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Important!

Read before proceeding!

General safety guidelines

This equipment is a relatively complicated apparatus. During rigging, installation, operation, maintenance, or service, individuals may be exposed to certain components or conditions including, but not limited to: heavy objects, refrigerants, materials under pressure, rotating components, and both high and low voltage. Each of these items has the potential, if misused or handled improperly, to cause bodily injury or death. It is the obligation and responsibility of rigging, installation, and operating/service personnel to identify and recognize these inherent hazards, protect themselves, and proceed safely in completing their tasks. Failure to comply with any of these requirements could result in serious damage to the equipment and the property in which it is situated, as well as severe personal injury or death to themselves and people at the site.

This document is intended for use by owner-authorized rigging, installation, and operating/service personnel. It is expected that these individuals possess independent training that will enable them to perform their assigned tasks properly and safely. It is essential that, prior to performing any task on this equipment, this individual shall have read and understood the on-product labels, this document and any referenced materials. This individual shall also be familiar with and comply with all applicable industry and governmental standards and regulations pertaining to the task in question.

Safety symbols

The following symbols are used in this document to alert the reader to specific situations:

- **DANGER**
  
  Indicates a possible hazardous situation that will result in death or serious injury if proper care is not taken.

- **WARNING**
  
  Indicates a potentially hazardous situation which will result in possible injuries or damage to equipment if proper care is not taken.

- **CAUTION**
  
  Identifies a hazard which could lead to damage to the machine, damage to other equipment and/or environmental pollution if proper care is not taken or instructions are not followed.

**Note:** Highlights additional information useful to the technician in completing the work being performed properly.
WARNING

External wiring, unless specified as an optional connection in the manufacturer’s product line, is not to be connected inside the control cabinet. Devices such as relays, switches, transducers and controls and any external wiring must not be installed inside the micro panel. All wiring must be in accordance with the manufacturer’s published specifications and must be performed only by a qualified electrician. The manufacturer will NOT be responsible for damage/problems resulting from improper connections to the controls or application of improper control signals. Failure to follow this warning will void the manufacturer’s warranty and cause serious damage to property or personal injury.

WARNING: This product can expose you to chemicals including formaldehyde, which is known to the state of California to cause cancer. For more information, go to http://www.P65Warnings.ca.gov.

Changeability of this document

In complying with the manufacturer’s policy for continuous product improvement, the information contained in this document is subject to change without notice. There is no commitment to update or provide current information automatically to the manual or product owner. Updated manuals, if applicable, can be obtained by contacting the nearest service office.

It is the responsibility of rigging, lifting, and operating/service personnel to verify the applicability of these documents to the equipment. If there is any question regarding the applicability of these documents, rigging, lifting, and operating/service personnel should verify whether the equipment has been modified and if current literature is available from the owner of the equipment prior to performing any work on the equipment.

Revision notes

Revisions made to this document are indicated in the following table. These revisions are to technical information, and any other changes in spelling, grammar, or formatting are not included.

<table>
<thead>
<tr>
<th>Affected pages</th>
<th>Description</th>
<th>Date implemented</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Revised VAV supply pressure control section</td>
<td>February 2020</td>
</tr>
<tr>
<td>17–28</td>
<td>Removed optional return air grille from Dimensional data drawings</td>
<td>February 2020</td>
</tr>
</tbody>
</table>
### Associated literature

<table>
<thead>
<tr>
<th>Manual description</th>
<th>Form number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable Frequency Drive (VFD) for Self-Contained Units Installation and Operation Instructions</td>
<td>145.13-NO1</td>
</tr>
<tr>
<td>Water Regulating Valve Kit for CSV096B-300B Units Installation Instructions</td>
<td>145.15-N1</td>
</tr>
<tr>
<td>Left-Hand Waterside Economizer (Model CVWSEK-060) for CSV060B Installation Instructions</td>
<td>145.15-IOM1</td>
</tr>
<tr>
<td>Right-Hand Waterside Economizer (Model CVWSEK-060) for CSV060B Installation Instructions</td>
<td>145.15-IOM1.1</td>
</tr>
<tr>
<td>Left-Hand Waterside Economizer (Model CVWSEK-120) for CSV096B/120B Installation Instructions</td>
<td>145.15-IOM2</td>
</tr>
<tr>
<td>Right-Hand Waterside Economizer (Model CVWSEK-120) for CSV096B/120B Installation Instructions</td>
<td>145.15-IOM2.1</td>
</tr>
<tr>
<td>Left-Hand Waterside Economizer (Model CVWSEK-180) for CSV180B Installation Instructions</td>
<td>145.15-IOM3</td>
</tr>
<tr>
<td>Right-Hand Waterside Economizer (Model CVWSEK-180) for CSV180B Installation Instructions</td>
<td>145.15-IOM3.1</td>
</tr>
<tr>
<td>Left-Hand Waterside Economizer (Model CVWSEK-240) for CSV240B Installation Instructions</td>
<td>145.15-IOM4</td>
</tr>
<tr>
<td>Right-Hand Waterside Economizer (Model CVWSEK-240) for CSV240B Installation Instructions</td>
<td>145.15-IOM4.1</td>
</tr>
<tr>
<td>Left-Hand Waterside Economizer (Model CVWSEK-300) for CSV300B Installation Instructions</td>
<td>145.15-IOM5</td>
</tr>
<tr>
<td>Right-Hand Waterside Economizer (Model CVWSEK-300) for CSV300B Installation Instructions</td>
<td>145.15-IOM5.1</td>
</tr>
</tbody>
</table>
Nomenclature

Water-cooled self-contained unit

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
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</thead>
<tbody>
<tr>
<td>CS</td>
<td>V</td>
<td>180</td>
<td>B</td>
<td>2</td>
<td>M</td>
<td>1</td>
<td>V</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>0</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Product Category
CS = Water-Cooled Packaged A/C, R-410A

Product Identifier
V = Vertical, Free Standing

Nominal Capacity
060 = 5 TON
096 = 8 TON
120 = 10 TON
180 = 15 TON
240 = 20 TON
300 = 25 TON

Design Series
B = Current

Voltage
2 = 208/230-60-3
4 = 460-60-3
5 = 575-60-3

Control Options
M = Std Microprocessor Controls

ID Motor
1 = Std
2 = High Static
3 = Std cw VFD & Transducer
4 = High Static cw VFD & Transducer
5 = Std VFD 2 Speed
6 = High Static VFD 2 Speed

Miscellaneous Options
A = None
D = Condensate Overflow Switch

Heating Options
0 = None

Refrigerant Circuit Options
A = None
B = Hot Gas Bypass

Condenser Options
A = Left Hand Water Connections
B = Right Hand Water Connections

Water Coil Options
A = Std Water Coil
N = Cupro-nickel Water Coil

Indoor Air-side Options
A = Std Air-side Coil
C = Corrosion Protective Coating
D = Stainless Steel Drain Pan
F = Coated Coil w/ S-S Drain Pan

Supply Air Discharge Configuration
V = Top Vertical
H = Front Horizontal
Installation

General information

All models 5–20 tons are shipped as factory-charged unitized packages. The 25-ton model is shipped factory split with nitrogen holding charge only. Refer to Start-up and operation for charge information.

All models can be selected with either a horizontal (front) or vertical (top) fan discharge. The evaporator fan discharge configuration is field convertible on all units. Refer to Evaporator blower discharge conversion for more information.

The 5-ton unit utilizes a single compressor. All 8–25 ton models are dual compressor units with two independent refrigerant circuits. All units come standard with a microprocessor control board with safety controls and troubleshooting LED (refer to Checking superheat and subcooling).

CAUTION

Only qualified personnel should perform installation and service of this equipment.

Pre-installation inspection of equipment

All units are factory tested to ensure safe operation and quality assembly. Units are packaged and sealed on shipping skids and shipped in first class condition. Torn and broken packaging and scratched or dented panels should be reported to carrier immediately. Internal inspection of all units should be performed prior to installation. Remove all access doors and check for visual defects that can occur during transport. Any problems found internally should be reported to carrier and manufacturer immediately. Refrigerant circuit should be checked to ensure no leaks have occurred during shipment. Install gauge set to high and low pressure ports to confirm pressure has been maintained and no leaks have occurred during shipment. Repair any damage prior to installation to ensure safe operation.

Note: Record any unit damage on the Bill of Lading and report to carrier and factory immediately. Shipping and handling damages are not warranty items.

Rigging

WARNING

Prior to mounting unit, check individual unit weights (Table 1) and verify lifting capacity of lifting equipment exceeds weight of units by safe margins. Failure to do so may result in unit damage, personal injury, or even death.

To ensure safe installation of the unit when ceiling mount application is specified, estimate the approximate center of gravity of the unit. The configuration of internal components for each unit is different and weight is unevenly distributed.
WARNING

Follow all applicable regulations and safety practices during rigging and lifting. Prepare and follow written rigging and lifting plan. Lifting must be directed by trained professional rigger. Spreader bars must be used and be long enough to prevent rigging from contacting unit. Use all and only designated lift points according to unit’s manual(s).

WARNING

Determine the actual center of gravity of the unit by performing a test lift. Lifting an unbalanced unit can cause personal injury or even death.

Installation site

WARNING

Lock all electrical power supply switches in the OFF position before installing the unit. Failure to disconnect power supply may result in electrical shock or even death.

WARNING

Do not install this unit outdoors.

WARNING

The system should be installed by qualified personnel. If not, it may cause water leakage, electric shock, or fire.

DANGER

Do not install units in a flammable environment due to the danger of an explosion.

DANGER

A compressor/unit comprises a pressurized system. Never loosen threaded joints while the system is under pressure, and never open pressurized system parts.
WARNING

Safety guards, shields, barrier, covers, and protective devices must not be removed while the compressor/unit is operating.

WARNING

All safety features, disengagement and interlocks must be in place and function correctly before the equipment is put into operation. Never bypass or wire around any safety device.

WARNING

Use gloves, protective goggles, and where appropriate, make sure to have a gas mask close at hand. Also use electrical protection equipment and tools suited for electrical operation purposes.

Location

To ensure unit operates at maximum efficiencies, choose a dry indoor area where the temperature is controlled between 50.0 °F and 115.0 °F. Consideration of surrounding areas should be taken when choosing a location to install the unit. Common vibration and sound levels associated with commercial equipment may be objectionable to people or equipment.

CAUTION

Failure to allow adequate space between units may result in poor unit performance and possible unit failure.

Install thermostats, air supplies, and returns so that each unit will operate only on individual unit control. To assure fast drainage of condensate run-off, unit can be slightly pitched in the same direction as drain pan outlet.

Table 1: CSV operating weight (lbs)

<table>
<thead>
<tr>
<th>Unit</th>
<th>Operating weight (condenser only)</th>
<th>Shipping weight (condenser only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSV060B</td>
<td>590</td>
<td>635</td>
</tr>
<tr>
<td>CSV096B</td>
<td>795</td>
<td>835</td>
</tr>
<tr>
<td>CSV120B</td>
<td>955</td>
<td>995</td>
</tr>
<tr>
<td>CSV180B</td>
<td>1310</td>
<td>1365</td>
</tr>
<tr>
<td>CSV240B</td>
<td>1465</td>
<td>1525</td>
</tr>
<tr>
<td>CSV300B</td>
<td>1930 (780)</td>
<td>2265 (980)</td>
</tr>
</tbody>
</table>
Unit mounting

The 5–20 ton models are shipped as a fully assembled integral package. The 25-ton model ships factory split with nitrogen holding charge only. Factory provided couplings are included for field assembly of the 25-ton model.

If required, units may be field split to allow for passage through doors, elevators, hallways, etc. Duct flanges for evaporator return are incorporated into the filter rack.

Units should be secured on a solid, level pad or sturdy stand. The use of an isolating rubber sheet is recommended to reduce vibration and noise transmission. Ensure that the entire base is continuously supported; **DO NOT SUPPORT UNIT AT CORNER POINTS ONLY!** Unit may be pitched slightly to ensure efficient drainage of condensate.

Blower section/condenser separation (CSV060B–CSV180B models)

The 5–15 ton models allow for easy removal of the blower section:

- Disconnect the evaporator motor high voltage wires. Pull all wiring into the evaporator compartment. Remove bushing/clamp from routing hole for evaporator motor wiring.
- Remove corner securing brackets from the outside corners of the cabinet, at the joint line between the blower and evaporator sections.
- Remove the blower section.

Evaporator/condenser separation (CSV240B model)

The 20-ton model requires the evaporator to be separated from the condenser:

- Reclaim the entire refrigerant charge from each compressor circuit.
- Disconnect the evaporator motor high voltage wires. Pull all wiring into the evaporator compartment. Remove bushing/clamp from routing hole for evaporator motor wiring.
- Cut and remove sections of all liquid and suction refrigerant lines. Units with optional Hot Gas Bypass will also require to be cut. Make two cuts in each line, approximately 6 inches above and below the evaporator floor/condenser roof.

**CAUTION**

Use a TUBING CUTTER ONLY; do not use a hacksaw to cut refrigerant tubing, otherwise serious damage can occur to refrigeration system!

- Remove corner securing brackets from the outside corners of the cabinet at the joint line between the evaporator and condenser sections.
- Remove the evaporator section.

Assembly of split units (CSV240B–CSV300B models)

The 25-ton model comes factory split and includes copper pipe couplings for assembly. Corner brackets are shipped inside the unit.

- Place the condenser section in the required location.
• Carefully position the evaporator section atop the condensing section. Align all sides, the evaporator motor wire routing hole, and the refrigerant line routing holes.

• Install the securing brackets at all four corners, on the evaporator/condenser separation joint.

• For the 25-ton model, cut off spun copper ends on each refrigerant pipe in evaporator and condenser. Units with optional Hot Gas Bypass will also require to have spun ends cut. Cut pipe to appropriate length to fit on couplings. Ensure circuit 1 from condenser connects to circuit 1 piping in evaporator; follow the same procedure for circuit 2. Do not cross circuits.

• Braze copper couplings to refrigerant pipe while using a flow of nitrogen gas through the refrigerant piping to minimize contamination to internal piping. Otherwise, fouling and damage to unit may occur. Use the service gauge ports for this procedure to introduce nitrogen flow. Once complete, pressure test with nitrogen (500 psig).

• Evacuate each circuit to at least 350 microns. If gauge pressure rises above 500 microns in one minute, evacuation is incomplete or the system has a leak.

• Charge circuit(s) to the value indicated on the unit nameplate, or see Start-up and operation.

• Install bushing/clamp into evaporator wiring routing hole, and pull wires through into electrical control panel. Connect motor leads to load terminals on contactor/overload relay.

   Note: Ensure evaporator motor rotation is correct upon unit start-up. Switch any two wires at contactor if blower rotation is not correct.

Water piping

All factory installed water piping terminates at the face of the unit and features a wrenchless connection. Multi-condenser units feature manifolded single water in and out connections.

**CAUTION**

Water connection fittings are threaded copper. Use caution when tightening steel pipe into copper fittings.

It is recommended that flexible connectors be provided on the water supply and return lines if noise and vibration transmission could be a problem.

Installer should include shutoff/balancing valves to the water piping so that the unit can be serviced without shutting down and draining the entire water supply circuit. Since units are piped in parallel piping circuits, the shutoff valves may be used to equalize the pressure drop to each branch for even condenser water distribution. A bibcock or a plugged tee fitting should be installed between the shutoff valves and the unit in both the inlet and outlet pipes. These connections are to provide for acid cleaning of the condenser, if this should become necessary.

Units can be factory supplied with water piping in either left-hand (typical, as shown in dimensional drawings) or right-hand configuration.

Waterside economizer

Optional Waterside economizer can be ordered as an accessory from the factory. When entering fluid temperatures are appropriate, unit will power off compressors and divert fluid to water coil to minimize power consumption. The control setpoint for the economizing cycle is user-adjustable (recommended operating setpoint is 55.0 °F). Equipped with water coil, internally mounted compressor, and temperature staging control panel and a three-way diverting valve. Refer to
the appropriate Waterside Economizer Installation, Operation, and Maintenance manuals for more
information on installation and sequence of operation:

- For CSV060B, see Form 145.15-IOM1 (left hand) or Form 145.15-IOM1.1 (right hand)
- For CSV096B/120B, see Form 145.15-IOM2 (left hand) or Form 145.15-IOM2.1 (right hand)
- For CSV180B, see Form 145.15-IOM3 (left hand) or Form 145.15-IOM3.1 (right hand)
- For CSV240B, see Form 145.15-IOM4 (left hand) or Form 145.15-IOM4.1 (right hand)
- For CSV300B, see Form 145.15-IOM5 (left hand) or Form 145.15-IOM5.1 (right hand)

**Figure 1: Waterside economizer**
Water regulating valve kit

Optional Water Regulating Valve Kit modulates the condenser water flow in order to control the condensing pressure in each refrigeration circuit. Valves open and close in response to rise and fall of the condensing pressure as sensed by the capillary tube, which is connected to the liquid line access fittings of the respective refrigerant circuits.

When the valves are properly installed and adjusted, water flow will automatically decrease as the discharge pressure falls and will increase as the discharge pressure rises. Refer to the Water Regulating Valve Kit for CSV096B-300B Installation manual (Form 145.15-N1) for more information on installation and operation.

![WARNING]

UNAUTHORIZED CUSTOMER MODIFICATIONS TO CERTIFIED PRODUCTS ARE PROHIBITED. The manufacturer has certified the product as being compliant with applicable government and/or industry standards.

Note: Product certification is designated either on the product itself or in the product literature. The certification mark identifies the applicable standards as well as the Nationally Recognized Test Lab (NRTL) or other testing facility that conducted the testing, where applicable. If changes are made to the product, an engineering review will be needed to assess the impact to the product certification. In some instances, the changes may be such that the NRTL or testing facility will need to review and potentially reapprove of the product by means of a field or site inspection and certification. Any person or entity making changes to the product is responsible for obtaining any necessary engineering review and reapproval. Unauthorized customer modifications to certified products are prohibited for the following reasons:

1. Modifications may create hazards that could result in death, serious injury, or equipment damage.
2. Modifications will void product warranties.
3. Modifications may invalidate product certifications.
4. Modifications may violate country standards. Country standards may require that only certified products be used in certain applications, and modifications that result in the loss of product certification may violate those standards.
Water quality

General guidelines for required water quality are provided as a part of this manual. Having a proper water treatment and maintenance program in place is essential for all closed and open loop hydronic systems. Local codes and requirements of various other components used in specific hydronic systems might mandate some changes to recommended values. It is our strong recommendation that a professional water treatment company is employed for initial commissioning and ongoing annual maintenance of water loop system.

**CAUTION**

It is strongly recommended that a professional water treatment company is used to perform ongoing maintenance of the water loop system, including chemical analysis and if necessary flushing. The water loop testing should be performed at intervals recommended by the professional water treatment consultant. It is up to the customer to carry out adequate water loop maintenance over the lifespan of the units, otherwise damage to the units may occur.

**Table 2: Water quality recommendation table**

<table>
<thead>
<tr>
<th>Potential problem</th>
<th>Controlled chemical/condition</th>
<th>Copper coaxial heat exchangers range</th>
<th>Cupro-nickel coaxial heat exchangers range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion</td>
<td>Cleaning</td>
<td>Proper surface cleaning required</td>
<td>Proper surface cleaning required</td>
</tr>
<tr>
<td></td>
<td>Filtration</td>
<td>Best practice filtration</td>
<td>Best practice filtration</td>
</tr>
<tr>
<td></td>
<td>Suspended solids</td>
<td>Less than 10 ppm</td>
<td>Less than 10 ppm</td>
</tr>
<tr>
<td></td>
<td>Water velocity</td>
<td>Less than 8 ft/s</td>
<td>Less than 12 ft/s</td>
</tr>
<tr>
<td>Bacteria/mold</td>
<td>Iron bacteria</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>Iron oxide</td>
<td>Less than 1 ppm</td>
<td>Less than 1 ppm</td>
</tr>
<tr>
<td>Scaling</td>
<td>Calcium &amp; magnesium carbonate</td>
<td>Less than 350 ppm</td>
<td>Less than 350 ppm</td>
</tr>
<tr>
<td></td>
<td>pH range</td>
<td>7 to 9</td>
<td>5 to 9</td>
</tr>
<tr>
<td>Corrosion</td>
<td>TDS (total dissolved solids)</td>
<td>Less than 1000 ppm</td>
<td>Less than 1500 ppm</td>
</tr>
<tr>
<td></td>
<td>Ammonia, ammonium hydroxide</td>
<td>Less than 0.5 ppm</td>
<td>Less than 0.5 ppm</td>
</tr>
<tr>
<td></td>
<td>Ammonium nitrate, ammonium chloride</td>
<td>Less than 0.5 ppm</td>
<td>Less than 0.5 ppm</td>
</tr>
<tr>
<td></td>
<td>Calcium chloride/sodium chloride</td>
<td>Less than 125 ppm</td>
<td>Less than 125 ppm</td>
</tr>
<tr>
<td></td>
<td>Chlorine</td>
<td>Less than 0.5 ppm</td>
<td>Less than 0.5 ppm</td>
</tr>
<tr>
<td></td>
<td>Hydrogen sulfide</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
Dimensional data

Figure 2: CSV060B front return/top discharge/LH water connection dimensional data
Figure 3: CSV060B front return/front discharge/LH water connection dimensional data
Figure 4: CSV060B front return/top discharge/RH water connection dimensional data

5 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- TOP DISCHARGE
- RIGHT HAND WATER
CONNECTION

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

NOTE: DIMENSION TOLERANCE IS 1/4"
Figure 5: CSV060B front return/front discharge/RH water connection dimensional data

5 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- FRONT DISCHARGE
- RIGHT HAND WATER CONNECTION

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

NOTE: DIMENSION TOLERANCE IS ±1/8"
Figure 6: CSV096/120B front return/top discharge/LH water connection dimensional data

8/10 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

-FRONT RETURN
-TOP DISCHARGE
-LEFT HAND WATER
CONNECTION

TOP VIEW

SUPPLY AIR

DRAIN PAN
3/4" NPT DRAIN
FLUSH MOUNT
CONNECTION

OUT IN

14.50

FLUSH MOUNT WATER
SUPPLY/RETURN
CONNECTIONS

LEFT VIEW

RETURN

COMPRESSOR
ACCESS PANEL

REMOTE

FILTER

POWER SUPPLY CABLE ENTRANCE

RIGHT VIEW

SUPPLY AIR

NOTE: DIMENSION TOLERANCE IS 1/16"
Figure 7: CSV096/120B front return/front discharge/LH water connection dimensional data

8/10 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- FRONT DISCHARGE
- LEFT HAND WATER CONNECTION

TOP VIEW

LEFT VIEW

RETURN AIR

FILTER

DRAIN PAN
3/4" NPT DRAIN
FLUSH MOUNT CONNECTION

YELLOW MOUNT WATER
SUPPLY/RETURN CONNECTIONS

IN

OUT

30.00
45.0
94.00

24.01
18.00
24.2

24.02
16.00
55.00

14.50
4.00
5.69

NOTE: DIMENSION TOLERANCE IS 1/16"
Figure 8: CSV096/120B front return/top discharge/RH water connection dimensional data

8/10 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- TOP DISCHARGE
- RIGHT HAND WATER CONNECTION

TOP VIEW

SUPPLY AIR

LEFT VIEW

RETURN AIR
ELECTRICAL BOX ACCESS DOOR
LOW VOLTAGE CONNECTION
POWER SUPPLY CABLE ENTRANCE

FRONT VIEW

COMPRESSOR ACCESS PANEL

RIGHT VIEW

FLUSH MOUNT WATER SUPPLY/RETURN CONNECTIONS
DRAIN PAN
3/4” NPT DRAIN
“FLUSH MOUNT CONNECTION 1.63

NOTE: DIMENSION TOLERANCE IS 1/16”

LD20651
Figure 9: CSV096/120B front return/front discharge/RH water connection dimensional data

8/10 TON WC VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- FRONT DISCHARGE
- RIGHT HAND WATER CONNECTION

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

NOTE: DIMENSION TOLERANCE IS 1/16"
Figure 10: CSV180B front return/top discharge/LH water connection dimensional data
Figure 11: CSV180B front return/front discharge/LH water connection dimensional data
Figure 12: CSV180B front return/top discharge/RH water connection dimensional data

15 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- TOP DISCHARGE
- RIGHT HAND WATER CONNECTION

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

NOTE: DIMENSION TOLERANCE IS 1/16"
Figure 13: CSV180B front return/front discharge/RH water connection dimensional data

15 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- FRONT DISCHARGE
- RIGHT HAND WATER
  CONNECTION

TOP VIEW

LEFT VIEW

LD20656
Figure 14: CSV240B front return/rear discharge/LH water connection dimensional data

20 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- REAR DISCHARGE
- LEFT HAND WATER
  CONNECTIONS

TOP VIEW

supply air

return air

filter access

8.00

16.37

2.63

left view

24.56

4.90

73.13

0.95

38.35

FRONT VIEW

FRONT VIEW

Rear view

rear view

LD29592

NOTE: DIMENSION TOLERANCE IS 1/16"
Figure 15: CSV240B front return/top discharge/LH water connection dimensional data
Figure 16: CSV240B front return/rear discharge/RH water connection dimensional data

20 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

-FRONT RETURN
-REAR DISCHARGE
-RIGHT HAND WATER CONNECTIONS

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

DETAIL A

NOTES:

- DIMENSIONS ARE IN MILLIMETERS
- CONSTRUCTION ORIENTATION NOT TO SCALE
- OPERATING CLEARANCE 9" (229 mm)

REAR VIEW

LD29594
Figure 17: CSV240B front return/top discharge/RH water connection dimensional data
Figure 18: CSV300B front return/rear discharge/LH water connection dimensional data
Figure 19: CSV300B front return/top discharge/LH water connection dimensional data
Figure 20: CSV300B front return/rear discharge/RH water connection dimensional data

25 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

DETAIL A

REAR VIEW

LD29560
Figure 21: CSV300B front return/top discharge/RH water connection dimensional data

25 TON W/C VERTICAL UNIT
DIMENSIONAL DATA

- FRONT RETURN
- TOP DISCHARGE
- RIGHT HAND WATER
  PIPE CONNECTION

TOP VIEW

LEFT VIEW

FRONT VIEW

RIGHT VIEW

REAR VIEW

DETAIL A

LD29581
Typical service clearances

Figure 22: CSV060B service clearances

5 TON W/C VERTICAL UNIT
SERVICE CLEARANCES

TOP VIEW

42 in. Side
36 in. Front

*42 in. clearance required at electrical box;
36 in. clearance required for water connection.

FRONT VIEW

LD20665
Figure 23: CSV096/120B service clearances

8/10 TON W/C VERTICAL UNIT
SERVICE CLEARANCES

TOP VIEW

42 in. Side*
36 in. Front

*42 in. clearance required at electrical box;
36 in. clearance required for water connection.

FRONT VIEW

LD20687
Figure 24: CSV180B service clearances

15 TON W/C VERTICAL UNIT
SERVICE CLEARANCES

TOP VIEW

42 in. Side*
36 in. Front

*42 in. clearance required at electrical box;
36 in. clearance required for water connection.

FRONT VIEW

LD20668
Figure 25: CSV240B service clearances

20 TON VERTICAL W/C UNIT
SERVICE CLEARANCES

TOP VIEW

42 in. Side
42 in. Front

*42 In. clearance required for air return, water connection and at electrical box side

Figure 26: CSV300B service clearances

25 TON VERTICAL W/C UNIT
SERVICE CLEARANCES

TOP VIEW

42 in. Side
42 in. Front

*42 In. clearance required for air return, water connection and at electrical box side
Ductwork

When installing ductwork, adhere to local codes and sensible practice. Minimize duct runs and avoid abrupt changes in direction where possible. Allow ample access space for servicing of the coils and changing of filters. Perform regular maintenance on ducts to increase unit life, maintain efficient operation, and reduce accumulation of explosive dust. Refer to blower performance charts and engineer duct runs and accessory pressure drop so as not to exceed maximum external static values.

Canvas or other types of flexible collars are recommended for connecting the air ducts to the unit. The supply air duct collar can be connected directly to the blower outlet flanges. Return air may be ducted to the unit, or drawn directly from the conditioned space (with optional return air grille). If a ducted return is desired, duct connection flanges may be secured directly to the air intake opening; filters are accessible from either the left-hand or right-hand side.

Note: The Manufacturer will not accept any liability resulting from incorrect installation of this equipment. Follow installation instructions carefully.

Evaporator blower discharge conversion

All models can be field converted to the alternate evaporator discharge orientation, as indicated on the unit dimensional drawings. However, it is not recommended to convert the blower discharge for the 25-ton models due to the size of the blower deck.

For the 5–15 ton models only, the removable upper blower section can be rotated 180° for top rear discharge applications (see below). The blower outlet panel may be interchanged with the front panel of the fan module. Interchanging these two panels allows horizontal fan discharge to either front or rear of the unit.

The procedure for converting the fan discharge from vertical to horizontal is similar on all models.

1. Remove blower drive belt on all models with base mounted motors. Remove the complete fan motor and drive on models with blower mounted motor assemblies.
2. Remove the panel attachment screws on the alternate location access panel (front blower module panel). The front roof support angle must be removed to allow access to the front panel. Remove the panel and set aside.
3. Remove the panel attachments screws on the blower outlet mounting panel. Do not remove fasteners securing blowers to panel! The blowers are to remain attached to the mounting panel at all times.
4. Carefully remove the blower panel assembly from the evaporator cabinet. Do not allow blower housings to contact the evaporator coil during the removal. On some models, the housing(s) will have to be “rotated” to exit through the panel opening.
5. Interchange the blower panel assembly with the position of the alternate access panel. Exercise care in locating the panel. Do not allow blower housings to contact the evaporator coil. Install the attachment screws and tighten securely.
6. Install the blank access panel into the remaining evaporator opening. Fasten securely.
7. Relocate the evaporator fan drive motor to the alternate location.
8. Install and adjust drive belts to appropriate tension. Test run blower and observe operation for unusual sounds or vibration.
In order to utilize the "rear vertical" or "rear horizontal" discharge, the upper fan module must be rotated.

1. Disconnect power wiring at motor terminal box.

![WARNING]

DISCONNECT AND LOCK OUT POWER WHEN SERVICING UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

2. Remove corner connecting brackets which secure the blower module to the lower evaporator unit.

3. Carefully lift the blower module and rotate 180°. Reposition the blower module on top of the evaporator/compressor unit. Reinstall the corner connecting brackets.

Connect new power wire leads from the evaporator motor contactor in the electrical box to the motor terminal box. Ensure wires are routed clear of any moving components. Secure the wiring so that it does not contact the evaporator coil.

**Figure 27: Evaporator blower discharge conversion**

---

**Variable frequency drive (VFD)**

Optional Variable Frequency Drive (VFD) controller for the evaporator fan, mounted in the corner post of the evaporator module, is available on the 10–25 ton models. The VFD shall be approved for plenum duty applications. There are two VFD applications that are available: Variable Air Volume (VAV) supply pressure controlled and two discrete speeds.

**VAV supply pressure control**

Airflow modulation and static pressure control shall be achieved by increasing or decreasing output from the VFD. The installer shall provide two pressure sensing tubes complete with static pressure taps connected to the factory pressure transducer. Compressor staging remains controlled by a
single stage thermostat on CSV060 or a two-stage thermostat on CSV096–300. If equipped, the factory hot gas bypass option is installed on refrigerant circuit #1.

Two discrete speeds

Indoor fan shall have two discrete speeds. High and Low indoor fan discrete speeds are achieved by means of VFD. The High speed is available only when both compressor stages are active. The Low speed (60% of High Speed RPM) is activated only when running single compressor stage, fan only, or air side economizer.

VFD is factory mounted and wired. Installer is required to field wire fan power wiring between evaporator and condenser if the unit being shipped factory split. The power wiring can be found inside the VFD enclosure, no extra power wiring is required—sufficient length is provided. The VFD option does not include a bypass circuit in case of microdrive failure. Microdrive will need to be replaced to reactivate unit. In case of VFD failure the evaporator fan will stop running, however unit compressors will continue to run until a low pressure safety trip is activated.

Refer to separate VFD for Self-Contained Units Installation and Operation manual (Form 145.13-NO1) for detailed installation and operation instructions.

Figure 28: VFD controller
Electrical wiring

Follow local electrical codes when making electrical connections. Units are completely factory wired for normal supply voltages (e.g., 208-230, 460, 575V/3Ph/60Hz). Confirm unit specifications by checking unit data plate. All electrical components are accessible through an independent electrical panel located on the right-hand (left-hand for RH units) end of the evaporator/compressor section. The electrical control boxes are located behind outer access panels. The compressor section electrical cover is provided with wiring diagrams on the inside, which must be opened to be read.

![WARNING]

DISCONNECT AND LOCK OUT POWER WHEN SERVICING UNIT. UNIT MAY START AUTOMATICALLY IF POWER IS NOT DISCONNECTED. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

Provide individual power disconnects for each unit. Install a secure ground to the bonding lug located in the electrical control panel. If canvas flexible joints are used on ductwork, install a ground wire to the ductwork as well.

![WARNING]

All wiring must comply with applicable local and national codes (NEC). Type and location of disconnect switches must comply with all applicable codes.

Unit requires installer to provide a 24-volt thermostat with appropriate heating and cooling stages as needed. For low voltage wiring, 18-gauge wire may be used for up to 50-foot lengths. Low voltage runs up to 125 feet require 16-gauge wire.

All models are designed for single zone (or multi zone with VFD) cooling applications, utilizing space, or return air thermostatic controls. A low voltage terminal block is provided for hook-up of conventional or programmable thermostats.
Unit wiring schematics

Figure 29: CSV060B units with 208-230, 460, 575V/3Ph/60Hz

CSV060B VERTICAL W/C UNIT WIRING SCHEMATIC
208–230, 460, 575V/3Ph/60Hz

LD20673
Figure 30: CSV096B-120B units with 208-230, 460, 575V/3Ph/60Hz and CSV180B units with 460, 575V/3Ph/60Hz
Figure 31: CSV180B units with 208–230V/3Ph/60Hz
Figure 32: CSV240B units with 208–230, 460, 575V/3pH/60Hz
Figure 33: CSV300B units with 208–230V/3pH/60Hz
Typical VFD electrical schematic

Figure 34: CSV096B-180B & CSV300B units with 208-230, 460, 575V/3Ph/60Hz and VFD

CSV096+180B, CSV300B VERTICAL W/C UNIT 208–230, 460V/3PH/60HZ WITH VFD WIRING SCHEMATIC
Figure 35: CSV120-180B & 300B units with 208–230V, 460V/3Ph/60Hz and VFD for 2 discrete speed

CSV120~180B, CSV300B VERTICAL W/C UNIT 208–230, 460V/3Ph/60Hz C/W VFD FOR 2 DISCRETE SPEED WIRING SCHEMATIC

LD20873

Figure 36: CSV120-180B & 300B units with 575V/3Ph/60Hz and VFD for 2 discrete speed
Figure 37: Typical wiring diagrams for VFD options

VFD OPTIONS

**Typical Wiring Schematic for Evaporator VFD with Duct Pressure Adjustment (208–230V/460V/3PH/60Hz)**

**Typical Wiring Schematic for Evaporator VFD with 2 Discrete Speed (208–230V/460V/3PH/60Hz)**

**Typical Wiring Schematic for VFD with 2 Discrete Speed (575V/3PH/60Hz)**

---

CVF – Evaporator Fan Motor
RTD – Pressure Transducer
CV – Compressor Two
EVFD – Evap. Fan Motor VFD
RVF2 – Evap. Fan Motor Relay
RVF1 – Evap. Fan Motor Relay 1
RVF2 – Evap. Fan Motor Relay 2
24VDC – Low Voltage Supply From VFD Transformer
F4 – Evap. Fan VFD Fuses

LD20875
Figure 38: Single compressor unit water condensate overflow switch (optional)
Figure 39: Dual compressor unit water condensate overflow switch (optional)
### Table 3: Standard evaporator motor electrical data

<table>
<thead>
<tr>
<th>Model #</th>
<th>Voltage</th>
<th>Compressor</th>
<th>Evaporator fan</th>
<th>Min. CCT. ampacity</th>
<th>Max fuse/CCT. bkr. amp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Qty</td>
<td>RLA</td>
<td>LRA</td>
<td>Hp</td>
</tr>
<tr>
<td>CSV 060B2</td>
<td>208–230/3/60</td>
<td>1</td>
<td>16.0</td>
<td>110.0</td>
<td>1.00</td>
</tr>
<tr>
<td>CSV 060B4</td>
<td>460/3/60</td>
<td>1</td>
<td>7.8</td>
<td>52.0</td>
<td>1.00</td>
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<tr>
<td>CSV 060B5</td>
<td>575/3/60</td>
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<td>5.7</td>
<td>38.9</td>
<td>1.00</td>
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<tr>
<td>CSV 096B2</td>
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<td>13.1</td>
<td>83.1</td>
<td>1.50</td>
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<tr>
<td>CSV 096B4</td>
<td>460/3/60</td>
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<td>41.0</td>
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<td>1.50</td>
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<tr>
<td>CSV 120B2</td>
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<td>16.0</td>
<td>110.0</td>
<td>2.00</td>
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<tr>
<td>CSV 120B4</td>
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<td>7.8</td>
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<td>2.00</td>
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<tr>
<td>CSV 120B5</td>
<td>575/3/60</td>
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<td>5.7</td>
<td>38.9</td>
<td>2.00</td>
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<td>23.2</td>
<td>164.0</td>
<td>3.00</td>
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<td>CSV 180B4</td>
<td>460/3/60</td>
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<td>11.2</td>
<td>75.0</td>
<td>3.00</td>
</tr>
<tr>
<td>CSV 180B5</td>
<td>575/3/60</td>
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<td>7.9</td>
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<td>3.00</td>
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<tr>
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<td>225.0</td>
<td>5.00</td>
</tr>
<tr>
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<td>16.7</td>
<td>114.0</td>
<td>5.00</td>
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<td>CSV 240B5</td>
<td>575/3/60</td>
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<td>12.2</td>
<td>80.0</td>
<td>5.00</td>
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<td>34.0</td>
<td>240.0</td>
<td>7.50</td>
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<td>CSV 300B4</td>
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<td>16.0</td>
<td>140.0</td>
<td>7.50</td>
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<tr>
<td>CSV 300B5</td>
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<td>12.9</td>
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### Table 4: Oversized evaporator motor electrical data

<table>
<thead>
<tr>
<th>Model #</th>
<th>Voltage</th>
<th>Compressor</th>
<th>Evaporator fan</th>
<th>Min. CCT. ampacity</th>
<th>Max fuse/CCT. bkr. amp</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Qty</td>
<td>RLA</td>
<td>LRA</td>
<td>Hp</td>
</tr>
<tr>
<td>CSV 060B2</td>
<td>208–230/3/60</td>
<td>1</td>
<td>16.0</td>
<td>110.0</td>
<td>1.50</td>
</tr>
<tr>
<td>CSV 060B4</td>
<td>460/3/60</td>
<td>1</td>
<td>7.8</td>
<td>52.0</td>
<td>1.50</td>
</tr>
<tr>
<td>CSV 060B5</td>
<td>575/3/60</td>
<td>1</td>
<td>5.7</td>
<td>38.9</td>
<td>1.50</td>
</tr>
<tr>
<td>CSV 096B2</td>
<td>208–230/3/60</td>
<td>2</td>
<td>13.1</td>
<td>83.1</td>
<td>2.00</td>
</tr>
<tr>
<td>CSV 096B4</td>
<td>460/3/60</td>
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<td>6.1</td>
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<tr>
<td>CSV 096B5</td>
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<td>4.4</td>
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<td>2.00</td>
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<tr>
<td>CSV 120B2</td>
<td>208–230/3/60</td>
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<td>16.0</td>
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<td>3.00</td>
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<tr>
<td>CSV 120B4</td>
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<td>7.8</td>
<td>52.0</td>
<td>3.00</td>
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<tr>
<td>CSV 120B5</td>
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<td>5.7</td>
<td>38.9</td>
<td>3.00</td>
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<td>CSV 180B2</td>
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<td>11.2</td>
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<td>CSV 180B5</td>
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<td>7.9</td>
<td>54.0</td>
<td>5.00</td>
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<td>30.1</td>
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<td>7.50</td>
</tr>
<tr>
<td>CSV 240B4</td>
<td>460/3/60</td>
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<td>16.7</td>
<td>114.0</td>
<td>7.50</td>
</tr>
<tr>
<td>CSV 240B5</td>
<td>575/3/60</td>
<td>2</td>
<td>12.2</td>
<td>80.0</td>
<td>7.50</td>
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</table>
## Table 5: CSV060B supply air blower performance

<table>
<thead>
<tr>
<th>Supply CFM</th>
<th>0.2 RPM</th>
<th>0.4 RPM</th>
<th>0.6 RPM</th>
<th>0.8 RPM</th>
<th>1.0 RPM</th>
<th>1.2 RPM</th>
<th>1.4 RPM</th>
<th>1.6 RPM</th>
<th>1.8 RPM</th>
<th>2.0 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field supplied low static drive</td>
<td>814</td>
<td>0.43</td>
<td>888</td>
<td>0.50</td>
<td>958</td>
<td>0.57</td>
<td>1024</td>
<td>0.64</td>
<td>1087</td>
<td>0.72</td>
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<tr>
<td>Standard drive + 1HP</td>
<td>1121</td>
<td>0.87</td>
<td>1178</td>
<td>0.95</td>
<td>1233</td>
<td>1.04</td>
<td>1295</td>
<td>1.17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
- At higher evaporator airflows and wet bulb conditions, condensate carry-over may occur.
- Blower performance includes evaporator coil and 2" filters.

## Table 6: CSV096B supply air blower performance

<table>
<thead>
<tr>
<th>Supply CFM</th>
<th>0.2 RPM</th>
<th>0.4 RPM</th>
<th>0.6 RPM</th>
<th>0.8 RPM</th>
<th>1.0 RPM</th>
<th>1.2 RPM</th>
<th>1.4 RPM</th>
<th>1.6 RPM</th>
<th>1.8 RPM</th>
<th>2.0 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field supplied low static drive</td>
<td>863</td>
<td>0.55</td>
<td>933</td>
<td>0.63</td>
<td>999</td>
<td>0.71</td>
<td>1061</td>
<td>0.79</td>
<td>1121</td>
<td>0.87</td>
</tr>
<tr>
<td>Standard drive + 1.5HP</td>
<td>1095</td>
<td>0.86</td>
<td>1095</td>
<td>0.95</td>
<td>1152</td>
<td>1.04</td>
<td>1207</td>
<td>1.13</td>
<td>1260</td>
<td>1.22</td>
</tr>
<tr>
<td>Optional hi-static + 1.5HP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
- At higher evaporator airflows and wet bulb conditions, condensate carry-over may occur.
- Blower performance includes evaporator coil and 2" filters.

## Table 7: CSV120B supply air blower performance

<table>
<thead>
<tr>
<th>Supply CFM</th>
<th>0.2 RPM</th>
<th>0.4 RPM</th>
<th>0.6 RPM</th>
<th>0.8 RPM</th>
<th>1.0 RPM</th>
<th>1.2 RPM</th>
<th>1.4 RPM</th>
<th>1.6 RPM</th>
<th>1.8 RPM</th>
<th>2.0 RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field supplied low static drive</td>
<td>795</td>
<td>1.23</td>
<td>853</td>
<td>1.43</td>
<td>915</td>
<td>1.64</td>
<td>973</td>
<td>1.85</td>
<td>1020</td>
<td>2.10</td>
</tr>
<tr>
<td>Standard drive + 2HP</td>
<td>846</td>
<td>1.40</td>
<td>902</td>
<td>1.59</td>
<td>959</td>
<td>1.78</td>
<td>1016</td>
<td>2.07</td>
<td>1074</td>
<td>2.36</td>
</tr>
<tr>
<td>Optional hi-static + 2HP</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Note:
- At higher evaporator airflows and wet bulb conditions, condensate carry-over may occur.
- Blower performance includes evaporator coil and 2" filters.
Table 8: CSV180B supply air blower performance

<table>
<thead>
<tr>
<th>Supply CFM</th>
<th>0.2</th>
<th>0.4</th>
<th>0.6</th>
<th>0.8</th>
<th>1.0</th>
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<tbody>
<tr>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
<td>BHP</td>
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<td>BHP</td>
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<td>RPM</td>
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<tr>
<td>Field supplied low static drive</td>
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<td>Standard drive + 3HP</td>
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<tr>
<td>Optional high static + 3.5HP</td>
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<th>Supply CFM</th>
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<th>1.4</th>
<th>1.6</th>
<th>1.8</th>
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<tbody>
<tr>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
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<td>BHP</td>
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<td>Field supplied low static drive</td>
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</tbody>
</table>

Note:
At higher evaporator airflow and wet bulb conditions, condensate carry-over may occur. Decrease airflow downward as necessary.

* Blower performance includes evaporator coil and 2" filters.

Table 9: CSV240B supply air blower performance

<table>
<thead>
<tr>
<th>Supply CFM</th>
<th>0.2</th>
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<th>1.2</th>
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<td>Standard drive + 3HP</td>
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<tr>
<td>Optional high static + 3.5HP</td>
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<th>0.8</th>
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<th>1.2</th>
<th>1.4</th>
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<td>BHP</td>
<td>RPM</td>
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<td>BHP</td>
<td>RPM</td>
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<td>RPM</td>
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<tr>
<td>Field supplied low static drive</td>
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<tr>
<td>Standard drive + 3HP</td>
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</tbody>
</table>

Note:
At higher evaporator airflow and wet bulb conditions, condensate carry-over may occur. Decrease airflow downward as necessary.

* Blower performance includes evaporator coil and 2" filters.

Table 10: CSV300B supply air blower performance

<table>
<thead>
<tr>
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<th>1.2</th>
<th>1.4</th>
<th>1.6</th>
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<tr>
<td>Standard drive + 3HP</td>
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<tr>
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<table>
<thead>
<tr>
<th>Supply CFM</th>
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<th>0.6</th>
<th>0.8</th>
<th>1.0</th>
<th>1.2</th>
<th>1.4</th>
<th>1.6</th>
<th>1.8</th>
<th>2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
<td>BHP</td>
<td>RPM</td>
</tr>
<tr>
<td>Field supplied low static drive</td>
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<td>Standard drive + 3HP</td>
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<td></td>
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</tr>
</tbody>
</table>

Note:
At higher evaporator airflow and wet bulb conditions, condensate carry-over may occur. Decrease airflow downward as necessary.

* Blower performance includes evaporator coil and 2" filters.
Motor and pulley data

Table 11: Evaporator - standard blower motor and drive data

<table>
<thead>
<tr>
<th>Model</th>
<th>Drive range (RPM)</th>
<th>Motor</th>
<th>Adjustable motor pulley</th>
<th>Fixed motor pulley</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Frame size</td>
<td>Pitch diameter (inches)</td>
</tr>
<tr>
<td>CSV060B</td>
<td>745-1117</td>
<td>1</td>
<td>145</td>
<td>1.9-2.9</td>
</tr>
<tr>
<td>CSV096B</td>
<td>614-921</td>
<td>1.5</td>
<td>145</td>
<td>1.9-2.9</td>
</tr>
<tr>
<td>CSV120B</td>
<td>711-984</td>
<td>2</td>
<td>145</td>
<td>2.4-3.4</td>
</tr>
<tr>
<td>CSV180B</td>
<td>724-925</td>
<td>3</td>
<td>184</td>
<td>3.4-4.4</td>
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<tr>
<td>CSV240B</td>
<td>848-1064</td>
<td>5</td>
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<td>4.7-5.9</td>
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<tr>
<td>CSV300B</td>
<td>716-882</td>
<td>7.5</td>
<td>213</td>
<td>5.2-6.4</td>
</tr>
</tbody>
</table>

Table 12: Evaporator - oversized blower motor and drive data

<table>
<thead>
<tr>
<th>Model</th>
<th>Drive range (RPM)</th>
<th>Motor</th>
<th>Adjustable motor pulley</th>
<th>Fixed motor pulley</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Frame size</td>
<td>Pitch diameter (inches)</td>
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<tr>
<td>CSV060B</td>
<td>897-1346</td>
<td>1.5</td>
<td>145</td>
<td>1.9-2.9</td>
</tr>
<tr>
<td>CSV096B</td>
<td>798-1105</td>
<td>2</td>
<td>145</td>
<td>2.4-3.4</td>
</tr>
<tr>
<td>CSV120B</td>
<td>875-1118</td>
<td>3</td>
<td>184</td>
<td>3.4-4.4</td>
</tr>
<tr>
<td>CSV180B</td>
<td>894-1122</td>
<td>5</td>
<td>184</td>
<td>4.7-5.9</td>
</tr>
<tr>
<td>CSV240B</td>
<td>1046-1287</td>
<td>7.5</td>
<td>213</td>
<td>5.2-6.4</td>
</tr>
<tr>
<td>CSV300B</td>
<td>850-1047</td>
<td>7.5</td>
<td>213</td>
<td>5.2-6.4</td>
</tr>
</tbody>
</table>

Blower speed adjustment

The RPM of the supply air blowers will depend on the required CFM, and the static resistances of both the supply and the return duct systems.

**Note:** Units with oversized motors or oversized drive kits are designed to operate in the shaded region of the fan table otherwise nuisance overload trips can occur. Motor overload trips can be remedied by increasing the external static pressure. Refer to fan tables.

With this information, the RPM for the blowers can be determined from the blower performance tables. Adjustment of blower speed is accomplished as follows:

1. Loosen belt tension by moving motor towards the blower shaft via the adjustable mounting.
2. Loosen the setscrew in the adjustable motor pulley flange. Remove external key on pulleys 4-in. diameter and larger.
3. Blower speed will increase when moveable flange is adjusted towards the fixed flange (closed). Blower speed will decrease when the moveable flange is adjusted away from the fixed flange (opened). Pulleys are adjustable only in half-turn increments. **Do not open pulley more than five full turns for "4L" and "A" belts or six full turns for "B" belts.**
4. Once the pulley has been opened/closed the appropriate number of turns, replace the external key and tighten the adjustment setscrew. Proper torque is 110-130 in.-lbs.
5. Install drive belt and adjust motor mount to tension belt.
Figure 40: Belt tension adjustment

<table>
<thead>
<tr>
<th>Cross section</th>
<th>Pounds force</th>
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<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>4L</td>
<td>1-1/2</td>
<td>2-1/2</td>
</tr>
<tr>
<td>A</td>
<td>3-1/2</td>
<td>6-1/2</td>
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<tr>
<td>B</td>
<td>5-1/2</td>
<td>8</td>
</tr>
<tr>
<td>BX</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

DEFLECTION: 1/64" per inch of span length

BELT TENSION ADJUSTMENT
DEFLECTION FORCE VERSUS DRIVE BELT CROSS-SECTION
LD20479
Waterside pressure drop data

Figure 41: CSV180–300 standard units - manifolded condensers water pressure drop

Figure 42: CSV060–120 standard units - manifolded condensers water pressure drop
Start-up and operation

Start unit and check rotation of fans and compressors.

Scroll compressors will only compress in one rotational direction. Three-phase compressors will rotate in either direction depending upon phasing of the power. Since there is a 50/50 chance of connecting power in such a way as to cause rotation in the reverse direction, it is important to ensure proper rotation direction is achieved when the system is installed and operated.

Monitor the microprocessor board for any fault codes. This will ensure proper unit operation. Verification of proper compressor direction is made by observing that suction pressure drops and discharge pressure rises when the compressor is energized. Reverse compressor rotation also results in an elevated sound level, as well as substantially reduced current draw.

**WARNING**

The Air Conditioning section of this equipment is charged with R-410A; a hi-pressure refrigerant. Only qualified technicians, using appropriately pressure-rated test instruments, should perform troubleshooting or service on this equipment.

There is no negative impact on durability caused by operating three-phase Scroll compressors in the reversed direction for a short period of time (under one hour). However, after several minutes of operation, the compressors internal protector will trip.

If opposite rotation is needed, disconnect and reverse any two leads of the three-phase supply. Reconnect power.

**Note:** Observe unit operation and check for unusual noise or vibration.

**Table 13: Pressure switch settings - all models**

<table>
<thead>
<tr>
<th>Cut out (PSIG)</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>625</td>
<td>68</td>
</tr>
<tr>
<td>Cut in (PSIG)</td>
<td>500</td>
<td>107</td>
</tr>
</tbody>
</table>

**Table 14: Refrigerant charge (lbs)**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Circuit 1</th>
<th>Circuit 2</th>
</tr>
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<tbody>
<tr>
<td>CSV060B</td>
<td>5.25 (5 lbs 4 oz)</td>
<td>-</td>
</tr>
<tr>
<td>CSV096B</td>
<td>5.18 (5 lbs 3 oz)</td>
<td>5.30 (5 lbs 5 oz)</td>
</tr>
<tr>
<td>CSV120B</td>
<td>6.12 (6 lbs 2 oz)</td>
<td>6.25 (6 lbs 4 oz)</td>
</tr>
<tr>
<td>CSV180B</td>
<td>8.69 (8 lbs 11 oz)</td>
<td>9.12 (9 lbs 2 oz)</td>
</tr>
<tr>
<td>CSV240B</td>
<td>12.45 (12 lbs 7 oz)</td>
<td>12.45 (12 lbs 7 oz)</td>
</tr>
<tr>
<td>CSV300B</td>
<td>17.40 (17 lbs 6 oz)</td>
<td>16.80 (16 lbs 13 oz)</td>
</tr>
</tbody>
</table>
Checking superheat and subcooling

R-410A temperature charts list the associated saturation temperature in one column and the associated pressure in another column. See Table 15.

**Subcooling**

When the refrigerant charge is correct, there is no vapor in the liquid sight glass with the system operating under full load conditions.

The subcooling temperature of each system can be calculated:

1. Record the temperature of the liquid line at the outlet of the condenser.
2. Subtract it from the saturation temperature listed in Table 15 for the corresponding discharge pressure.
3. If the unit lacks an access port for liquid access, subtract the condenser coil pressure drop value from Table 15 from the discharge pressure to determine the equivalent saturation temperature.

For example, when the discharge pressure is 388 psig and the liquid line temperature is 95.0°F:

- Liquid Pressure = Discharge Pressure (388 psig) minus 33 psig = 355 psig
- Saturation Temperature for 355 psig = 108.0°F
- Liquid Line Subcooling = Saturation Temperature (108.0°F) minus Liquid Line Temperature (95.0°F) = 13.0°F

Subcooling should be 12.0–15.0°F at design conditions.

**Table 15: R-410A pressure and temperature chart**

<table>
<thead>
<tr>
<th>PSIG</th>
<th>Temp °F</th>
<th>PSIG</th>
<th>Temp °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>78</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>-58</td>
<td>80</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>-54</td>
<td>85</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>-50</td>
<td>90</td>
<td>26</td>
</tr>
<tr>
<td>8</td>
<td>-46</td>
<td>95</td>
<td>29</td>
</tr>
<tr>
<td>10</td>
<td>-42</td>
<td>100</td>
<td>32</td>
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<td>-39</td>
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<td>-36</td>
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<td>16</td>
<td>-33</td>
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</table>
Table 15: R-410A pressure and temperature chart

<table>
<thead>
<tr>
<th>PSIG</th>
<th>Temp °F</th>
<th>PSIG</th>
<th>Temp °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>54</td>
<td>4</td>
<td>265</td>
<td>88</td>
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<tr>
<td>56</td>
<td>6</td>
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</tr>
<tr>
<td>62</td>
<td>10</td>
<td>305</td>
<td>97</td>
</tr>
<tr>
<td>64</td>
<td>11</td>
<td>325</td>
<td>101</td>
</tr>
<tr>
<td>66</td>
<td>13</td>
<td>355</td>
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<td>68</td>
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<td>375</td>
<td>112</td>
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<tr>
<td>70</td>
<td>15</td>
<td>405</td>
<td>118</td>
</tr>
<tr>
<td>72</td>
<td>16</td>
<td>500</td>
<td>134</td>
</tr>
<tr>
<td>74</td>
<td>17</td>
<td>600</td>
<td>149</td>
</tr>
<tr>
<td>76</td>
<td>19</td>
<td>700</td>
<td>159</td>
</tr>
</tbody>
</table>

Superheat

Only check superheat after establishing the steady state operation of the unit, pulling down the discharge air temperature to within the control range, and running the unit in a fully loaded condition.

The superheat is calculated as the difference between the actual temperature of the refrigerant gas in the suction line and the temperature corresponding to the suction pressure as shown in Table 15.

For example, when the suction pressure is 130 psig and the suction line temperature is 57.0°F:

- Saturation Temperature for 130 psig = 45.0°F
- Evaporator Superheat = Suction Line Temperature (57.0°F) minus Saturation Temperature (45.0°F) = 12.0°F

When adjusting the expansion valve, do not turn the adjusting screw more than one turn at a time. This allows sufficient time (approximately 15 minutes) between adjustments for the system and the thermal expansion valve to respond and stabilize.

The superheat setting should be adjusted to 8.0–11.0°F at design conditions.

Leak checking

Leak check compressors, fittings, and piping to ensure there are no leaks. Verify the evaporator distributor tubes do not have bare copper touching each other or are against a sheet metal edge. If leak checking a unit charged with R-410A, ensure the leak test device is capable of sensing refrigerant R-410A.

Microprocessor controller

The microprocessor control system is specifically designed for single and dual stage systems. The control system interfaces with a conventional type thermostat.

- Unit shall be complete with self-contained low-voltage control circuit.
- Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit, should any of the following standard safety devices trip and shut off compressor.
  - Loss-of-charge/low-pressure switch
  - High-pressure switch
  - Condensate overflow protection switch
• Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
• Unit control board shall have on-board diagnostics and fault code display.
• Standard controls shall include anti-short cycle and low voltage protection.
• Control board shall monitor each compressor and refrigerant safety switch independently.
• Control board shall have random start feature.
• Control board shall retain last five fault codes in non-volatile memory, which will not be lost in the event of a power loss.

Operation

For cooling the room t-stat energizes the low-voltage circuit between “R” & “Y1.”
The call is passed to the unit microprocessor control, which then determines whether the requested operation is available, and if so, which components to energize.

Continuous blower

By setting the room t-stat fan switch set to “ON,” the supply air blower will operate continuously. With the room t-stat fan switch set to “AUTO,” the blower is energized whenever a cooling operation is requested. The blower is energized after any specified delay associated with the operation.

When energized, the indoor blower has a minimum run time of 30 seconds. Additionally, the indoor blower has a delay of 10 seconds between operations.

When the room t-stat calls for cooling, the low-voltage control circuit from “R” to “Y1” and “G” is completed. The compressor and fan motor are energized. After completing the specified fan on delay for cooling, the microprocessor control will energize the blower motor.

Once the room t-stat has been satisfied, it will de-energize “Y1.” If the compressor has satisfied its minimum run time, the compressor and fan de-energize. Otherwise, the unit operates the cooling system until the minimum run time for the compressor has been completed. After the compressor de-energizes, the blower is stopped following the elapse of the fan-off delay for cooling.

To be available, a compressor must not be locked-out due to a high-pressure switch; low-pressure switch; condensate overflow switch; and the anti-short cycle delay (ASCD) must have elapsed.

Safety switches

Each refrigerant system is monitored to ensure it does not operate outside of its intended operating parameters. Safety switches are handled as described below. All system errors override minimum run times for compressors.

High-pressure limit switch

If a high-pressure limit switch opens, the microprocessor control de-energizes the compressor, initiates the ASCD, and stops the fan. If a call for cooling or heating is still present at the conclusion of the ASCD, the microprocessor control will re-energize the compressor and unit fan.

Should a high-pressure switch open three times within two hours of operation, the microprocessor control will permanently lock-out the compressor. The system must be manually reset by de-energizing the 24-volt power to unit, or turning the room t-stat to the “OFF” position then back to cooling position. The microprocessor control will flash a fault code indicating a high-pressure lock-out.
Low-pressure limit switch

The low-pressure limit switch is not monitored during the initial 30 seconds of compressor operation. After the initial 30 seconds have passed, the microprocessor control will monitor the low-pressure switch for another 30 seconds. If the low-pressure switch fails to close after the 30 second monitoring phase, the microprocessor control will de-energize the compressor, initiate the ASCD, and stop the fan.

Once the low-pressure switch has been proven (closed during the 30-second monitoring period as described above), the microprocessor control board will continue to monitor the low-pressure limit switch for any openings. If the low-pressure switch opens for greater than 5 seconds, the microprocessor control board will de-energize the compressor, initiate the ASCD, and stop the fan.

If the call for cooling is still present at the conclusion of the ASCD, the microprocessor control will re-energize the compressor.

Should a low-pressure switch fault three times within one hour of operation, the microprocessor control board will lock-out the compressor and flash a fault code indicating a low-pressure lock-out.

Condensate overflow switch

A Condensate Overflow fault occurs when the condensate overflow switch opens for more than two line cycles. The compressor is shut down regardless of Minimum Run Time, ASCD is initiated, and alarm is tripped. The fan continues operating in its current state. Compressor will re-energize once the condensate overflow switch closes, ASCD has been satisfied, and a call for cooling is still present.

The microprocessor control board logs the first incident per compressor request. If the compressor request is removed, the fault occurrence counter is reset to zero. Should the condensate overflow switch open 3 times within 1 hour of run time, the microprocessor control board will lock out the compressor, turn off the fan, and flash a fault code indicating a Condensate Overflow lockout.

The condensate overflow switch is a normal close switch. For the condensate overflow switch shown in Figure 39 in the normal situation, the coil of the relay R3 is energized, two of the normal open contacts in R3 are closed, the two lines on both FS1 and FS2 are connected similar to a jumper, and the two compressors run based on the other condition. Upon the Condensate Overflow fault occurring, the normally closed contacts in this switch will become open, it will cut off the line of the circuit, the two lines on both FS1 and FS2 will disconnect, and the two compressors will shut down.

Safety controls

The microprocessor control monitors the following inputs:

1. A High-Pressure Switch on each compressor circuit to protect against excessive discharge pressures.
2. A Low-Pressure Switch on each compressor circuit to protect against loss of refrigerant charge.
3. A Condensate Overflow Switch to protect against condensate overflow.

Compressor protection

In addition to the external pressure switches, the compressor also has inherent (internal) protection. If there is an abnormal temperature rise in a compressor, the internal protection will immediately shut down the compressor. The microprocessor control incorporates features to minimize compressor wear and damage. An ASCD is utilized to prevent short cycling of the compressor. Additionally, a minimum run time is imposed any time a compressor is energized. The ASCD is initiated on unit start-up and on any compressor reset or lockout.
Microprocessor control unit flash codes

Various flash codes are utilized by the microprocessor control to aid in troubleshooting. Flash codes are distinguished by the short on and off cycle used (approximately 200ms on and 200ms off). To show normal operation, the control boards flash a 1 second on, 1 second off “heart beat” during normal operation. This is to verify that the microprocessor is functioning correctly. Do not confuse this with an error flash code. To avoid confusion, the 1-flash fault code is not used.

Current alarms or active restrictions are flashed on the microprocessor control LED.

1. LAST ERROR – When this button is pressed and released, it flashes the last five flash codes on the board’s LED. The most recent alarm is shown first and the oldest alarm is shown last.

2. TEST RESET – When this button is pressed and released, any ASCDs are bypassed for one cycle. When pressed twice, any active lockouts are reset.

3. COMM SETUP – If the board is to be networked with other units, this button is used to set the network address. Press the button once and it scans the bus, then assigns itself the first available address (starts at 2). It then flashes that address one time. Pressing the button twice causes the control to flash the address.

<table>
<thead>
<tr>
<th>Flash codes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>On steady</td>
<td>Control failure</td>
</tr>
<tr>
<td>2 flashes</td>
<td>Control waiting anti-short cycle delay (ASCD)*</td>
</tr>
<tr>
<td>3 flashes</td>
<td>High pressure compressor 1 lockout</td>
</tr>
<tr>
<td>4 flashes</td>
<td>High pressure compressor 2 lockout</td>
</tr>
<tr>
<td>5 flashes</td>
<td>Low pressure compressor 1 lockout</td>
</tr>
<tr>
<td>6 flashes</td>
<td>Low pressure compressor 2 lockout</td>
</tr>
<tr>
<td>7 flashes</td>
<td>Condensate overflow switch lockout</td>
</tr>
<tr>
<td>11 flashes</td>
<td>Compressor(s) locked out due to economizer running (free cooling)*</td>
</tr>
<tr>
<td>13 flashes</td>
<td>Compressor held off due to low voltage</td>
</tr>
<tr>
<td>14 flashes</td>
<td>EEPROM storage failure</td>
</tr>
<tr>
<td>OFF</td>
<td>No power or control failure</td>
</tr>
</tbody>
</table>

Note: Flash rates marked with * are NOT alarms.
Maintenance/service

**WARNING**

DISCONNECT AND LOCK OUT POWER WHEN SERVICING UNIT. FAILURE TO DO SO MAY RESULT IN PERSONAL INJURY OR DEATH DUE TO ELECTRICAL SHOCK.

**CAUTION**

Exercise care when working around the sharp metal edges of door panels, door frames, etc. These edges can cause injury.

**Evaporator coil**

Inspect the evaporator coil at filter change intervals. Dirty or clogged evaporator coils causes low suction pressure and lost capacity. If the coils appear dirty, they should be cleaned using a mild detergent or an approved commercial coil cleaning agent. Do not use cleaners that contain acids (e.g., vinegar) or ammonia as they can damage evaporator coil and lead to coil leaks due to formicy corrosion.

**Refrigerant circuit(s)**

**WARNING**

The Air Conditioning section of this equipment is charged with R-410A; a high pressure refrigerant. Only qualified technicians, using appropriately pressure rated test instruments, should perform troubleshooting or service on this equipment.

With the unit operating, check and record the compressor discharge and suction pressures. The compressor running current should also be recorded. A maintenance log of these readings can indicate if the unit is operating within its normal limits. Abnormal readings should be investigated and the cause corrected.

**Blower**

Inspect the evaporator blower at each regular service interval. Clean blower wheel as needed. Bearings are permanently sealed ball type and do not require lubrication. Check bearings for any signs of wear (movement between inner and outer races). Ensure bearing locking collars are secure to the shaft and that collar locking screw is properly set. Check that the blower wheel is tight on the shaft and that the hub set screws are properly torqued.

**Drive belt**

Examine belt periodically for wear. Glazed areas on the drive surfaces indicate overheating due to belt slippage. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Over-tensioning shortens belt and bearing life (see section Blower speed adjustment).
The tension on the belt should be adjusted for a deflection of 1/64 of an inch per inch of belt span, with the appropriate force applied at the midpoint of the span (see section Blower speed adjustment). Tension “New” belts at the maximum value indicated. Used belts should be maintained at the minimum value.

Filters

Inspect filters monthly and replace as necessary. Use UL Class 2 rated filters. Factory supplied filters are medium efficiency, extended surface pleated type. Replacements should be of the same type in order to maintain optimum airflow performance. Filter sizes are as follows:

**Table 17: Filter sizes**

<table>
<thead>
<tr>
<th>Filters</th>
<th>Qty/size</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSV060B</td>
<td>2/20x18x2</td>
</tr>
<tr>
<td>CSV096B</td>
<td>6/14x20x2</td>
</tr>
<tr>
<td>CSV120B</td>
<td>6/14x20x2</td>
</tr>
<tr>
<td>CSV180B</td>
<td>2/16x20x2</td>
</tr>
<tr>
<td>CSV240B</td>
<td>4/16x25x2</td>
</tr>
<tr>
<td>CSV300B</td>
<td>6/20x25x2</td>
</tr>
<tr>
<td>CSV300B</td>
<td>6/20x18x2</td>
</tr>
</tbody>
</table>

Drain pan & condensate

Inspect the field installed condensate trap for any blockage. Remove and clean as necessary. Inspect the drain pan regularly to ensure for adequate drainage and that no sitting water is present.
R-410A quick reference guide

Refer to Installation Instructions for specific installation requirements.

- R-410A Refrigerant operates at 50–70% higher pressures than R-22. Be sure that servicing equipment and replacement components are designed to operate with R-410A.
- R-410A Refrigerant cylinders are rose colored.
- Recovery cylinder service pressure rating must be 400 psig. DOT 4BA400 or DOT BW400.
- Recovery equipment must be rated for R-410A.
- Do not use R-410A service equipment on R-22 systems. All hoses, gages, recovery cylinders, charging cylinders and recovery equipment must be dedicated for use on R-410A systems only.
- Manifold sets must be at least 700 psig high side and 180 psig low side with 550 psig retard.
- All hoses must have a service pressure rating of 800 psig.
- Leak detectors, must be designed to detect HFC refrigerants.
- Systems must be charged with refrigerant. Use a commercial type metering device in the manifold hose.
- R-410A can only be used with POE type oils.
- POE type oils rapidly absorb moisture from the atmosphere.
- Vacuum pumps will not remove moisture from POE type oils.
- Do not use liquid line driers with a rated working pressure rating less than 600 psig.
- Do not install suction line driers in the liquid line.
- A liquid line drier is required on every unit.
- Do not use an R-22 TXV. If a TXV is to be used, it must be an R-410A TXV.
- Never open system to atmosphere when under vacuum.
- If system must be opened for service, evacuate system then break the vacuum with dry nitrogen and replace filter driers.