EconoPhase Thermal Management System Low GWP

Installer/User Guide

14 to 72 Ton (50 to 250 kW) Capacity, 50 and 60 Hz

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Technical Support Site

If you encounter any installation or operational issues with your product, check the pertinent section of this manual to see if the issue can be resolved by following outlined procedures.

Visit https://www.vertiv.com/en-us/support/ for additional assistance.

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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 Vertiv™ EconoPhase. Read this manual thoroughly before attempting to install or operate this unit.

This equipment is required to be installed only in locations not accessible to the general public. Installation, service, and maintenance work must be performed only by properly trained, certified, and qualified personnel and in accordance with applicable regulations and manufacturers' specifications.

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.

WARNING! Arc flash and electric shock hazard. Can cause serious injury or death. Building and equipment damage may also result. Disconnect all local and remote electric power supplies and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.

Verify with a voltmeter that power is Off. The Vertiv™ iCOM™ controller does not isolate power from the unit, even in the “Unit Off” mode. Some internal components still require and receive power even during the “Unit Off” mode of the Vertiv™ iCOM™ 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.

Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. Follow all local codes.

WARNING! Risk of electric shock. Can cause serious injury or death. Building and equipment damage may also result. Open all local and remote electric power supply disconnect switches and verify that power is off with a voltmeter before working within any electric connection enclosures. The Vertiv™ iCOM™ microprocessor does not isolate power from the unit, even in the "Unit Off" mode. Some internal components require and receive power even during the "unit off" mode of the Vertiv™ iCOM™ control.

Installation, 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 over-pressurization of the refrigeration system. Can cause serious injury or death. Building and equipment damage may also result. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, environmental pollution, or building and equipment damage. This unit contains fluids and gases under high pressure. 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 improper wire sizing/rating and loose electrical connections. Can cause overheated wire and electrical connection terminals resulting in smoke, fire, equipment and building damage, injury or death. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.

WARNING! Risk of improper wiring, piping, moving, lifting and handling. Can cause serious injury or death. Improper handling can cause building or equipment damage. Installation and service of this equipment should be done only by qualified personnel who have been specially-trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE.

WARNING! Risk of improper moving. Can cause serious injury or death. Building and equipment damage may also result. Use only lifting equipment that is rated for the unit weight by an OSHA-certified rating organization. The center of gravity varies depending on the unit size and selected options. The slings must be equally spaced on either side of the center of gravity indicator. Shipping weights and unit weights are listed in the tables in **Table 4.2** on page 21. Use the center of gravity indicators on the unit to determine the position of the slings.

WARNING! Risk of short circuits and electric shock. Can cause serious injury or death. Building and equipment damage can result from cut insulation or damaged wires. Can cause overheated wiring, smoke, fire, activation of fire suppression systems and EMS personnel, and loss of power to fans. Verify that all wiring connections are tight and that all wiring is contained within the junction box prior to closing and securing the cover.

Insert CSA-certified or UL-listed bushings into holes and/or knockouts used to route wiring through metal panels to protect the wire insulation from contact with sheet metal edges.

WARNING! Risk of explosive discharge of high-pressure refrigerant. Can cause serious injury or death. Building and equipment damage may also result. The handling, installation, cleaning, servicing, and disposal/reclaim of refrigerant shall be in accordance with ASHRAE 15 in the US and CSA B52 in Canada and all national and local codes.

WARNING! Risk of improper lifting. Can cause serious injury or death. Building and equipment damage may also result. A spreader bar or equivalent must be used when rigging to ensure the lifting force is completely vertical at these fasteners. Lift points are rated for lifting this section only. Do not lift assembled sections from these lift points.

WARNING! Risk of top-heavy unit falling over when improperly lifted or moved. Can cause serious injury or death. Building and equipment damage may also result. 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 4.2** on page 21.

WARNING! Risk of contact with sharp edges, exposed fasteners, and improper handling of very heavy parts. Can cause serious injury or death. Building and equipment damage may also result. Use extreme caution and wear appropriate, OSHA-approved PPE.

More than one person may be required to complete the assembly and installation. Installer(s) must be properly trained and qualified to lift, move, and manipulate very heavy equipment from floor level to the top of the unit.

Equipment used in moving, lifting, and installing must meet OSHA requirements. If ladders are used, verify that they are rated for the weight of the components and installer(s) as loaded.

Read and follow the lifting equipment and/or ladder manufacturer's operating instructions and safety requirements.

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.

CAUTION: Risk of contact with hot surfaces. Can cause injury. Personal burn injury can be the result of touching the refrigerant discharge lines, pump motor, and some other electrical components that are extremely hot during unit operation. Allow sufficient time for them to cool to a touch safe temperature before working within the unit cabinet. Use extreme caution and wear appropriate, OSHA-approved PPE when working on or near hot components.

CAUTION: Risk of excessive refrigerant line pressure. Can cause equipment damage or injury resulting from tubing and component rupture. 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 be 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).

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

CAUTION: Risk of heavy unit falling into defective raised floor. Can cause injury and equipment damage. Prior to installation, all floor tiles immediately around floor stand are to be removed and inspected. Make sure tiles are not cracked, and ribs have not been cut. If free from defects, re-install. Replace with new tiles if defects are found.

CAUTION: Risk of exposure to harmful noise levels. Can cause hearing injury or loss. Depending on the installation and operating conditions, a sound pressure level greater than 70 dB(A) may arise. Take appropriate technical safety measures. Operating personnel must wear appropriate, OSHA-approved PPE and observe all appropriate hearing protection safety requirements.

NOTICE

Risk of improper power-supply connection. Can cause equipment damage and loss of warranty coverage.

Prior to connecting any equipment to a main or alternate power source (for example back-up generator systems) for start-up, commissioning, testing, or normal operation, ensure that these sources are correctly adjusted to the nameplate voltage and frequency of all equipment to be connected. In general, power-source voltages should be stabilized and regulated to within +/- 10% of the load nameplate nominal voltage. Also, ensure that no three-phase sources are single-phased at any time.

See transformer label for primary tap connections. Installer will need to change transformer primary taps if applied unit voltage is other than pre-wired tap voltage.

NOTICE

Risk of improper electrical connection of three-phase input power. Can cause backward pump rotation and unit damage. Service technicians should use a gauge set on the system during the initial start up to verify that the three-phase power is connected properly. Three-phase power must be connected to the unit line voltage terminals in the proper sequence so that the pump rotates in the proper direction. Incoming power must be properly phased to prevent pump from running backward. We recommend checking the unit's phasing with proper instrumentation to ensure that the power connections were made correctly. We also recommend verifying discharge and suction pressures during start up to ensure that the pumps are running in the correct direction.

NOTICE

Risk of improper program adjustment. Can cause equipment damage and loss of warranty.

The VSD is factory programmed for proper operation. Altering the VSD program without authorization from the factory may void the warranty.

NOTICE

Risk of mismatched input power supply and VSD requirements. May cause equipment damage and failure.

The EMC filter must be removed from the VSD if the power supply is Delta-connected.

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 improper control circuits. Can cause equipment damage.

When using jumpers for troubleshooting, always remove jumpers when maintenance is complete. Jumpers left connected could override controls and cause equipment damage.

NOTICE

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

Vertiv™ CoolPhase Perimeter Thermal Management System Low GWP 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 digital scroll compressors without proper refrigerant charging can cause the compressors to operate at less than 15°F (–9.4°C) evaporator temperature and at less than 70 psig (483 kPa). Operation for extended periods at less than 70 psig (483 kPa) can cause premature compressor failure.

NOTICE

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

NOTICE

Vertiv™ Thermal Management unit cannot be operated below 25% load. Operating units below 25% load can have detrimental effects on compressor longevity and reliability. The failure of a compressor increases with low load conditions due to short run time and frequent cycling. Compressor warranty claims are subject to rejection if the unit has been operating below the minimum load of 25%.

NOTICE

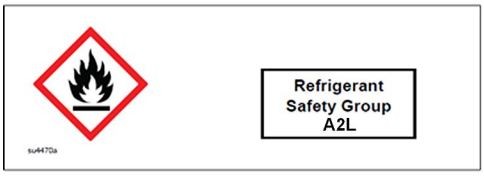
Risk of improper component re-installation. Can cause equipment damage.

Identify and mark location of suction pressure transducer and discharge pressure switch. These devices look similar and they must be reinstalled in their original location.

NOTICE

This unit is suitable for ITE (Information Technology Equipment) applications, such as data centers, computer rooms or other ITE areas only.

NOTE: The Vertiv indoor cooling unit has a factory installed, high pressure safety switch in the high side refrigerant circuit. Each refrigerant receiver contains a fusible plug for fire safety purposes. Consult your local building code to determine whether the refrigerant piping will require additional, field provided pressure relief devices.


Refrigerant
Safety Group
A2L

2 Nomenclature and Components

This section describes the model configuration numbers for Vertiv™ EconoPhase units and components.

2.1 Model Number Nomenclature Detail

Vertiv™ EconoPhase Model Number Digit Definitions below describes each digit of the model number.

Table 2.1 Vertiv™ EconoPhase Model Number Example

1	2	3	4	5	6	7	8	9	10	11	12
P	R	1	2	5	A	A	6	D	D	—	*

Table 2.2 Vertiv™ EconoPhase Model Number Digit Definitions

Digit	Description
Digits 1 to 2 - Product Family	
	PR = Vertiv™ Pumped Refrigerant Economizer System
Digits 3 to 5 - Nominal Sensible Capacity, kW	
	050
	085
	125
	200
	250
Digit 6 - Air Discharge	
	Z = R-454B
Digit 7 - Power Supply	
	A = 460-3-60
	B = 575-3-60
	G = 415-3-50
	Y = 208/230-3-60
	2 = 380-3-60
Digit 8 - Disconnect Switch, Amperage	
	5 = 5,000 Amp SCCR
	6 = 65,000 Amp SCCR
Digit 9 - Pump Configuration	
	S = Single
	D = Dual

Table 2.2 Vertiv™ EconoPhase Model Number Digit Definitions (continued)

Digit	Description
Digit 10 - Packaging	
D = Domestic	
C = Export Crating	
Digit 11 - Pump Design (internal reference only)	
Digit 12 - Configuration Code	
0 = No SFAs (Any Numeric or Alpha letter except S)	
S = SFA	

Table 2.3 Vertiv™ EconoPhase Specifications and Electrical Power Requirements

Digits				Volts	Phase	Hertz	FLA	Minimum Supply Circuit Ampacity	Max Fuse Size	Single Pump Motor (One Pump per Circuit)	
1-5 Product Family	7 Power Supply	9 Pump Configuration	11 Pump Design							HP	FLA
PRO50	A	S	-	460	3	60	3.5	4.4	15	1.6	3.5
PRO50	Y	S	-	208/230	3	60	6.9	8.6	15	1.6	6.9
PRO50	B	S	_	575	3	60	2.8	3.5	15	1.6	3.5
PRO50	2	S	_	380	3	60	4.2	5.3	15	1.6	4.2
PRO50	G	3	_	415	3	50	3.7	4.7	15	1.2	3.7
PRO50	A	S	H	460	3	60	1.3	1.6	15	0.75	1.3
PRO50	Y	S	H	208/230	3	60	2.6	3.3	15	0.75	2.6
PRO50	B	S	H	575	3	60	1	1.3	15	0.75	1.3
PRO50	2	S	H	380	3	60	1.6	2	15	0.75	1.6
PRO50	G	S	H	415	3	50	1.2	1.5	15	0.75	1.2
PR085	A	D	-	460	3	60	7	7.9	15	1.6	3.5
PR085	Y	D	-	208/230	3	60	13.8	15.5	20	1.6	6.9
PR085	B	D	-	575	3	60	5.6	6.3	15	1.6	3.5
PR085	2	D	-	380	3	60	8.4	9.5	15	1.6	4.2
PR085	G	D	-	415	3	50	7.4	8.3	15	1.2	3.7
PR085	A	D	H	460	3	60	2.6	2.9	15	0.75	1.3
PR085	Y	D	H	208/230	3	60	5.2	5.9	15	0.75	2.6
PR085	B	D	H	575	3	60	2	2.3	15	0.75	1.3
PR085	2	D	H	380	3	60	3.2	3.6	15	0.75	1.6
PR085	G	D	H	415	3	50	2.4	2.7	15	0.75	1.2

Table 2.3 Vertiv™ EconoPhase Specifications and Electrical Power Requirements (continued)

Digits				Volts	Phase	Hertz	FLA	Minimum Supply Circuit Ampacity	Max Fuse Size	Single Pump Motor (One Pump per Circuit)	
1-5 Product Family	7 Power Supply	9 Pump Configuration	11 Pump Design							HP	FLA
PR125	A	D	-	460	3	60	7	7.9	15	1.6	3.5
PR125	Y	D	-	208/230	3	60	13.8	15.5	20	1.6	6.9
PR125	B	D	-	575	3	60	5.6	6.3	15	1.6	3.5
PR125	2	D	-	380	3	60	8.4	9.5	15	1.6	4.2
PR125	G	D	-	415	3	50	7.4	8.3	15	1.2	3.7
PR125	A	D	4	460	3	60	6.4	7.2	15	1.5	3.2
PR125	B	D	4	575	3	60	5.2	5.9	15	1.5	2.6
PR125	2	D	4	380	3	60	7.8	8.8	15	1.5	3.9
PR200	A	D	3	460	3	60	4.6	5.2	15	1.5	2.3
PR200	B	D	3	575	3	60	3.6	4.1	15	1.5	1.8
PR200	2	D	3	380	3	60	5.6	6.3	15	1.5	2.8
PR250	A	D	2	460	3	60	7	7.9	15	1.6	3.5
PR250	Y	D	2	208/230	3	60	13.8	15.5	20	1.6	6.9
PR250	B	D	2	575	3	60	5.6	6.3	15	1.6	3.5
PR250	2	D	2	380	3	60	8.4	9.5	15	1.6	4.2
PR250	2	D	5	380	3	60	7.8	8.8	15	1.5	3.9
PR250	G	D	2	415	3	50	7.4	8.3	15	1.2	3.7
PR250	A	D	5	460	3	60	6.4	7.2	15	1.5	3.2
PR250	B	D	5	575	3	60	5.2	5.9	15	1.5	2.6

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3 Vertiv™ EconoPhase Pumped Refrigerant Economizer with a Vertiv™ CoolPhase Perimeter System

Vertiv™ CoolPhase Perimeter systems are designed to provide precision air conditioning to computer racks in a data center or computer room as efficiently and effectively as possible.

A Vertiv™ CoolPhase Perimeter system with Vertiv™ EconoPhase is composed of individually-shipped components or components assembled together on skids. Some examples are:

System example 1

- Vertiv™ CoolPhase Perimeter—High efficiency, floor mounted indoor unit
- Vertiv™ CoolPhase Condenser—Air cooled microchannel condenser, premium version
- Vertiv™ EconoPhase—Vertiv™ EconoPhase pumped refrigerant economizer (PRE)

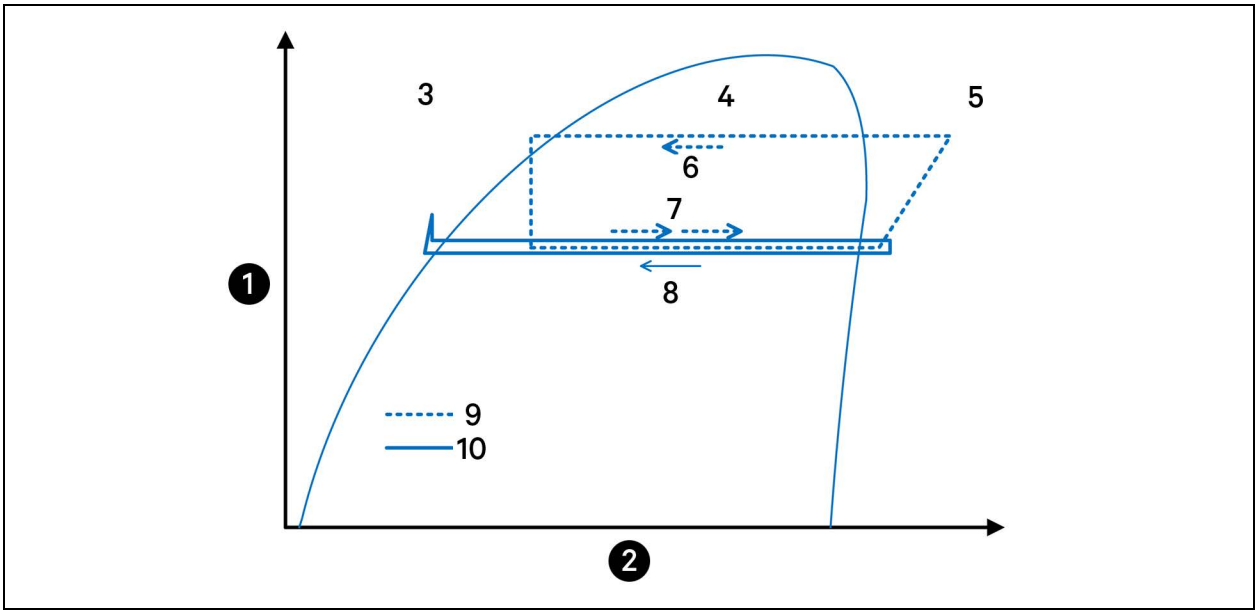
System example 2

- Vertiv™ CoolPhase Perimeter—High efficiency, floor mounted indoor unit
- Vertiv™ CoolPhase Condenser Heat rejection skid—Air cooled microchannel condenser, premium version with a Vertiv™ EconoPhase pumped-refrigerant economizer (PRE)

The Vertiv™ EconoPhase PRE is an add on module for use with an air cooled Vertiv™ CoolPhase Perimeter system. The Vertiv™ EconoPhase allows the system to switch to EconoPhase operation when the outdoor temperature is low enough to provide the required temperature difference between the inside air and the outside air, which, in turn, provides significant energy savings because the compressor(s) do not operate. At lower temperatures, the system switches one or both circuits from Compressor Mode to Pump Mode. The pump consumes roughly one-tenth of the power consumed by the compressor.

The Vertiv™ EconoPhase system maintains this energy efficiency by employing the heat absorption properties of a liquid (pumped refrigerant) through a phase change. Refrigerant is pumped as a liquid, becomes a gas within the Vertiv™ CoolPhase Perimeter evaporator and is then returned to the condenser where it condenses to a liquid. The sub-cooled liquid refrigerant from the condenser is run directly into the Vertiv™ EconoPhase pumps and circulates back to the Vertiv™ CoolPhase Perimeter unit (see Figure 3.1 on the next page). The system operates as a typical air cooled direct expansion system when outdoor ambient conditions are unfavorable to Vertiv™ EconoPhase operation. The pumps in the Vertiv™ EconoPhase PRE are turned off and by-passed during compressor operation.

Figure 3.1 Vertiv™ EconoPhase Pumped Refrigerant Pressure Enthalpy Diagram



Item	Description	Item	Description
1	Pressure	6	Condenser (DX mode)
2	Enthalpy	7	Indoor unit
3	Liquid	8	Condenser (pump mode)
4	Liquid/Vapor maximum	9	Traditional vapor-compression cycle
5	Vapor	10	Vertiv™ EconoPhase cycle

3.1 Overview of Operating Modes

Each circuit on a system combining a Vertiv™ EconoPhase, Vertiv™ CoolPhase Perimeter and Vertiv™ CoolPhase Condenser has six distinct operating modes:

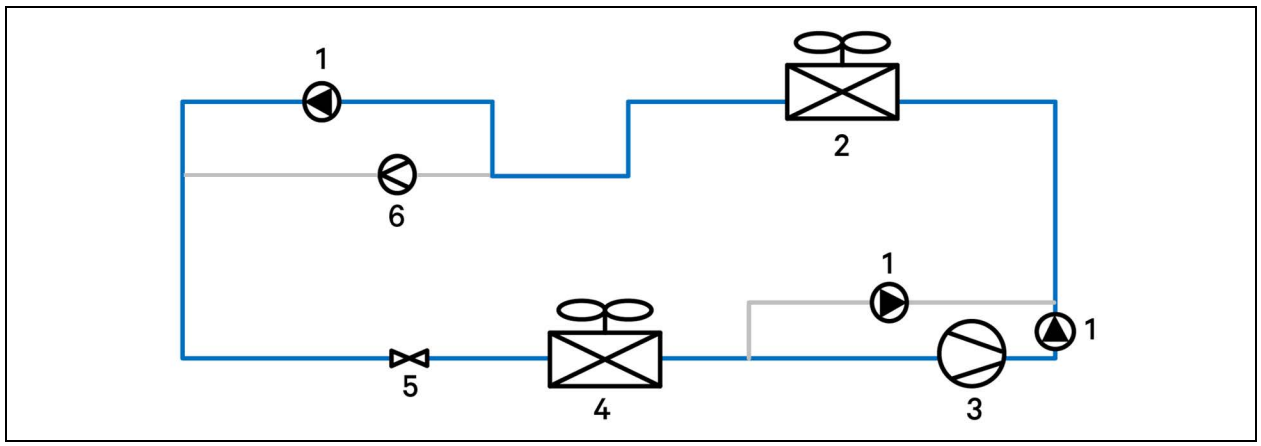
- Idling with compressor and pumps Off
- Start up
- Compressor operation
- Compressor to pump changeover
- Pump operation
- Pump to compressor changeover

A circuit will run most of the time in either compressor or pump operation mode. These modes both efficiently remove heat from the conditioned space and reject it via the air cooled condenser. The flow paths during each mode of operation are detailed in Figure 3.2 below and Figure 3.3 on the next page .

A couple of differences to note between Compressor Mode and Vertiv™ EconoPhase operation:

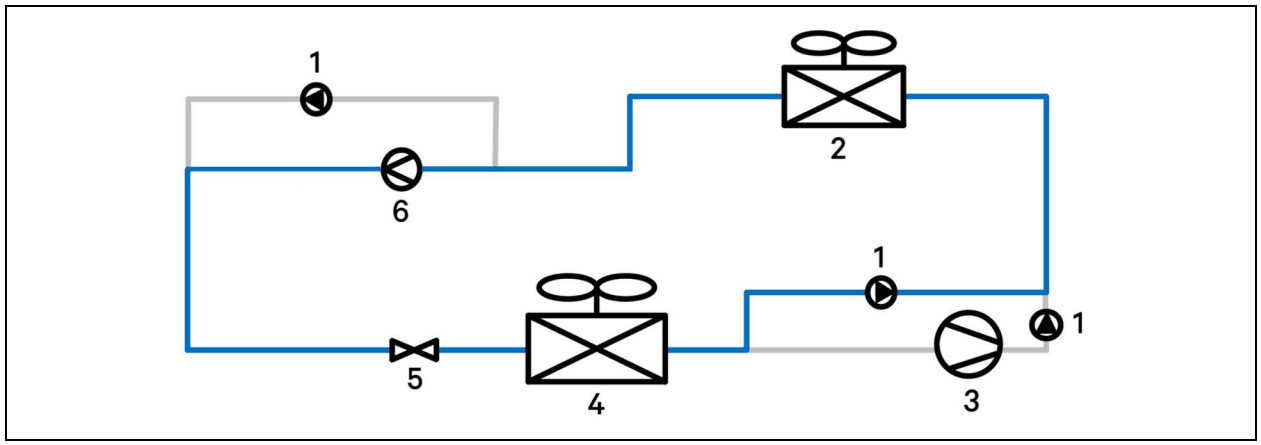
- The unit does not dehumidify in Vertiv™ EconoPhase operation. If dehumidification is desired, EconoPhase operation must be disabled.
- Bubbles may be seen in the site glass in the indoor unit when the system is in Vertiv™ EconoPhase operation. This does not necessarily mean the system is low on charge. Refer to the Vertiv™ CoolPhase Perimeter user manual (available at www.Vertiv.com) for complete charging instructions for the Vertiv™ CoolPhase Perimeter/Vertiv™ EconoPhase system.

Figure 3.2 Compressorized Operation Flow Path



Item	Description	Item	Description
1	Check valve	4	Evaporator
2	Condenser	5	Electronic expansion valve (EEV)
3	Compressor	6	Pump

Figure 3.3 Pump Operation Flow Path



Item	Description	Item	Description
1	Check valve	4	Evaporator
2	Condenser	5	Electronic expansion valve (EEV)
3	Compressor	6	Pump

3.2 Vertiv™ EconoPhase Operation

The Vertiv™ EconoPhase unit enables the Vertiv™ CoolPhase Perimeter system to operate in any of three modes to control temperature, depending on the outdoor temperature and the load.

- Compressor Mode
- Pump Mode
- Mixed Mode

When the outdoor temperature becomes low enough to provide the required temperature difference between the inside air and the outside air, there is no need to compress the refrigerant to a higher pressure/temperature. When the outdoor temperature is low enough, the system switches from Compressor Mode to Pump Mode or to Mixed Mode.

- Compressor Mode: All available compressors may be used to maintain the control temperature. All the available Vertiv™ EconoPhase pumps are Off. The control will typically run in this mode when the load and temperatures are such that full or partial Vertiv™ EconoPhase operation is not possible, or because certain pumps have experienced alarms.
- Pump Mode: All of the available pumps may be used to maintain the Control Temperature. All the compressors in the system are Off. The control will typically run in this mode when load and temperatures permit.
- Mixed Mode (Dual pump models only): The pump in Circuit 1 is On and the compressor(s) in Circuit 2 is On. Some systems may not have Mixed Mode capability, depending on the manufacture date. Contact the factory to inquire about a software upgrade.

3.2.1 Vertiv™ EconoPhase Control

Vertiv™ EconoPhase operation has three main controlled parameters:

- Room temperature
- Refrigerant temperature
- Pump pressure differential (outlet pressure - inlet pressure)

Room Temperature

When the system is in Pump Mode, the room temperature is controlled by modulating the pump speed with a variable frequency drive. The load requirement will determine if one pump or two are needed. Figure 3.4 below , shows the sequence of operation in terms of pump speed. Minimum speed is 45% and maximum speed is 100%. See Table 3.1 below , for more detail on the events depicted and the conditions that trigger action.

Figure 3.4 Two Circuit Pump Control

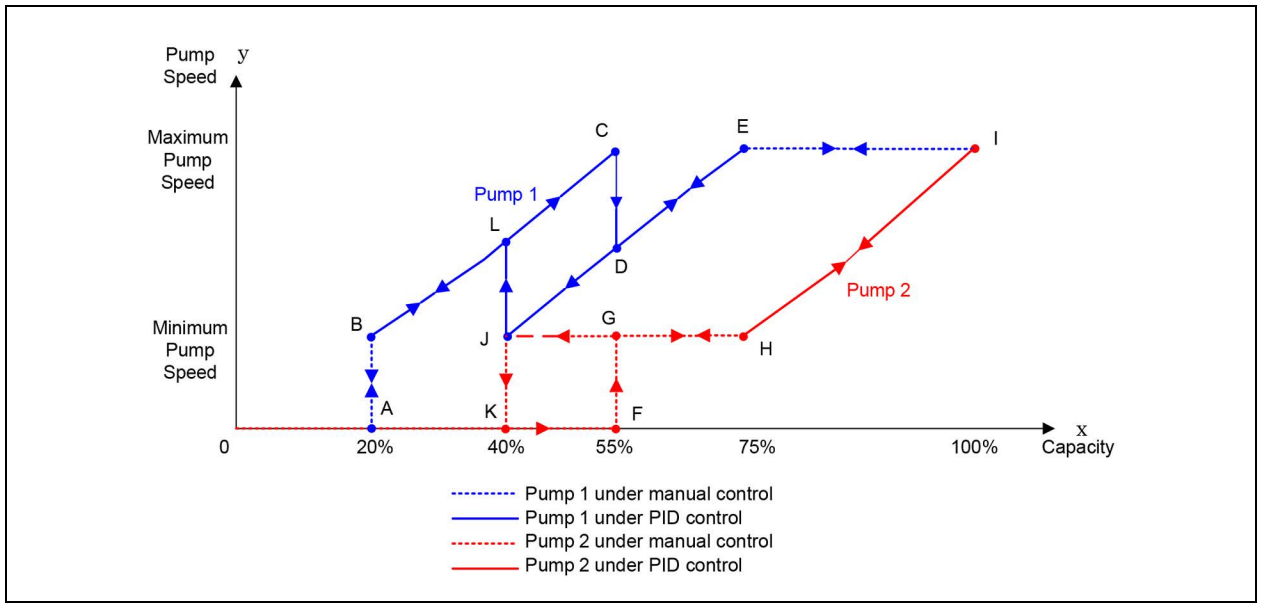


Table 3.1 Events and Actions of Two Circuit Pump Control

Event	Condition to Trigger Action	Action
B to A	Pump 2 Off; and (Pump 1 at minimum speed for 60 sec.; and Delta T [indoor air temperature - setpoint] < -4°F (2.2°C).	Pump 1 turns Off; Pump 2 remains Off
A to B	Both Pump 1 and Pump 2 Off; and Delta T >0°F (0°C)	Pump 1 turns On and runs on PID; Pump 2 remains Off
F to G	Pump 2 Off; and Pump 1 at maximum speed for 600 seconds; and Delta T >1°F (-0.6°C)	Pump 2 turns On at starting speed, then goes to minimum speed immediately. Pump 1 continues to run on PID
At E and H upward	Pump 1 at maximum speed; and Pump 2 at minimum speed; and Delta T >1°F (-0.6°C)	Pump 1 runs at maximum speed, while Pump 2 runs on PID

Table 3.1 Events and Actions of Two Circuit Pump Control (continued)

Event	Condition to Trigger Action	Action
At E and H downward	Pump 1 at maximum speed; and Pump 2 at minimum speed; and Delta T < -1°F (-0.6°C)	Pump 1 runs on PID, while Pump 2 runs at minimum speed
J to K	Both Pump 1 and Pump 2 at minimum speed for 60 sec.; and Delta T < -1°F (-0.6°C)	Pump 2 turns Off, while Pump 1 runs at minimum speed
Pump 2 Early Startup	Pump 2 Off; and Delta T >2°F (1.1°C)	No action to Pump 1; turn On Pump 2 at 80% speed, once the start-up procedure is finished, step change to minimum speed immediately

In the case of a transition from Compressor Mode to Pump Mode, the pumps will be given initial speeds based on the call for cooling at the time of transition. The pumps will go to this initial speed after the start-up routine is completed. This will mean that, depending on the load, both pumps will start immediately at the transition to Pump Mode from Compressor Mode.

When the system is in Mixed Mode, the room temperature is controlled either by modulating the digital compressor(s) on Circuit 2 with the pump on Circuit 1 at 100%, or by modulating the pump speed on Circuit 1 with the compressor(s) operating at the minimum digital percent.

Refrigerant Temperature

When a circuit is running in Pump Mode, the refrigerant temperature is controlled by the condenser fan speed. When a circuit switches from Compressor Mode to Pump Mode, the condenser fan speed control changes from pressure control to temperature control, with the controlled parameter being condenser outlet refrigerant temperature.

The default setpoint on Circuit 1 is 45°F, while on Circuit 2 it is 37°F. The condenser fan speed will modulate to provide the respective temperature. But if the outdoor temperature is warm enough, or if the load is high enough, the fans might be at 100% and the actual refrigerant temperature might be above the setpoint. In that case, the temperature will depend on the heat rejection capability of the condenser at the given conditions.

Actual fan speed will depend on the load and the outdoor temperature. The fan speed will be lower for a given heat load with lower outdoor temperature in order to maintain the setpoint.

Because the refrigerant temperature could be below the dew point inside, the indoor piping must be insulated to prevent condensation. In addition, the outdoor piping must be insulated so that heat is not lost to the outdoor air at very low ambient temperatures, causing the refrigerant temperature to fall and increasing the possibility of frost at the evaporator.

Pump Pressure Differential

The pump pressure differential must to be maintained above a minimum for cooling and lubricating flow to be provided to the pump motor and bearings. The differential is controlled by EEV position. When the system switches to Vertiv™ EconoPhase operation, the EEV control changes from superheat control to manual control. The Vertiv™ iCOM™ controller then signals the EEV to control its position based on pump differential , unless during pump mode operation, the suction superheat drops below the minimum acceptable level, then the EEV will begin to close and restrict refrigerant mass flow to build superheat.

The pump differential setpoint is 20 psid. If the pump is running at a high speed at steady state, the actual pump differential may be above 25 psid.

If the pump differential drops below 5 psid continuously for 30 minutes, the system will switch to direct expansion mode for 30 minutes. The system will switch back to Vertiv™ EconoPhase operation if the conditions are still qualified for pump operation.

3.2.2 Pump Start-up Routine

When either pump attempts to start, the first attempt will be at 80% of full speed. If flow is not established (as detected by pump differential being at least 12 psid within 60 seconds), the pump will turn Off for 10 seconds before trying again at 90% speed. If flow is still not established, the pump will turn Off for 10 seconds before trying again at 100% speed. If flow is not established after the 100% speed attempt, the system will switch to DX mode for 10 minutes before attempting to start the pumps again if the conditions are still compatible.

The second start-up routine is the same as above. If the second start-up attempt is unsuccessful, the system will switch to DX mode for 60 minutes before trying again.

The third start-up routine will be the same as above. If the third start-up attempt is unsuccessful, a “Pump Startup Fail” alarm will be displayed and Vertiv™ EconoPhase operation will be locked out until the user manually resets the event at the Vertiv™ iCOM™.

3.2.3 Switch from Compressor Operation to Pump Operation

The Vertiv™ iCOM™ runs the system in the most efficient operating mode, given the load and temperature conditions. If Mixed Mode is available, the system will change from Compressor Mode to Mixed Mode when partial Vertiv™ EconoPhase operation is possible and from Compressor or Mixed Mode to Pump Mode when full EconoPhase operation is possible.

3.2.4 Switch from Pump Operation to Compressor Operation

The unit will switch from Pump Mode to Mixed Mode or Compressor Mode when at least one of the following is true:

- The difference between the actual controlled air temperature and the setpoint is 75% into the Cooling Proportional Band for 5 minutes. The default is 75%, but the percentage can be changed at the Vertiv™ iCOM™.

NOTE: At start-up and at switchover from compressor operation to pump operation, more time is allowed to bring the temperature under control, but the temperature will never be allowed to go outside the cooling proportional band of +2°F (1.2°C).

- The pump differential pressure is below 5 psid for 30 minutes.
- The refrigerant temperature leaving the pump is below 30°F for 60 minutes.
- The pump does not establish flow at a pump start-up attempt.
- Power is lost at the Vertiv™ EconoPhase unit.

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4 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 Nomenclature and Components on page 7 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 53 .

- Verify that the floor is level, solid and sufficient to support the unit. See Table 4.2 on page 21 . for unit weights.
- 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.

Engineer of record must ensure the room has the required minimum Effective Dispersal Volume for the refrigerant charge amount of the largest refrigerant circuit. See A2L Refrigerant Effective Dispersal Volume Calculation on page 21 . Allow for additional charge due to appropriate subcooling or receiver site glass charging. If installing the unit in an ITE area with less than the required VED (Effective Dispersal Volume), it is required to have a mechanical ventilation system(s) in accordance with ASHRAE 15.

We recommend installing an under floor water detection system. Contact your Vertiv representative for information.

NOTICE

If the unit is not installed in a conditioned space, the location must be constructed such that should any refrigerant leak occur, it will not stagnate and create a fire or explosion hazard.

WARNING! Auxiliary devices which may be a POTENTIAL IGNITION SOURCE shall not be installed in the duct work. Examples of such POTENTIAL IGNITION SOURCES are hot surfaces with a temperature exceeding 700°C and electric switching devices. Only auxiliary devices approved by Vertiv or declared suitable with the refrigerant shall be installed in connecting ductwork.

WARNING! When appliances connected via an air duct system to one or more rooms with A2L REFRIGERANTS are installed in a room with an EFFECTIVE DISPERSAL VOLUME VED less than the minimum as determined by A2L Refrigerant Effective Dispersal Volume Calculation on page 21 , that room shall be without continuously operating open flames (e.g. an operating gas appliance) or other POTENTIAL IGNITION SOURCES (for e.g. an operating electric heater, hot surfaces).

4.1 Standard Air Cooled Systems versus Vertiv™ EconoPhase Systems

There are differences between the standard air cooled Vertiv™ CoolPhase Perimeter system and a system designed with the Vertiv™ EconoPhase. You should be aware of these differences to achieve the best operation the Vertiv™ CoolPhase Perimeter and Vertiv™ EconoPhase. This section summarizes the differences.

- Vertiv™ EconoPhase Operation—when the outdoor temperature is low enough to provide the required temperature difference between the indoor air and the outside air, the compressors turn off and the Vertiv™ EconoPhase pumps turn on.
- Refrigerant Pumping—during Vertiv™ EconoPhase operation, the refrigerant is pumped around the air-cooled loop instead of going through the vapor compression cycle. System pressures will vary significantly depending on whether the system is operating in standard, air cooled mode or in Vertiv™ EconoPhase operation.
- Energy Savings—the system's coefficient of performance increases significantly during Vertiv™ EconoPhase operation, which results in significant energy savings.
- EEV—an electronic expansion valve is employed during both direct expansion and Vertiv™ EconoPhase operation. The EEV provides energy savings and helps the pump maintain proper differential during Vertiv™ EconoPhase operation.
- Piping—The condenser piping is larger than the size typically specified for Vertiv™ Thermal Management systems. The pipe sizing allows oil return to the compressor and efficient operation in both modes of operation. All field-piped lines must be insulated because the fluid temperatures can be well below the dew point during Vertiv™ EconoPhase operation. All outdoor insulation must be UV rated and rated for outdoor use.
- Unit/Module Communications—A CANbus connection links the Vertiv™ CoolPhase Perimeter and the condenser and the Vertiv™ EconoPhase to achieve the most efficient operation.

4.2 Determine Cooling Requirements of the System

Refer to the Vertiv™ CoolPhase Perimeter user manual for complete instructions.

1. Calculate the total cooling required.
2. Determine placement of the Vertiv units.
3. Determine required line sizes.
4. Calculate the refrigerant volume of the Vertiv™ CoolPhase Perimeter/Vertiv™ EconoPhase system.
5. Complete design details including, electrical, mounting, piping, etc.

4.3 Mechanical Considerations

The Vertiv™ EconoPhase pump is located at the condenser (receiver) outlet and always needs liquid at its inlet for proper function. The lines between the receiver and the Vertiv™ EconoPhase unit must be sloped down toward the EconoPhase unit without any traps and with minimal bends. Traps in those lines will prevent the pump from establishing and from maintaining flow.

It is equally important to pump operation that the receiver be sufficiently above the Vertiv™ EconoPhase unit. See Placement Options and Piping Restriction for the Vertiv™ EconoPhase Unit and Vertiv™ CoolPhase Condenser on page 30 for the proper height difference. The maximum equivalent piping between the Vertiv™ CoolPhase Condenser and Vertiv™ EconoPhase unit is 25 ft (7.6 m). The Vertiv™ EconoPhase unit must be mounted outdoors for proper operation.

It is also important that the circuits do not get crossed between the indoor unit, the condenser and the Vertiv™ EconoPhase unit. If they get crossed, the system will not operate correctly, in DX mode or in Vertiv™ EconoPhase operation.

4.4 Planning Dimensions

The unit is described in the submittal documents included in the Submittal Drawings on page 53 .

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

Table 4.1 Dimension Planning Drawings

Document Number	Title
20000501	Vertiv™ EconoPhase PR050-PR125 Cabinet Dimensional Data

4.5 Vertiv™ EconoPhase Unit Weights

Table 4.2 Typical Vertiv™ EconoPhase Unit Weights

Model	Circuits	Unit Voltage, Hz	Approximate Unit Weight, lb (kg)
PR050	1	208/230 V, 460 V, 60 Hz 380 V, 575 V, 60 Hz 415 V, 50 Hz	217 (98) 242 (110) 217 (98)
PR085 - PR125 and PR250	2	208/230 V, 460 V, 60 Hz 380 V, 575 V, 60 Hz 415 V, 50 Hz	340 (154) 390 (177) 347 (157)
PR200	2	460 V, 60 Hz	350 (159)
PR200	2	380 V, 575 V, 60 Hz	400 (181)
Source 20000531, Rev. A			

4.6 A2L Refrigerant Effective Dispersal Volume Calculation

Engineer of record to determine the Refrigerant Charge mc and required minimum Effective Dispersal Volume VED of the space to which the appliance can be utilized for the cooling of ITE areas.

The required minimum Effective Dispersal Volume VED is a function of the refrigerant charge, mc and is represented by the following equation:

$V_{ED} = m_c/0.5 \times LFL$

V_{ED} = the minimum Effective Dispersal Volume in ft^3 (m^3)

m_c = the refrigerant charge of the largest single circuit of a unit in lbs (kg)

0.5 = the concentration factor

LFL = the Lower Flammability Limit in lbs/1000 ft^3 (kg/m^3)

NOTE: The LFL of R-454B is 18.5 lbs/1000 ft^3 (296.8 g/m^3) according to ASHRAE 34-2024.

Minimum Effective Dispersal Volume VED of the space shall be based on altitude of the installation location. For locations above sea level, the engineer of record will need to adjust the value of LFL in accordance with ANSI/ASHRAE 34 before applying it to the equation for determining the required minimum Effective Dispersal Volume V_{ED}.

Figure 4.1 Change Size vs Effective Dispersal Volume

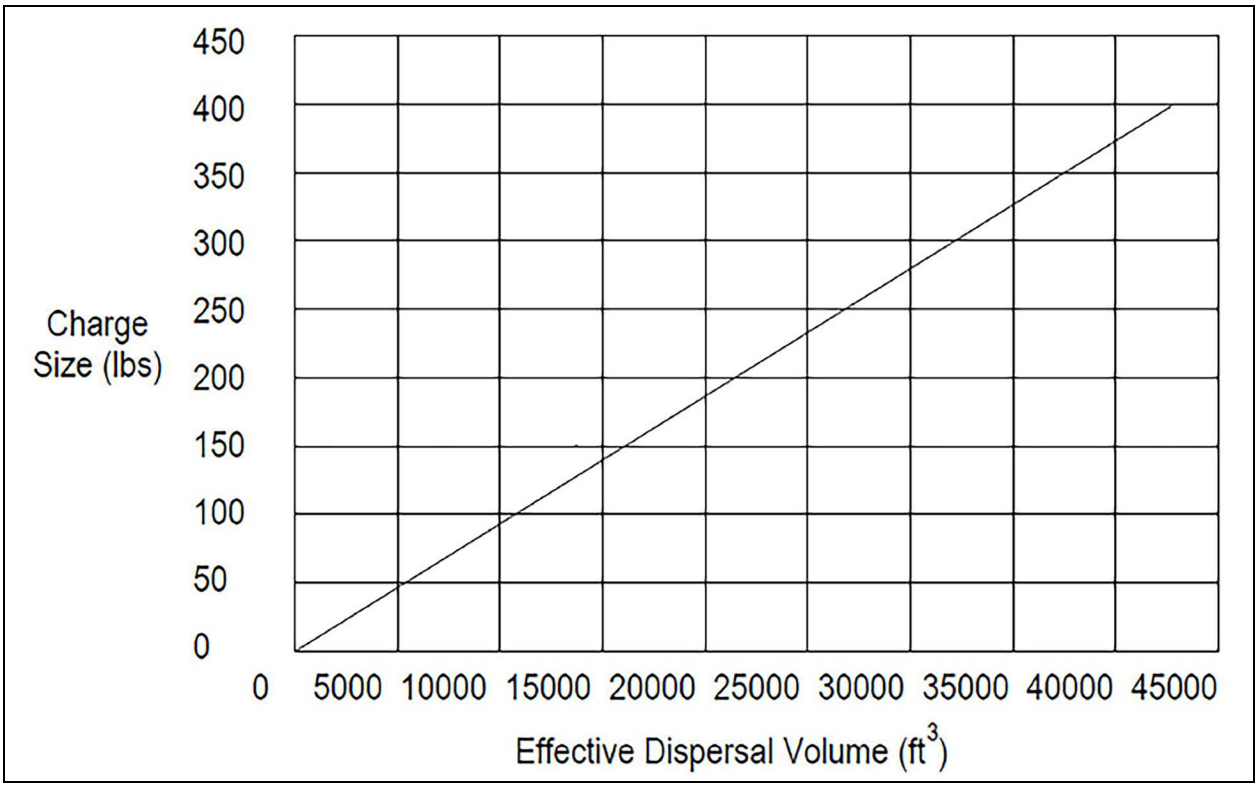
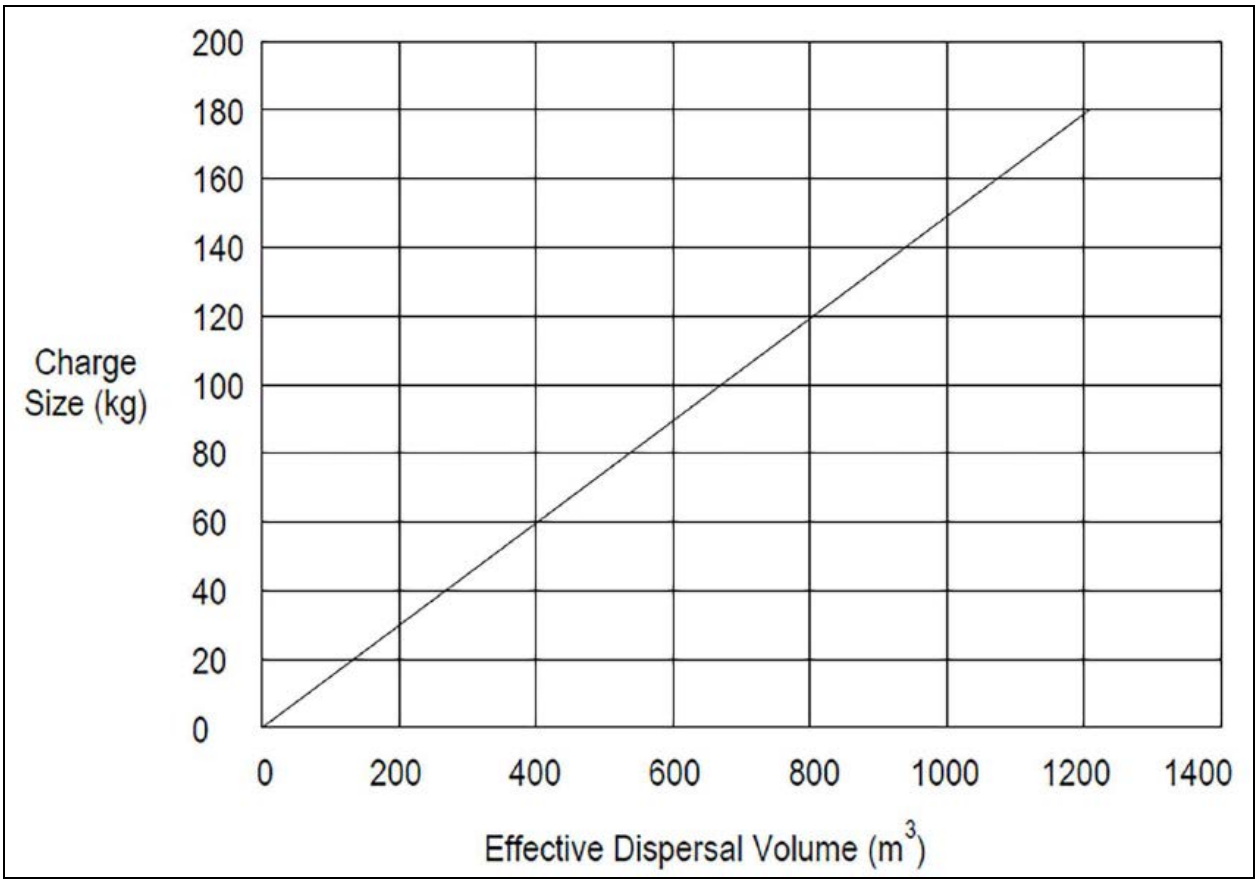


Figure 4.2 Charge Size vs Effective Dispersal Volume



4.6.1 How to Determine the Effective Dispersal Volume of an ITE Area

Volume Calculations shall be based on the overall volume of space available to which the refrigerant disperses within the Circulation Airflow in the event of a refrigerant leak. This overall volume shall be modified with the appropriate deductions. For the purposes of determining the Effective Dispersal Volume of an ITE area the following shall apply:

a. The Effective Dispersal Volume shall only include the circulated airflow of the system.
b. The Effective Dispersal Volume shall initially include the ITE area enclosed by the floor, walls, and ceiling of that space.
c. When the Circulation Airflow includes underfloor spaces, suspended ceiling spaces, or other partitioned spaces, such as equipment galleries, the volume of those spaces may be included.

In general, the volume of equipment, piping, wiring, or other apparatus that consume space within and are isolated from the Circulation Airflow shall be deducted from the Effective Dispersal Volume. The following deductions shall be applied:

a. When the Circulation Airflow has been fully contained on both hot and cold sides of the aisle, via ducts or other apparatus, any room volume outside of that containment shall not be included when calculating the Effective Dispersal Volume.

b. When the overall volume of space available, or a partitioned portion of that volume includes ducted openings from partially ducted systems, some volume of that space may require a deduction. No volume greater than four feet away in height from the upper most supply or return duct opening in the space may be included when calculating the Effective Dispersal Volume, unless an analysis of the airflow has been conducted to show that the volume of air has effective movement for the mixing of a leaked refrigerant.
c. Obstructions of tubing, piping, wiring, etc., consuming more than 0.0071 m^3 (0.25 ft^3) of space shall be included in the deductions from the overall volume.
d. The ITE within the circulated airflow shall be evaluated for their deduction from the Effective Dispersal Volume. The deducted volume of the ITE shall be based on the designed maximum capacity or fill of the servers.
e. As a maximum value, no more than 75 % of the ITE's volume shall be included as circulating air space in the Effective Dispersal Volume. The total volume of the ITE shall be defined by the overall dimensions of its ITE enclosure. Small gaps in between individual server racks shall not be included in the Effective Dispersal Volume.
f. Any other volume within the circulation airflow that is otherwise enclosed or partitioned off from the airflow shall be deducted in the calculation of the Effective Dispersal Volume.

4.7 Refrigerant Leak Mitigation

For information regarding the Refrigerant Leak Detection system, Mitigation Mode, and testing procedures, refer to the Diagnosing Water Leak Detection Issues section of the Vertiv™ iCOM™ Installer/User Guide SL-80185.

5 Equipment Handling

Vertiv™ EconoPhase modules are installed with the Vertiv™ CoolPhase Perimeter, Vertiv™ CoolPhase Perimeter Packaged Free Cooling Solution (60 kW, 400 and 500 kW) and the Vertiv™ CoolPhase Condenser. When your system uses Vertiv™ CoolPhase Condensers, or is included with the Vertiv™ CoolPhase Perimeter Packaged Free Cooling Solution, the Vertiv™ EconoPhase unit is factory installed on the skid, so no unpacking or moving is needed.

WARNING! Risk of improper wiring, piping, moving, lifting and handling. Can cause serious injury or death. Building and equipment damage may also result. Installation and service of this equipment should be done only by qualified personnel who have been specially-trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE.

WARNING! Risk of improper moving. Can cause serious injury or death. Building and equipment damage may also result. Use only lifting equipment that is rated for the unit weight by an OSHA-certified rating organization. The center of gravity varies depending on the unit size and selected options. The slings must be equally spaced on either side of the center of gravity indicator. Shipping weights and unit weights are listed in Table 4.2 on page 21. Use the center of gravity indicators on the unit to determine the position of the slings.

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.

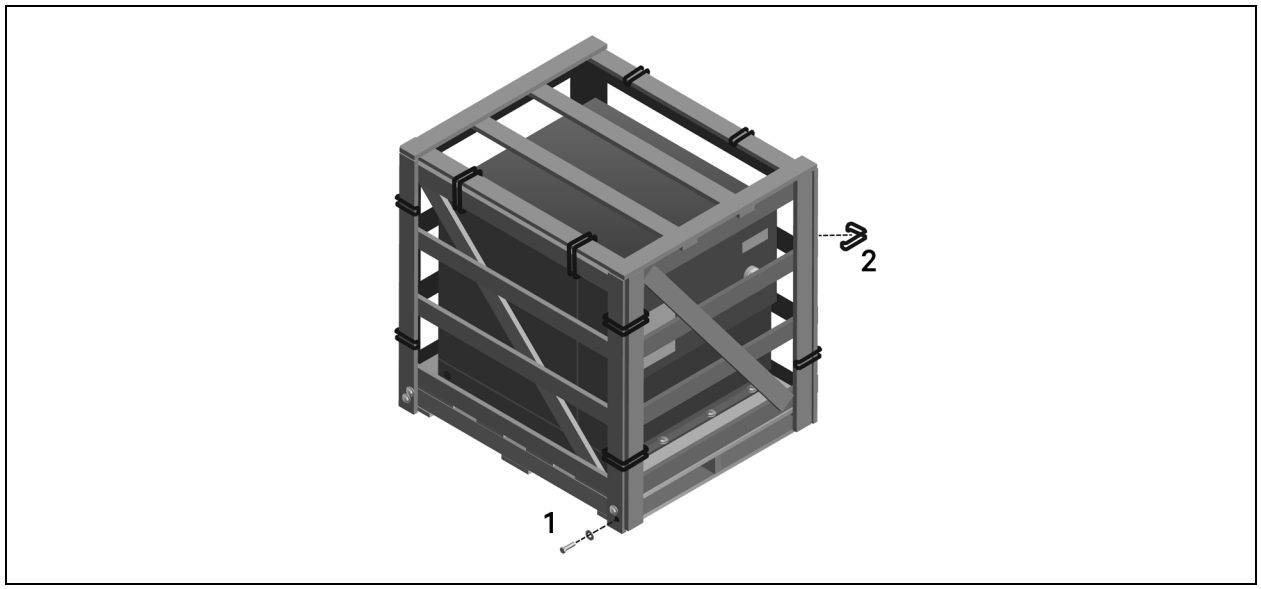
NOTICE

Risk of 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.

5.1 Unpacking and Moving the Vertiv™ EconoPhase Unit

1. Referring to Figure 5.1 below , remove the screw and washers and the retaining clips from the shipping crate, them remove the crate from the unit.

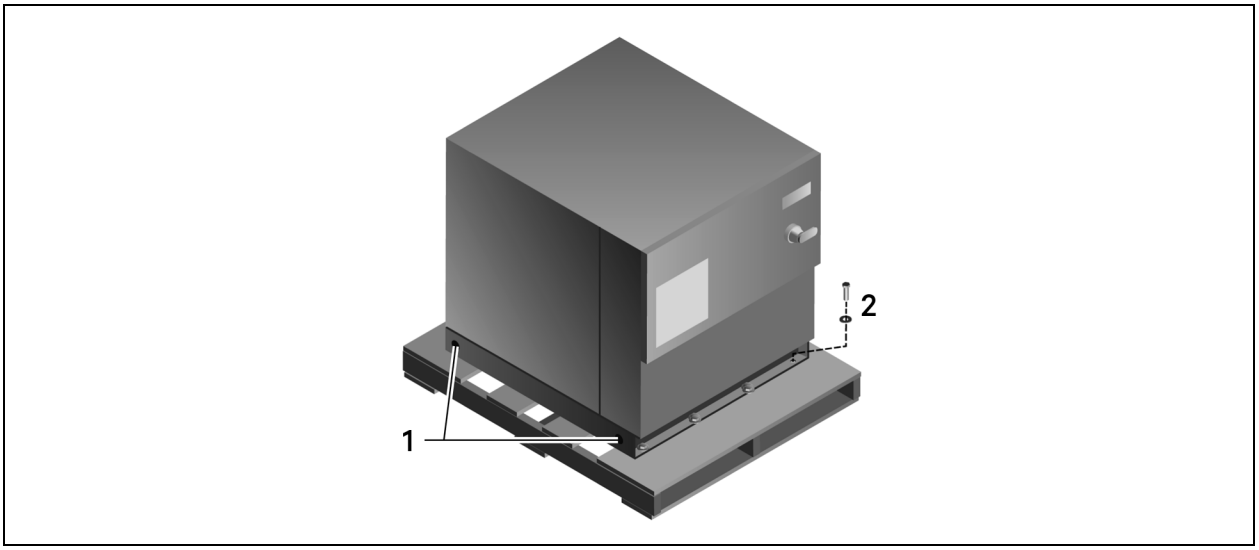
Figure 5.1 Removing the Shipping Crate



Item	Description	Item	Description
1	Screw and washer (typically 8 places)	2	Retaining clip (typically 12 places)

2. Remove the screws and washers that secure the unit to the skid, Figure 5.2 below .
3. Use the four 1-1/32 in. (26.2 mm) diameter holes, shown in Figure 5.2 below , to lift and move the unit.
    - After installation, place the hole plugs that are included with the manual in the lifting holes.

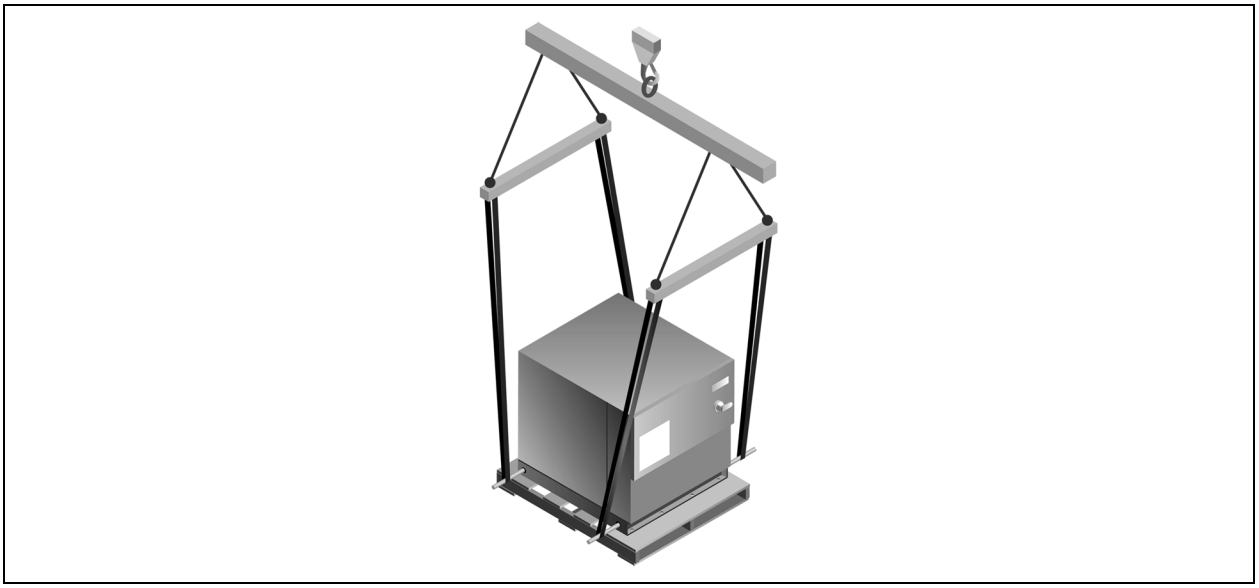
Figure 5.2 Removing Screws Securing the Unit to the Skid



Item	Description	Item	Description
1	Lifting holes, 2 each side	2	Screw and washer (typically 8 places)

4. See Figure 5.3 below , for the typical use of lifting holes and sling arrangement.

Figure 5.3 Typical Sling Arrangement for Lifting Unit



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6 Piping and Refrigerant Requirements

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.

The pipe connection locations, piping general arrangement and schematics are described in the submittal documents included in the Submittal Drawings on page 53 .

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

Table 6.1 Typical Vertiv™ EconoPhase to Condenser Arrangement Drawings

Document Number	Title
20000476	Vertiv™ CoolPhase Condenser MC Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA050-DA165 without Receivers
20000475	Vertiv™ CoolPhase Condenser MC Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA050-DA165 without Receivers
20000341	Vertiv™ CoolPhase Condenser MCV Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA125-DA265 with Receivers
20000342	Vertiv™ CoolPhase Condenser MCV Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA125-DA265 without Receivers

Table 6.2 Piping General Arrangement Drawings

Document Number	Title
Schematics	
20000469	Vertiv™ CoolPhase Perimeter DA050-DA085 Piping Schematic with Vertiv™ CoolPhase Condenser MC without Receivers
20000470	Vertiv™ CoolPhase Perimeter DA080-DA085 Piping Schematic with Vertiv™ CoolPhase Condenser MC with Receivers
20000472	Vertiv™ CoolPhase Perimeter DA125-DA165 Piping Schematic with Vertiv™ CoolPhase Condenser MC with Receivers
20000473	Vertiv™ CoolPhase Perimeter DA125-DA165 Piping Schematic with Vertiv™ CoolPhase Condenser MCV with Receivers
20000474	Vertiv™ CoolPhase Perimeter DA125-DA265 Piping Schematic with Vertiv™ CoolPhase Condenser MCV without Receivers
20000553	Vertiv™CoolPhase Perimeter DP060 Piping Schematic
20000532	Vertiv™CoolPhase Perimeter 400/500 kW Perimeter and Rooftop Unit Piping Schematic

Table 6.2 Piping General Arrangement Drawings (continued)

Document Number	Title
Internal Piping	
20000533	Vertiv™ EconoPhase PR050 General Arrangement Diagram
20000534	Vertiv™ EconoPhase PR085, PR125, and PR250 Models General Arrangement Diagram
20000535	Vertiv™ EconoPhase PR200 General Arrangement Diagram

6.1 Placement Options and Piping Restriction for the Vertiv™ EconoPhase Unit and Vertiv™ CoolPhase Condenser

The Vertiv™ CoolPhase Condenser and Vertiv™ EconoPhase must be installed next to each other (For guidelines, refer to the appropriate drawing for your system in the Submittal Drawings on page 53 . The Vertiv™ EconoPhase is dependent on sub-cooled liquid leaving the condenser and entering the pumps. For this reason there must be no large pressure drop between the two units because that could lead to flashing of the refrigerant and pump cavitation. There must be no traps in the liquid line between the condenser and the Vertiv™ EconoPhase unit because these will allow vapor to enter the pump suction during start up.

NOTE: The condenser must not be installed below the level of the Vertiv™ CoolPhase Perimeter. The condenser may be installed on the same level as the Vertiv™ CoolPhase Perimeter or as much as 60 ft (18.3 m) above the Vertiv™ CoolPhase Perimeter. See 20000475 in the Submittal Drawings on page 53 , for details.

6.2 Refrigerant Piping and Charging

Proper line size selections are critical to proper operation of the Vertiv™ EconoPhase system. The line sizes shown in Table 6.3 below , must be followed for proper operation and maximum efficiency of the Vertiv™ EconoPhase and vapor compression modes. The line size selections have been optimized to reduce pressure drop throughout the system and still maintain oil return to the compressor for reliability.

Refer to the Vertiv™ CoolPhase Perimeter user manual for complete list of piping guidelines and instructions.

Table 6.3 Line Sizing for Vertiv™ CoolPhase Perimeter/Vertiv™ EconoPhase System

Model	DA050		DA080 and DA085		DA125		DA150 and DA165		DA250 and DA265	
Equivalent Length	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.
50 ft (15 m)	1-1/8**	7/8	1-1/8	7/8	1-3/8	7/8	1-3/8	7/8	1-5/8	1-3/8
100 ft (30 m)	1-1/8**	7/8	1-1/8	7/8	1-3/8	7/8	1-3/8	1-1/8	1-5/8	1-3/8
150 ft (45 m)	1-1/8**	7/8	1-1/8	7/8	1-3/8	7/8	1-3/8	1-1/8	1-5/8*	1-3/8*

Table 6.3 Line Sizing for Vertiv™ CoolPhase Perimeter/Vertiv™ EconoPhase System (continued)

Model	DA050		DA080 and DA085		DA125		DA150 and DA165		DA250 and DA265	
Equivalent Length	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.	Hot Gas Line, in.	Liquid Line, in.
300 ft (90 m)	1-1/8**	7/8	1-1/8	7/8	1-3/8	7/8	1-3/8	1-1/8	1-5/8*	1-3/8*

*Consult factory for proper line sizing for runs longer than maximum equivalent length shown in table.

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

Source: DPN000788, Rev. 22

6.2.1 Refrigerant Charge for Vertiv™ EconoPhase Systems

WARNING! Risk of over-pressurization of the refrigeration system. Can cause serious injury or death. Building and equipment damage may also result. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, or environmental pollution. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.

Table 6.4 System Refrigerant Pressures

Maximum Design Pressure (High Side)	540 psig	3723 kPa	Noted on the unit serial tag
Source: DPN000788, Rev. 22			

Before charging system, make sure disconnect switch is in the "OFF" position. After charging is complete, turn disconnect switch to the "ON" position. Refer to the Vertiv™ CoolPhase Perimeter Installer/User Guide (SL-18933 for DA050-165 units or SL-18945 for DA250-265 units) for complete charging instructions for the Vertiv™ CoolPhase Perimeter/Vertiv™ EconoPhase system.

Table 6.5 Vertiv™ EconoPhase Refrigerant Charge

Model	R-454B Charge per Circuit, lb (kg)
PR050	5.2 (2.5)
PR085	5.2 (2.5)
PR125	5.2 (2.5)
PR200	5.2 (2.5)
PR250	8.8 (4.0)
Source: DPN003082, Rev. B	

NOTE: Field installed interconnecting piping should be properly selected based on local codes and unit labeling.

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7 Electrical Connections

WARNING! Arc flash and electric shock hazard. Can cause serious injury or death. Building and equipment damage may also result. Disconnect all local and remote electric power supplies and wear appropriate, OSHA-approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.

Verify with a voltmeter that power is Off. The Vertiv™ iCOM™ controller does not isolate power from the unit, even in the "Unit Off" mode. Some internal components still require and receive power even during the "Unit Off" mode of the Vertiv™ iCOM™ 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.

Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. Follow all local codes.

WARNING! Risk of electric shock. Can cause serious injury or death. Building and equipment damage may also result. Open all local and remote electric power supply disconnect switches and verify that power is off with a voltmeter before working within any electric connection enclosures. The Vertiv™ iCOM™ 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 Vertiv™ iCOM™ controller.

Installation, 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 improper wire sizing/rating and loose electrical connections causing overheated wire and electrical connection terminals resulting in smoke or fire. Can cause serious injury or death. Building and equipment damage may also result. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.

WARNING! Risk of improper wiring, piping, moving, lifting and handling. Can cause serious injury or death. Building and equipment damage may also result. Installation and service of this equipment should be done only by qualified personnel who have been specially-trained in the installation of air-conditioning equipment and who are wearing appropriate, OSHA-approved PPE.

NOTICE

Risk of improper power-supply connection. Can cause equipment damage and loss of warranty coverage.

Prior to connecting any equipment to a main or alternate power source (for example back-up generator systems) for start-up, commissioning, testing, or normal operation, ensure that these sources are correctly adjusted to the nameplate voltage and frequency of all equipment to be connected. In general, power-source voltages should be stabilized and regulated to within +/- 10% of the load nameplate nominal voltage. Also, ensure that no three-phase sources are single-phased at any time.

See transformer label for primary tap connections. Installer will need to change transformer primary taps if applied unit voltage is other than pre-wired tap voltage.

NOTICE

Risk of improper electrical connection of three-phase input power. Can cause backward pump rotation and unit damage. Service technicians should use a gauge set on the system during the initial start up to verify that the three-phase power is connected properly. Three-phase power must be connected to the unit line voltage terminals in the proper sequence so that the pump rotates in the proper direction. Incoming power must be properly phased to prevent pump from running backward. We recommend checking the unit's phasing with proper instrumentation to ensure that the power connections were made correctly. We also recommend verifying discharge and suction pressures during start up to ensure that the pumps are running in the correct direction.

NOTE: Seal openings around piping and electrical connections to prevent air leakage.

7.1 High Voltage Electrical Connections

Three phase electrical service is required for all models. Electrical service must conform to national and local electrical codes. Refer to equipment nameplate regarding wire size and circuit protection requirements. Refer to electrical schematic when making connections. A manual electrical disconnect switch should be installed in accordance with local codes and distribution system. Consult local codes for external disconnect requirements.

The electrical connections and service entrances to the unit are described in the submittal documents included in the Submittal Drawings on page 53 .

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

Table 7.1 Electrical Field Connection Drawings

Document Number	Title
20000503	Vertiv™ EconoPhase PR050 Electrical Field Connections
20000502	Vertiv™ EconoPhase PR085-PR125 Electrical Field Connections

7.2 Low Voltage, Communication Wiring Connections

The Vertiv™ CoolPhase Perimeter, Vertiv™ CoolPhase Condenser, and Vertiv™ EconoPhase PRE require communication when combined into a system. This is done through a CANbus communication interface. A CANbus cable must be connected from the Vertiv™ CoolPhase Perimeter at the designated terminal(s) to TB49 on the Vertiv™ CoolPhase Condenser board (refer to the Vertiv™ CoolPhase Perimeter User Manual, SL-80190). If there is an additional condenser, TB50 of the first condenser will continue out to TB49 on the second condenser.

In a system equipped with an Vertiv™ EconoPhase, the CANbus cable must be connected from TB50 on the last condenser to TB49 on the Vertiv™ EconoPhase CANbus terminal block.

The two devices that are connected at the ends of the CANbus will require termination to be set by jumper or plug. One end will be at the last outdoor device in the connection chain; the other end of the CANbus is either in the indoor unit or at a remote sensor. To terminate, place a jumper on J6 Pins 1 and 2 on the Vertiv™ CoolPhase Condenser or Vertiv™ EconoPhase board. For other Vertiv™ iCOM™ boards directly associated with the indoor unit, terminate by placing a jumper on P78 Pins 2 and 3.

See Figure 7.1 on the next page or Figure 7.2 on the next page for CANbus connections, jumper and DIP switch settings.

- Length Restrictions
  - The indoor Vertiv™ CoolPhase Perimeter can be no more than 300 ft. (91 m) from the condenser. The CAN communication cable can be longer, but the total length should not exceed 500 ft. (152 m) between the indoor Vertiv™ CoolPhase Perimeter unit and all outdoor equipment.
- Cable Type
  - Conductors—22-18AWG stranded, tinned copper
  - Twisted pair (one pair is required for connection)
  - Braided shield or foil shield with drain wire
  - Low capacitance (<=15pF/ft)
  - Cat5e or similar
  - UL approved temperature rated to 75°C (167°F)
  - UL approved voltage rated to 300 V
  - UV – and moisture – resistant if not run in conduit
  - Plenum rated—NEC type CMP, if required by national or local codes
- High Voltage Restrictions
  - Do not run communications cable with high voltage cable.
  - When routing cable, avoid laying, fastening or coiling near or on high voltage wiring, conduit, or light ballasts. Communication signals in equipment may be disturbed.
  - Keep communications cable away from other electrical noise sources.
- Environmental and Safety
  - We recommend routing cable inside conduit where the cable exits the building to outdoor units, between outdoor units and any other location where environmental conditions could degrade the cable's integrity.
  - Follow all national and local codes regarding cable routing, ratings, etc.

Figure 7.1 CANbus Cable Connections for Single Circuit System, PR050 and DA050

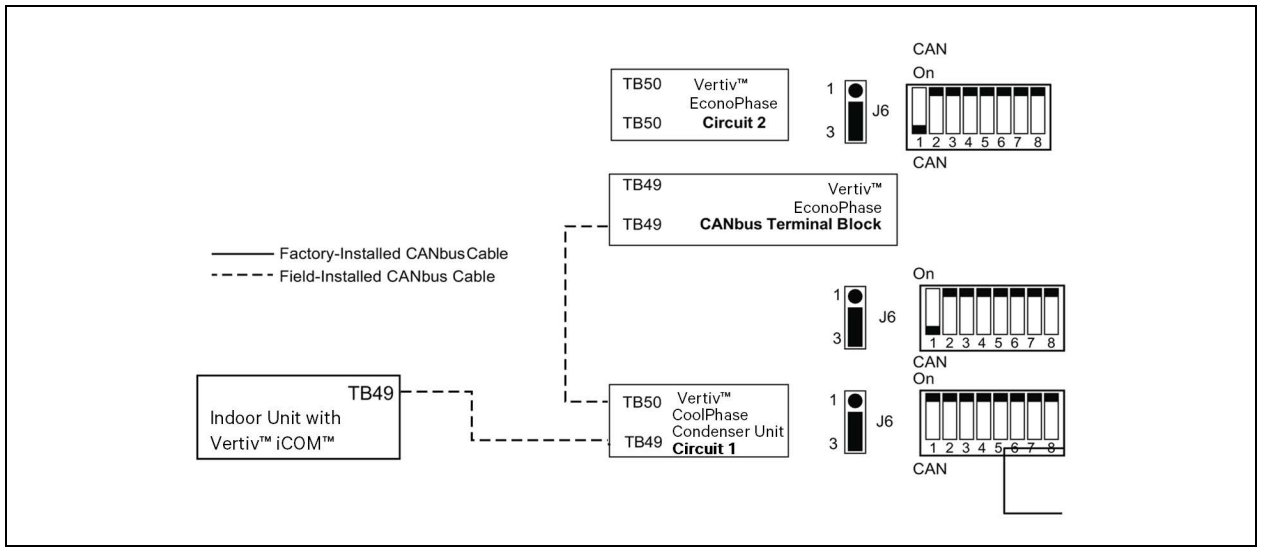
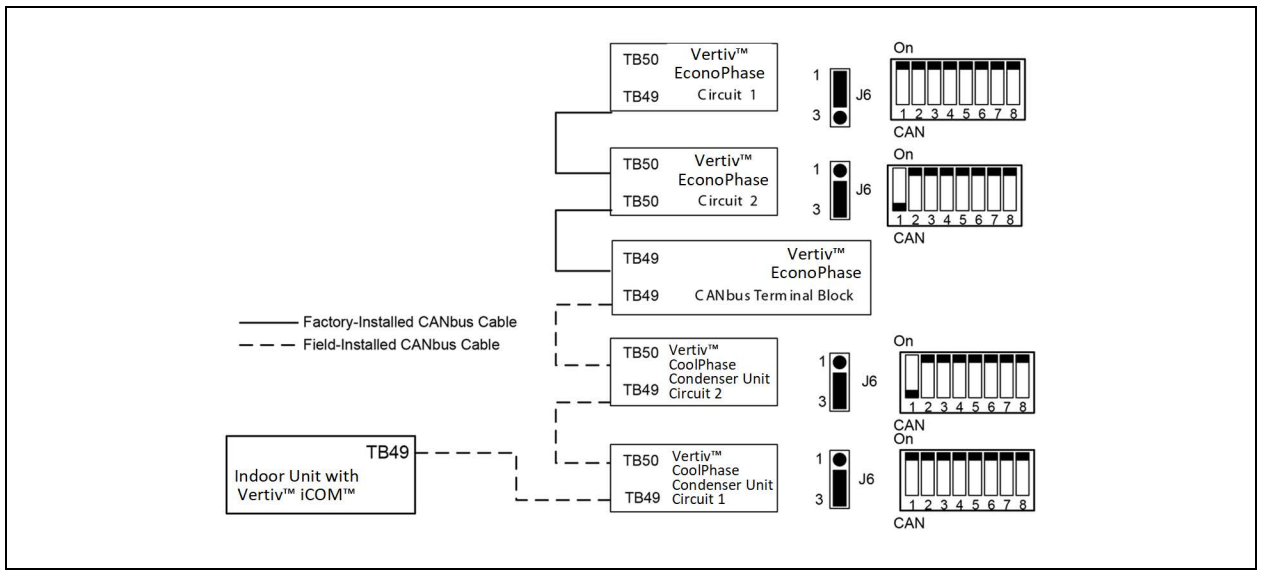


Figure 7.2 CANbus Cable Connections for Dual Circuit System, PR080 to PR250



8 Troubleshooting

NOTICE

Risk of improper control circuits. Can cause equipment damage.

When using jumpers for troubleshooting, always remove jumpers when maintenance is complete. Jumpers left connected could override controls and cause equipment damage.

Table 8.1 below , shows the current list of alarms that will display, along with a list of possible causes for the alarm condition.

Table 8.1 Vertiv™ EconoPhase Alarms and Possible Causes

Vertiv™ iCOM™ Alarm Text	Event Description	Notes (Possible Causes/ Troubleshooting)	Reset Type MA = Manual Acknowledge MR = Manual Reset AR = Auto Reset
PB1/2 BOARD FAIL	An unrecoverable fatal system error has occurred. Pump shut down. Pump board must be rebooted to reset event.	Reboot system but a new pump board must be installed.	MA, MR
PB1/2 IN PRES SENS FAIL	Inlet refrigerant pressure sensor failure. Pump shut down. Event is reset when condition clears.	Plug disconnected at board. Disconnected at sensor. Sensor failure.	MA, AR
PB1/2 IN TEMP SENS FAIL	Inlet refrigerant temperature sensor failure. Pump shut down. Event is reset when condition clears.	Sensor unplugged at board. Lead material separated from resistor element (damaged sensor). Short circuit.	MA, AR
PB1/2 INV DATA SHUTDOWN	Invalid data detected and pump has been shut down. Event is reset when Vertiv™ iCOM™requests a new start up.	CAN communication error Software error (reboot system if occurring continually) Mismatched versions of code between the Vertiv™ iCOM™ and Pump boards.	MA, AR
PB1/2 LO DIFF PRESSURE	Pump differential pressure fell below a lower threshold and pump has been shut down. Event is reset when Vertiv™ iCOM™ requests a new start up.	EEV not operating properly (see EEV operating mode for Vertiv™ EconoPhase). Pump phased incorrectly. Pressure transducers reversed. Pressure transducers reading incorrectly. Line between condenser and Vertiv™ EconoPhase not sloped properly or has traps. Pump failure (mechanical or electrical).	MA, AR
PB1/2 LO OUTLET TEMP	Pump outlet refrigerant temperature fell below a lower threshold and pump has been shut down. Event is reset when Vertiv™ iCOM™ requests a new start up.	Refrigerant temperature sensor failure at condenser outlet. Condenser fans not operating correctly. Indoor load too low at very low outdoor temperatures.	MA, AR

Table 8.1 Vertiv™ EconoPhase Alarms and Possible Causes (continued)

Vertiv™ iCOM™ Alarm Text	Event Description	Notes (Possible Causes/ Troubleshooting)	Reset Type MA = Manual Acknowledge MR = Manual Reset AR = Auto Reset
PB1/2 OUT PRES SEN FAIL	Outlet refrigerant pressure sensor failure. Pump shut down. Event is reset when condition clears.	Plug disconnected at board. Disconnected at sensor. Sensor failure.	MA, AR
PB1/2 OUT TEMP SEN FAIL	Outlet refrigerant temperature sensor failure. Pump shut down. Event is reset when condition clears.	Sensor unplugged at board. Lead material separated from resistor element (damaged sensor). Short circuit.	MA, AR
PB1/2 COMMS ERROR	Vertiv™ iCOM™ lost CAN communications with pump board. Pump shut down. Event is reset when condition clears.	Hardware failure on the pump board. Pump board should be replaced.	MA, AR
PB1/2 REMOTE SHUTDWN	Remote shutdown alarm state. Pump shut down. Event is reset when condition clears.	Jumper removed on PCB at TB38.	MA, AR
PB1/2 STARTUP FAIL	Three pump start ups in a row have failed. Event must be manually reset by user.	Low refrigerant charge. Pump phased incorrectly. Pressure transducers reversed. Pressure transducers reading incorrectly. Line between condenser and Vertiv™ EconoPhase not sloped properly or has traps. Condenser fans not operating properly. (See condenser operating mode for Vertiv™ EconoPhase). EEV not operating properly (see EEV operating mode for Vertiv™ EconoPhase). Pump failure (mechanical or electrical). Refrigerant circuits crossed.	MA, MR
PB1/2 COMMUNICATE FAIL	Ethernet communications failure. Pump not shut down. Event is reset when condition clears. USB communications failure. Pump not shut down. Event is reset when condition clears.	Hardware failure on the pump board. Pump board should be replaced.	MA, AR
PB1/2 INVERTER FAIL	Pump Board inverter fail.	Refer to inverter display and manual for cause of failure.	MA, AR
PB1/2 PUMP HRS EXCEEDED	Vertiv™ EconoPhase pump hours exceeded. Event is reset when condition clears.	Hours since last maintenance have exceeded the designated limit.	MA, AR
PB1/2 TVSS FAILURE		Power surge has tripped TVSS. TVSS must be replaced.	MA, AR

9 Maintenance

WARNING! Arc flash and electric shock hazard. Can cause serious injury or death. Building and equipment damage may also result. Disconnect all local and remote electric power supplies and wear appropriate, OSHA approved personal protective equipment (PPE) per NFPA 70E before working within the electric control enclosure. Customer must provide earth ground to unit, per NEC, CEC and local codes, as applicable.

Verify with a voltmeter that power is Off. The Vertiv™ iCOM™ controller does not isolate power from the unit, even in the “Unit Off” mode. Some internal components still require and receive power even during the “Unit Off” mode of the Vertiv™ iCOM™ 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.

Before proceeding with installation, read all instructions, verify that all the parts are included and check the nameplate to be sure the voltage matches available utility power. Follow all local codes.

WARNING! Risk of electric shock. Can cause serious injury or death. Building and equipment damage may also result. Open all local and remote electric power supply disconnect switches and verify that power is off with a voltmeter before working within any electric connection enclosures. The Vertiv™ iCOM™ 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 Vertiv™ iCOM™ controller.

Installation, 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 short circuits and electric shock. Can cause serious injury or death. Building and equipment damage can result from cut insulation or damaged wires. Can cause overheated wiring, smoke, fire, activation of fire suppression systems and EMS personnel, and loss of power to fans. Verify that all wiring connections are tight and that all wiring is contained within the junction box prior to closing and securing the cover. Insert CSA-certified or UL-listed bushings into holes and/or knockouts used to route wiring through metal panels to protect the wire insulation from contact with sheet metal edges.

WARNING! Risk of improper wire sizing/rating and loose electrical connections causing overheated wire and electrical connection terminals resulting in smoke or fire. Can cause serious injury or death. Building and equipment damage may also result. Use correctly sized copper wire only and verify that all electrical connections are tight before turning power On. Check all electrical connections periodically and tighten as necessary.

WARNING! Risk of explosive discharge of high-pressure refrigerant. Can cause serious injury or death. Building and equipment damage may also result. The handling, installation, cleaning, servicing and disposal/reclaim of refrigerant shall be in accordance with all national and local codes.

WARNING! Risk of fire due to flammable refrigerant. Perform safety check to minimize the risk of ignition before working on unit. All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Ventilation is required and work in confined spaces shall be avoided. Check for presence of refrigerant with appropriate detector. Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used. Fire extinguisher shall be available. No ignition sources during service, with "no smoking" signs displayed.

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

The Vertiv™ CoolPhase Perimeter Thermal Management System Low GWP is a single component in the facility heat removal system. The system includes air distribution (raised floors, duct systems), outdoor heat rejection (condensers, pumps) and indoor cooling and humidity loads (equipment load, location, outside air infiltration). Proper application and maintenance of the entire system is critical to the life and reliability of the thermal-management units.

- Good maintenance practices are essential to minimizing operation costs and maximizing product life.
- Read and follow monthly and semi-annual maintenance schedules included in this manual. These minimum maintenance intervals may need to be more frequent based on site-specific conditions.
- See the Vertiv™ iCOM™ User Manual, SL-80185, available at www.Vertiv.com, for instructions on using the controller to predict some service maintenance intervals.
- We recommend the use of trained and authorized service personnel, extended service contracts and factory specified replacement parts. Contact your Vertiv sales representative.

9.1 Electronic Expansion Valve (EEV) Maintenance

The EEV controls superheat through the Vertiv™ iCOM™ controls by actively measuring suction pressure via a transducer attached to the suction line rotalock and suction temperature via a thermister strapped to the suction line. The EEV actively adjusts the orifice size and resulting mass flow of refrigerant to maintain the superheat setpoint (set in Vertiv™ iCOM™). The EEV is used in place of the standard thermal expansion valve (TXV).

WARNING! Risk of electric shock. Can cause serious injury or death. Building and equipment damage may also result. Open all local and remote electric power supply disconnect switches and verify that power is off with a voltmeter before working within any electric connection enclosures. The Vertiv™ iCOM™ 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 Vertiv™ iCOM™ controller.

Installation, 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.

NOTE: Intermittent loss of subcooling may result in EEV/superheat instability. If superheat instability is observed, check for proper refrigerant level in receiver (see Refrigerant Piping Guidelines for Air Cooled Systems on page 45 for the proper charge level). If proper charge is observed in receiver, and superheat remains unstable, then increase superheat setting in the Vertiv™ iCOM™ to 15°F (8.49°C).

9.2 Compressor Maintenance

WARNING! Risk of over-pressurization of the refrigeration system. Can cause serious injury or death. Building and equipment damage may also result. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, or environmental pollution. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.

9.2.1 Compressor Oil

NOTICE

Risk of improper compressor lubrication. Can cause compressor and refrigerant system damage. Failure to use oil types, viscosities and quantities recommended by the compressor manufacturer may reduce compressor life and void the compressor warranty.

- Do not mix polyolester (POE) and mineral based oils.
- Do not mix oils of different viscosities.
- Consult Vertiv technical support or the compressor manufacturer if questions arise.

Table 9.1 Compressor Oil Types for R-454B Refrigerant

Compressor Type	Oil Type
Copeland Digital Scroll	POE oil - ISO 32 Centistoke viscosity[1]
1. Use Copeland POE oil ULTRA 32-3MAF or other Copeland approved oils.	
Source 20000354, Rev. A	

9.2.2 Replacement Compressors

Replacement compressors are available through your Vertiv sales office. If the unit is under warranty, the replacement compressor must be obtained from and the original compressor returned to your local Vertiv sales office. Compressors are shipped in reusable packaging, and the original compressor should be returned in the same packaging.

9.2.3 Unloading Solenoid(s) on a Digital Scroll Compressor

When replacing a digital scroll compressor, the digital solenoid valve and coil must be replaced. The compressor and valve kit are shipped separately. The valve kit must be field brazed to the top of the compressor in proper orientation and supported with the original factory bracket.

9.2.4 Compressor Electrical Failure (Motor Burnout)

If a burnout has occurred, a full system clean out is required. If not cleaned, compressor and system problems will continue.

Consult the factory for compressor maintenance. Do not attempt to remove the compressor without first contacting Vertiv support at 1-800-543-2778.

9.2.5 Replacing a Compressor with Electrical Failure (Motor Burnout)

WARNING! Risk of electric shock. Can cause serious injury or death. The Vertiv™ iCOM™ microprocessor does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the unit off mode of the Vertiv™ iCOM™ control. Open all local and remote electric power disconnect switches and verify with a voltmeter that power is Off before working on any component of the system.

WARNING! Risk of over-pressurization of the refrigeration system. Can cause serious injury or death. Building and equipment damage may also result. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, or environmental pollution. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.

NOTE: Release of refrigerant to the atmosphere is harmful to the environment. Refrigerant must be recycled or discarded in accordance with federal, state, and local regulations.

1. Attach suction and discharge gauges to access fittings.
2. Recover refrigerant using an approved recovery procedure and equipment. Use a filter drier when charging the system with recovered refrigerant.
3. Remove the marked pressure transducer and the discharge pressure switch. Disconnect all electrical connections.
4. Detach service valves from the compressor.
5. Remove the failed compressor.
6. Follow compressor manufacturer's suggested clean-out procedures.
7. Install the replacement compressor and make all connections. Replace the gaskets or seals on the service valves.
   - Replace the unloading solenoid.
8. Evacuate, charge and operate per the appropriate procedure per local codes:
   - Refer to the Vertiv™ CoolPhase Perimeter Installer/User Guide (SL-80190 for DA050-165 units or SL-71322 for DA250-265 units
9. Verify oil charge per Verifying Additional Oil Charge on the facing page .

NOTICE

Risk of improper component re-installation. Can cause equipment damage.

Identify and mark location of suction pressure transducer and discharge pressure switch. These devices look similar and they must be reinstalled in their original location.

9.2.6 Verifying Additional Oil Charge

1. Using unit manual mode, turn on the fans and operate the compressor/tandem at 100% for 30 minutes.
2. After 30 minutes, exit manual mode and let the compressor/tandem settle for two to three minutes. For tandems, waiting two to three minutes will allow the oil to equalize between the two connected compressors.

   Oil levels are checked while the tandem/compressor is in an off state to avoid sump turbulence which could show inaccurate levels.

3. Proper oil levels:

   Oil level should be checked in both sight glasses in the tandem and they should be equal.

   The oil level should be between 1/4 and 3/4 of the site glass.

   If the sight glass is completely empty, add oil until the level is at least a 1/4 full. Once the adjustment to the oil level has been made, operate the fans and compressor/tandem at 100% to verify level.

4. Document the amount of oil added or removed on the oil tag attached to the compressor, unit data plate or other applicable location.

9.2.7 Compressor Mechanical Failure

If mechanical failure of the compressor has occurred, only the compressor needs replaced. A full system clean out is not required.

9.2.8 Replacing a Compressor with Mechanical Failure

WARNING! Risk of electric shock. Can cause serious injury or death. The Vertiv™ iCOM™ microprocessor does not isolate power from the unit, even in the Unit Off mode. Some internal components require and receive power even during the unit off mode of the Vertiv™ iCOM™ control. Open all local and remote electric power disconnect switches and verify with a voltmeter that power is Off before working on any component of the system.

WARNING! Risk of over-pressurization of the refrigeration system. Can cause serious injury or death. Building and equipment damage may also result. Can cause explosive discharge of high-pressure refrigerant, loss of refrigerant, or environmental pollution. This unit contains fluids and gases under high pressure. Use extreme caution when charging the refrigerant system. Do not pressurize the system higher than the design pressure marked on the unit's nameplate.

NOTE: Release of refrigerant to the atmosphere is harmful to the environment. Refrigerant must be recycled or discarded in accordance with federal, state, and local regulations.

1. Attach suction and discharge gauges to access fittings.
2. Recover refrigerant using an approved recovery procedure and equipment. Use a filter drier when charging the system with recovered refrigerant.
3. Remove the marked pressure transducer and the discharge pressure switch. Disconnect all electrical connections.
4. Remove the failed compressor.
5. Install the replacement compressor and make all connections. Replace the unloading solenoid.

6. Evacuate, charge and operate per the appropriate procedure per local codes:
   - Refer to the Vertiv™ CoolPhase Perimeter Installer/User Guide (SL-80190 for DA050-165 units or SL-71322 for DA250-265 units.
7. Verify oil charge per Verifying Additional Oil Charge on the previous page .

NOTICE

Risk of improper component re-installation. Can cause equipment damage.

Identify and mark location of suction pressure transducer and discharge pressure switch. These devices look similar and they must be reinstalled in their original location.

9.3 Units with a Refrigeration Detection System

For units with a Refrigerant Detection System:

REFRIGERANT DETECTION SYSTEMS shall only be replaced with sensors specified by Vertiv.

A service schedule shall be made to verify the safety systems of the appliance are working as intended, at a minimum interval of once per year.

A design failure mode and effects analysis of the circulation airflow path must be conducted, in the ITE (Information Technology Equipment) AREA, to ensure the airflow velocity is at least 1 m/s for all operating conditions expected for the life of the ITE AREA.

Vertiv models with A2L refrigerants provide an output signal for use in notifying the user that a REFRIGERANT DETECTION SYSTEM has been activated. The user shall provide a notification means of receiving the output signal. If this signal is used for an alarm, the alarm shall comply with all national and local codes.

9.4 Decommissioning

Equipment shall be labeled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed.

9.5 Qualification of Workers

The manual shall contain specific information about the required qualification of the working personnel for maintenance, service and repair operations. Every working procedure that affects safety means shall only be carried out by competent persons.

Examples for such working procedures are:

- Breaking into the refrigerating circuit
- Opening of sealed components
- Opening of ventilated enclosures

Information of procedures additional to usual information for refrigerating appliance installation, repair, maintenance and decommission procedures is required when an appliance with FLAMMABLE REFRIGERANTS is affected.

The training of these procedures is carried out by national training organizations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation.

The achieved competence should be documented by a certificate.

9.6 Information on Servicing

The manual shall contain specific information for service personnel according to the following:

9.6.1 Checks to the Area

Prior to beginning work on systems containing FLAMMABLE REFRIGERANTS, safety checks are necessary to ensure that the risk of ignition is minimized. For repair to the REFRIGERATING SYSTEM, the following checks to the area shall be completed prior to conducting work on the system.

9.6.2 Work Procedure

Work shall be undertaken under a controlled procedure so as to minimize the risk of a flammable gas or vapor being present while the work is being performed.

9.6.3 General Work Area

All maintenance staff and others working in the local area shall be instructed on the nature of work being carried out. Work in confined spaces shall be avoided.

9.6.4 Checking for Presence of Refrigerant

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed or intrinsically safe.

9.6.5 Presence of Fire Extinguisher

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.

9.6.6 No Ignition Sources

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion. All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space. Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks. “No Smoking” signs shall be displayed.

9.6.7 Ventilated Area

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere.

9.6.8 Checks to the Refrigerating Equipment

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

The following checks shall be applied to installations using FLAMMABLE REFRIGERANTS:

- The actual REFRIGERANT CHARGE is in accordance with the room size within which the refrigerant containing parts are installed.
- The ventilation machinery and outlets are operating adequately and are not obstructed.
- Marking to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected.
- Refrigerating pipe or components are installed in a position where they are unlikely to be exposed to any substance which may corrode refrigerant containing components, unless the components are constructed of materials which are inherently resistant to being corroded or are suitably protected against being so corroded.

9.6.9 Checks to Electrical Devices

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include:

- That capacitors are discharged: this shall be done in a safe manner to avoid possibility of sparking.
- That no live electrical components and wiring are exposed while charging, recovering or purging the system.
- That there is continuity of earth bonding.

9.6.10 Cabling

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

9.6.11 Detection of Flammable Refrigerants

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

Examples of leak detection fluids are:

- Bubble method
- Fluorescent method agents

If a leak is suspected, all naked flames shall be removed/extinguished.

If a leakage of refrigerant is found which requires brazing, all of the refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak. Removal of refrigerant shall be according to Clause DD.9.

9.6.12 Removal and Evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration.

The following procedure shall be adhered to:

- Safely remove refrigerant following local and national regulations.
- Evacuate (optional for A2L); continuously flush or purge with inert gas when using flame to open circuit; and open the circuit.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

For appliances containing flammable refrigerants, refrigerants purging shall be achieved by breaking the vacuum in the system with oxygen-free nitrogen and continuing to fill until the working pressure is achieved, then venting to atmosphere, and finally pulling down to a vacuum (optional for A2L). This process shall be repeated until no refrigerant is within the system (optional for A2L). When the final oxygen-free nitrogen charge is used, the system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

9.6.13 Charging Procedures

In addition to conventional charging procedures, the following requirements shall be followed:

- Ensure that contamination of different refrigerants does not occur when using charging equipment. Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

9.6.14 Decommissioning

Before carrying out this procedure, it is essential that the technician is completely familiar with the equipment and all its detail. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before attempting the procedure, ensure that:
    a. Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
    b. All personal protective equipment is available and being used correctly.
    c. The recovery process is supervised at all times by a competent person.
    d. Recovery equipment and cylinders conform to the appropriate standards.
4. Pump down refrigerant system, if possible.
5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that cylinder is situated on the scales before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80% volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

9.6.15 Labeling

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

9.6.16 Recovery

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed. Ensure that the correct number of cylinders for holding the total system charge is available. All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i.e., special cylinders for the recovery of refrigerant). Cylinders shall be complete with pressure-relief valve and associated shut-off valves in good working order. Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the flammable refrigerant. If in doubt, the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.

The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

Appendices

Appendix A: Technical Support and Contacts

A.1 Technical Support/Service in the United States

Vertiv Group Corporation

24x7 dispatch of technicians for all products.

1-800-543-2378

Vertiv™ Thermal Management Products

1-800-543-2378

Vertiv™ Channel Products

1-800-222-5877

Vertiv™ AC and DC Power Products

1-800-543-2378

A.2 Locations

United States

Vertiv Headquarters

505 N. Cleveland Ave.

Westerville, OH 43082, USA

Europe

Via Leonardo Da Vinci 8 Zona Industriale Tognana

35028 Piove Di Sacco (PD) Italy

Asia

7/F, Dah Sing Financial Centre

3108 Gloucester Road

Wanchai, Hong Kong

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Appendix B: Submittal Drawings

Table B.1 Submittal Drawings Contents

Document Number	Title
Dimensional Planning Drawings	
20000531	Vertiv™ EconoPhase PR050-PR125 Cabinet Dimensional Data
EconoPhase to Condenser Arrangement	
20000476	Vertiv™ CoolPhase Condenser MC Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA050-DA165 without Receivers
20000475	Vertiv™ CoolPhase Condenser MC Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA080-DA165 with Receivers
20000341	Vertiv™ CoolPhase Condenser MCV Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA125-DA265 with Receivers
20000342	Vertiv™ CoolPhase Condenser MCV Mounting Considerations Above/Same Level as Vertiv™ CoolPhase Perimeter DA125-DA265 without Receivers
Piping Schematics	
20000469	Vertiv™ CoolPhase Perimeter DA050-DA085 Piping Schematic with Vertiv™ CoolPhase Condenser MC without Receivers
20000470	Vertiv™ CoolPhase Perimeter DA080-DA085 Piping Schematic with Vertiv™ CoolPhase Condenser MC with Receivers
20000471	Vertiv™ CoolPhase Perimeter DA125-DA165 Piping Schematic with Vertiv™ CoolPhase Condenser MC without Receivers
20000472	Vertiv™ CoolPhase Perimeter DA125-DA165 Piping Schematic with Vertiv™ CoolPhase Condenser MC with Receivers
20000473	Vertiv™ CoolPhase Perimeter DA125-DA165 Piping Schematic with Vertiv™ CoolPhase Condenser MCV with Receivers
20000474	Vertiv™ CoolPhase Perimeter DA125-DA265 Piping Schematic with Vertiv™ CoolPhase Condenser MCV without Receivers
20000532	Vertiv™ CoolPhase Perimeter DP400-DP500 Perimeter and Rooftop Unit Piping Schematic
Unit Internal Piping	
20000533	Vertiv™ EconoPhase PR050 General Arrangement Diagram
20000534	Vertiv™ EconoPhase PR085, PR125, and PR250 Models General Arrangement Diagram
20000535	Vertiv™ EconoPhase PR200 General Arrangement Diagram
Electrical Field Connection	
20000503	Vertiv™ EconoPhase PR050 Electrical Field Connections
20000502	Vertiv™ EconoPhase PR085-PR125 Electrical Field Connections

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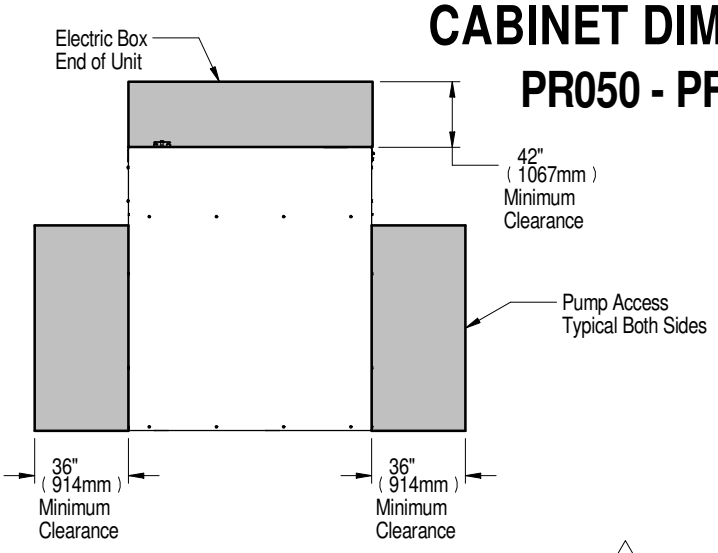
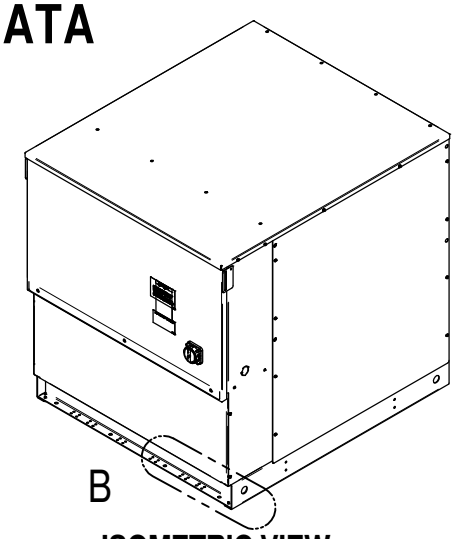
ECONOPHASE

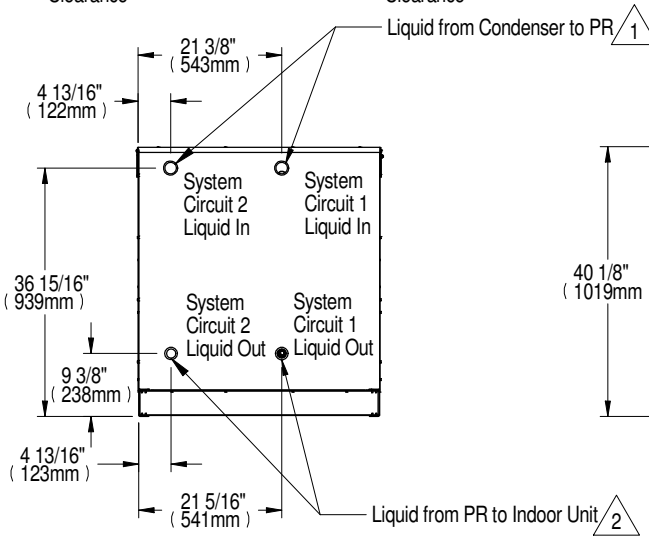
CABINET DIMENSIONAL DATA

PR050 - PR250 MODELS

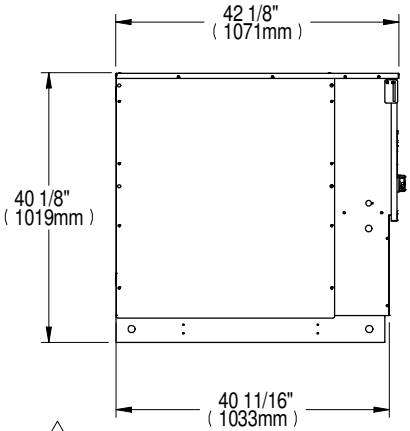




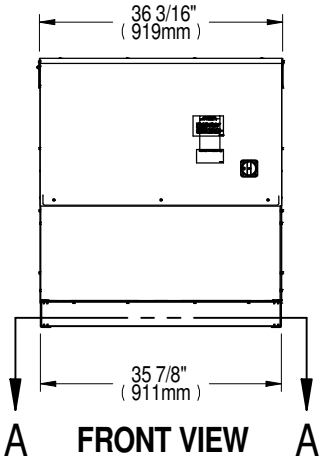
ISOMETRIC VIEW



REAR VIEW (PIPING END)



LEFT SIDE VIEW

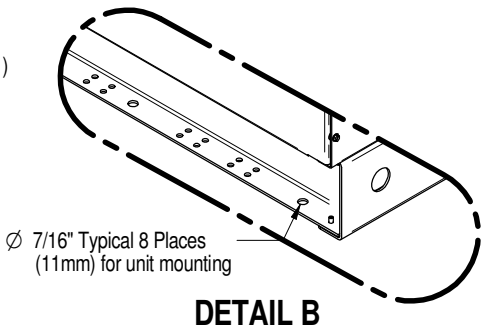


FRONT VIEW

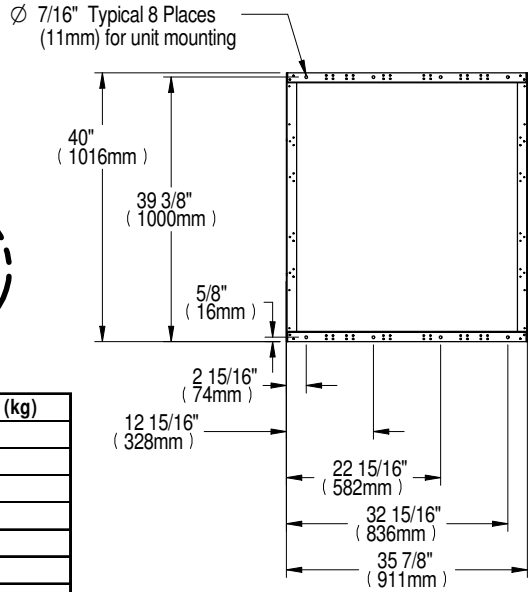
Notes:

1. 1-3/8" for PR050 (only contains circuit 1)
   1-3/8" for PR085-PR200
   1-5/8" for PR250

2. 7/8" for PR050 (only contains circuit 1)
   7/8" for PR085-PR200
   1-3/8" for PR250



DETAIL B

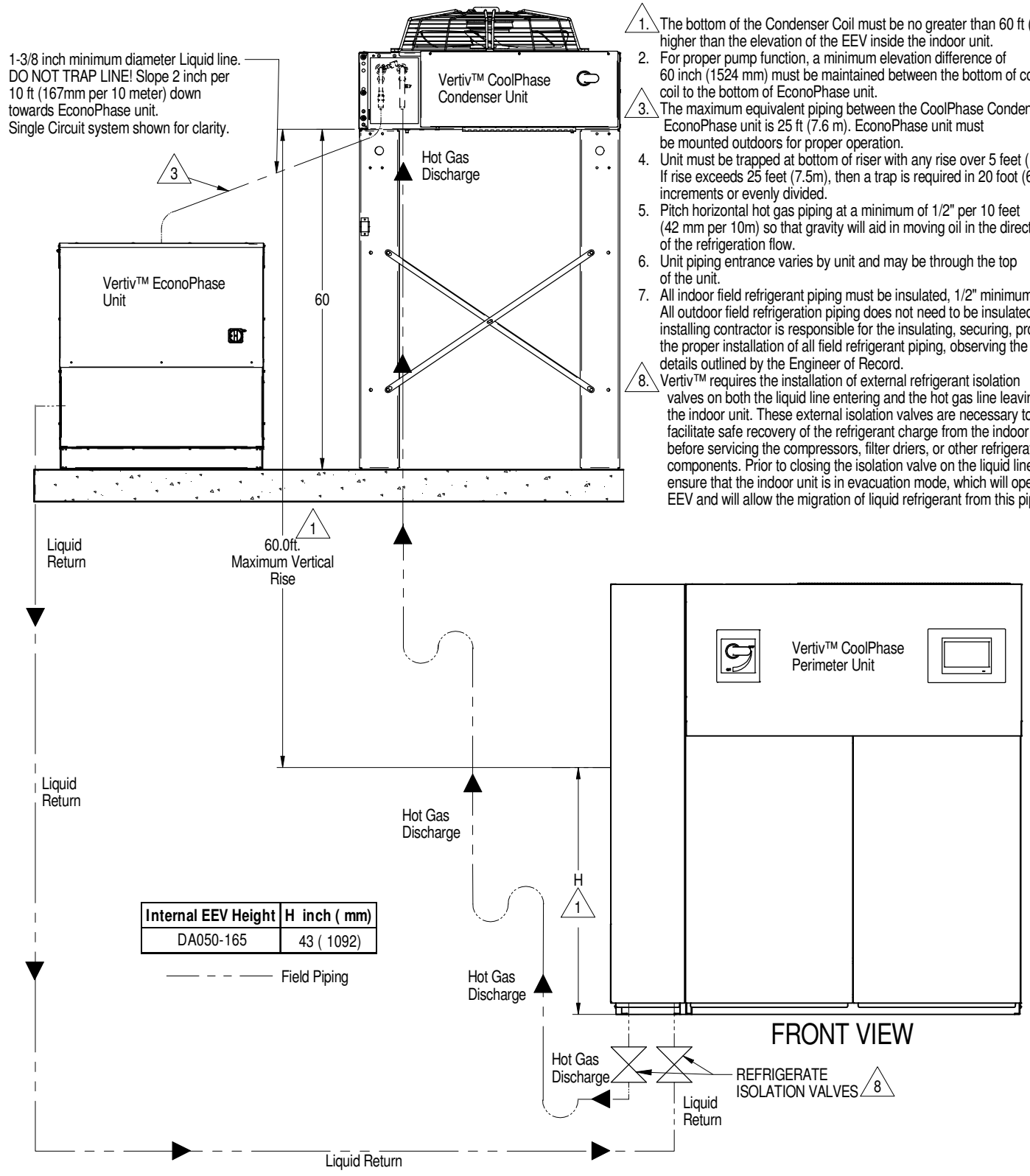


SECTION A-A

Model	Circuits	Unit Voltage, Hz	Approximate Dry Weight lb. (kg)
PR050	1	208/230V, 460V 60Hz	217 (98)
		380V, 575V 60Hz	242 (110)
		415V 50Hz	217 (98)
PR085-PR125 and PR250	2	208/230V, 460V 60Hz	340 (154)
		380V, 575V 60Hz	390 (177)
		415V 50Hz	347 (157)
PR200	2	460V 60Hz	350 (159)
PR200	2	380V, 575V 60Hz	400 (181)

COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC
RECEIVERS MOUNTED ABOVE DA050-DA165



Internal EEV Height	H inch (mm)
DA050-165	43 (1092)

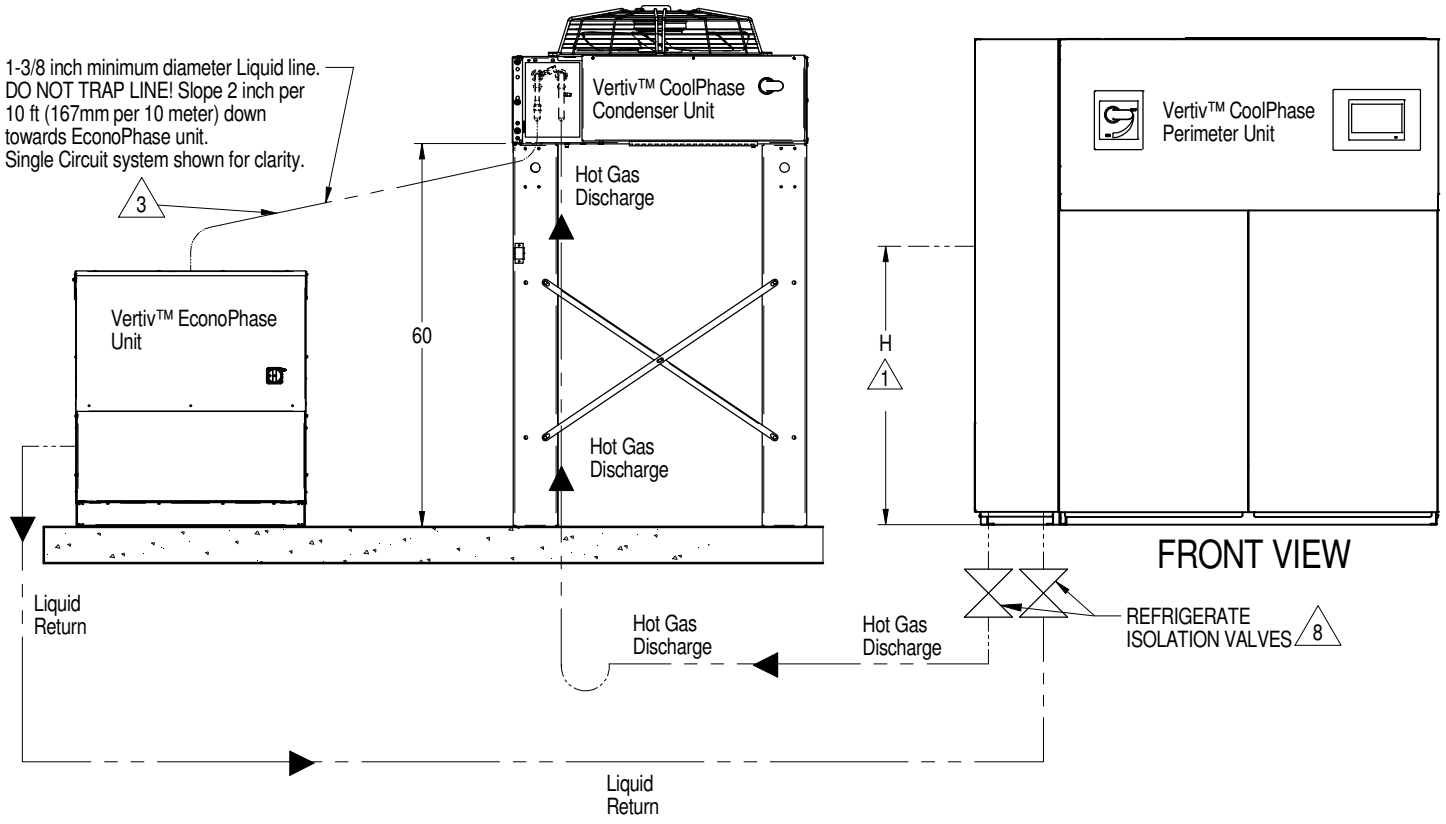
Field Piping

Notes:

1. The bottom of the Condenser Coil must be no greater than 60 ft (18.3m) higher than the elevation of the EEV inside the indoor unit.
2. For proper pump function, a minimum elevation difference of 60 inch (1524 mm) must be maintained between the bottom of condenser coil to the bottom of EconoPhase unit.
3. The maximum equivalent piping between the CoolPhase Condenser and EconoPhase unit is 25 ft (7.6 m). EconoPhase unit must be mounted outdoors for proper operation.
4. Unit must be trapped at bottom of riser with any rise over 5 feet (1.5m) high If rise exceeds 25 feet (7.5m), then a trap is required in 20 foot (6.1m) increments or evenly divided.
5. Pitch horizontal hot gas piping at a minimum of 1/2" per 10 feet (42 mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
6. Unit piping entrance varies by unit and may be through the top of the unit.
7. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

AIR COOLED PIPING SCHEMATIC

DA050-DA165 WITHOUT RECEIVERS AT SIMILAR LEVELS



Internal EEV Height	H inch (mm)
DA050-165	43 (1092)

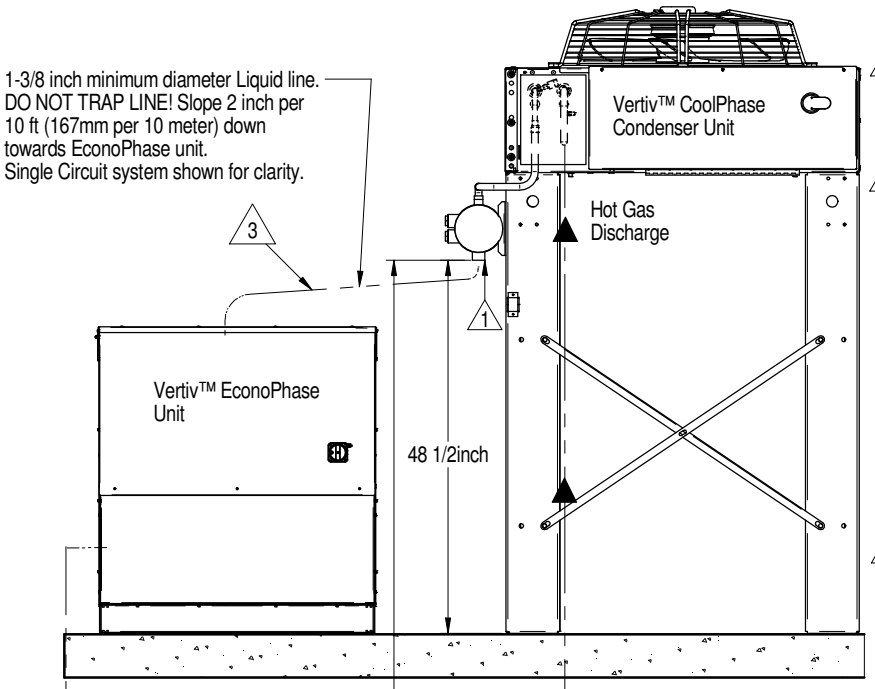
—— – – —— Field Piping

Notes:

1. The bottom of the condenser coil cannot be more than 15ft (4.6m) below the elevation of the EEV inside the indoor unit.
2. For proper pump function, a minimum elevation difference of 60 inch (1524 mm) must be maintained between the bottom of condenser coil to the bottom of EconoPhase unit.
3. The maximum equivalent piping between the CoolPhase Condenser and EconoPhase unit is 25 ft (7.6 m). EconoPhase unit must be mounted outdoors for proper operation.
4. Unit must be trapped at bottom of riser with any rise over 5 feet (1.5m) high. If rise exceeds 25 feet (7.5m), then a trap is required in 20 foot (6.1m) increments or evenly divided.
5. Pitch horizontal hot gas piping at a minimum of 1/2" per 10 feet (42 mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
6. Unit piping entrance varies by unit and may be through the top of the unit.
7. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC
RECEIVERS MOUNTED ABOVE DA080-DA165



Internal EEV Height	H inch (mm)
DA080-165	43 (1092)

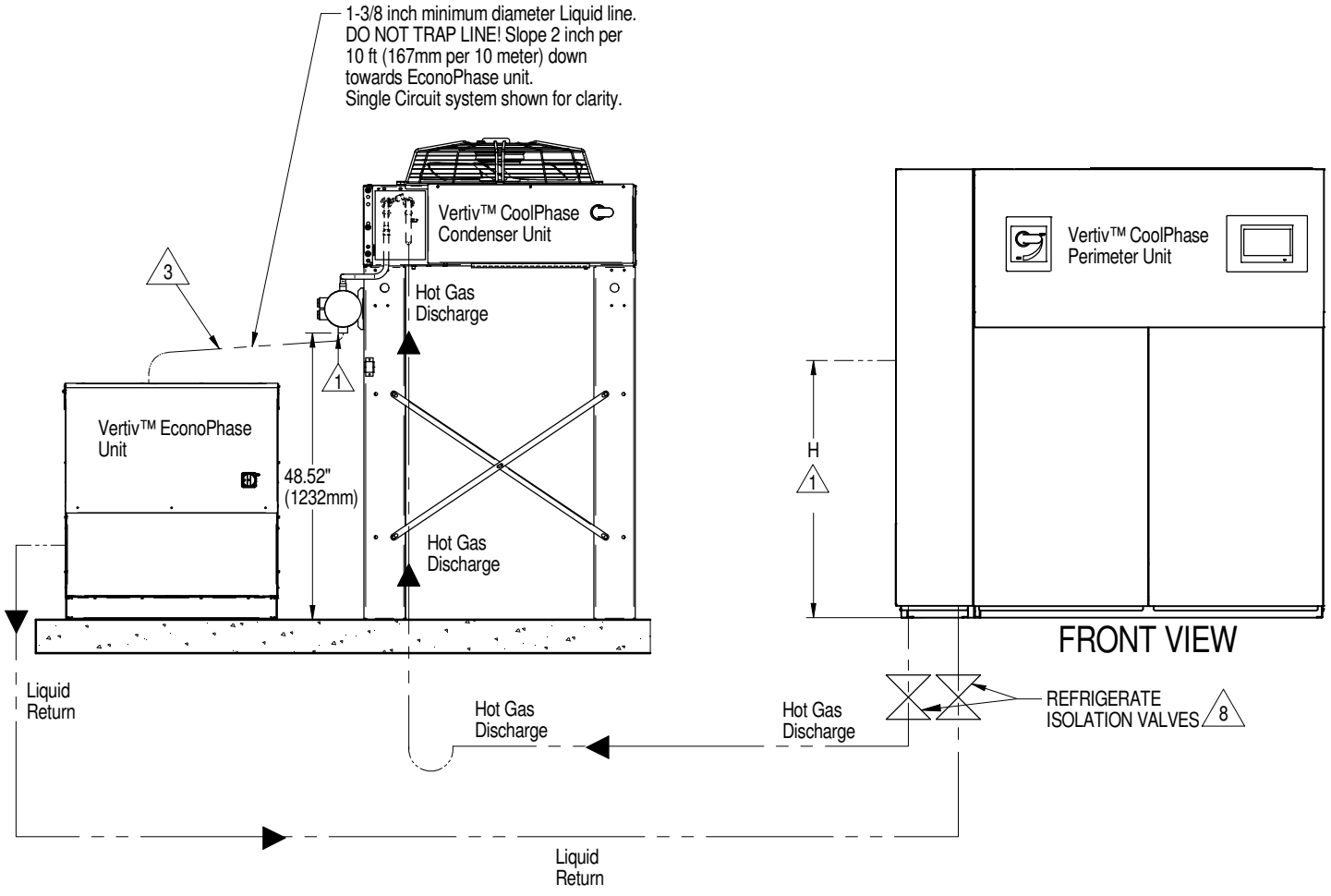
Field Piping

Notes:

1. The outlet of the receiver must be higher than the elevation of the EEV inside the indoor unit. The vertical height must not exceed 60 ft (18.3m).
2. For proper pump function, a minimum elevation difference of 60 inch (1524 mm) must be maintained between the bottom of condenser coil to the bottom of EconoPhase unit.
3. The maximum equivalent piping between the CoolPhase Condenser and EconoPhase unit is 25 ft (7.6 m). EconoPhase unit must be mounted outdoors for proper operation.
4. Unit must be trapped at bottom of riser with any rise over 5 feet (1.5m) high If rise exceeds 25 feet (7.5m), then a trap is required in 20 foot (6.1m) increments or evenly divided.
5. Pitch horizontal hot gas piping at a minimum of 1/2" per 10 feet (42 mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
6. Unit piping entrance varies by unit and may be through the top of the unit.
7. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC
DA080-DA165 WITH RECEIVERS AT SIMILAR LEVELS



Internal EEV Height	H inch (mm)
DA080-165	43 (1092)

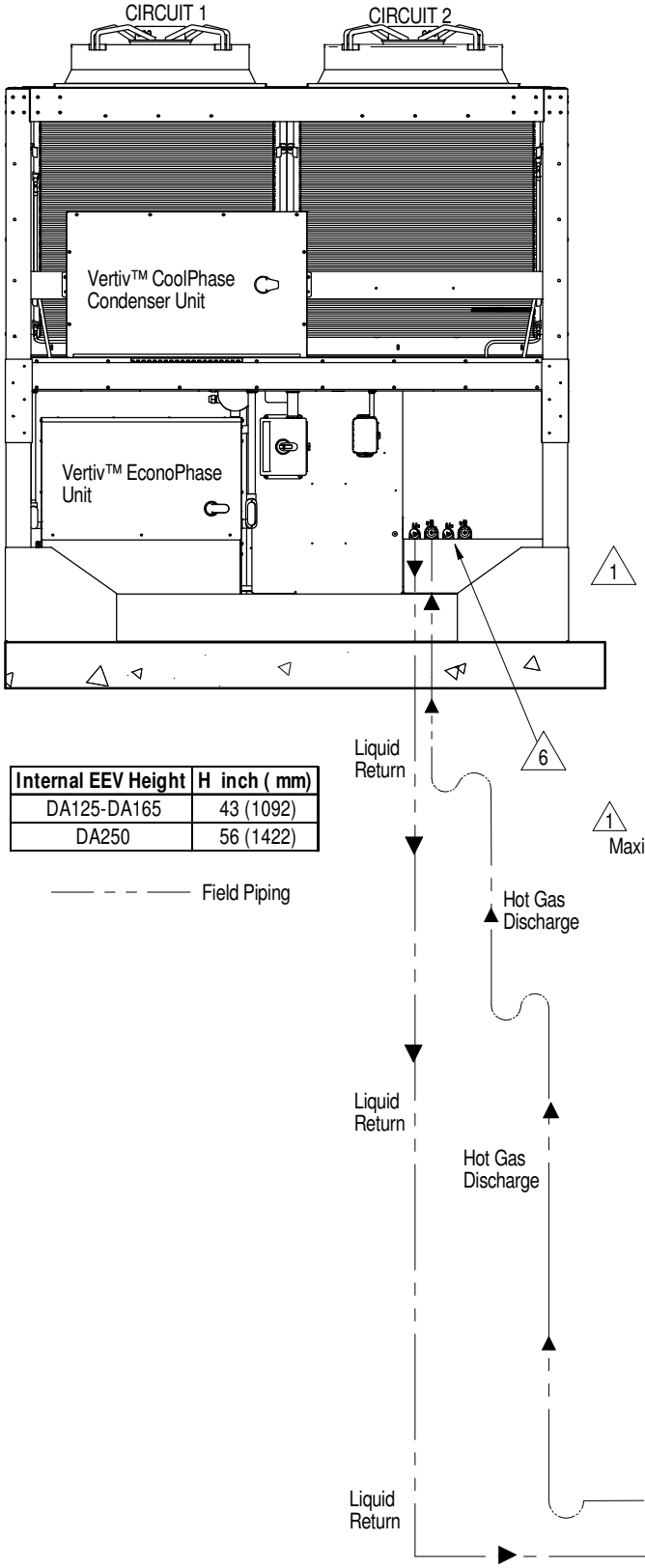
—— – – —— Field Piping

Notes:

1. The outlet of the receiver must be higher than the elevation of the EEV inside the indoor unit.
2. For proper pump function, a minimum elevation difference of 60 inch (1524 mm) must be maintained between the bottom of condenser coil to the bottom of EconoPhase unit.
3. The maximum equivalent piping between the CoolPhase Condenser and EconoPhase unit is 25 ft (7.6 m). EconoPhase unit must be mounted outdoors for proper operation.
4. Unit must be trapped at bottom of riser with any rise over 5 feet (1.5m) high. If rise exceeds 25 feet (7.5m), then a trap is required in 20 foot (6.1m) increments or evenly divided.
5. Pitch horizontal hot gas piping at a minimum of 1/2" per 10 feet (42 mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
6. Unit piping entrance varies by unit and may be through the top of the unit.
7. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC
MCV WITH RECEIVERS MOUNTED ABOVE DA125-DA250



Internal EEV Height	H inch (mm)
DA125-DA165	43 (1092)
DA250	56 (1422)

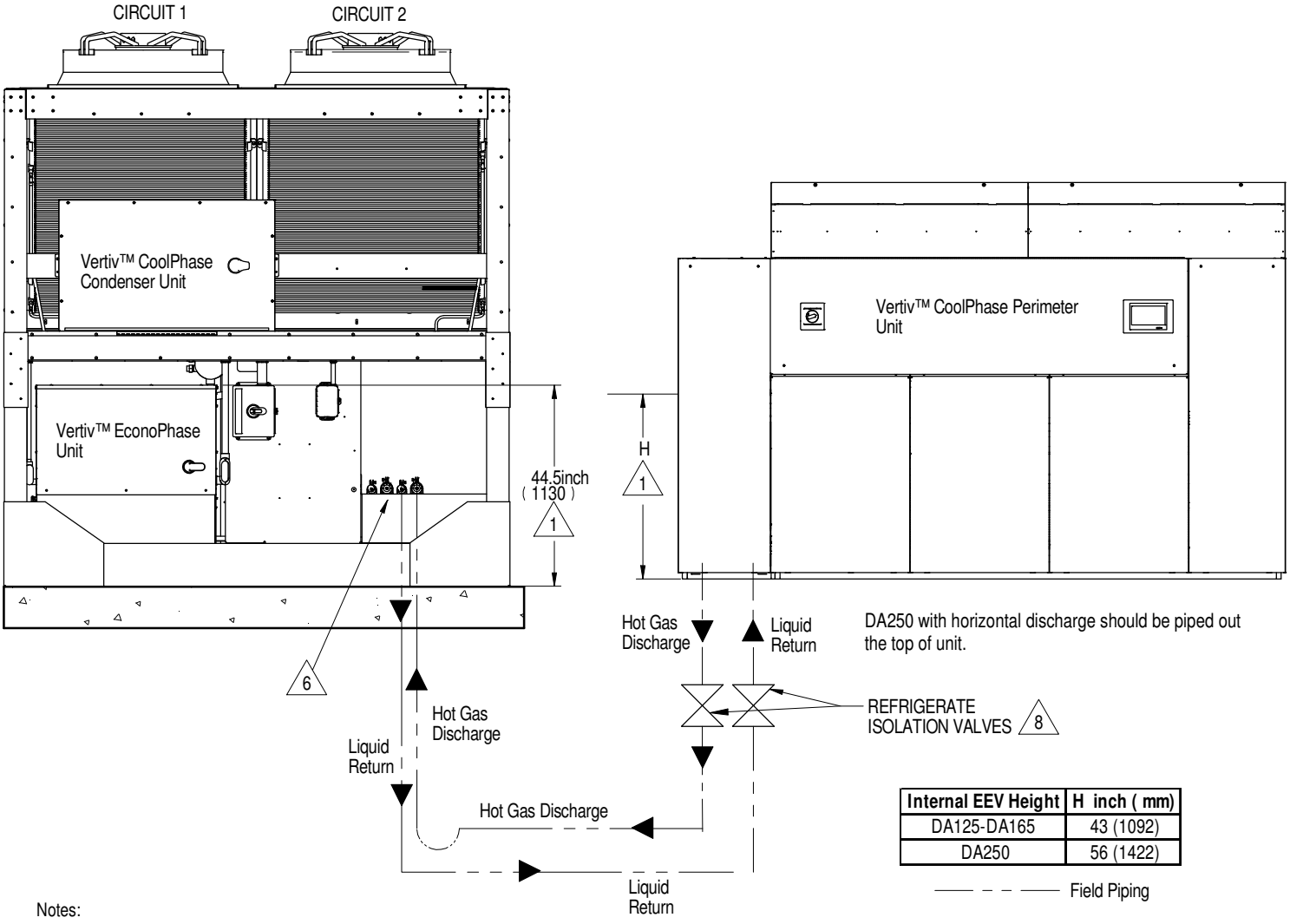
—— – – – —— Field Piping

Notes:

1. The bottom of the condenser coil must be no greater than 60 ft (18.3m) higher than the elevation of the EEV inside the indoor unit.
2. Unit must be trapped at bottom of riser with any rise over 5 feet (1.5m) high. If rise exceeds 25 feet (7.5m), then a trap is required in 20 foot (6.1m) increments or evenly divided. DA265 with horizontal discharge has internally installed traps on the hot gas discharge line.
3. Pitch horizontal hot gas piping at a minimum of ½ inch per 10 feet (42mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
4. Unit piping entrance varies by unit and may be through the top of the unit.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated. The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. DA265 with horizontal discharge should be piped out the top of unit.
7. Piping for R-410a shown. R-454b enters right or left side or rear (single skid only) of the unit.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC
DA125-DA250 AND MCV WITH RECEIVERS AT SIMILAR LEVELS



Internal EEV Height	H inch (mm)
DA125-DA165	43 (1092)
DA250	56 (1422)

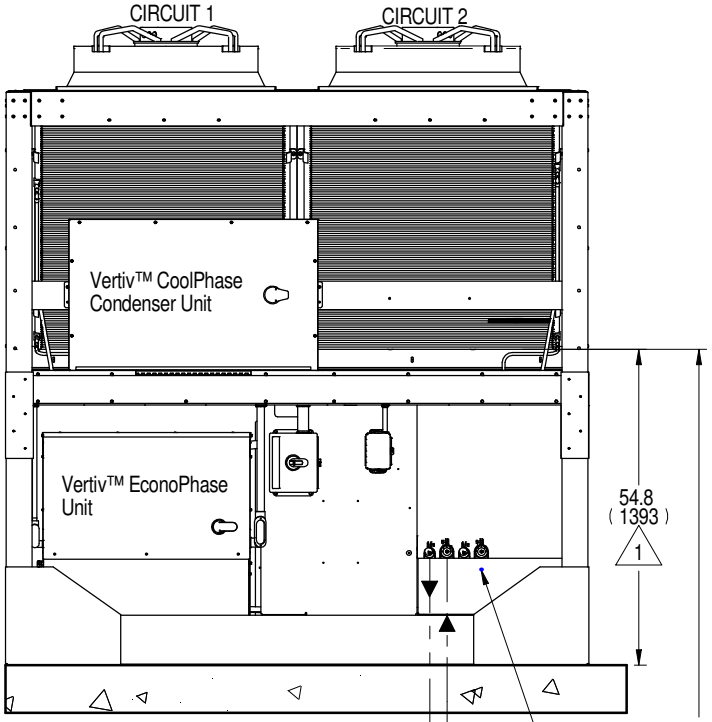
Notes:

1. The bottom of the condenser coil must be less than 15 ft (4.6 m) below the elevation of the EEV inside the indoor unit.
2. Unit must be trapped at bottom of riser with any rise over 5 ft (1.5 m) high. If rise exceeds 25 feet (7.5m), then a trap is required in 20 ft (6.1 m) increments or evenly divided. DA265 with horizontal discharge has internally installed traps on the hot gas discharge line.
3. Pitch horizontal hot gas piping at a minimum of ½ inch per 10 ft (42 mm per 10 m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
4. Unit piping entrance varies by unit and may be through the top of the unit.
5. All indoor field refrigerant piping must be insulated, ½ in. minimum thickness. All outdoor field refrigeration piping does not need to be insulated. The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. DA265 with horizontal discharge should be piped out the top of unit.
7. Piping for R-410a shown. R-454b enters right or left side or rear (single skid only) of the unit.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

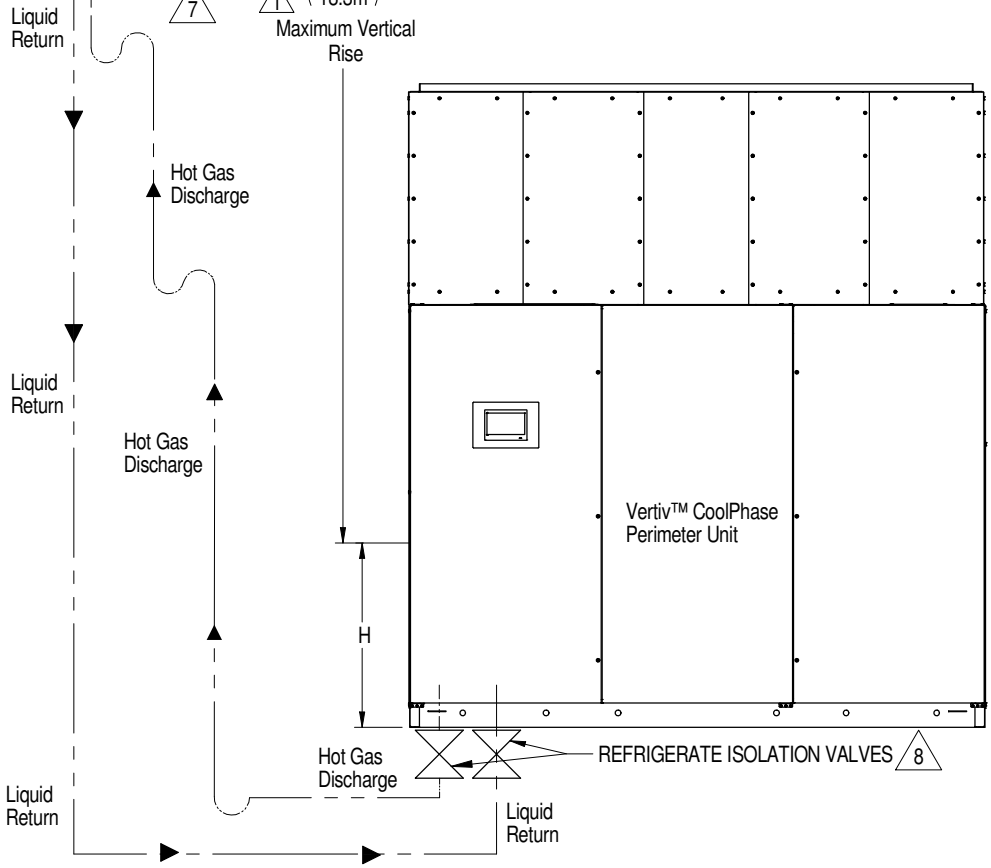
COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC

MCV WITHOUT RECEIVERS MOUNTED ABOVE DA125-DA265



Internal EEV Height	H inch (mm)
DA125-DA165	43 (1092)
DA250	56 (1422)
DA265	56 (1422)



Notes:

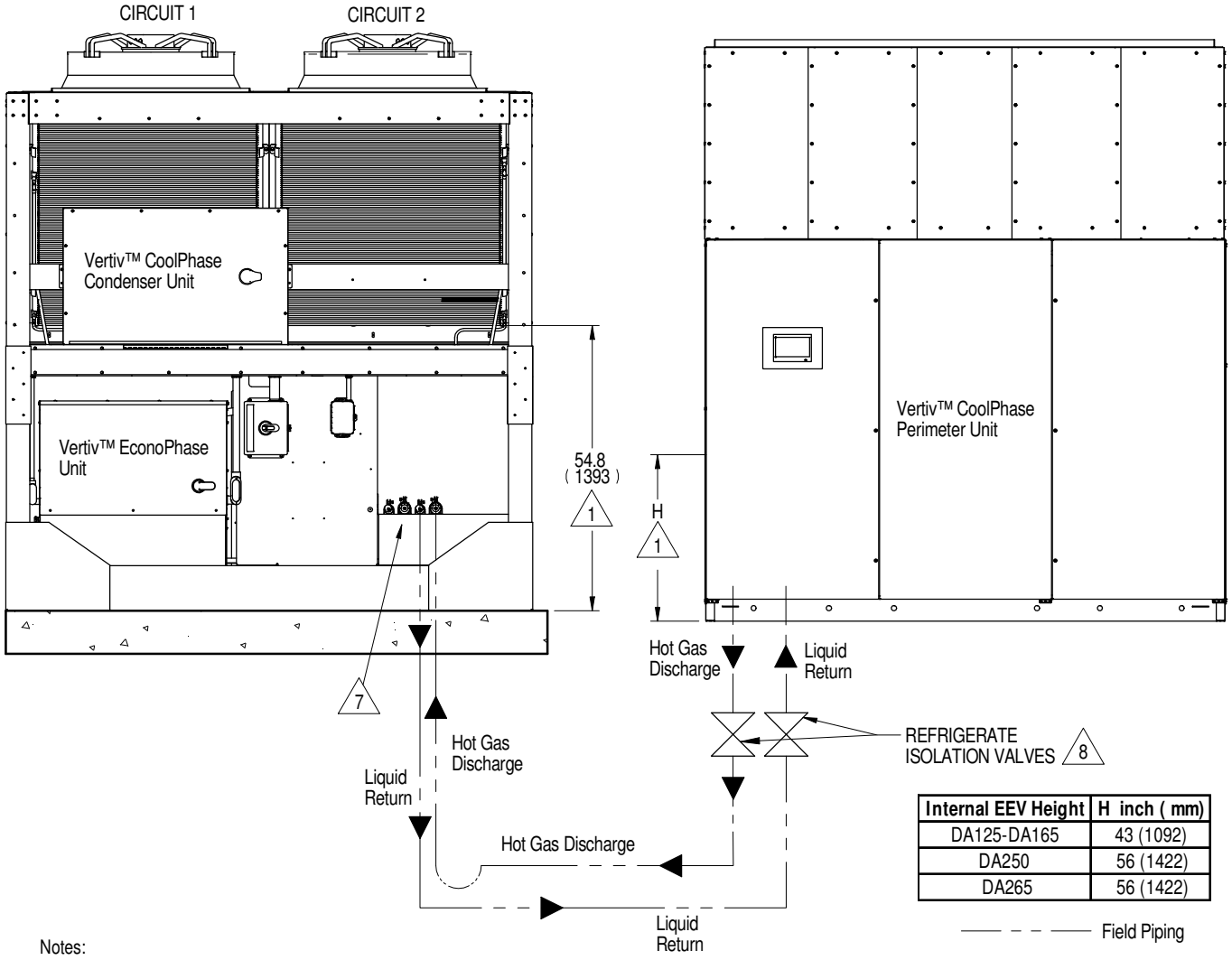
1. The bottom of the condenser coil must be no greater than 60 ft (18.3m) higher than the elevation of the EEV inside the indoor unit.
2. Unit must be trapped at bottom of riser with any rise over 5 feet (1.5m) high. If rise exceeds 25 feet (7.5m), then a trap is required in 20 foot (6.1m) increments or evenly divided. DA265 with horizontal discharge has internally installed traps on the hot gas discharge line.
3. Pitch horizontal hot gas piping at a minimum of ½ inch per 10 feet (42mm per 10m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
4. Unit piping entrance varies by unit and may be through the top of the unit.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated. The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. DA265 with horizontal discharge should be piped out the top of unit.

7. Piping for R-410a shown. R-454b enters right or left side or rear (single skid only) of the unit.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

COOLPHASE PERIMETER

AIR COOLED PIPING SCHEMATIC

DA125-DA265 AND MCV WITHOUT RECEIVERS AT SIMILAR OR BELOW LEVELS



Internal EEV Height	H inch (mm)
DA125-DA165	43 (1092)
DA250	56 (1422)
DA265	56 (1422)

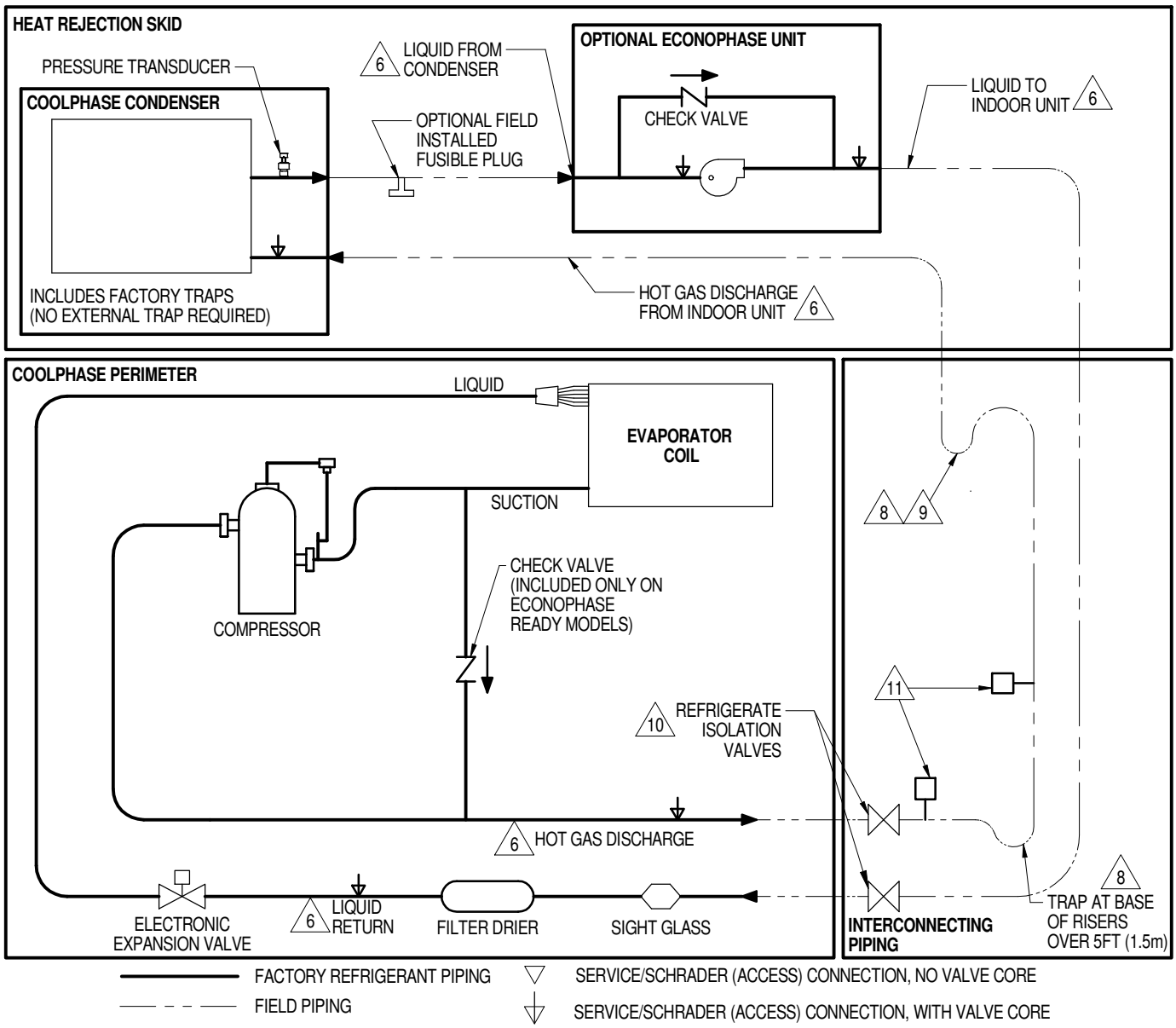
Notes:

1. The bottom of the condenser coil must be less than 15 ft (4.6 m) below the elevation of the EEV inside the indoor unit.
2. Unit must be trapped at bottom of riser with any rise over 5 ft (1.5 m) high. If rise exceeds 25 feet (7.5m), then a trap is required in 20 ft (6.1 m) increments or evenly divided. DA265 with horizontal discharge has internally installed traps on the hot gas discharge line.
3. Pitch horizontal hot gas piping at a minimum of ½ inch per 10 ft (42 mm per 10 m) so that gravity will aid in moving oil in the direction of the refrigeration flow.
4. Unit piping entrance varies by unit and may be through the top of the unit.
5. All indoor field refrigerant piping must be insulated, ½ in. minimum thickness. All outdoor field refrigeration piping does not need to be insulated. The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. DA265 with horizontal discharge should be piped out the top of unit.
7. Piping for R-410a shown. R-454b enters right or left side or rear (single skid only) of the unit.
8. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.

COOLPHASE PERIMETER

PIPING SCHEMATIC

DA050, DA080, & DA085 W/ WITHOUT RECEIVERS

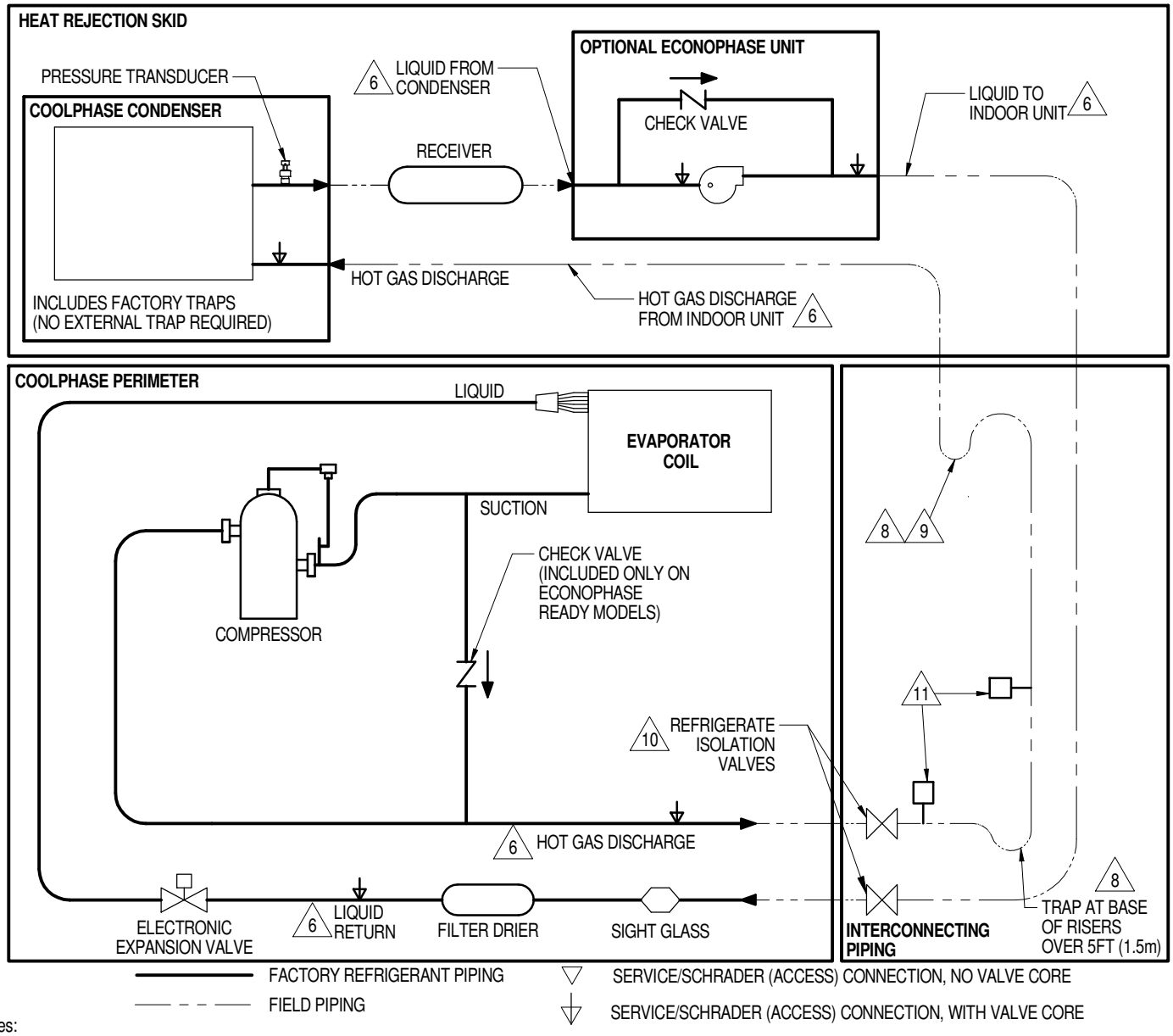


Notes:

1. Single refrigeration circuit provided on DA050. Two refrigeration circuits provided on DA080 & DA085. Single refrigeration circuit shown for clarity.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the Condenser Coil must be no greater than 60ft. (18.3m) above, and less than 15ft. (4.6m) below the elevation of the EEV inside the indoor unit.
4. Do not isolate any refrigeration circuits from over pressurization protection.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. Circuit 1 and circuit 2 must be maintained between indoor unit, condenser and EconoPhase unit.
7. Traps must be installed and horizontal lines pitched to ensure proper oil return and to reduce liquid flood back to compressor. 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 refrigeration flow.
8. Components are not supplied by Vertiv™ but are required for proper circuit operation and maintenance.
9. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.
10. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.
11. Unit rated maximum 650 psig (45 bar) (see local requirement for relief valve installation).

COOLPHASE PERIMETER

PIPING SCHEMATIC
DA080 & DA085 MODELS WITH RECEIVERS



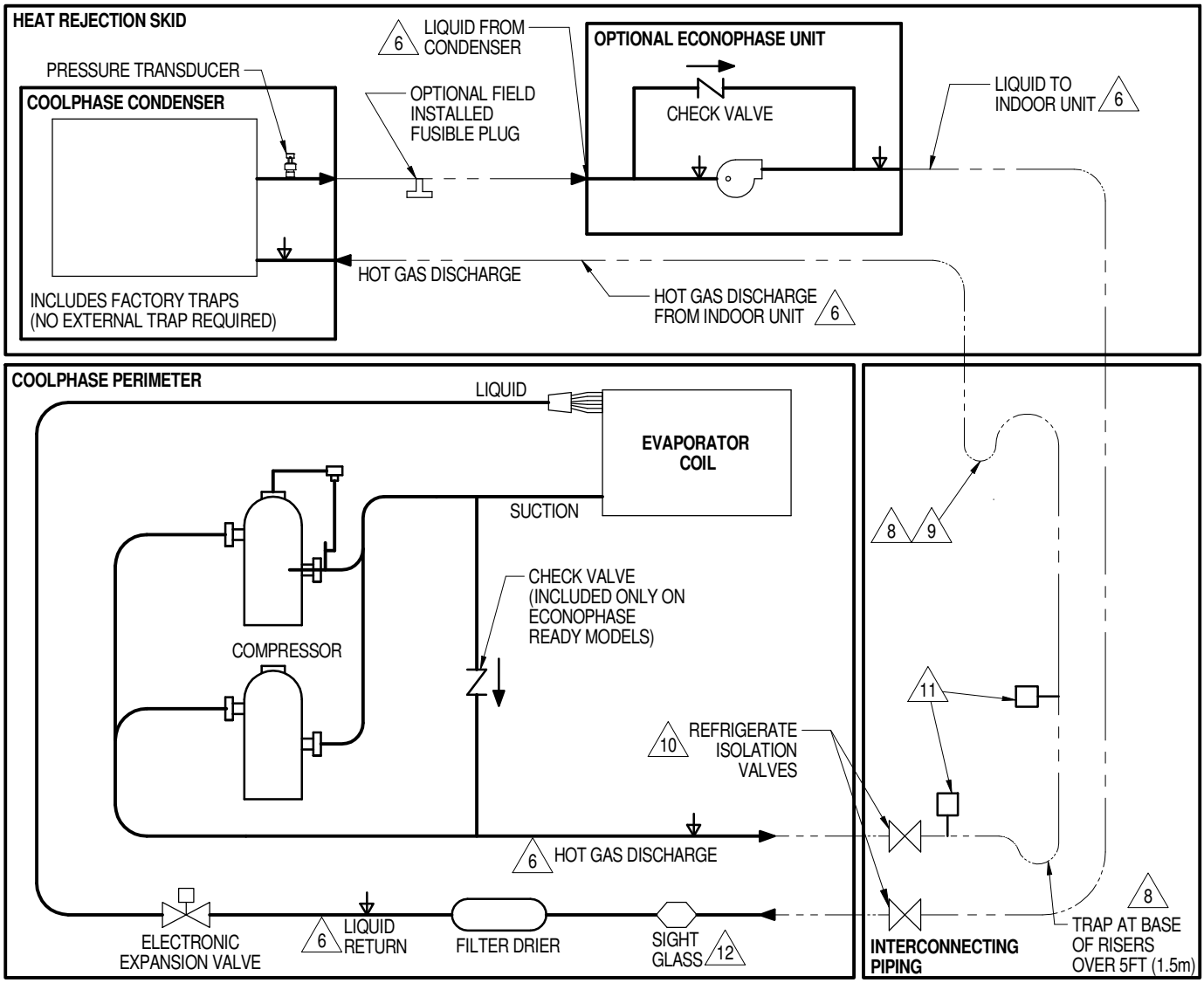
Notes:

1. Two refrigeration circuits provided on DA080 & DA085. Single refrigeration circuit shown for clarity.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the Condenser Coil must be no greater than 60ft. (18.3m) above, and less than 15ft. (4.6m) below the elevation of the EEV inside the indoor unit.
4. Do not isolate any refrigeration circuits from over pressurization protection.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. Circuit 1 and circuit 2 must be maintained between indoor unit, condenser and EconoPhase unit.
7. Traps must be installed and horizontal lines pitched to ensure proper oil return and to reduce liquid flood back to compressor. 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 refrigeration flow.
8. Components are not supplied by Vertiv™ but are required for proper circuit operation and maintenance.
9. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.
10. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.
11. Unit rated maximum 650 psig (45 bar) (see local requirement for relief valve installation).

COOLPHASE PERIMETER

PIPING SCHEMATIC

DA125, DA150, & DA165 WITHOUT RECEIVERS



FACTORY REFRIGERANT PIPING

FIELD PIPING

SERVICE/SCHRADER (ACCESS) CONNECTION, NO VALVE CORE

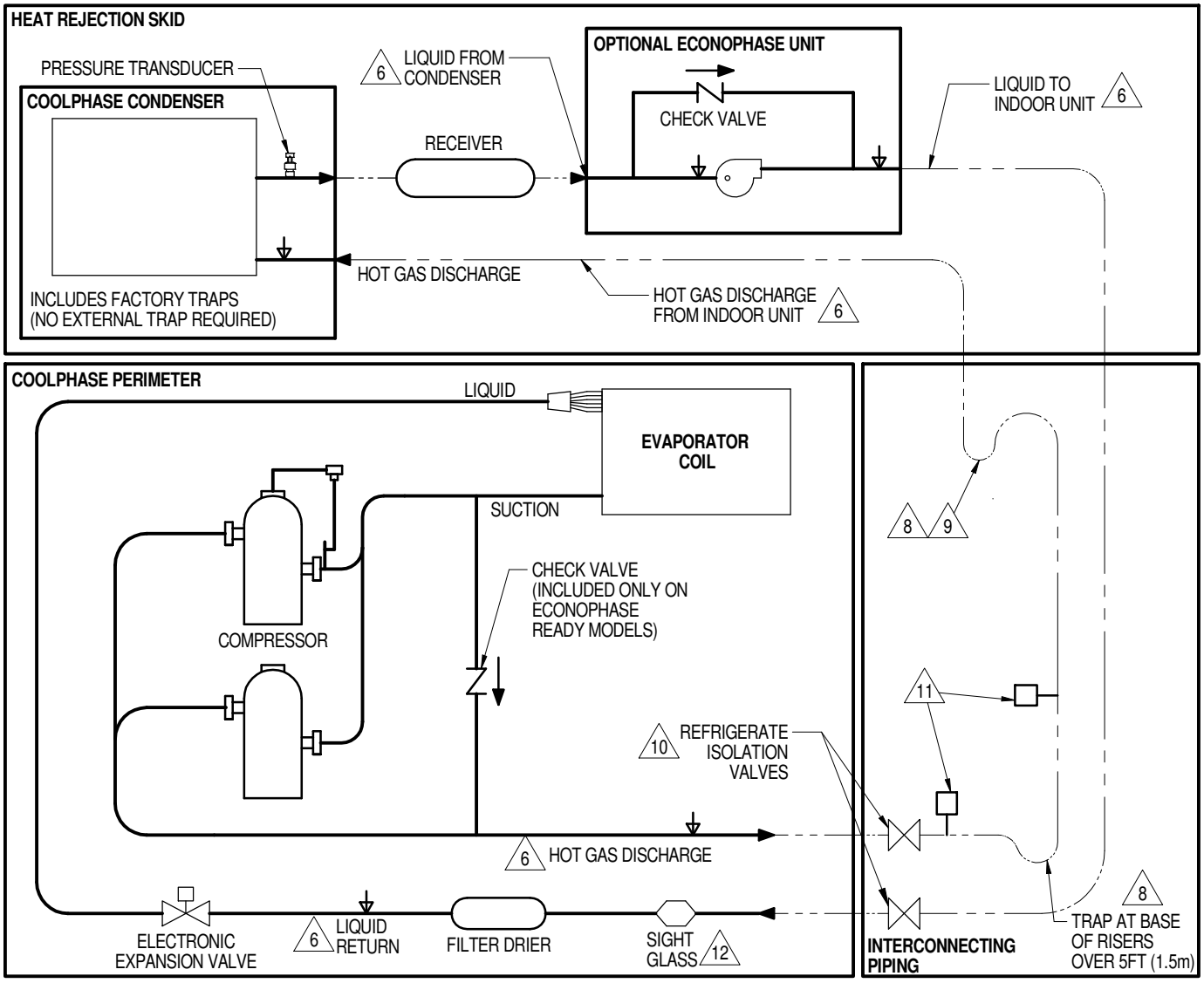
SERVICE/SCHRADER (ACCESS) CONNECTION, WITH VALVE CORE

Notes:

1. Two refrigeration circuits provided. Single refrigeration circuit shown for clarity.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the Condenser Coil must be no greater than 60ft. (18.3m) above, and less than 15ft. (4.6m) below the elevation of the EEV inside the indoor unit.
4. Do not isolate any refrigeration circuits from over pressurization protection.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. Circuit 1 and circuit 2 must be maintained between indoor unit, condenser and EconoPhase unit.
7. Traps must be installed and horizontal lines pitched to ensure proper oil return and to reduce liquid flood back to compressor. 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 refrigeration flow.
8. Components are not supplied by Vertiv™ but are required for proper circuit operation and maintenance.
9. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.
10. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.
11. Unit rated maximum 650 psig (45 bar) (see local requirement for relief valve installation).
12. Typical location for Sight Glass on DA150 and DA165. On DA125, Sight Glass is located between filter drier and electronic expansion valve.

COOLPHASE PERIMETER

PIPING SCHEMATIC
DA125, DA150, & DA165 WITH RECEIVERS



FACTORY REFRIGERANT PIPING
FIELD PIPING
SERVICE/SCHRADER (ACCESS) CONNECTION, NO VALVE CORE
SERVICE/SCHRADER (ACCESS) CONNECTION, WITH VALVE CORE

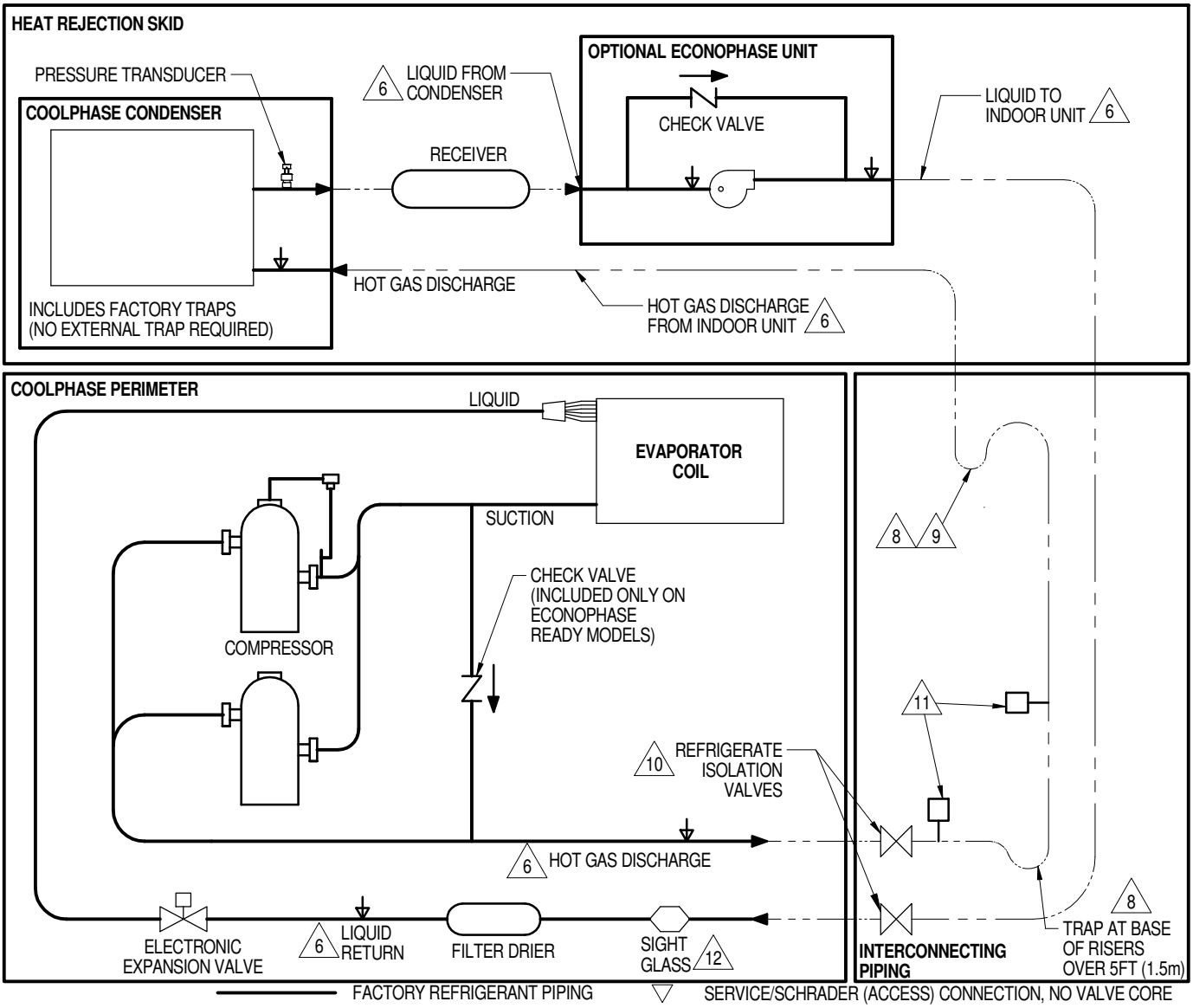
Notes:

1. Two refrigeration circuits provided. Single refrigeration circuit shown for clarity.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the Condenser Coil must be no greater than 60ft. (18.3m) above, and less than 15ft. (4.6m) below the elevation of the EEV inside the indoor unit.
4. Do not isolate any refrigeration circuits from over pressurization protection.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. Circuit 1 and circuit 2 must be maintained between indoor unit, condenser and EconoPhase unit.
7. Traps must be installed and horizontal lines pitched to ensure proper oil return and to reduce liquid flood back to compressor. 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 refrigeration flow.
8. Components are not supplied by Vertiv™ but are required for proper circuit operation and maintenance.
9. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.
10. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.
11. Unit rated maximum 650 psig (45 bar) (see local requirement for relief valve installation).
12. Typical location for Sight Glass on DA150 and DA165. On DA125, Sight Glass is located between filter drier and electronic expansion valve.

COOLPHASE PERIMETER

PIPING SCHEMATIC

DA125, DA150, DA165, & DA250 WITH RECEIVERS



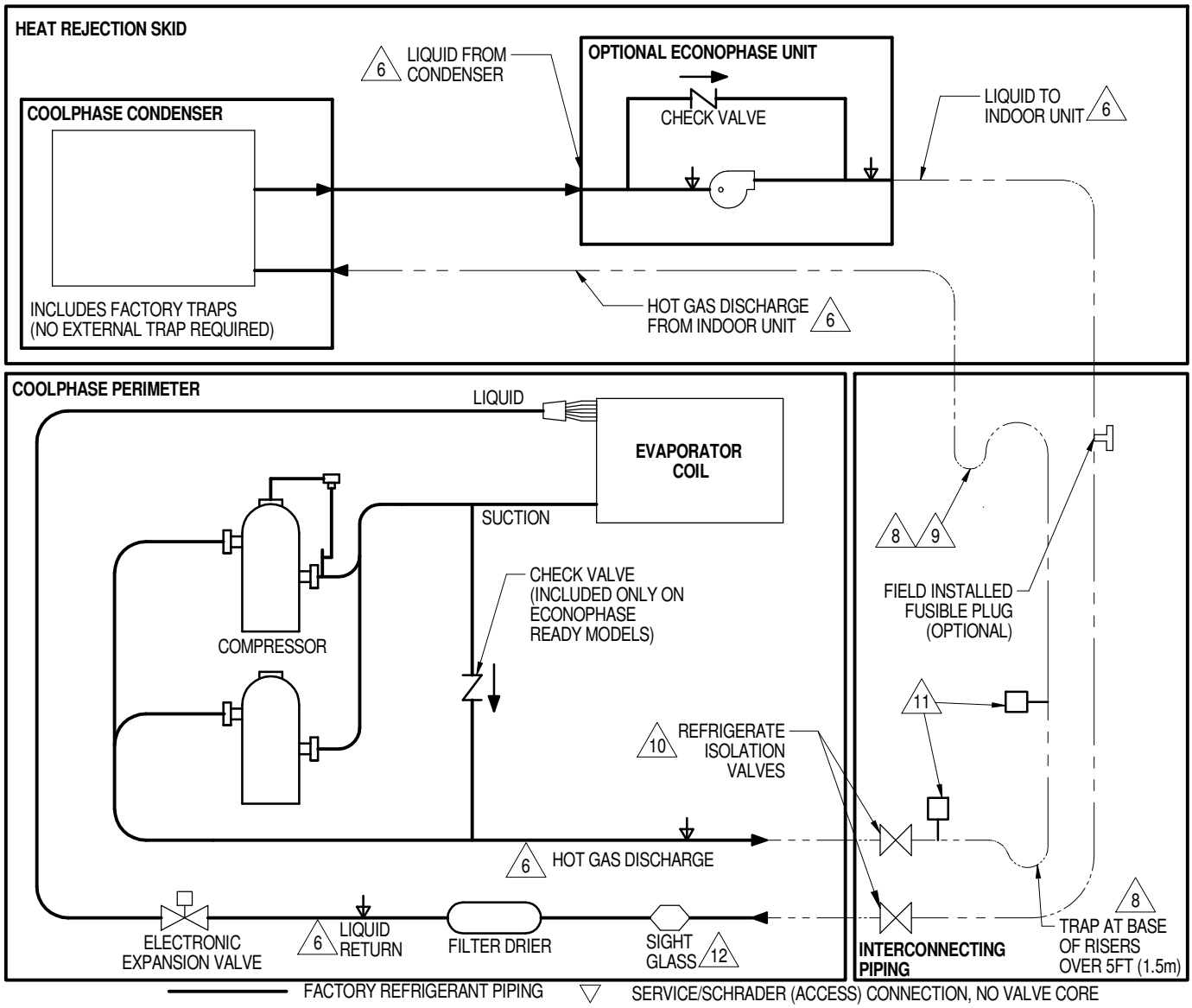
Notes:

1. Two refrigeration circuits provided. Single refrigeration circuit shown for clarity.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the Condenser Coil must be no greater than 60ft. (18.3m) above, and less than 15ft. (4.6m) below the elevation of the EEV inside the indoor unit.
4. Do not isolate any refrigeration circuits from over pressurization protection.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. Circuit 1 and circuit 2 must be maintained between indoor unit, condenser and EconoPhase unit.
7. Traps must be installed and horizontal lines pitched to ensure proper oil return and to reduce liquid flood back to compressor. 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 refrigeration flow.
8. Components are not supplied by Vertiv™ but are required for proper circuit operation and maintenance.
9. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.
10. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.
11. Unit rated maximum 650 psig (45 bar) (see local requirement for relief valve installation).
12. Typical location for Sight Glass on DA150 and DA165. On DA125, Sight Glass is located between filter drier and electronic expansion valve.

COOLPHASE PERIMETER

PIPING SCHEMATIC

DA125, DA150, DA165, DA250, & DA265 WITHOUT RECEIVERS

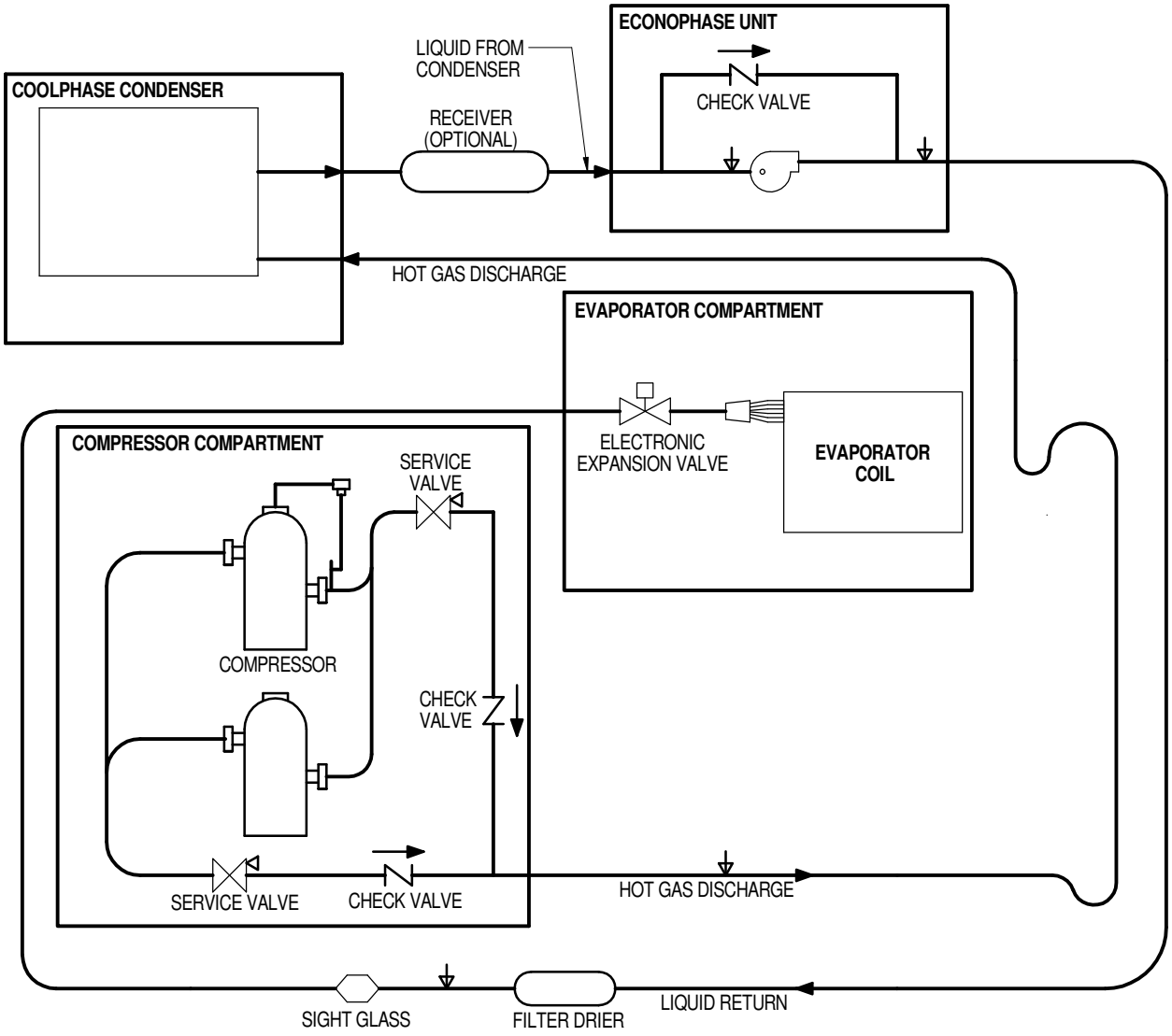


Notes:

1. Two refrigeration circuits provided. Single refrigeration circuit shown for clarity.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the Condenser Coil must be no greater than 60ft. (18.3m) above, and less than 15ft. (4.6m) below the elevation of the EEV inside the indoor unit.
4. Do not isolate any refrigeration circuits from over pressurization protection.
5. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
6. Circuit 1 and circuit 2 must be maintained between indoor unit, condenser and EconoPhase unit.
7. Traps must be installed and horizontal lines pitched to ensure proper oil return and to reduce liquid flood back to compressor. 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 refrigeration flow.
8. Components are not supplied by Vertiv™ but are required for proper circuit operation and maintenance.
9. For rises over 25 ft (7.6 m), trap every 20 ft (6 m) or evenly divided.
10. Vertiv™ requires the installation of external refrigerant isolation valves on both the liquid line entering and the hot gas line leaving the indoor unit. These external isolation valves are necessary to facilitate safe recovery of the refrigerant charge from the indoor unit before servicing the compressors, filter driers, or other refrigeration components. Prior to closing the isolation valve on the liquid line, ensure that the indoor unit is in evacuation mode, which will open the EEV and will allow the migration of liquid refrigerant from this piping.
11. Unit rated maximum 650 psig (45 bar) (see local requirement for relief valve installation).
12. Typical location for Sight Glass on DA150 and DA165. On DA125, Sight Glass is located between filter drier and electronic expansion valve.

ECONOPHASE

PIPING SCHEMATIC
400/500kW PERIMETER & ROOFTOP UNIT



FACTORY REFRIGERANT PIPING

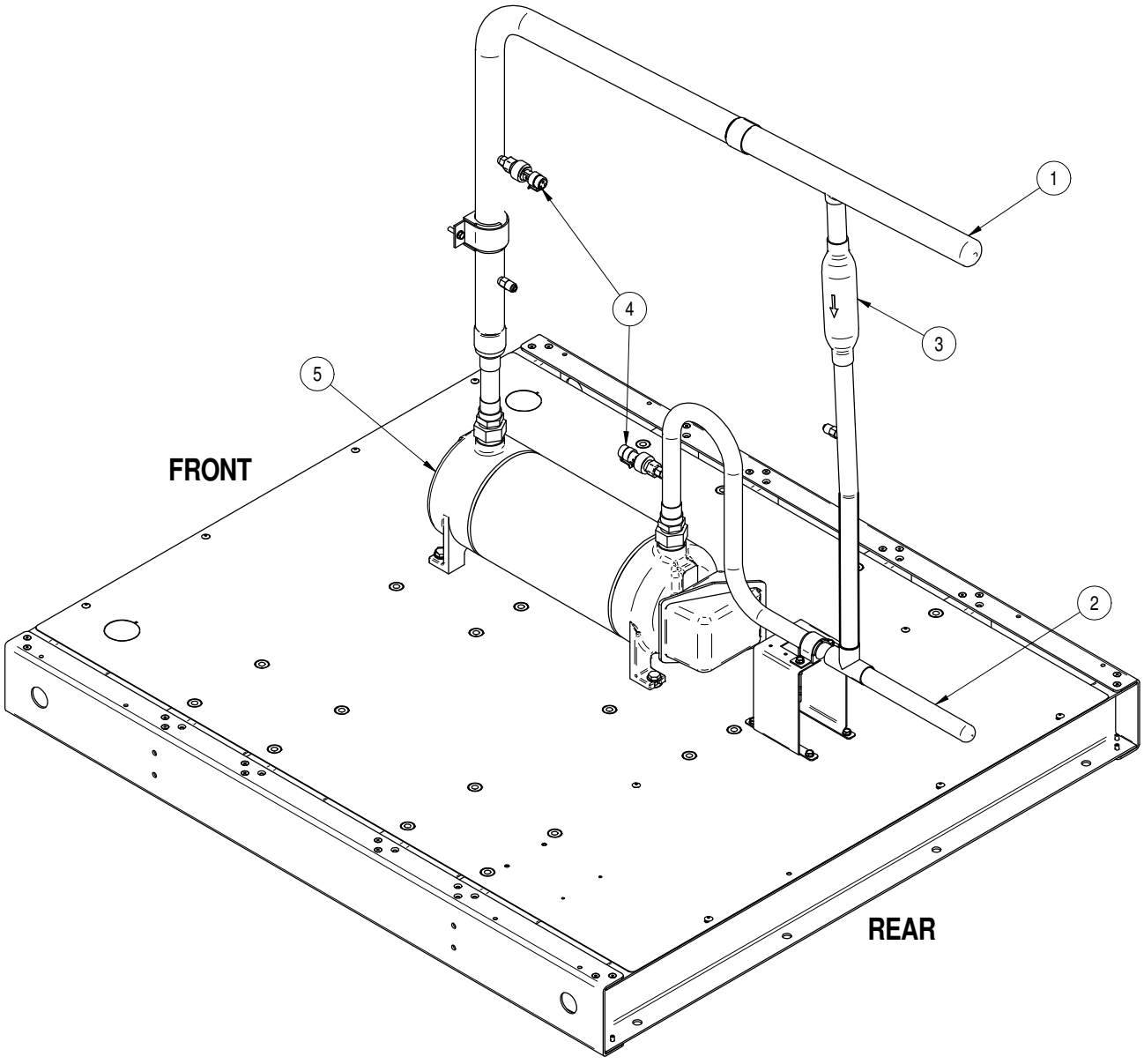
SERVICE/SCHRADER (ACCESS) CONNECTION, NO VALVE CORE

SERVICE/SCHRADER (ACCESS) CONNECTION, WITH VALVE CORE

Notes:
1. Refrigerant charge may need to be adjusted at start-up to optimize system performance. See user manual for additional details.
2. Schematic representation shown. Do not use for specific connection locations.
3. The bottom of the condenser coil must be no greater than 60ft (18.3m) above and less than 15ft (4.6m) below the elevation of the EEV inside the indoor unit.
4. All indoor field refrigerant piping must be insulated, 1/2" minimum thickness. All outdoor field refrigeration piping does not need to be insulated.The installing contractor is responsible for the insulating, securing, protecting and the proper installation of all field refrigerant piping, observing the details outlined by the Engineer of Record.
5. Do not isolate any refrigerant circuits from over pressurization protection.

ECONOPHASE

GENERAL ARRANGEMENT DIAGRAM
PR050 MODELS

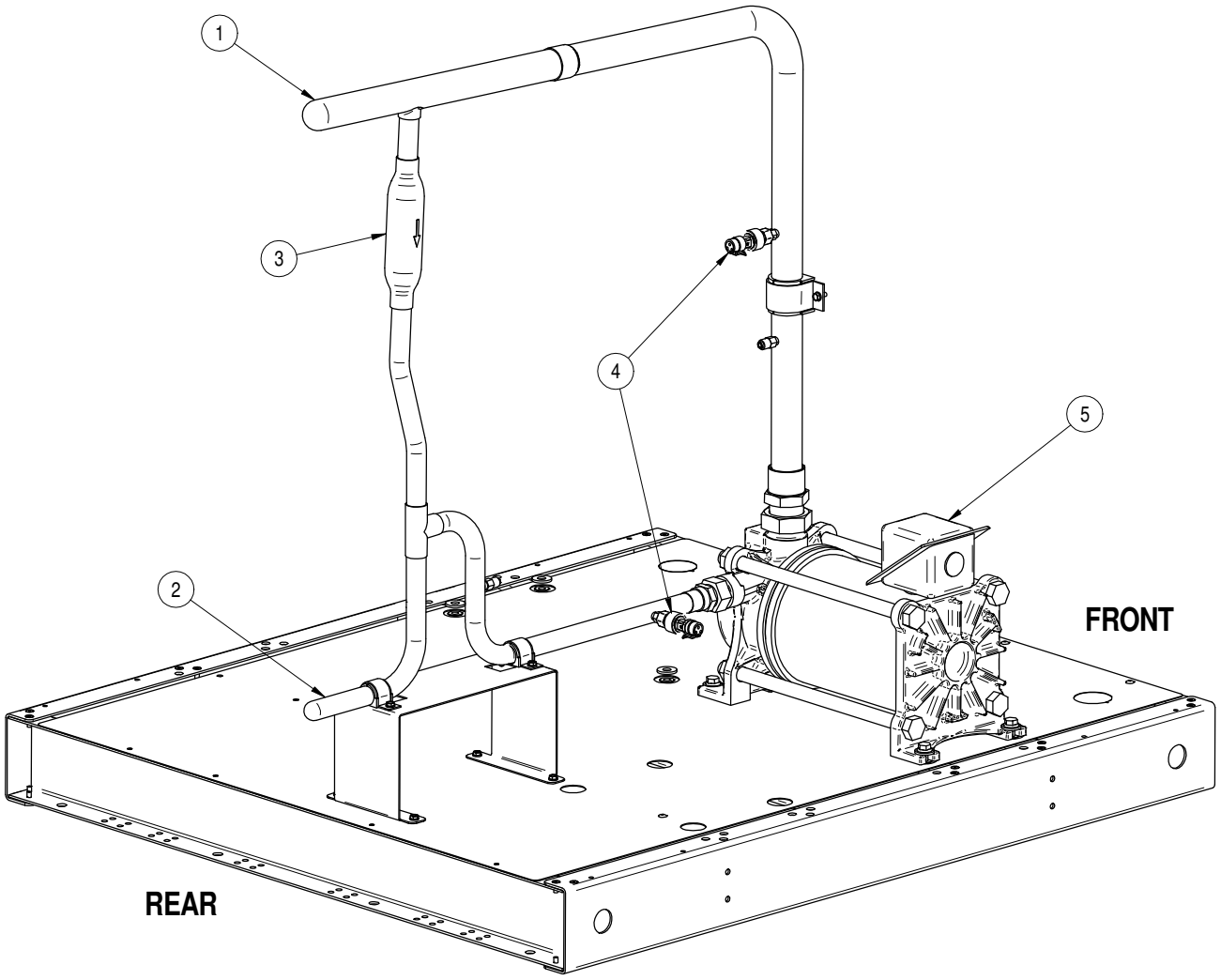


Single Pump Circuit shown
(Panels removed for clarity)

Item #	Description
1	Liquid from Condenser 1-3/8"
2	Liquid to Indoor Unit 7/8"
3	Check Valve
4	Transducer
5	Pump

ECONOPHASE

GENERAL ARRANGEMENT DIAGRAM
PR085, PR125, & PR250 MODELS

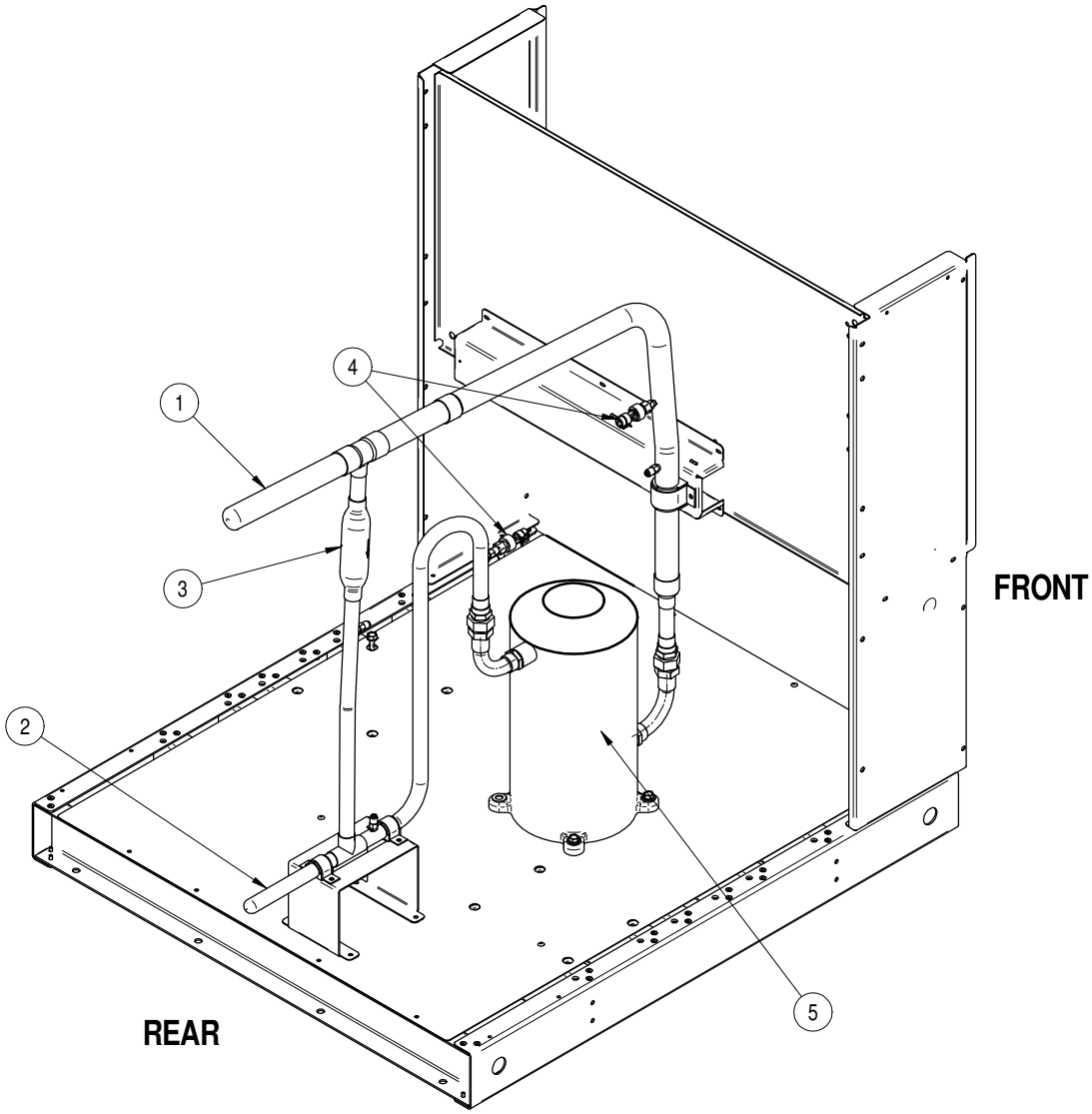


Single Pump Circuit shown
(Typical 2 Circuit Systems)
(Panels removed for clarity)

Item #	Description
1	Liquid from Condenser 1-3/8"
2	Liquid to Indoor Unit 7/8"
3	Check Valve
4	Transducer
5	Pump

ECONOPHASE

GENERAL ARRANGEMENT DIAGRAM
PR200 MODELS

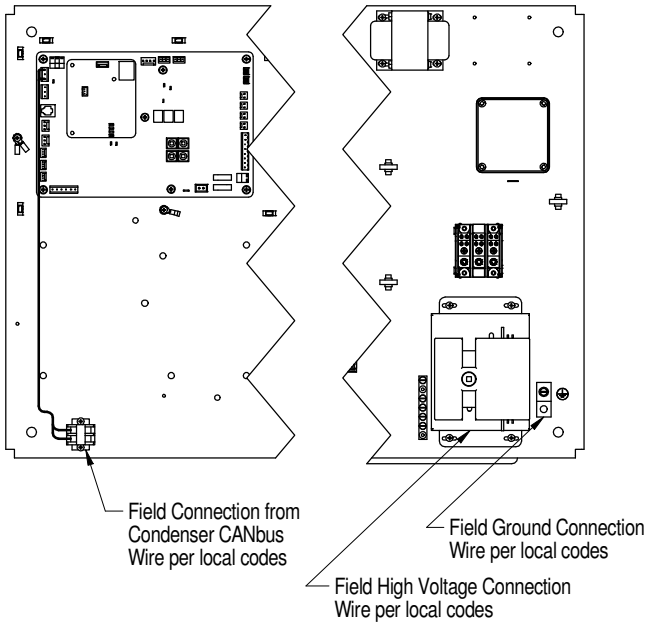


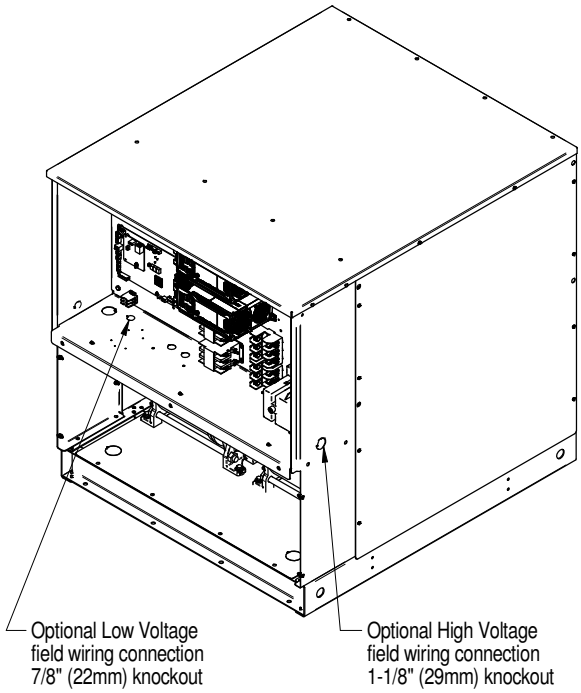
Single Pump Circuit shown
(Typical 2 Circuit Systems)
(Panels removed for clarity)

Item #	Description
1	Liquid from Condenser 1-3/8"
2	Liquid to Indoor Unit 7/8"
3	Check Valve
4	Transducer
5	Pump

ELECTRICAL FIELD CONNECTIONS

PR050 SINGLE CIRCUIT MODELS

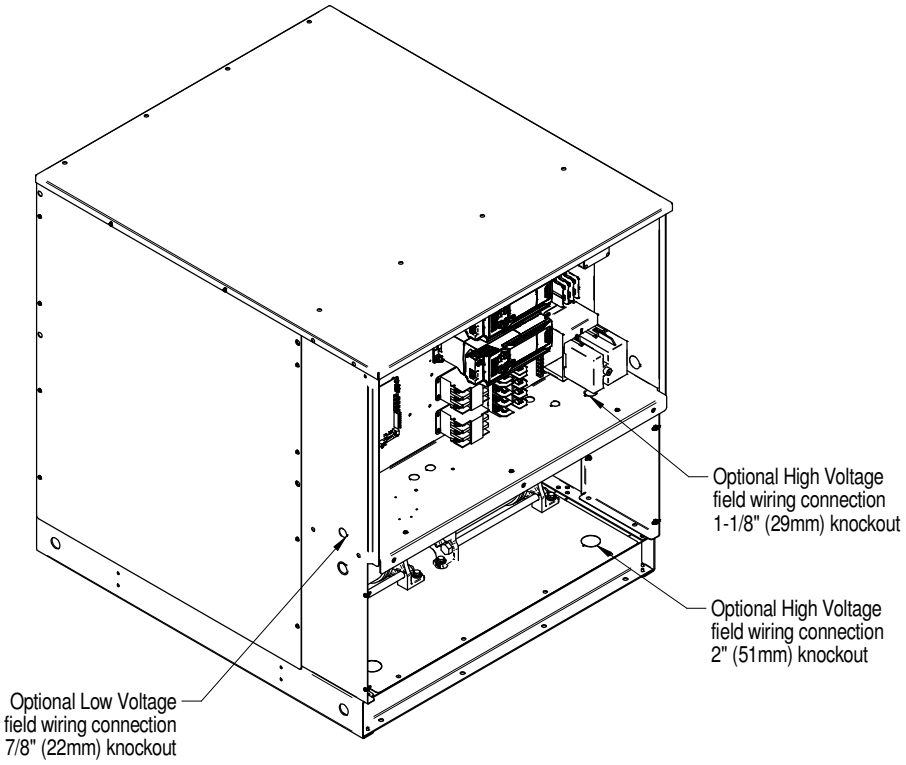


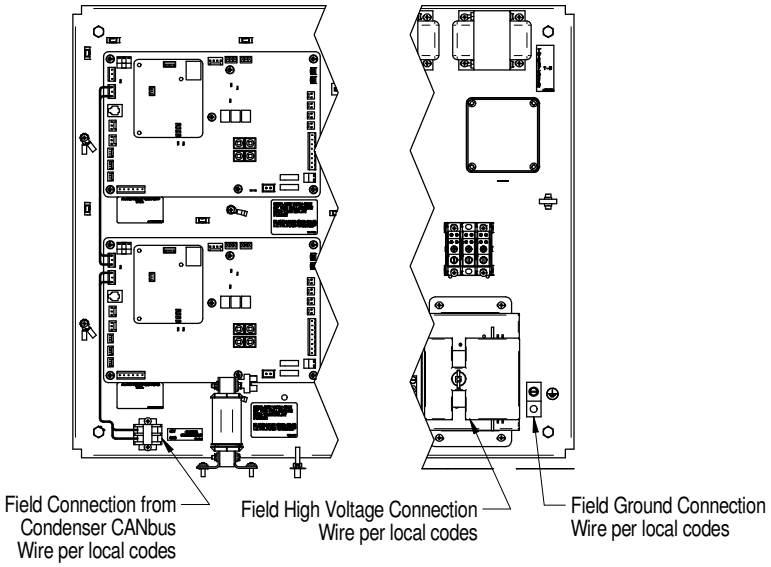


Model	Unit Electrical Specifications						Single Pump Motor	
	Voltage	Phase	Hz	FLA	Minimum Supply Circuit Ampacity	Maximum Fuse Size	HP	FLA
PR050AA***_	460	3	60	3.5	4.4	15	1.6	3.5
PR050AY***_	208/230			6.9	8.6			6.9
PR050AB***_	575			2.8	3.5			3.5
PR050A2***_	380			4.2	5.3			4.2
PR050AG***_	415		50	3.7	4.6		1.2	3.7
PR050AA***H	460		60	1.3	1.6		0.75	1.3
PR050AY***H	208/230			2.6	3.3			2.6
PR050AB***H	575			1	1.3			1.3
PR050A2***H	380			1.6	2			1.6
PR050AG***H	415		50	1.2	1.5			1.2

ECONOPHASE

ELECTRICAL FIELD CONNECTIONS
PR085 - PR250 DUAL CIRCUIT MODELS





ELECTRICAL FIELD CONNECTIONS
PR085 - PR250 DUAL CIRCUIT MODELS

Model	Unit Electrical Specifications						Single Pump Motor (one pump per circuit)	
	Voltage	Phase	Hz	FLA	Minimum Supply Circuit Ampacity	Maximum Fuse Size	HP	FLA
PR085AA***- PR125AA***- PR250AA***2	460	3	60	7.0	7.9	15	1.6	3.5
PR085AY***- PR125AY***- PR250AY***2	208/230			13.8	15.5	20		6.9
PR085AB***- PR125AB***- PR250AB***2	575			5.6	6.3	15		3.5
PR085A2***- PR125A2***- PR250A2***2	380			8.4	9.5			4.2
PR085AG***- PR125AG***- PR250AG***2	415		50	7.4	8.3		1.2	3.7
PR085AA***H	460		60	2.6	2.9		0.75	1.3
PR085AY***H	208/230			5.2	5.9			2.6
PR085AB***H	575			2	2.3			1.3
PR085A2***H	380			3.2	3.6			1.6
PR085AG***H	415		50	2.4	2.7			1.2
PR200AA***3	460		60	4.6	5.2		1.5	2.3
PR125A2***4	380			7.8	8.8			3.9
PR125AA***4	460			6.4	7.2			3.2
PR125AB***4	575			5.2	5.9			2.6
PR200AB***3	575			3.6	4.1			1.8
PR200A2***3	380			5.6	6.3			2.8
PR250A2***5	380			7.8	8.8			3.9
PR250AA***5	460			6.4	7.2			3.2
PR250AB***5	575			5.2	5.9			2.6
PR250AA ***6	460			7.0	7.9		1.6	3.5

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