation, normally open dry contact is closed across terminals 58 & 59 for remote indication. The LiquiTect sensor notifies iCOM of indication through terminals 60 & 61. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.

19) **Additional Common Alarm –** On any alarm, one additional normally open dry contact is closed across terminals 94 & 95 for remote indication. 1 AMP, 24VAC max load. Use Class 1 field supplied wiring.

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS

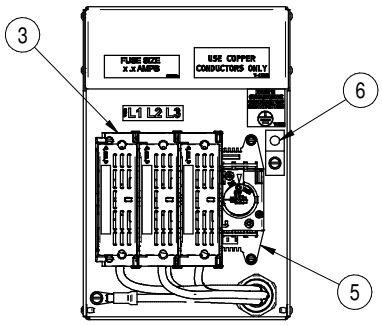
300mm (12in.) MODELS



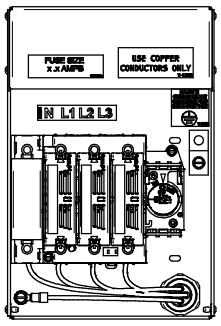
Note: All internal low voltage field wiring must be secured with cable ties away from moving parts, high temperature surfaces, and high voltage wiring.

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS
300mm (12in.) MODELS

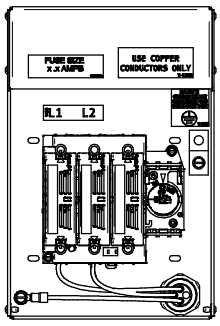
DISCONNECT VIEWS



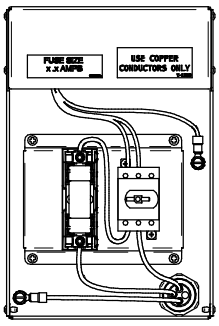
208/230V 3 phase



460V wye
(3 phase + neutral + ground)



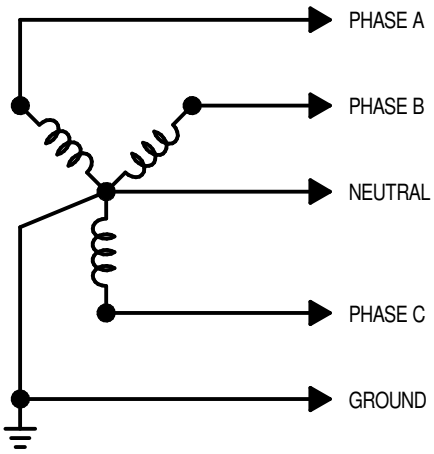
208/230V 1 phase
(CW only)



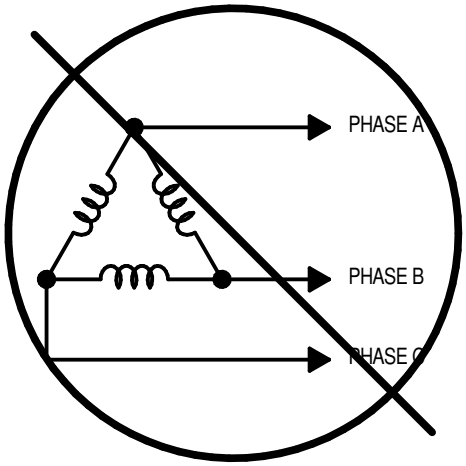
120V cord connected
(CW only)

POWER SUPPLY REQUIREMENTS FOR 460V CRV 300 mm (12in.) UNITS

460V Wye Power Supply Connection
(3 phase + Neutral + Ground)



460V Delta Power Supply Connection



NOTE

The 460 volt Liebert CRV 300 mm (12in.) unit is designed to operate with Wye-connected power with a solidly grounded neutral. It will not operate properly with Wye-connected power with high-resistance (or impedance) ground or with Delta-connected power.

Acceptable Power Supplies—480V Nominal Units

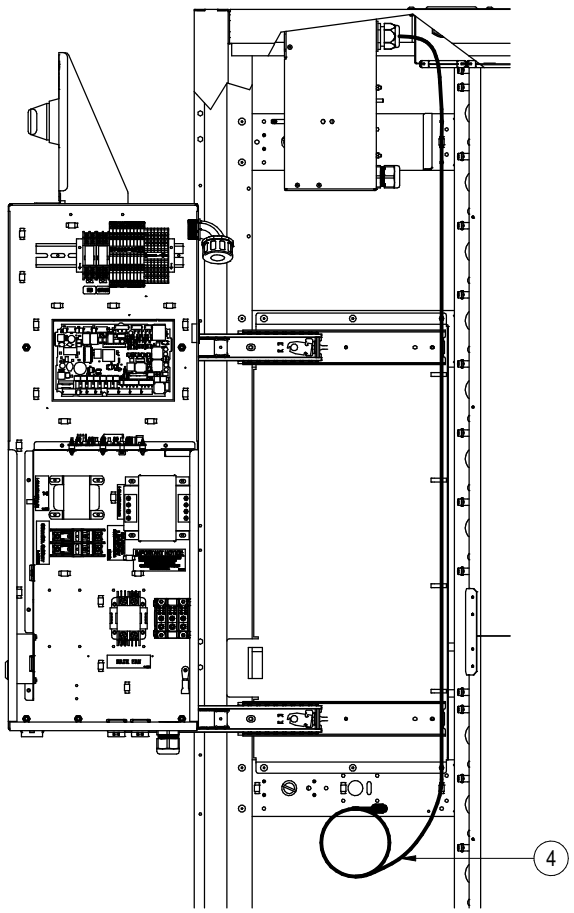
- 480V wye with solidly grounded neutral and 277V line-to-neutral

Unacceptable Power Supplies— 480V Nominal Units

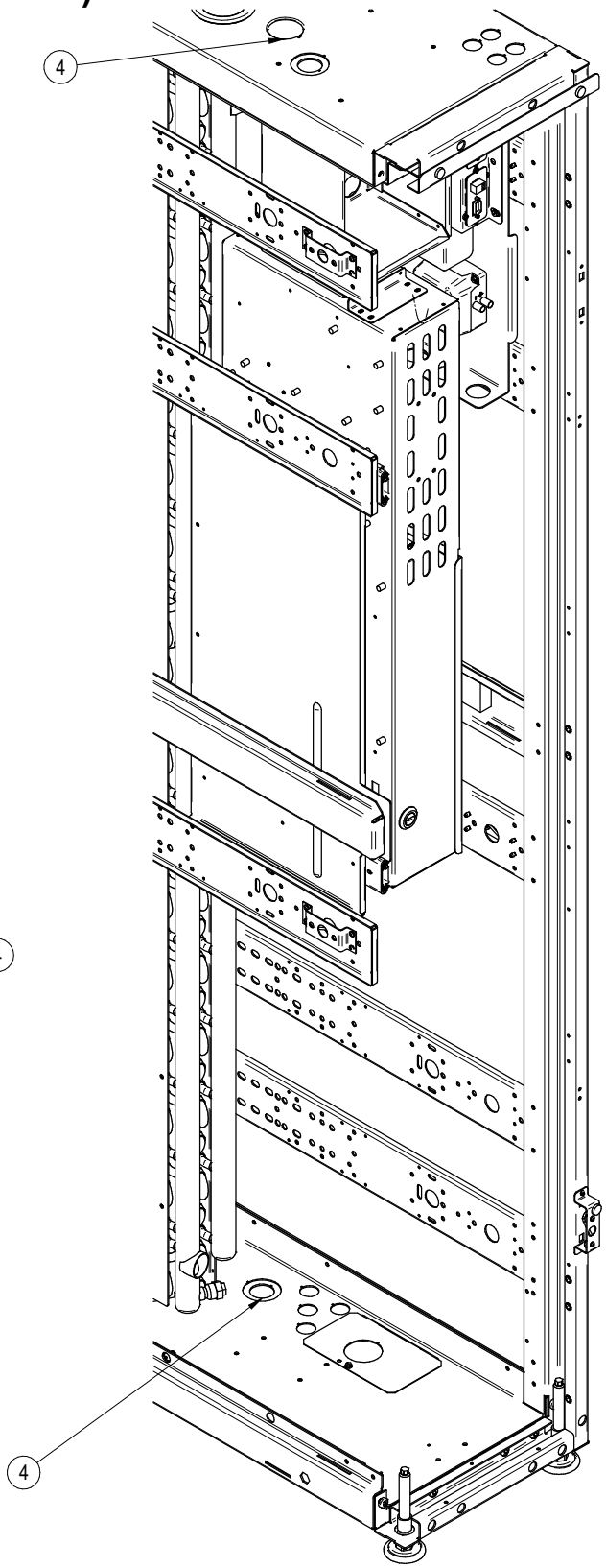
- Wye with high-resistance (or impedance) ground
- Delta without ground or with floating ground
- Delta with corner ground
- Delta with grounded center tap

ELECTRICAL FIELD CONNECTIONS DESCRIPTIONS

300mm (12in.) MODELS



MAIN POWER CORD ROUTING - 120V CW UNITS



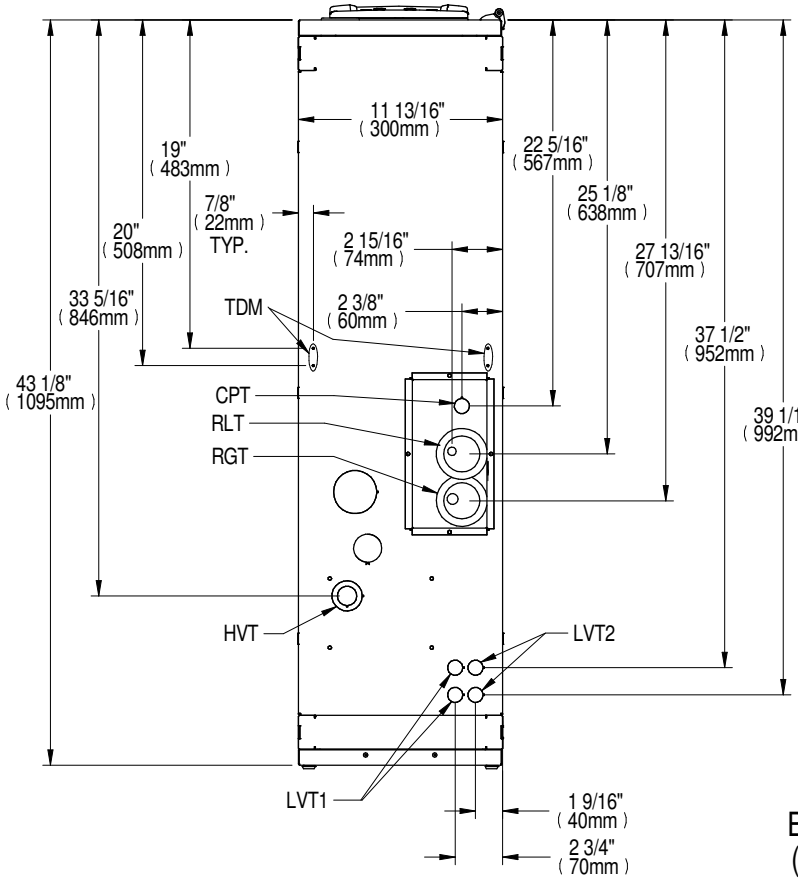
LIEBERT CRV

PRIMARY CONNECTION LOCATIONS
300mm (12in.) AIR COOLED MODELS

PIPING AND ELECTRICAL CONNECTIONS AVAILABLE AT THE TOP AND BOTTOM OF UNIT.

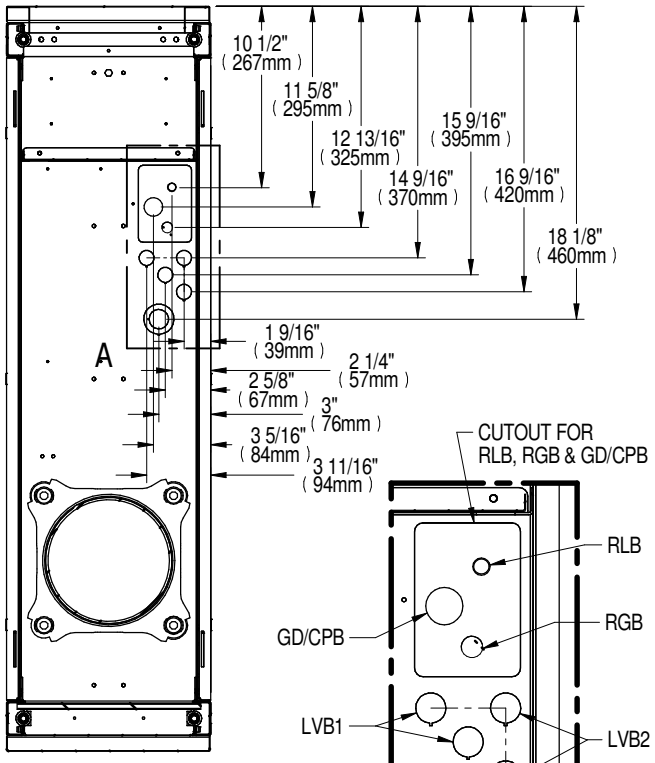
ATTENTION, AIR COOLED SYSTEMS MAY REQUIRE ADDITIONAL OIL TO BE ADDED IN THE FIELD IN ORDER TO ALLOW FOR SUFFICIENT COMPRESSOR LUBRICATION. SEE UNIT USER MANUAL FOR DETAILS.

FRONT OF UNIT



TOP CONNECTIONS

FRONT OF UNIT



BOTTOM CONNECTIONS
(possible with raised floor)

DETAIL A

UNIT TOP CONNECTIONS		CR19 (60Hz)	UNIT BOTTOM CONNECTIONS		CR19 (60Hz)
RLT	Refrigerant Liquid Line Inlet	1/2" O.D. Copper Sweat	**RLB**	Refrigerant Liquid Line Inlet	1/2" O.D. Copper Sweat
RGT	Refrigerant Gas Line Outlet	5/8" O.D. Copper Sweat	**RGB**	Refrigerant Gas Line Outlet	5/8" O.D. Copper Sweat
CPT	Condensate Pump	Knockout Hole Diameter 1-3/8" (35 mm)	**GD**	Gravity Coil Pan Drain	Knockout Hole Diameter 1-3/4" (44 mm)
			CPB	Condensate Pump	
HVT	High Voltage Top Connection	Combination Knockout 1-1/8" (29 mm) & 1-3/4" (44 mm)	**HVB**	High Voltage Bottom Entrance (feed through the base of the unit)	Combination Knockout 1-1/8"(29 mm) & 1-3/4" (44 mm)
LVT1	Low Voltage Top Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB1**	Low Voltage Bottom Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places
LVT2	Low Voltage Top Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB2**	Low Voltage Bottom Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places
TDM	Tie Down (Top) Mounting	Hole Diameter 1/8" (3 mm) 4 places			

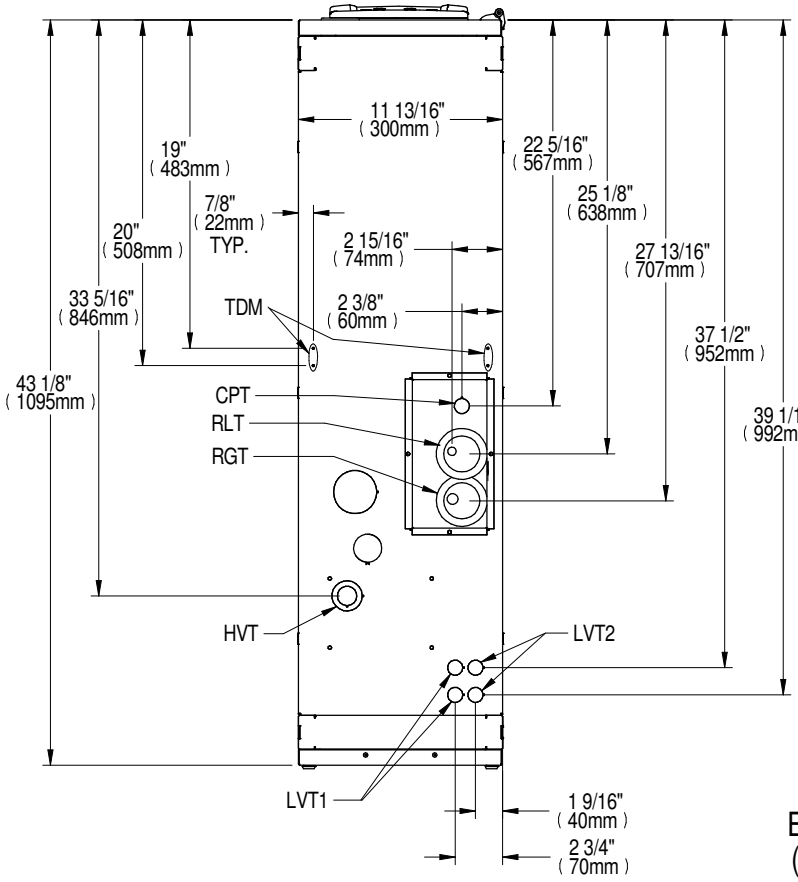
LIEBERT CRV

PRIMARY CONNECTION LOCATIONS
300mm (12in.) AIR COOLED MODELS

PIPING AND ELECTRICAL CONNECTIONS AVAILABLE AT THE TOP AND BOTTOM OF UNIT.

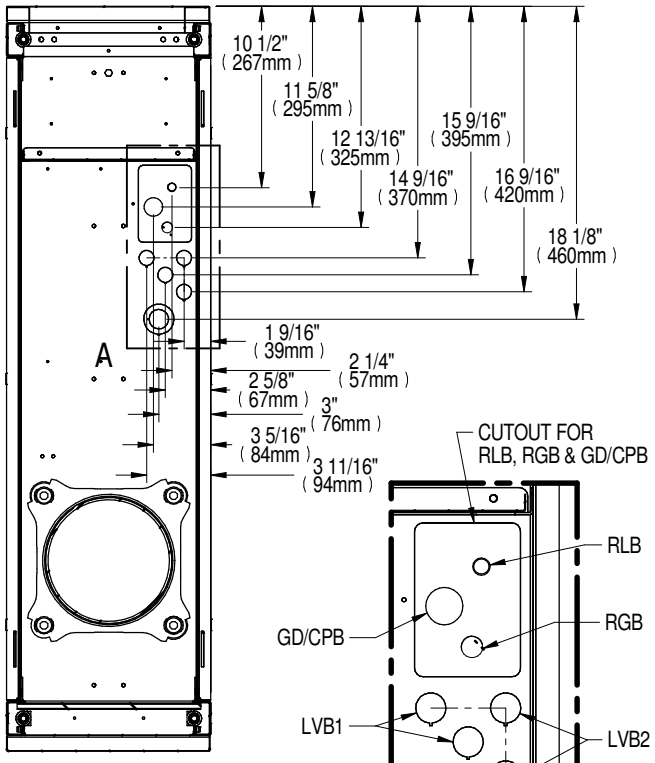
ATTENTION, AIR COOLED SYSTEMS MAY REQUIRE ADDITIONAL OIL TO BE ADDED IN THE FIELD IN ORDER TO ALLOW FOR SUFFICIENT COMPRESSOR LUBRICATION. SEE UNIT USER MANUAL FOR DETAILS.

FRONT OF UNIT



TOP CONNECTIONS

FRONT OF UNIT



BOTTOM CONNECTIONS
(possible with raised floor)

DETAIL A

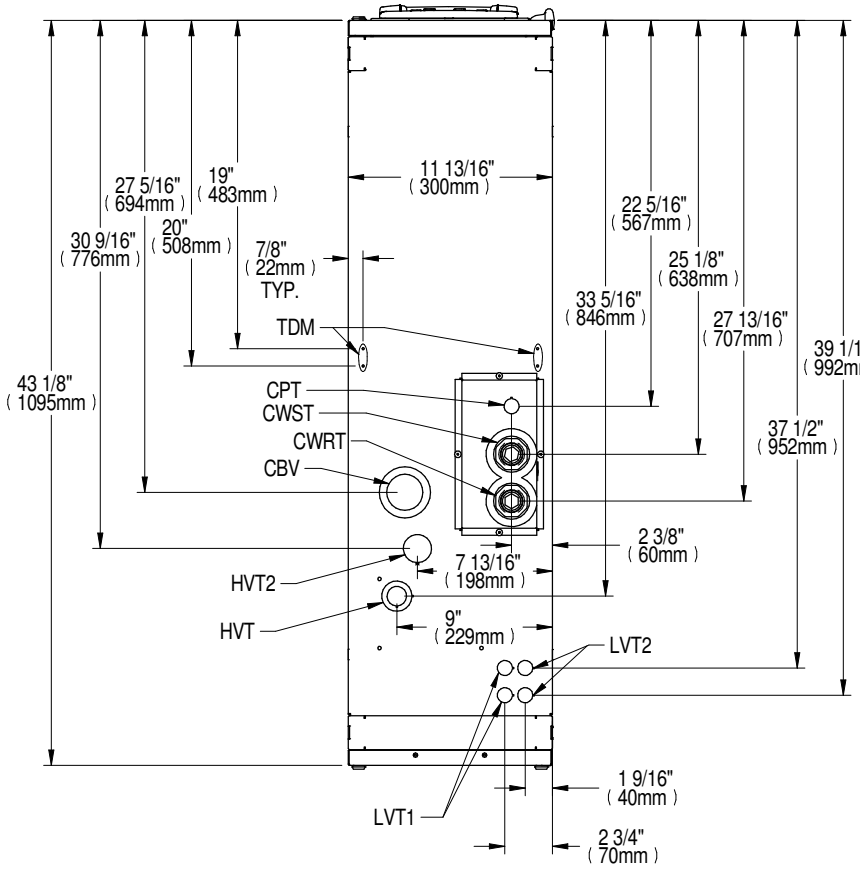
UNIT TOP CONNECTIONS		CR19 (60Hz)	UNIT BOTTOM CONNECTIONS		CR19 (60Hz)
RLT	Refrigerant Liquid Line Inlet	1/2" O.D. Copper Sweat	**RLB**	Refrigerant Liquid Line Inlet	1/2" O.D. Copper Sweat
RGT	Refrigerant Gas Line Outlet	5/8" O.D. Copper Sweat	**RGB**	Refrigerant Gas Line Outlet	5/8" O.D. Copper Sweat
CPT	Condensate Pump	Knockout Hole Diameter 1-3/8" (35 mm)	**GD**	Gravity Coil Pan Drain	Knockout Hole Diameter 1-3/4" (44 mm)
			CPB	Condensate Pump	
HVT	High Voltage Top Connection	Combination Knockout 1-1/8" (29 mm) & 1-3/4" (44 mm)	**HVB**	High Voltage Bottom Entrance (feed through the base of the unit)	Combination Knockout 1-1/8"(29 mm) & 1-3/4" (44 mm)
LVT1	Low Voltage Top Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB1**	Low Voltage Bottom Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places
LVT2	Low Voltage Top Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB2**	Low Voltage Bottom Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places
TDM	Tie Down (Top) Mounting	Hole Diameter 1/8" (3 mm) 4 places			

LIEBERT CRV

PRIMARY CONNECTION LOCATIONS
300mm (12in.) CHILLED WATER MODELS

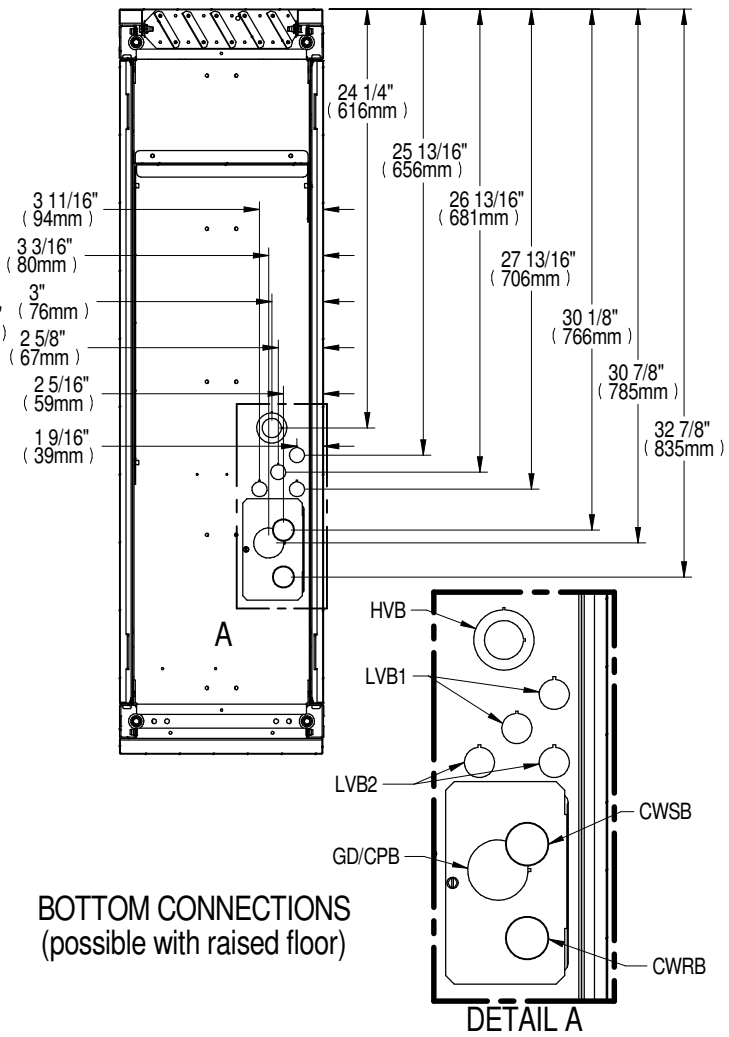
PIPING AND ELECTRICAL CONNECTIONS AVAILABLE AT THE TOP AND BOTTOM OF UNIT.

FRONT OF UNIT



TOP CONNECTIONS

FRONT OF UNIT



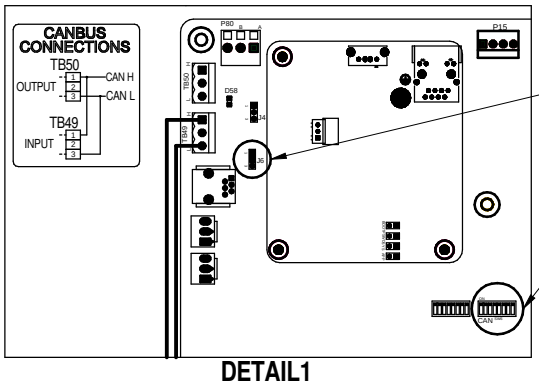
BOTTOM CONNECTIONS
(possible with raised floor)

DETAIL A

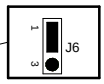
UNIT TOP CONNECTIONS		CR032 (60Hz)	UNIT BOTTOM CONNECTIONS		CR032 (60Hz)
CWST	Chilled Water Supply	1-1/4" FPT	**CWSB**	Chilled Water Supply	1-1/4" FPT
CWRT	Chilled Water Return	1-1/4" FPT	**CWRB**	Chilled Water Return	1-1/4" FPT
CPT	Condensate Pump	Knockout 35 mm (1-3/8")	**GD**	Gravity Coil Pan Drain	Knockout Hole Diameter 1-3/4" (44 mm)
CBV	Coil Bleeder (Schrader Valve Access)	Rubber Plug 51 mm (2.0")	**CPB**	Condensate Pump	
HVT	High Voltage Top Connection	Combination Knockout 1-1/8"(29 mm) & 1-3/4" (44 mm)	**HVB**	High Voltage Bottom Entrance (feed through the base of the unit)	Combination Knockout 1-1/8" (29 mm) & 1-3/4" (44 mm)
HVT2	High Voltage Top Connection (120V Units)	Knockout 1-3/4" (44 mm)			
LVT1	Low Voltage Top Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB1**	Low Voltage Top Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places
LVT2	Low Voltage Top Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB2**	Low Voltage Top Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places
TDM	Tie Down (Top) Mounting	Hole Diameter 1/8" (3 mm) 4 places			

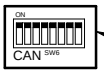
LIEBERT CRV

CANbus & INTERLOCK CONNECTIONS
BETWEEN 600mm (24in.) UNIT & LIEBERT MC CONDENSER (PREMIUM)



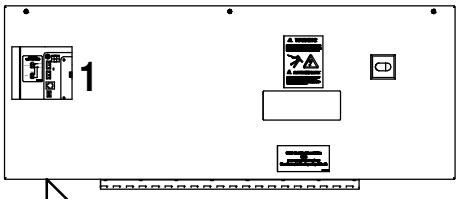
J6 TERMINATION JUMPER
MUST BE SET TO PINS 1 AND 2.





CANbus
ADDRESSING
SWITCH

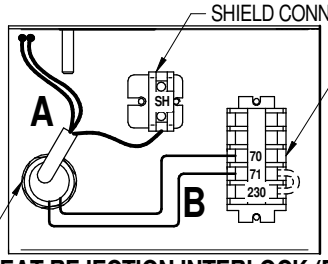
CONDENSER



DETAIL1
CAN CABLE CONNECTION (A)

SHIELD CONNECTION

FACTORY WIRING BETWEEN
MC CONTROL BOARD AND
TERMINAL STRIP.



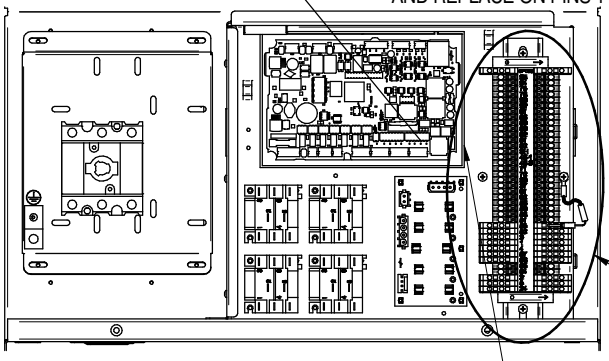
LOW VOLTAGE FIELD ENTRANCE
LOCATED ON BOTTOM LEFT OF
CONDENSER ENCLOSURE.

HEAT REJECTION INTERLOCK (B)

B
HEAT REJECTION INTERLOCK WIRE

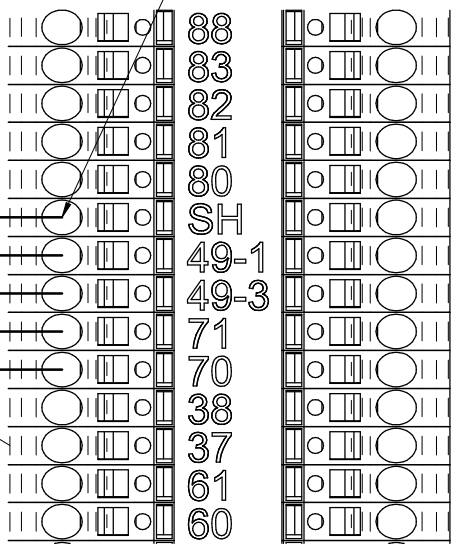
A
CANBUS COMMUNICATION CABLE

P78 TERMINATION JUMPER
FACTORY SET TO PINS 2 AND 3,
FIELD MUST REMOVE JUMPER
AND REPLACE ON PINS 1 AND 2.



PARTIAL VIEW SHOWN FOR CLARITY

SHIELDED CONNECTION



FACTORY WIRING BETWEEN
ICOM & TERMINAL STRIP

PARTIAL VIEW SHOWN FOR CLARITY

CANbus & INTERLOCK CONNECTIONS
BETWEEN 600mm (24in.) UNIT & LIEBERT MC CONDENSER (PREMIUM)

COMPONENT NOTES:
1. COMPONENT APPEARANCE, ORIENTATION,
   AND POSITION MAY VARY
   TERMINAL NAMES AND CALLOUTS REMAIN CONSTANT.
2. ALL CIRCUITS TO THESE CONNECTION POINTS ARE CLASS 2.

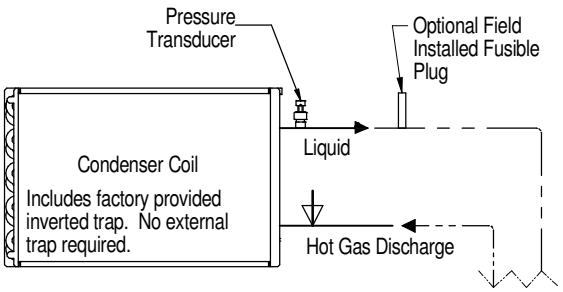
CAN & CABLE NOTES (A):
1. CABLE MUSTHAVE THE FOLLOWING SPECIFICATIONS:
   - BRAIDED SHIELD OR FOIL SHIELD WITH DRAIN WIRE
   - SHIELD MUST BE WIRED TO GROUND AT INDOOR UNIT
   - 22-18AWG STRANDED TINNED COPPER
   - TWISTED PAIR (MINIMUM 4 TWISTS PER FOOT)
   - LOW CAPACITANCE (15pF/FT OR LESS)
   - MUST BE RATED TO MEET LOCAL CODES AND CONDITIONS.
   - EXAMPLES BELDEN 89207 (PLENUM RATED), OR ALPHA WIRE 6454 CATEGORY 5, 5E, OR HIGHER.
2. DO NOT RUN IN SAME CONDUIT, RACEWAY, OR CHASE AS HIGH VOLTAGE WIRING.
3. FOR CANBUS NETWORK LENGTHS GREATER THAN 450FT(137M), CONTACT FACTORY.

INTERLOCK WIRE NOTES (B):
1. FIELD SUPPLIED WIRE - 18AWG OR GREATER - RATED 600V
2. RUN TWO WIRES FROM INDOOR UNIT TO CONDENSER.

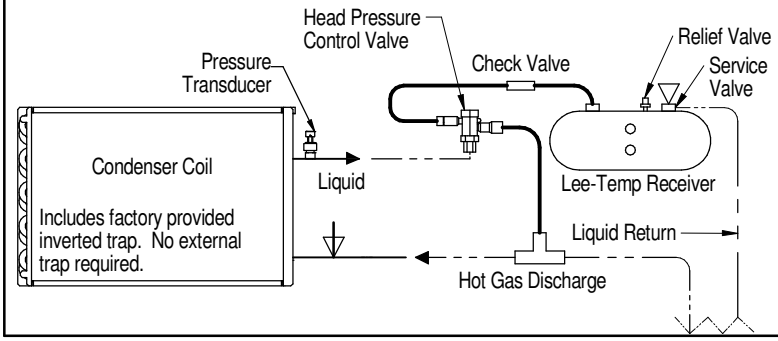
LIEBERT CRV

GENERAL ARRANGEMENT DIAGRAM
600mm (24in.) AIR COOLED W/ LIEBERT MC CONDENSER MODELS

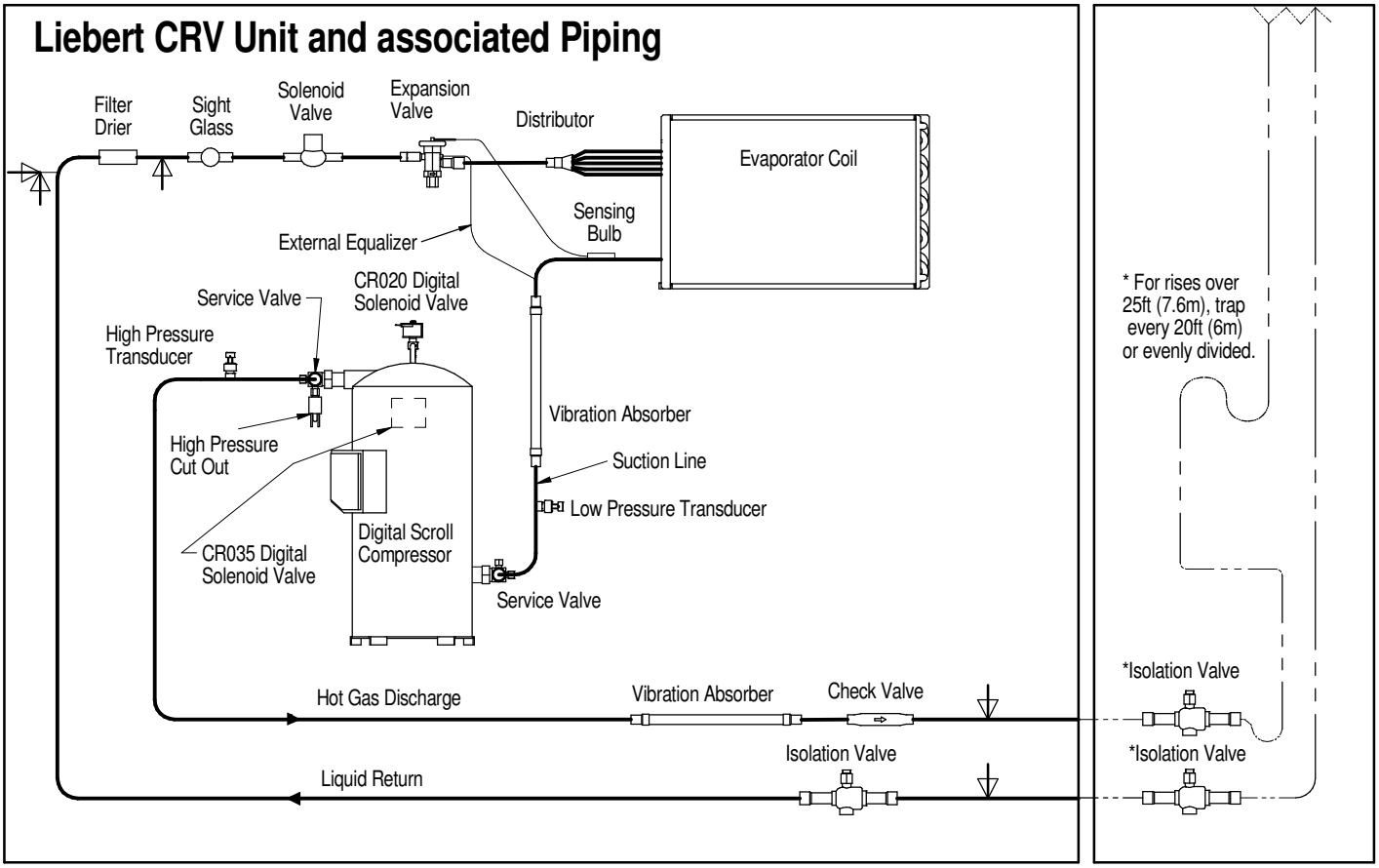
LIEBERT MC CONDENSER



LIEBERT MC CONDENSER WITH LEE-TEMP RECEIVER



Liebert CRV Unit and associated Piping



FACTORY REFRIGERANT PIPING

FIELD PIPING

SERVICE / SCHRADER (ACCESS) CONNECTION NO VALVE CORE

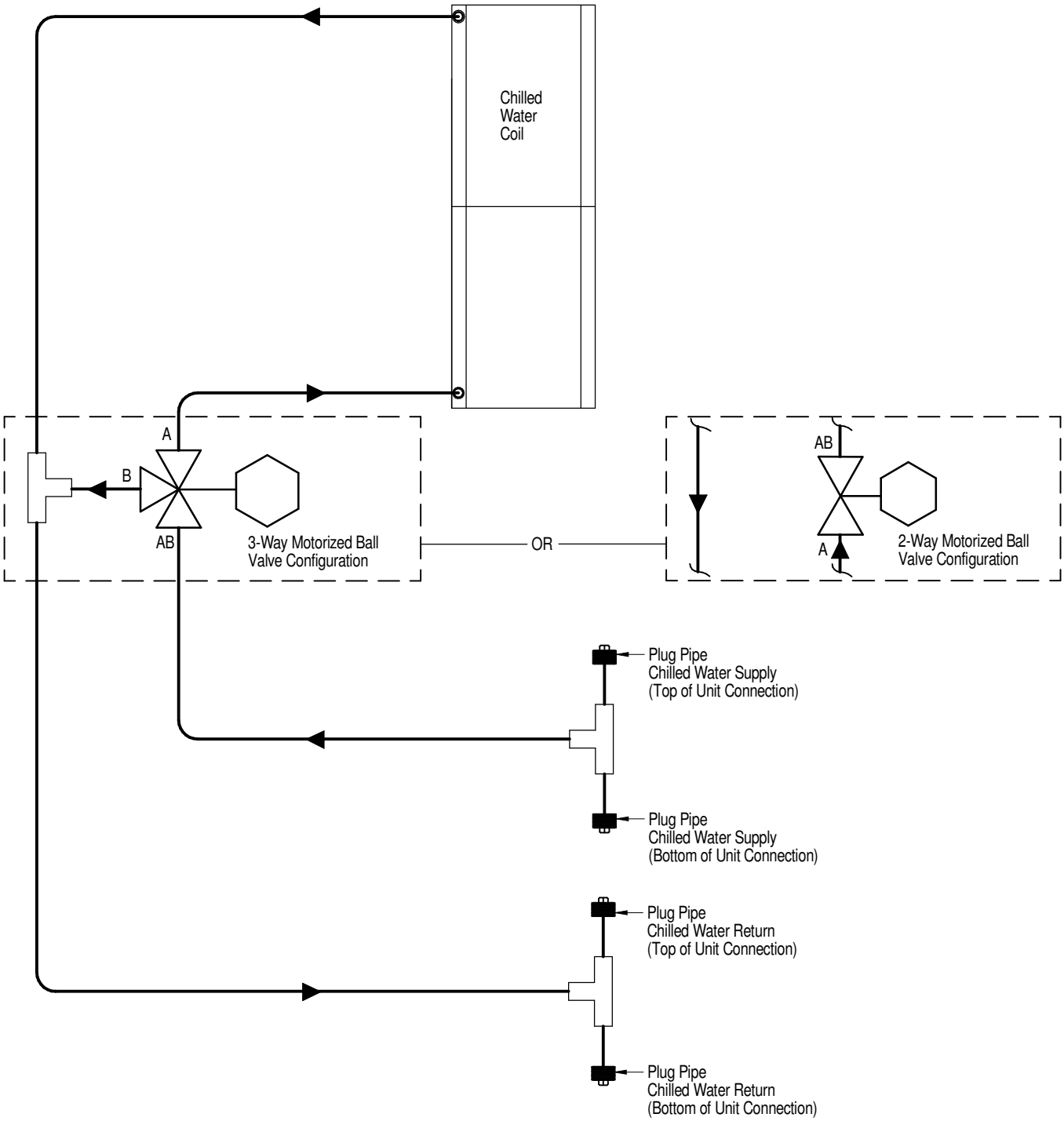
SERVICE / SCHRADER (ACCESS) CONNECTION WITH VALVE CORE

* Components are not supplied by Liebert but are recommended for proper circuit operation and maintenance. Should be located near the indoor Liebert CRV unit.

NOTES:

1. SCHEMATIC REPRESENTATION SHOWN. DO NOT USE FOR SPECIFIC CONNECTION LOCATIONS.
2. ONE OR MORE ADDITIONAL PRESSURE RELIEF VALVES ARE REQUIRED DOWNSTREAM OF ANY AND ALL FIELD-INSTALLED ISOLATION. DO NOT ISOLATE ANY REFRIGERANT CIRCUITS FROM OVERPRESSURIZATION PROTECTION.

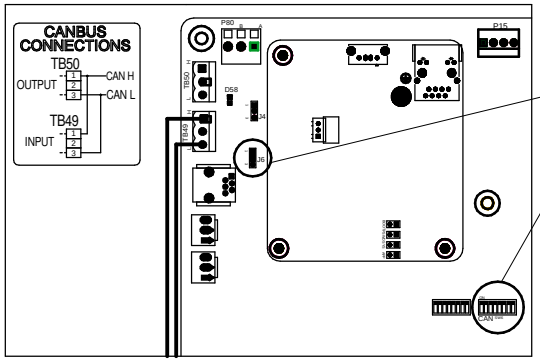
GENERAL ARRANGEMENT DIAGRAM
300mm (12in.) CHILLED WATER MODELS



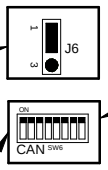
NOTE: SCHEMATIC REPRESENTATION SHOWN. DO NOT USE FOR SPECIFIC CONNECTION LOCATIONS.

LIEBERT CRV

CANbus & INTERLOCK CONNECTIONS
BETWEEN 300mm (12in.) UNIT & LIEBERT MC CONDENSER (PREMIUM)



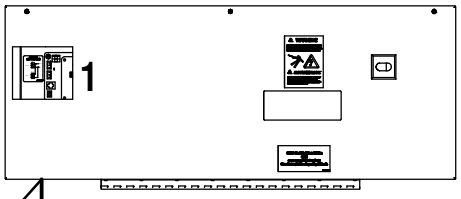
DETAIL1
CAN CABLE CONNECTION (A)



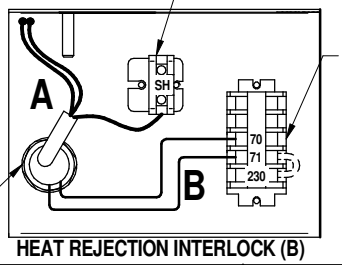
J6 TERMINATION JUMPER
MUST BE SET TO PINS 1 AND 2.

CANbus
ADDRESSING
SWITCH

CONDENSER



SHIELD CONNECTION



FACTORY WIRING BETWEEN
MC CONTROL BOARD AND
TERMINAL STRIP.

A CANbus CABLE CONNECTION

B
HEAT REJECTION INTERLOCK

LOW VOLTAGE FIELD ENTRANCE
LOCATED ON BOTTOM LEFT OF
CONDENSER ENCLOSURE.

HEAT REJECTION INTERLOCK (B)

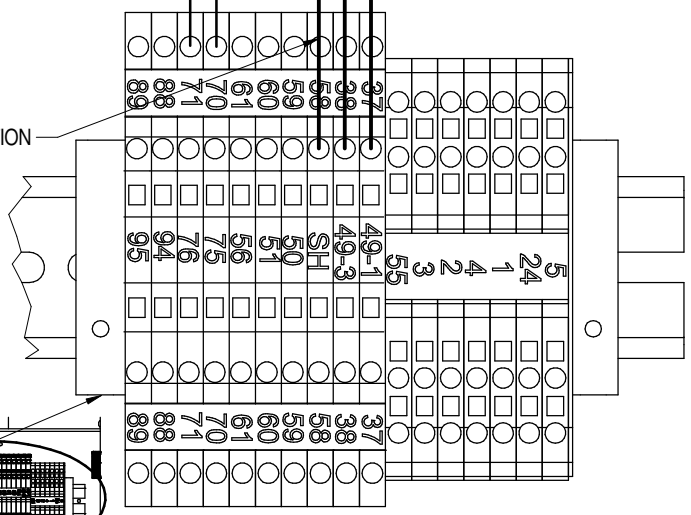
COMPONENT NOTES:
1. COMPONENT APPEARANCE, ORIENTATION AND POSITIONING MAY VARY TERMINAL NAMES AND CALLOUTS REMAIN CONSTANT.
2. ALL CIRCUITS TO THESE CONNECTION POINTS ARE CLASS 2.

CAN & CABLE NOTES (A):
1. CABLE MUSTHAVE THE FOLLOWING SPECIFICATIONS:
   - BRAIDED SHIELD OR FOIL SHIELD WITH DRAIN WIRE
   - SHIELD MUST BE WIRED TO GROUND AT INDOOR UNIT
   - 22-18AWG STRANDED TINNED COPPER
   - TWISTED PAIR (MINIMUM 4 TWISTS PER FOOT)
   - LOW CAPACITANCE (15pF/FT OR LESS)
   - MUST BE RATED TO MEET LOCAL CODES AND CONDITIONS.
   - EXAMPLES BELDEN 89207 (PLENUM RATED), OR ALPHA WIRE 6454 CATEGORY 5, 5E, OR HIGHER.
2. DO NOT RUN IN SAME CONDUIT, RACEWAY, OR CHASE AS HIGH VOLTAGE WIRING.
3. FOR CANBUS NETWORK LENGTHS GREATER THAN 450FT(137M) CONTACT FACTORY.

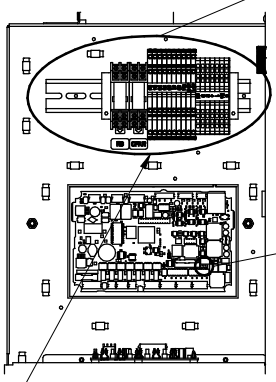
INTERLOCK WIRE NOTES (B):
1. FIELD SUPPLIED WIRE
   - 18AWG OR GREATER
   - RATED 600V
2. RUN TWO WIRES FROM INDOOR UNIT TO CONDENSER.

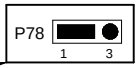
CRV300 INDOOR UNIT

SHIELD CONNECTION



PARTIAL VIEW SHOWN FOR CLARITY



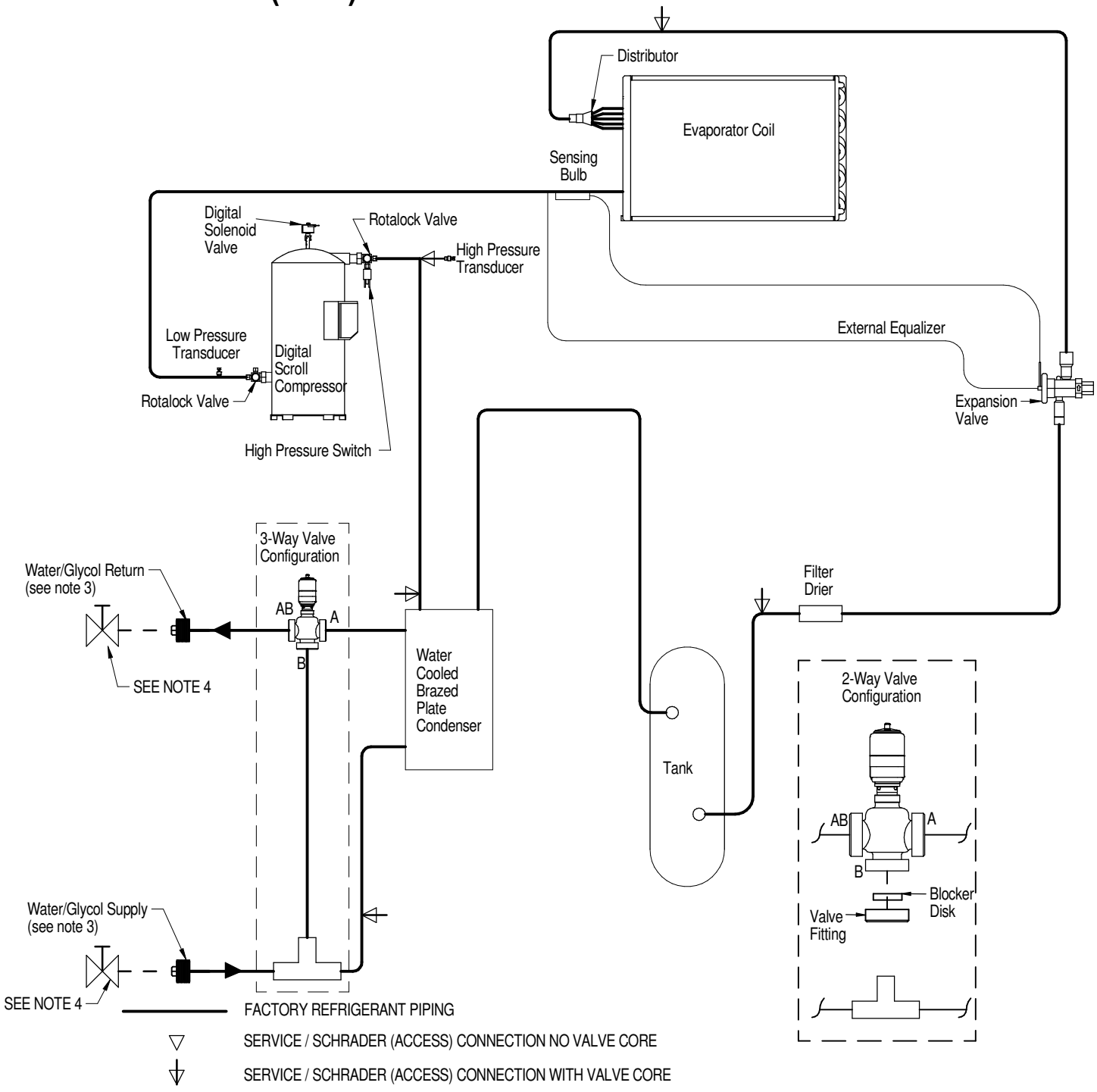


P78 TERMINATION JUMPER
FACTORY SET TO PINS 2 AND 3,
FIELD MUST REMOVE JUMPER
AND REPLACE ON PINS 1 AND 2.

FACTORY WIRING BETWEEN ICOM AND TERMINAL STRIP.

LIEBERT CRV

GENERAL ARRANGEMENT DIAGRAM
300mm (12in.) WATER/GLYCOL COOLED MODELS



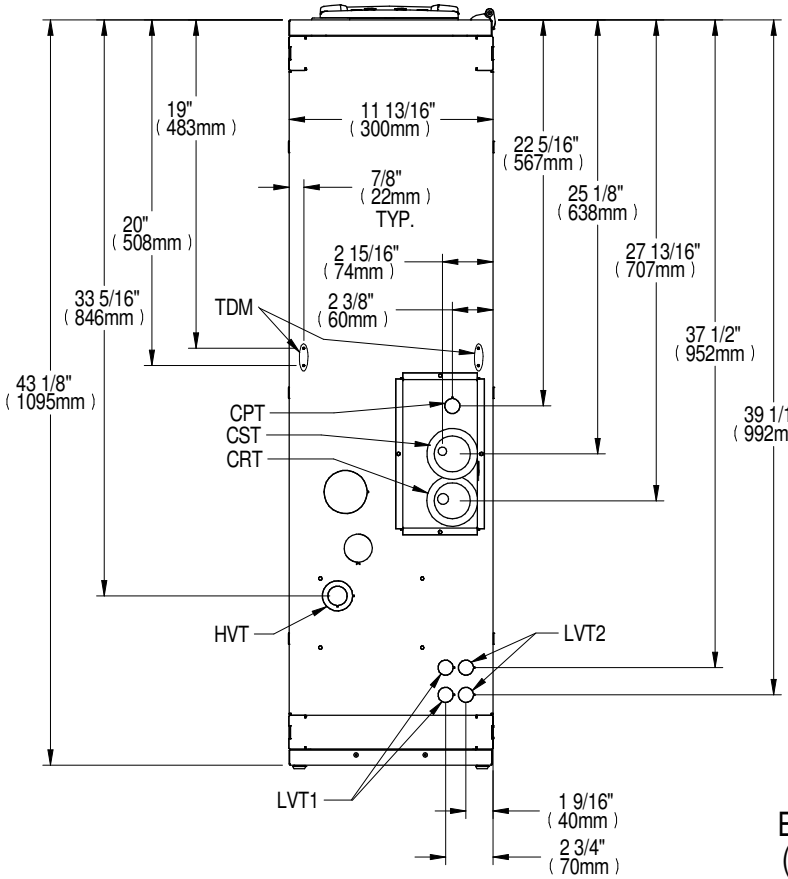
NOTES:
1. SCHEMATIC REPRESENTATION SHOWN. DO NOT USE FOR SPECIFIC CONNECTION LOCATIONS.
2. INSTALL A 20 MESH STRAINER, IN AN EASILY ACCESSIBLE LOCATION, ON THE WATER/GLYCOL SUPPLY TO PREVENT PARTICLES FROM ENTERING THE HEAT EXCHANGER. STRAINER BYPASS VALVES ARE RECCOMENDED TO ALLOW THE STRAINER TO BE CLEANED WHILE MAINTAINING FLOW TO THE COOLING UNIT.
3. UNIT CONNECTIONS MAY BE ORDERED TOP OR BOTTOM.
4. VALVE NOT PROVIDED BY LIEBERT BUT ARE REQUIRED FOR PROPER CIRCUIT OPERATION AND MAINTENANCE. THEY SHOULD BE LOCATED NEAR THE LIEBERT CRV300 UNIT.

LIEBERT CRV

PRIMARY CONNECTION LOCATIONS
300mm (12in.) WATER/GLYCOL COOLED MODELS

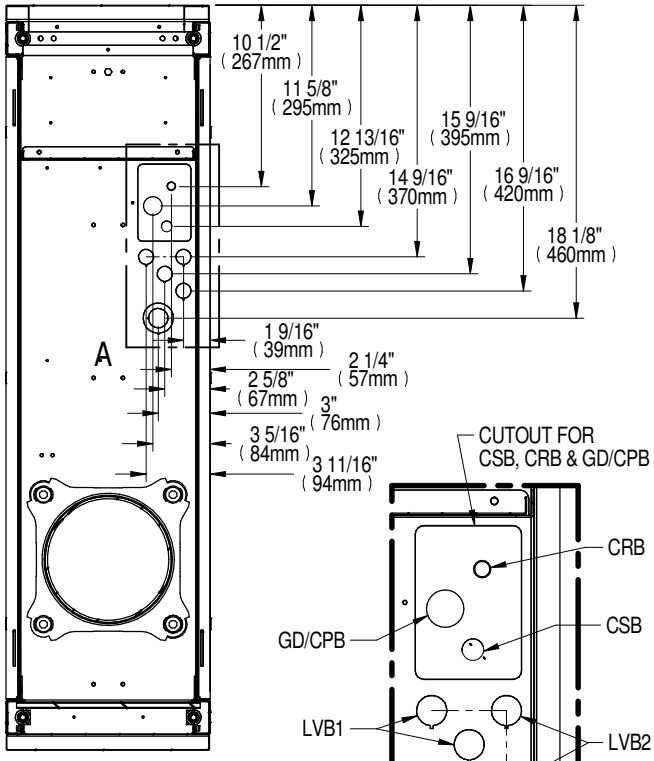
PIPING CONNECTION LOCATIONS MUST BE ORDERED TOP OR BOTTOM.
ELECTRICAL CONNECTIONS AVAILABLE TOP OR BOTTOM OF UNIT.

FRONT OF UNIT



TOP CONNECTIONS

FRONT OF UNIT



BOTTOM CONNECTIONS
(possible with raised floor)

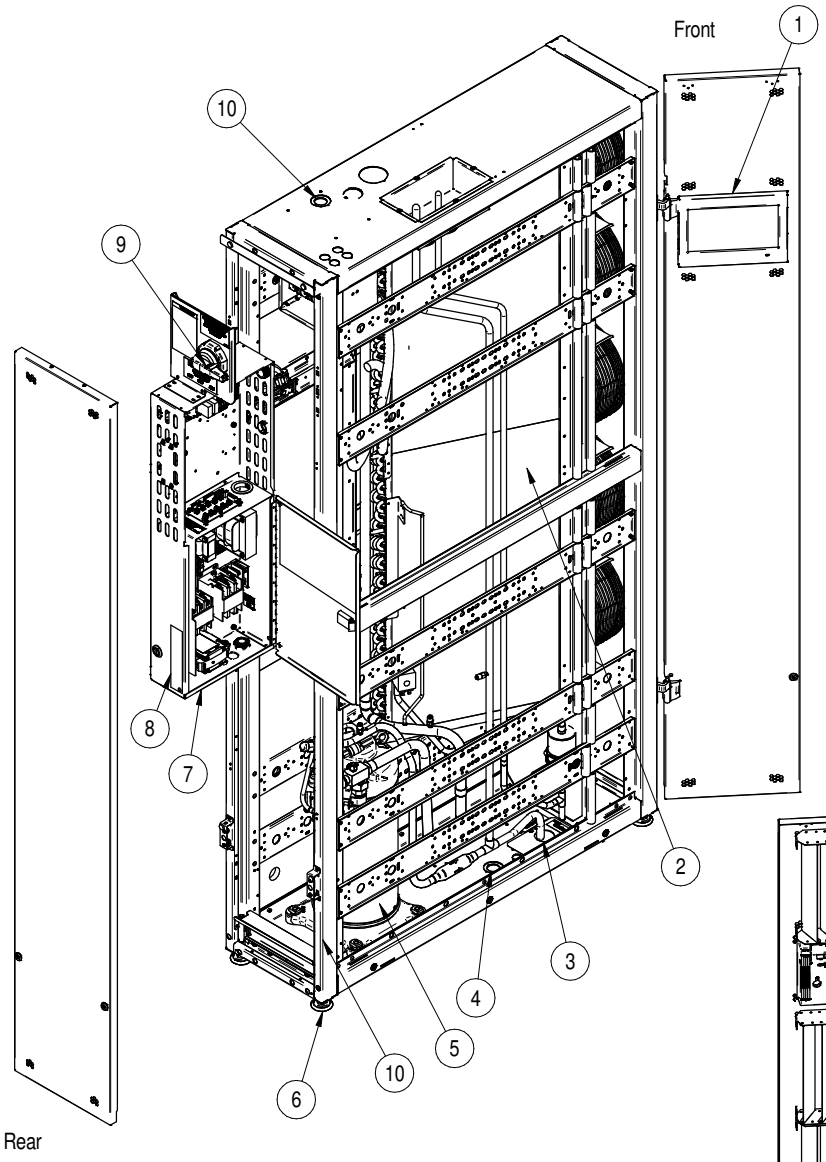
DETAIL A

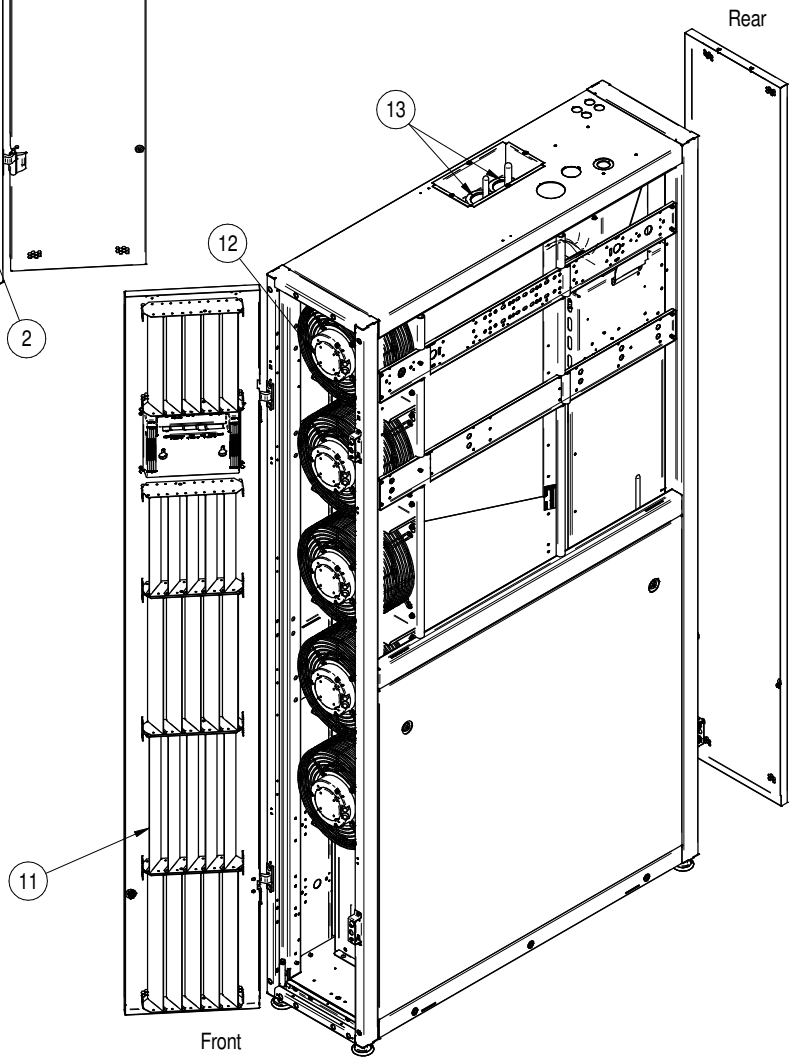
UNIT TOP CONNECTIONS		CR19 (60Hz)	UNIT BOTTOM CONNECTIONS		CR19 (60Hz)
CST	Water / Glycol Coolant Supply	1-1/4" FPT	**CSB**	Water / Glycol Coolant Supply	1-1/4" FPT
CRT	Water / Glycol Coolant Return	1-1/4" FPT	**CRB**	Water / Glycol Coolant Return	1-1/4" FPT
CPT	Condensate Pump	Knockout Hole Diameter 1-3/8" (35 mm)	**GD**	Gravity Coil Pan Drain	Knockout Hole Diameter 1-3/4" (44 mm)
			CPB	Condensate Pump	
HVT	High Voltage Top Connection	Combination Knockout 1-1/8" (29 mm) & 1-3/4" (44 mm)	**HVB**	High Voltage Bottom Entrance (feed through the base of the unit)	Combination Knockout 1-1/8" (29 mm) & 1-3/4" (44 mm)
LVT1	Low Voltage Top Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB1**	Low Voltage Bottom Connection (Twisted Pair)	Knockout Hole Diameter 7/8" (22 mm) 2 places
LVT2	Low Voltage Top Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places	**LVB2**	Low Voltage Bottom Connection (Shielded Cable)	Knockout Hole Diameter 7/8" (22 mm) 2 places
TDM	Tie Down (Top) Mounting	Hole Diameter 1/8" (3 mm) 4 places			

COMPONENT LOCATION

300mm (12in.) AIR COOLED MODELS

1	Liebert HMI Display
2	Evaporator Coil
3	Refrigerant piping connections & Condensate Pump Drain (Bottom)
4	Electrical connection (Bottom)
5	Compressor
6	Caster & Leveling Foot (each corner)
7	Electric Box
8	Serial Tag
9	Main Disconnect Switch
10	Top Electrical Entrance
11	Baffles (5 assemblies)
12	EC Plug Fans
13	Top Refrigerant Connections

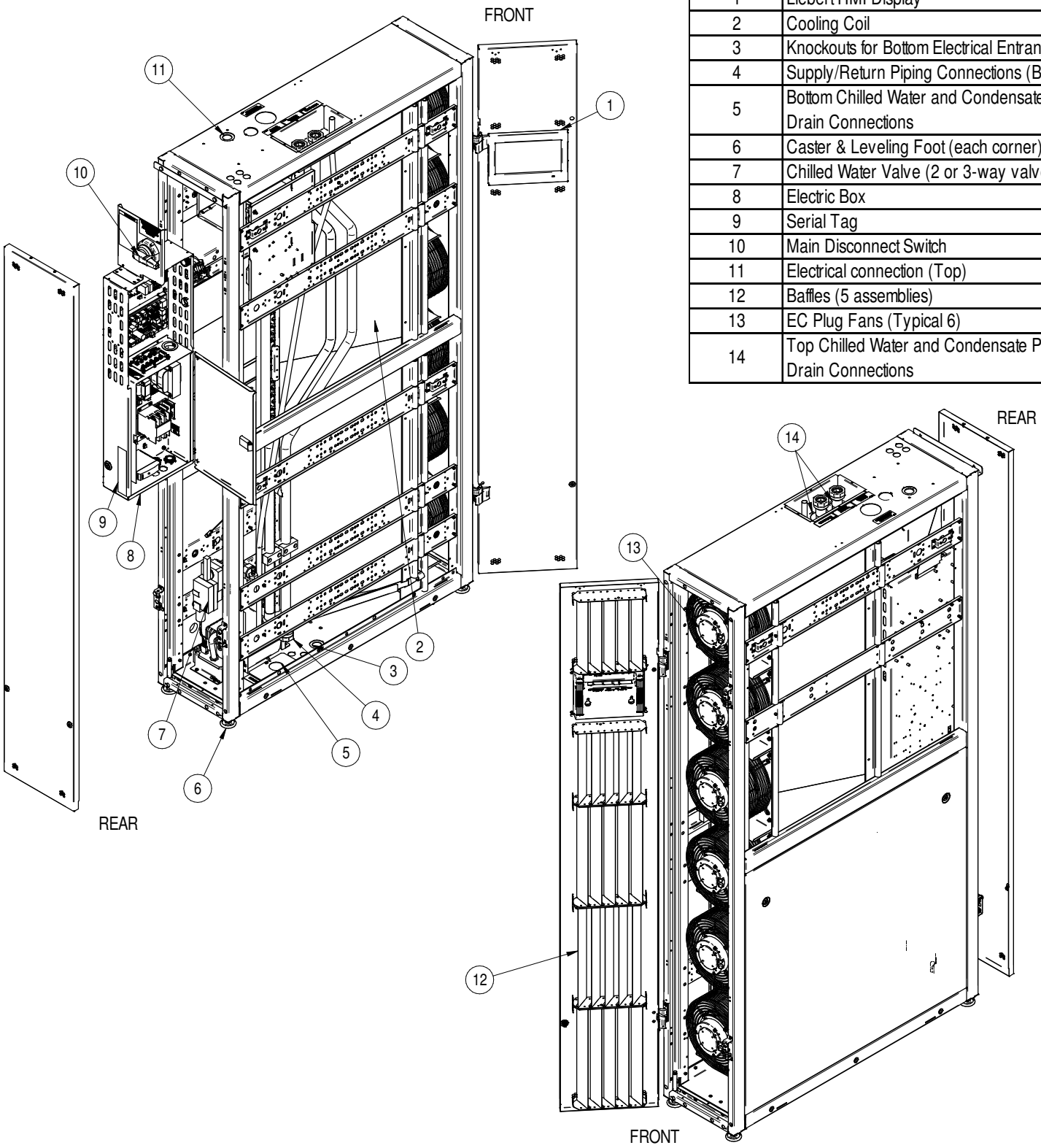




LIEBERT CRV

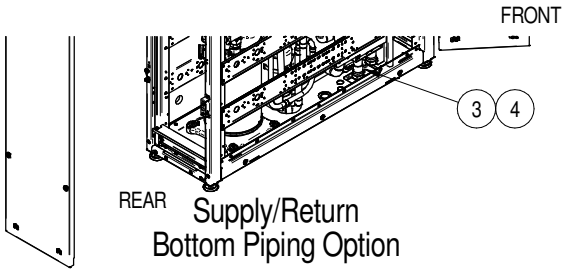
COMPONENT LOCATION
30mm (12in.) CHILLED WATER MODELS

1	Liebert HMI Display
2	Cooling Coil
3	Knockouts for Bottom Electrical Entrance
4	Supply/Return Piping Connections (Bottom)
5	Bottom Chilled Water and Condensate Pump Drain Connections
6	Caster & Leveling Foot (each corner)
7	Chilled Water Valve (2 or 3-way valve)
8	Electric Box
9	Serial Tag
10	Main Disconnect Switch
11	Electrical connection (Top)
12	Baffles (5 assemblies)
13	EC Plug Fans (Typical 6)
14	Top Chilled Water and Condensate Pump Drain Connections

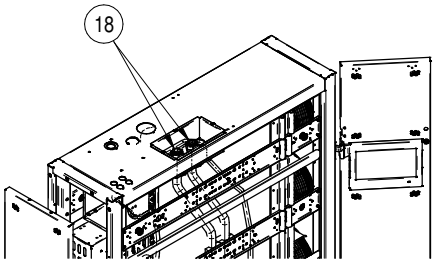


COMPONENT LOCATION

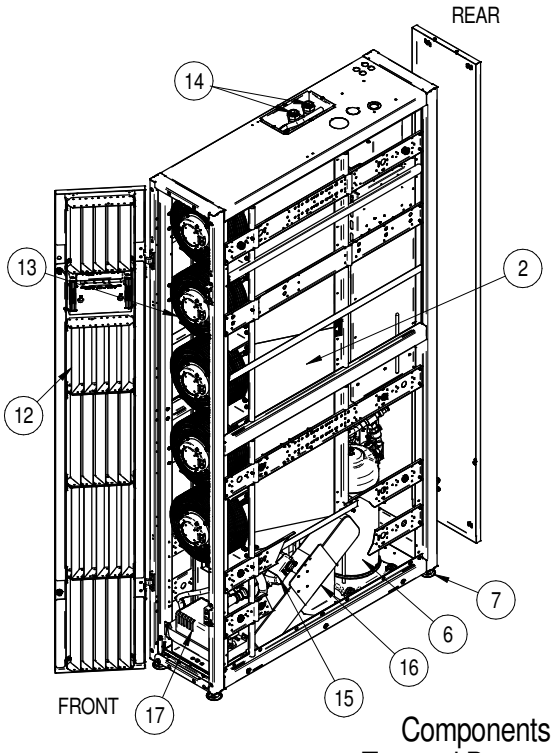
300mm (12in.) WATER GLYCOL COOLED MODELS

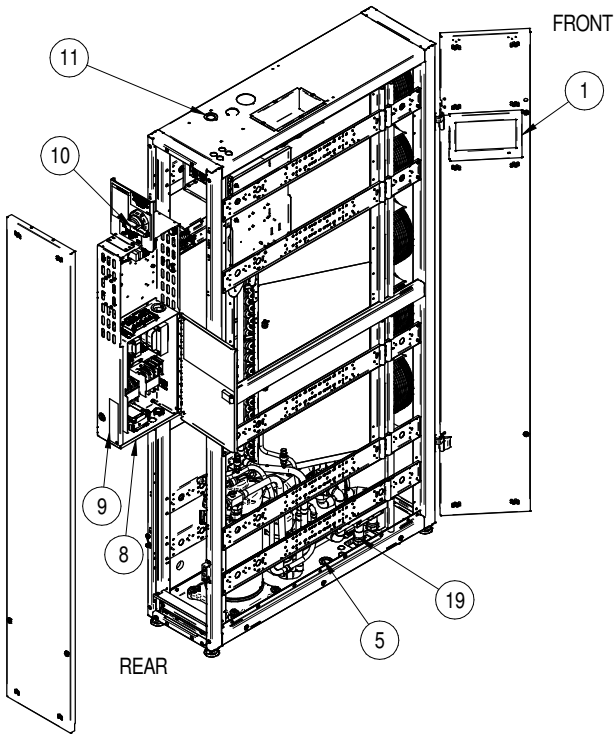


Supply/Return
Bottom Piping Option



Supply/Return
Top Piping Option

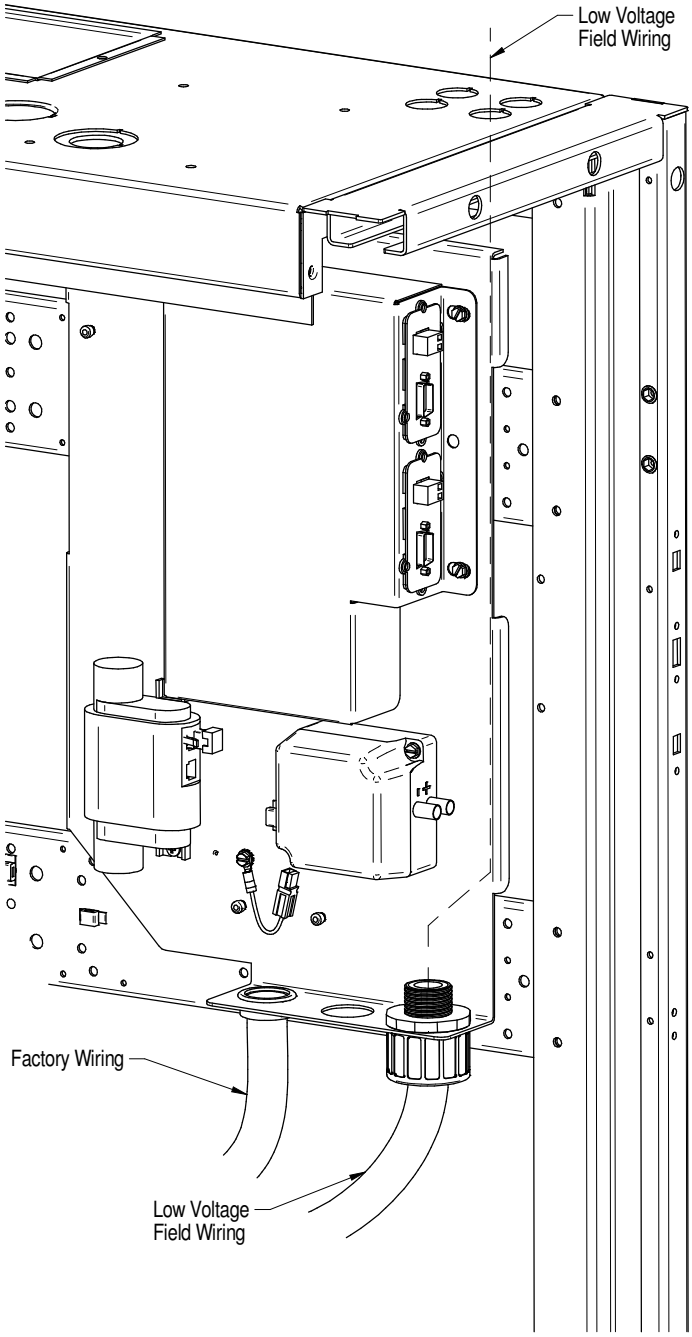




Components common to
Top and Bottom Piping Options

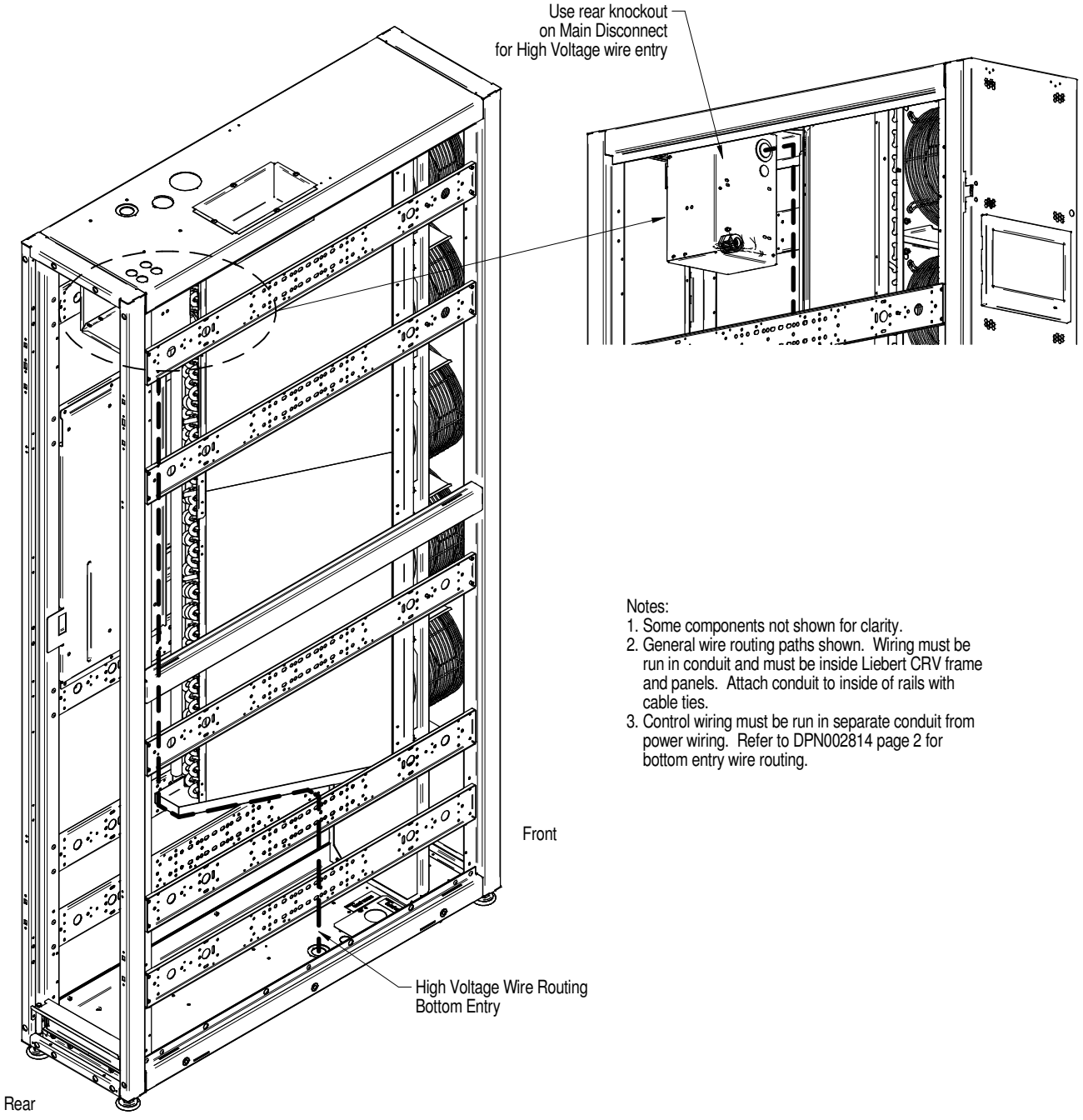
1	Liebert iCOM Display	11	Top Electrical Entrance
2	Evaporator Coil	12	Baffles (5 assemblies)
3	Supply/Return Connections (Bottom Piping Option)	13	EC Plug Fans (5 typ.)
4	Knockouts for Supply/Return (Bottom Piping Option)	14	Condensate Pump Drain Top Connection
5	Bottom Electrical Entrance	15	Control Valve
6	Compressor	16	Heat Exchanger (Plate)
7	Caster & Leveling Foot (Each Corner)	17	Condensate Pump
8	Electric Box	18	Supply/Return Connections (Top Piping Option)
9	Serial Tag	19	Condensate Pump Drain Bottom Connection
10	Main Disconnect Switch		

LOW VOLTAGE FIELD WIRING ROUTING
300mm (12in.) ALL MODELS



LIEBERT CRV

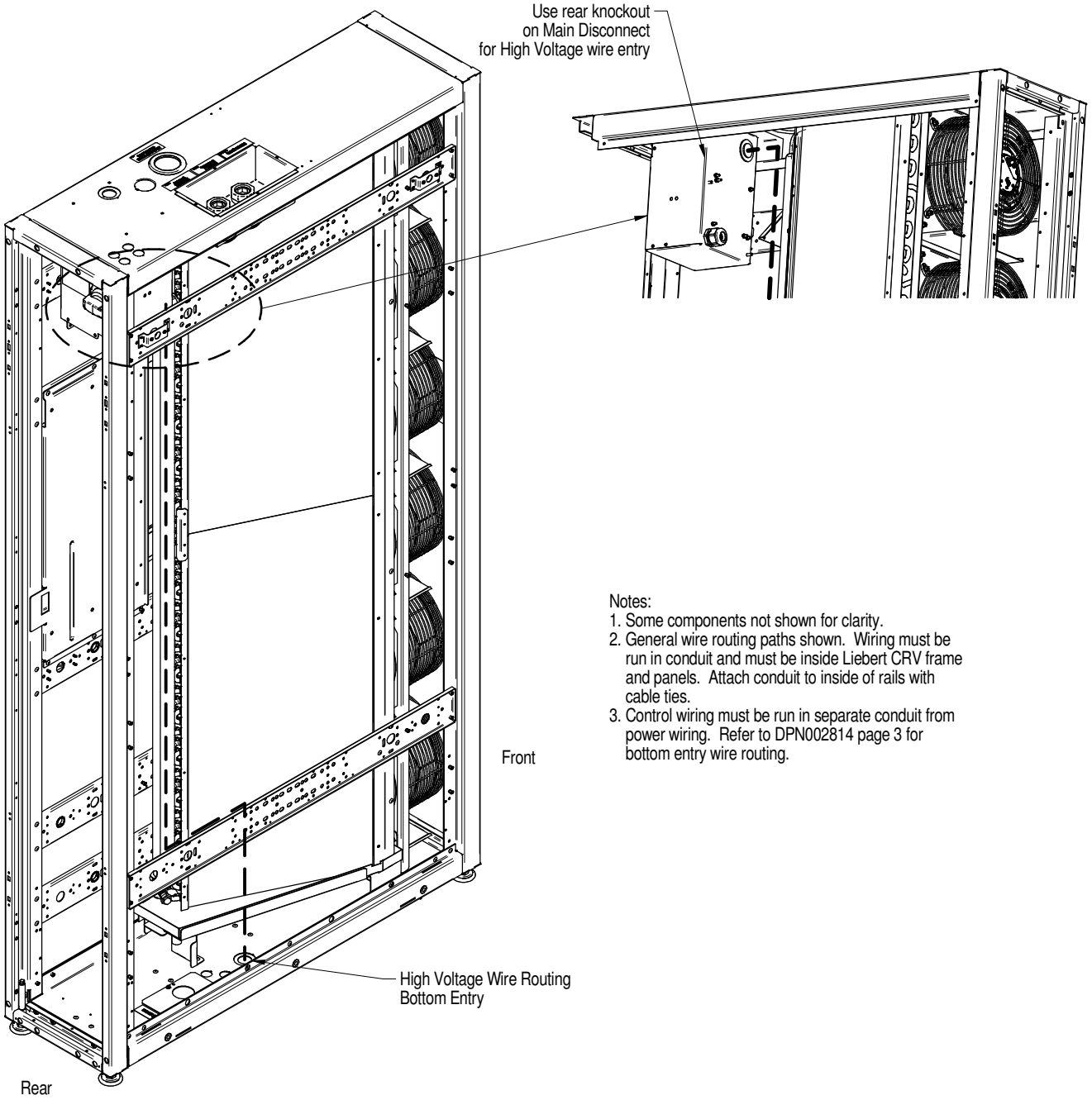
POWER CABLE ROUTING BOTTOM ENTRY
300mm (12in.) AIR COOLED & WATER GLYCOL COOLED MODELS



Notes:
1. Some components not shown for clarity.
2. General wire routing paths shown. Wiring must be run in conduit and must be inside Liebert CRV frame and panels. Attach conduit to inside of rails with cable ties.
3. Control wiring must be run in separate conduit from power wiring. Refer to DPN002814 page 2 for bottom entry wire routing.

LIEBERT CRV

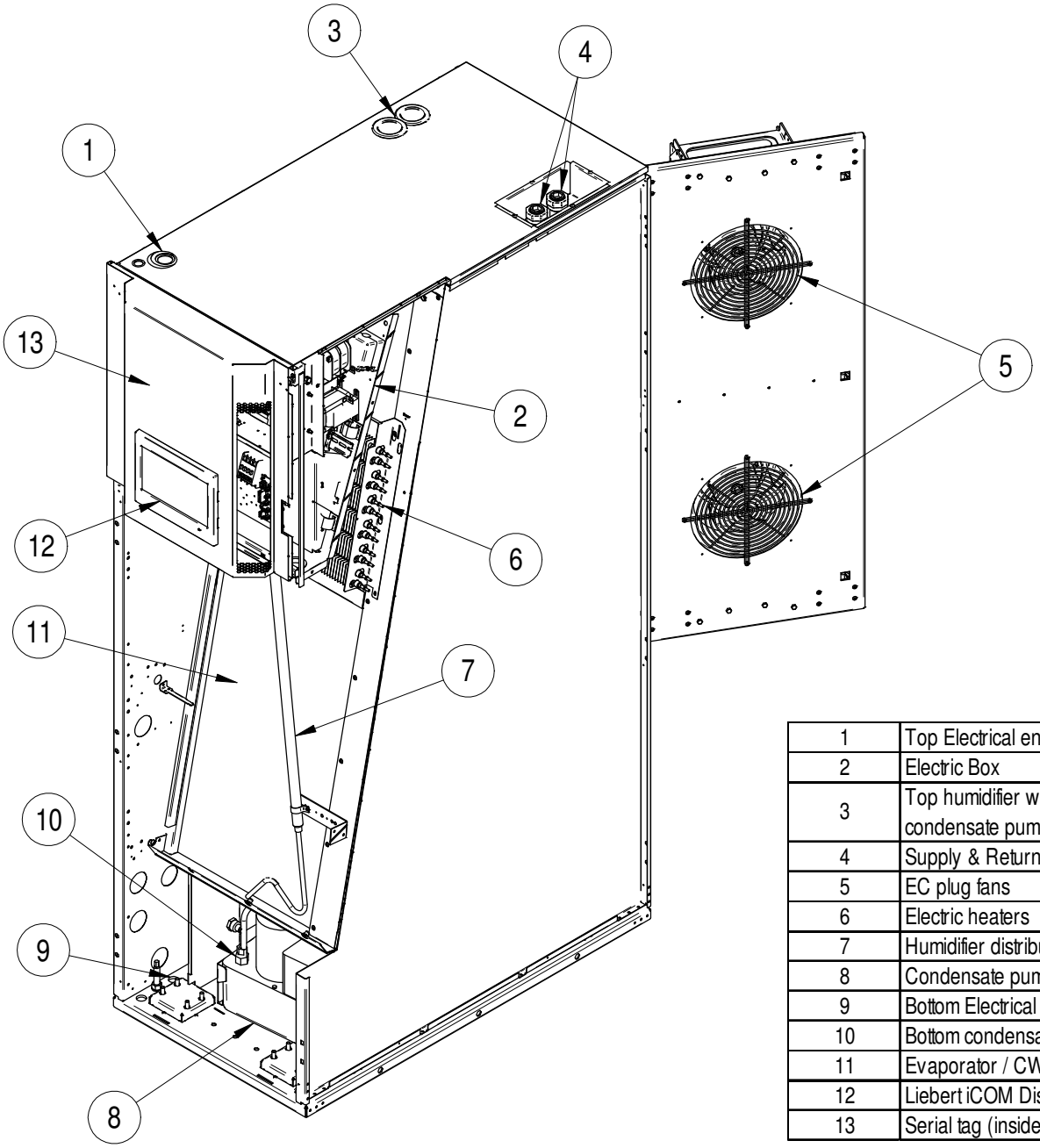
POWER CABLE ROUTING BOTTOM ENTRY
300mm (12in.) CHILLED WATER MODELS



Notes:
1. Some components not shown for clarity.
2. General wire routing paths shown. Wiring must be run in conduit and must be inside Liebert CRV frame and panels. Attach conduit to inside of rails with cable ties.
3. Control wiring must be run in separate conduit from power wiring. Refer to DPN002814 page 3 for bottom entry wire routing.

COMPONENT LOCATION DIAGRAM

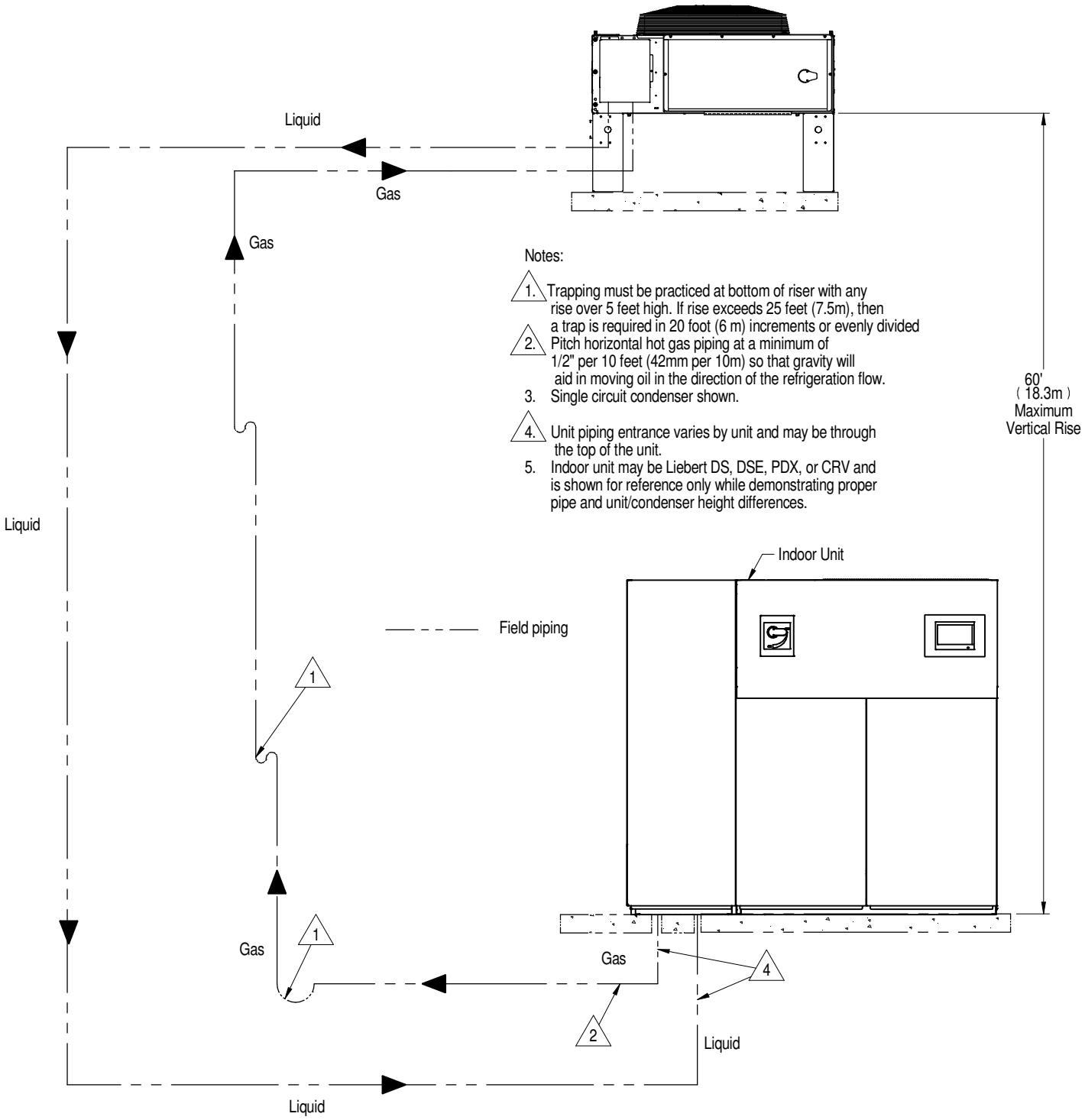
600mm (24in.) MODELS



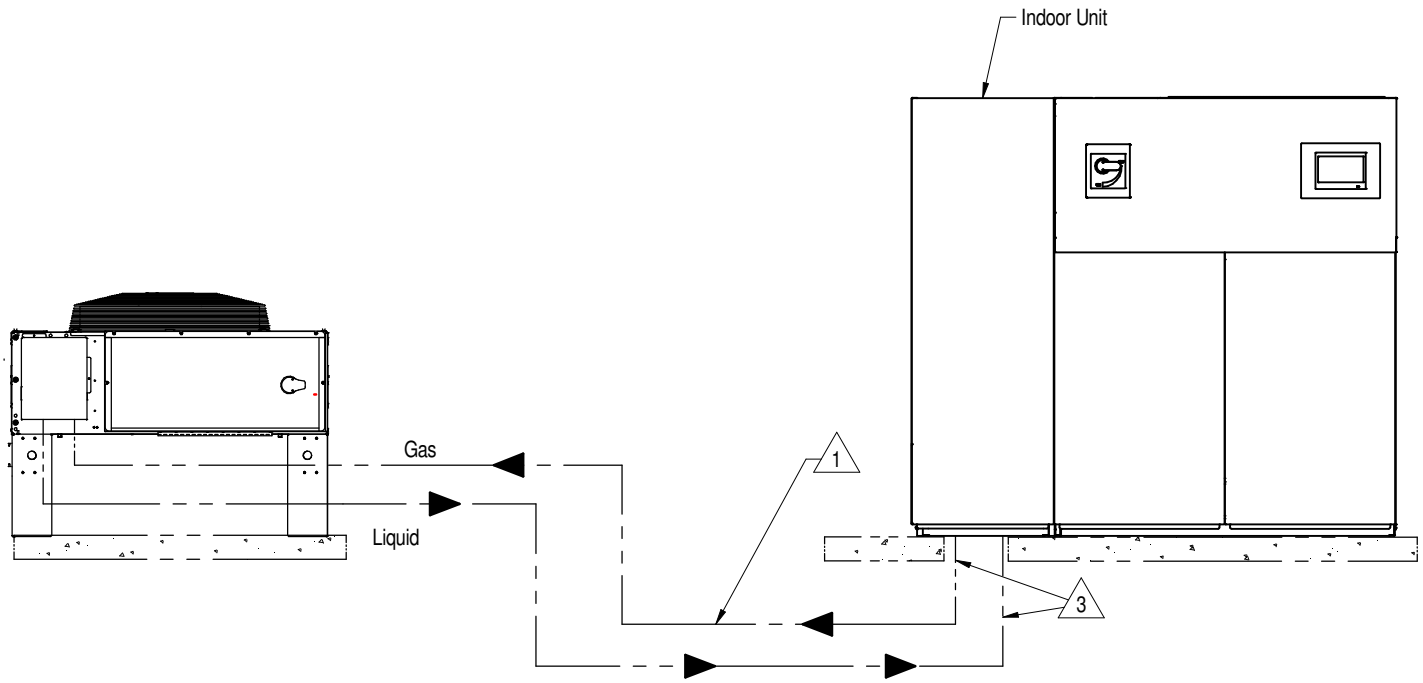
1	Top Electrical entrance
2	Electric Box
3	Top humidifier water supply, condensate pump drain
4	Supply & Return connections
5	EC plug fans
6	Electric heaters
7	Humidifier distributor
8	Condensate pump
9	Bottom Electrical entrance
10	Bottom condensate pump drain
11	Evaporator / CW coil
12	Liebert iCOM Display
13	Serial tag (inside door)

LIEBERT MC CONDENSER

AIR COOLED PIPING SCHEMATIC
CONDENSER ABOVE INDOOR UNIT



AIR COOLED PIPING SCHEMATIC
CONDENSER AND INDOOR UNIT AT SAME LEVEL

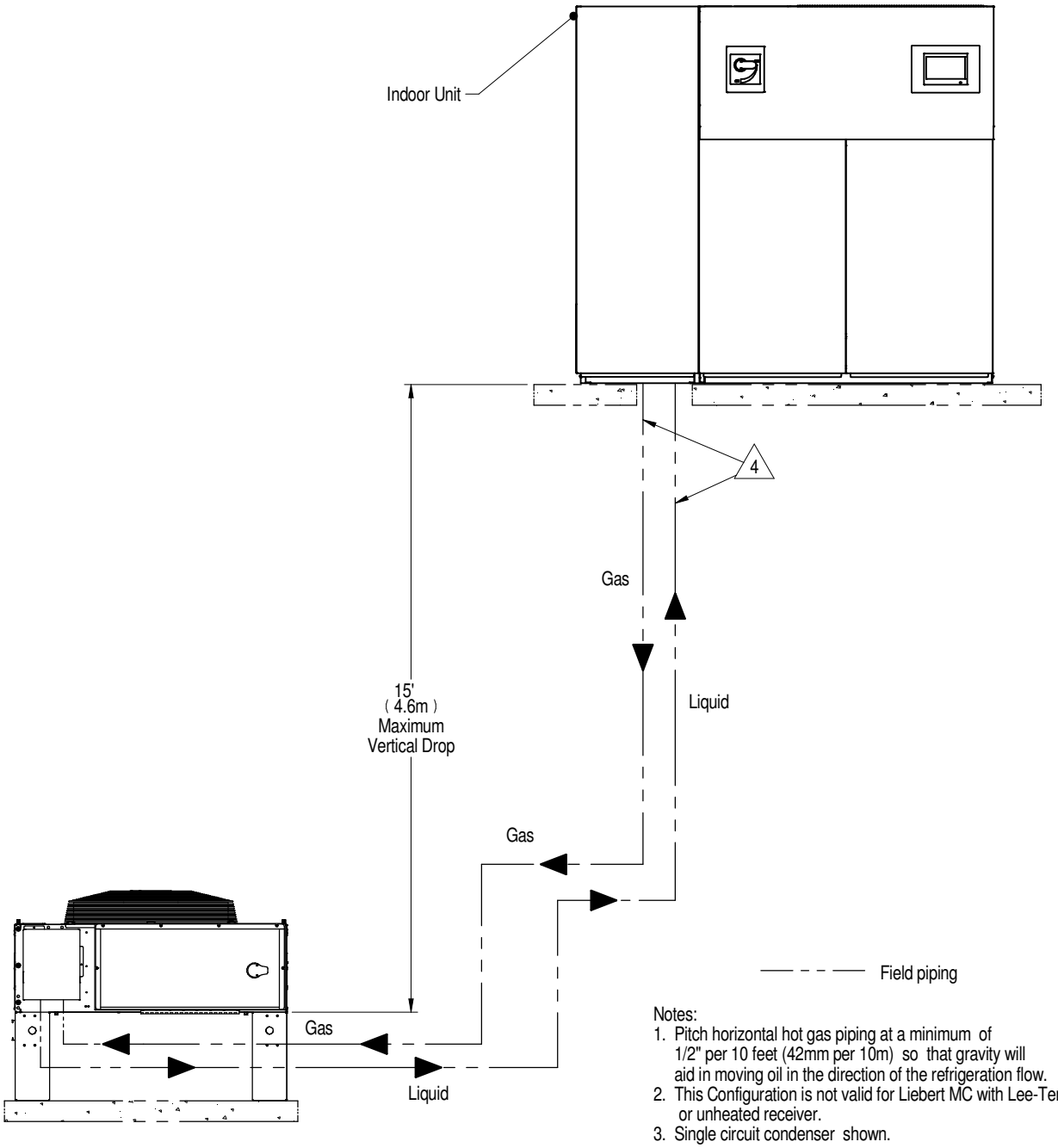


—— – – —— Field piping

Notes:

1. Pitch horizontal hot gas piping at a minimum of 1/2" per 10 feet (42mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
2. Single circuit condenser shown.
3. Unit piping entrance varies by unit and may be through the top of the unit.
4. Indoor unit may be Liebert DS, DSE, PDX, or CRV and is shown for reference only.

AIR COOLED PIPING SCHEMATIC
CONDENSER BELOW INDOOR UNIT



Notes:
1. Pitch horizontal hot gas piping at a minimum of 1/2" per 10 feet (42mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
2. This Configuration is not valid for Liebert MC with Lee-Temp or unheated receiver.
3. Single circuit condenser shown.
4. Unit piping entrance varies by unit and may be through the top of the unit.
5. Indoor unit may be Liebert DS, DSE, PDX, or CRV and is shown for reference only while demonstrating proper pipe and unit/condenser height differences.

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