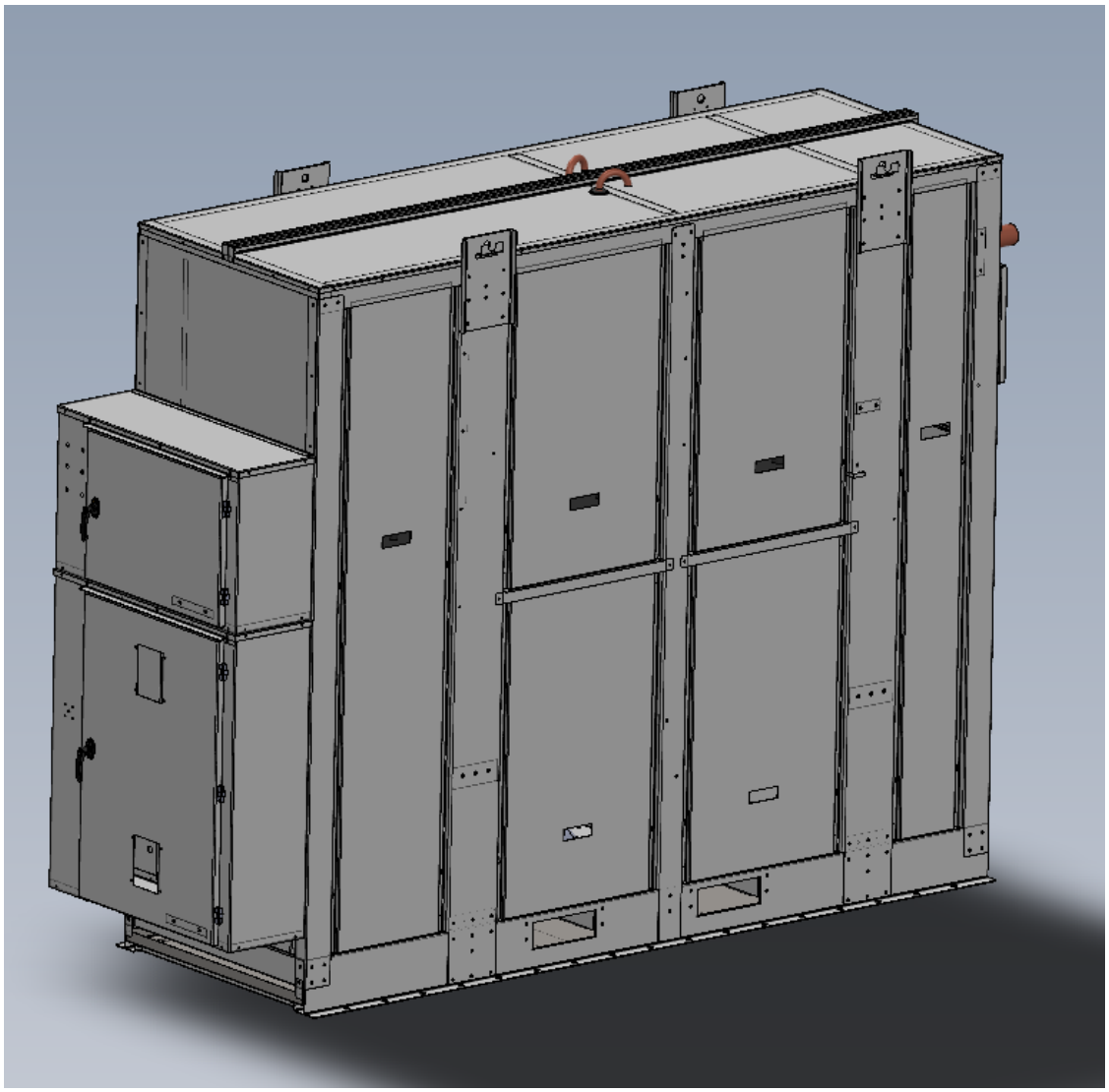
Installation, Operation, and Maintenance
Secondary CO2



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Secondary CO2 Installation & Operation

Local code disclaimer

- The following information is to be used as a guide for installing and operating Secondary CO2 equipment. It is important that the installation contractor understands and follows local codes. Review all unit, piping, and electrical drawings for installation information.

Receiving and inspection

- Immediately upon receiving shipment, the equipment should be inspected for evidence of any damage. Evidence of damage may include:
    - Damaged sheet metal
    - Refrigerant or CO2 piping leaks
    - Broken sensors
- It is recommended that the equipment be photographed for documentation. If shipping damage has occurred, a claim should be made with the transportation company, and your RAE representative should be advised of the nature of the damage.
- Equipment should be inspected for compliance with original order acknowledgement. This includes things such as:
    - Model numbers
    - Voltages
    - Special components

Storage of equipment prior to installation

- Each Secondary CO2 unit should be shipped sealed and pressurized with Nitrogen. Care should be taken to preserve this seal to prevent ingress of moisture into the Secondary CO2 unit.
- Tarp or otherwise cover the unit to prevent buildup of snow, ice, plant debris, or debris in general from building up on the unit.
- Once per month, check the unit for pressure leaks.

Rigging

WARNING: Failure to follow rigging instructions may cause damage to the equipment and could put personnel at risk of injury or death.

- Rigging equipment, straps, lifting bars, etc. should be provided by the installing contractor.
- Spreader bars must be used to hold lifting cables vertical and away from the unit to prevent damage.

- RAE Secondary CO2 equipment is provided with lifting lugs that must be utilized to safely move the equipment.
    - Use all lifting points provided on the unit.
- If a load is unbalanced, adjust the cable lengths to achieve proper balance.
- When lifting with a forklift care must be taken to ensure forks extend all the way through the unit to avoid damage to the catch pan.

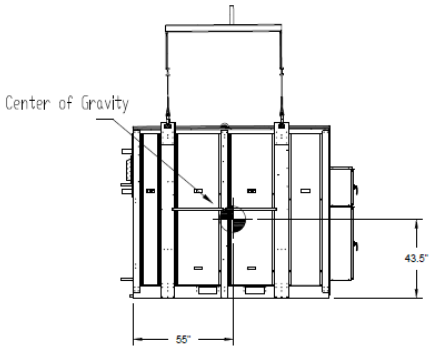
Figure A

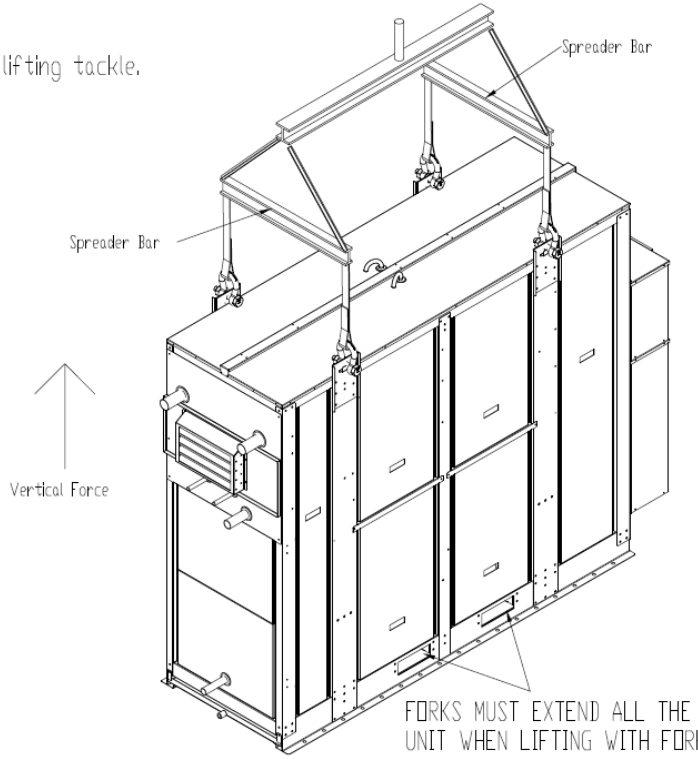
Lifting Requirements:

1. Use all lifting points.
2. A spreader bar must be used to keep vertical force on lifting tackle.

Failure to use each lifting point, along with spreader bars and/or neglecting proper lifting procedures may lead to property damage, injury, or death.

UNIT WEIGHT LISTED ON U1 UNIT DRAWING





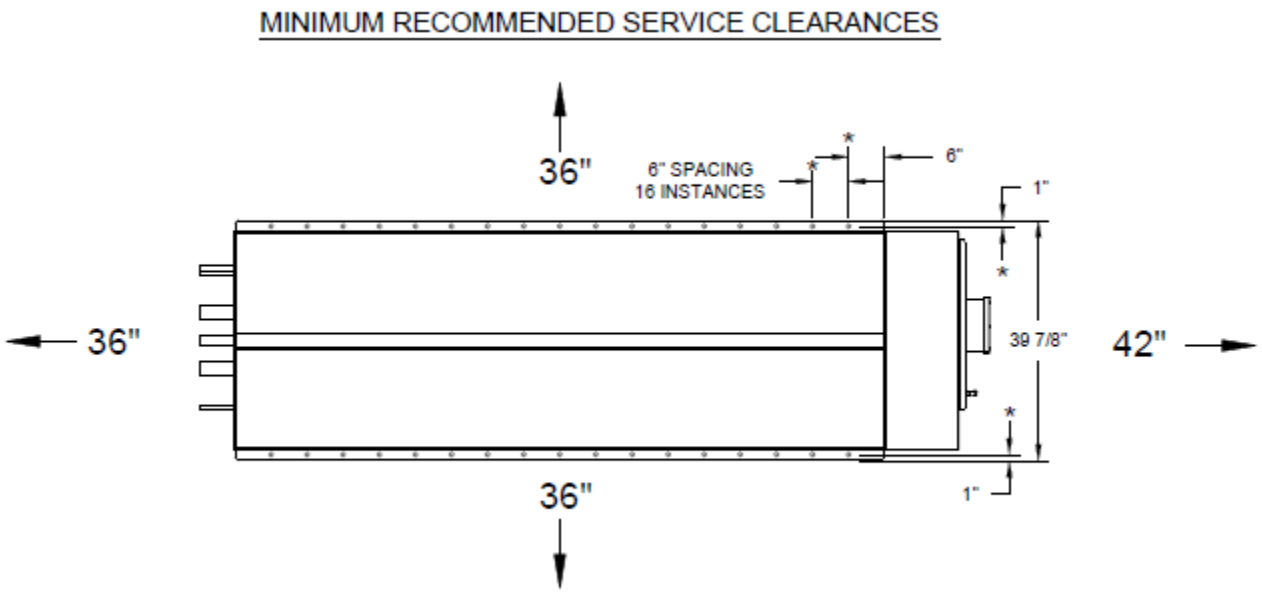
RAE CORPORATION	SCALE: NONE	ENGINEERING APPROVED BY:	QUALITY CONTROL APPROVED BY:	DRAWN BY: M.L
	DATE: 05/02/2024			
	SUB-TITLE: WMT-CO2-LIFTING			DRAWING NUMBER: WMT-CO2-RIGGING

4492 Hunt Street, Pryor Oklahoma 74361 918.825.7222 www.RAECorp.com

Mounting and Setup

- Refer to the most recent unit drawings for clearance information. If you do not have a unit drawing, or believe it is outdated, contact your RAE representative.
- Clearance should be left around equipment for unrestricted airflow and serviceability. Reference the submittal drawing below for specific clearances. If these are not available, contact the factory.

Figure B



- All ship loose equipment should be properly installed prior to start up.
  - Ship loose equipment can be found within the unit enclosure or in a separate ship loose box.
  - If it is believed that ship loose components are missing, contact your RAE representative.
  - Check with other personnel that may have had access to the equipment prior to installation. It is common for parts to be placed in storage without being communicated to all parties involved.
- All equipment must be mounted on a smooth, hard, and level surface.
  - Consideration should be given to prevent structural noise transmission to surrounding areas.
  - Reference base detail drawing for mounting support requirements.
    - Reference CO2 Base Mounting Details, CO2 AES Curb Drawing

Refrigerant & CO2 Piping

- Refer to the most recent piping drawings for a general component schematic.
- All piping must be in accordance with applicable national, state, and local codes.
- Piping should be designed and installed in accordance with recommended practices as outlined in ASHRAE piping guidelines.
    - Carbon dioxide quality should be maintained in order to extend the life of the equipment.
    - Piping should be adequately insulated for the application.
- Valves with packing or flanges should be checked for tightness. Flare fittings are factory installed using a liquid sealant. The seal will be broken if tightened which can result in a leak.

System Charging

- All Secondary CO2 equipment will be required to be charged with CO2 prior to start-up.
    - The system must be cleaned and flushed according to applicable ASHRAE Standard.
    - System must be evacuated down to 200 microns before charging, 2-2.5 days is normal for evacuation.
    - Isolate the supply line with the provided ball valve, open the bypass valve, and leave the return line open to the system.
    - Charge the entire system with Carbon dioxide gas up to 250 psi.
    - Expansion valves can now be opened and verified.
    - All equipment should be verified as operational before charging the Secondary CO2 skid with liquid CO2.
    - Enable the Unit and/or the Emergency Condensing Unit.
    - Burp the bottle of CO2 and throttle the valve so that pressure does not climb too quickly.
    - Fill the liquid vapor separator until mid-level switch is satisfied (~35% level, 550lbs of CO2)
    - Let the System cool to setpoint and turn off the ECU.
    - Open the Supply ball valve and circulate liquid with the CO2 supply pump to confirm pump rotation.
    - If CO2 liquid level falls below the mid-level switch, add liquid until mid-level switch is satisfied. (too much liquid in the vessel will negatively impact the thermosiphon, causing an increase in CO2 supply temperature)
    - Use flow setting procedure to set CO2 flow. See CO2 Flow Setting Guideline
- All Secondary CO2 equipment is delivered with the initial refrigerant charge in the Emergency Condensing Unit Circuit.
- In the event of a refrigerant leak:
    - Review the equipment submittal for refrigerant charge amounts or consult the RAE National Accounts Service department for assistance.
        - All charging lines and manifolds must be evacuated prior to admitting refrigerant into the system to prevent contaminating the system with non-condensable.

    - With the system wired, piped, and evacuated, the unit is ready for refrigerant charging.
  - Connect the refrigerant charging line to the suction valve of the compressor and charge “gas” refrigerant to the low side of the system until pressure equalizes. The ECU should take approximately 3 lbs. of R448a.
  - Energize the equipment.

Catch Pan Drain Piping

- The standard condensate drain connection is ¾” stainless steel NPT.
- As standard, the drain connection is located at one end of the catch pan and can be oriented toward either end of the unit by removing the catch pan and rotating 180 degrees if needed.
- The drain line should be sloped away from the unit at ¼" per foot of drain line.
- The catch pan is open to ambient conditions and could accumulate debris. Catch pans should be regularly cleared of any debris and drain piping should have a means clearing debris.
- If ambient temperatures can fall below freezing, the drain line is recommended to be wrapped with heat tape and insulated.

Wiring and Electrical Information

Warning: This unit utilizes VFD drives. To avoid electrical shock, wait three minutes after power is disconnected before servicing any electrical components.

- Refer to the most recent wiring diagrams. Each diagram should be examined and thoroughly understood before field wiring connections are made.
- All wiring must be in accordance with applicable national, state, and local codes. Follow good electrical practices to ensure the best installation possible.
- Power supply should be checked to be certain that the supply voltage matches with the equipment nameplate voltage. Serious damage to motors can occur if improper voltage is applied.
- Power wiring to the equipment must be adequately sized for minimum ampacity as shown on the unit nameplate.
  - Power wiring will be landed on the power distribution block.
  - A separate lug is provided for grounding.
  - Incoming power penetration should be located at the designated power penetration location. This location should be pre-punched by the factory and shipped with a plug.
  - Refer to the unit drawing for power entry location.

NOTE: On equipment with constant speed pumps, the phasing of the three phase power will need to be tested. This can be accomplished by “bumping” the pump and ensuring that differential pressure is established. If the pump fails to generate adequate differential pressure, switch two of the power three leads at the power block.

- A disconnect is supplied as standard with each Secondary CO2 Unit
- All field wiring should be complete before commissioning the unit to ensure proper operation.
  - Field wiring is designated by the dashed lines on the wiring diagram. See the legend at the top left of the wiring diagram for details.
  - Terminals for landing field wiring are labeled according to the wiring diagram. There should be sufficient terminal space for all field wiring shown on the diagram.
  - All field wiring should be routed through conduit and the proper conduit connectors must be utilized at any enclosure penetration.
  - All field wiring insulation should be rated to a minimum of 600V. If wire insulation is not rated to 600V, unit operation may be affected.
- All screw-type wiring terminals should be checked for tightness before power is applied to the equipment.
- Utility and or generator power quality must comply with industry standards.

Controller and Sensors

- Check all sensor readings displayed on the controller. If values appear to be incorrect, check the sensor and its wiring to confirm proper installation. Confirm communication between controllers if wiring is correct.

- CO2 Supply Temp and CO2 Return Temp sensors
  - Measures fluid temperature in the main supply and return piping for the system.
  - The sensors should be installed with copper straps on the supply and return piping.
- Refrigerant Suction temperature sensors (1A, 1B, 2A, 2B)
  - Measures compressor rack suction temperature for each circuit.
  - Used by EEV controller to control superheat.
  - This will come installed on the suction side of the heat exchanger copper strapped to each line.
- Refrigerant Suction Pressure Transducers (1A, 1B, 2A, 2B)
  - Measures suction pressure on the refrigerant suction side of each heat exchanger
  - Used in conjunction with the Suction temperature sensors to control superheat
- EEV Controller
  - Emerson EXD-SH2
  - Used to control each EEV based on superheat.
- Carel Controller

    - C.pCO Medium
    - Used to communicate with other controllers and control the operation of each module.
    - Stages EEV's according to SOO
    - Reference CO2 Controller User Guide
- Liquid Vapor Separator Pressure Transducer
    - Used to stage cooling on and off based off of vapor separator pressure
    - This will come mounted on a packed angle valve located at the top of the liquid vapor separator.
- High Pressure Switch
    - This is used as a loss of charge avoidance mechanism to enable the emergency condensing unit if pressure in the system rises too high
    - This is mounted on a packed angle valve located at the top of the liquid vapor separator.

Start-Up

- The following items must be performed before the equipment can be left operating and unattended. Start-up consists of checking operating and safety controls, setting valves, and refrigerant levels.
- The Commissioning Request Form that was supplied with the equipment must be filled out and returned to the RAE National Accounts service department to get the unit scheduled for commissioning.

Pressure Control

- Pressure is controlled by the Carel Controller. Cooling is enabled through the Carel by sending an enable to the EXD Superheat controller and opening the expansion valves which are controlled to a superheat setpoint. Cooling is disabled once pressure reaches the low setpoint.

Pump Lead/Lag

- Pumps will cycle at minimum every Wednesday at 9am if no faults occur. If a fault occurs and the pump fails to prove flow, the Carel controller will enable the other available pump. If the second pump fails to prove flow as well, the controller will retry the first pump and check for flow. This will occur every 30 seconds for a 5-minute period. After 5-minutes, the Carel will alarm and require a user reset.

Pump Isolation Valves

- The pump isolation valves are located on the suction side of the pumps and the discharge side of the liquid filter driers. These are manual valves meant for isolation and maintenance of the pumps.

Heat Exchanger Isolation Valves

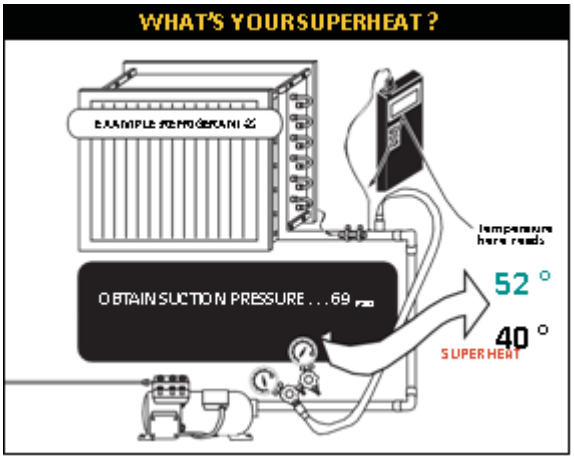
- The heat exchanger isolation valves are mounted on the inlet or outlet of the brazed plate heat exchangers to isolate the heat exchanger when service is required. These are manual ball valves only meant for serving the heat exchangers.

Electronic Expansion Valve

- An electronic expansion valve is used in conjunction with a controller, transducer, and temperature probe to calculate and control superheat.
- The electronic expansion valve can also be used as an MOP to maintain a maximum suction pressure. If the suction pressure exceeds the acceptable range for the compressor envelope, the valve will close down to protect the compressor. Superheat will rise as a result.
- The superheat setpoint should be verified and adjusted as needed. Setpoint should be adjusted through the Carel Controller as the Carel will overwrite the EXD Controller setpoint via MODBUS communication.
- Superheat control should be verified at the controller. When superheat is low, the valve should close down. When superheat is high, the valve should open up.
- If one of these items is faulty and is not operating properly, the superheat can be checked by performing the following calculation.

1. Measure the temperature of the suction line at the point the bulb is clamped.
2. Obtain the suction pressure that exists in the suction line at the bulb location.
3. Convert the suction pressure to saturated evaporator temperature by using a temperature-pressure chart (see Appendix “A”).
4. Subtract the two temperatures obtained in 1 and 3, the difference is superheat. Figure D illustrates a typical example of superheat measurement on a refrigeration system using R-22. The temperature of the suction line at the bulb location is read at 52°F. The suction pressure at the compressor is 69 psig and the estimated suction line pressure drop is 2 psig…69 psig + 2 psig = 71 psig at the bulb, which is equivalent to a 40°F saturation temperature. 40°F subtracted from 52°F = 12°F superheat.

Figure D



Liquid Driers and Suction Filters

- Liquid Drier Cores
  - 3 Liquid Drier Cores are provided with each Secondary CO2 unit. One core is provided in the charging line and one core at the discharge of each pump.
  - Liquid drier cores should be changed according to the maintenance schedule provided.
  - Drier cores originally supplied with the secondary CO2 units are anti-acid cores that contain 20% activated alumina. The activated alumina adsorbs polar molecules such as acids contained within the CO2. This is intended to reduce the formation of Carbonic acid within the system.

Note: If the drier core is changed due to contamination from pump burnout, it is recommended that the parallel pump core and charging core be changed out as well.

Note: Charging Line Drier should be changed each time after charge is added to the system.

Cut Sheets

- Equipment cut sheets are available using the QR code located inside of the power panel for each unit.

Shut down

- Equipment being shut down for a short period of time for maintenance should be disabled using the shutdown switch located on the control enclose at the front of the unit.
  - The Emergency Condensing Unit can be enabled through the Carel controller to increase the length of time the system can be down before over pressurization occurs.
- Equipment which will not be required to operate for a period of time should be evacuated of all liquid CO2 charge.

- Charge should be evacuated by disabling the system and opening the high point vent valves at the top of the CO2 vapor lines into the HX. The system pressure should be monitored during the evacuation process and kept above 100psi to avoid the formation of dry ice. If system pressure is dropping too quickly, slow the release of CO2 gas
- If system pressure falls below 100psi and discharge gas flowrate drops significantly, dry ice has likely formed inside of the vapor separator. Check LVS sight glasses to verify.

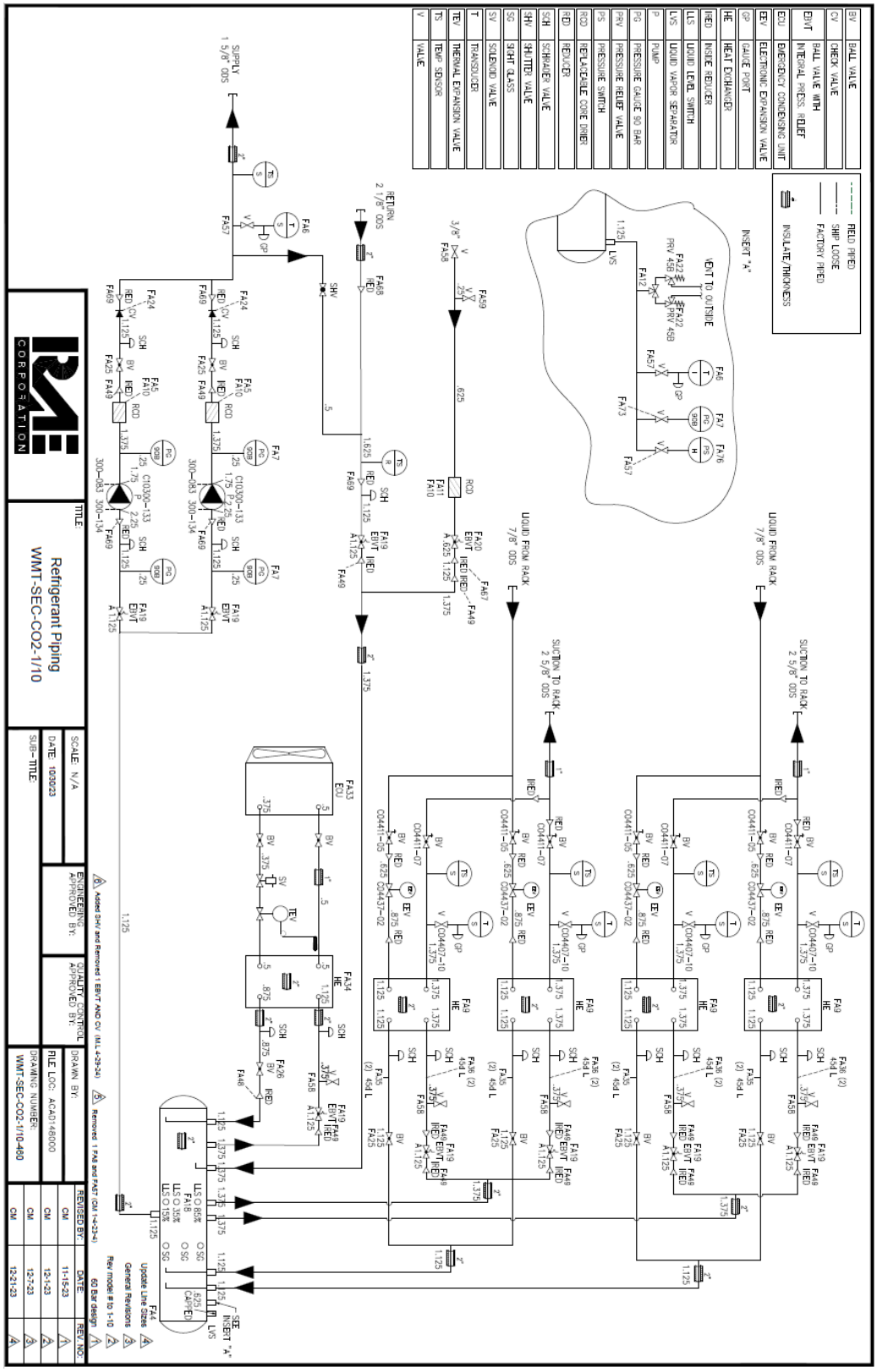
Note: If dry ice is allowed to form, the time to evacuate the system will increase dramatically as the dry ice will have to be allowed to melt/sublimate before evacuation can recommence. Heat may be added to speed the sublimation process.

System restart after shutdown

- If the system is being restarted after an evacuation of the system, follow the charging process from the system charging section above.
- If the ECU has been manually enabled in the Carel Controller, disable the ECU.
- Re-enable the Secondary CO2 unit using the enable switch located on the control enclosure.
- If additional load has been added to the system, a new flow setpoint may need to be established.
    - If true, follow the flow setting procedure prescribed in the flow setting document.
    - Reference CO2 Flow Setting Guideline

Additional System Information

Piping and Instrumentation Diagram



Sequence of Operation

See CO2 Sequence of Operation

Maintenance

Under normal usage and conditions, it is recommended that the following list of preventative maintenance steps be followed at the recommended intervals.

For up to date Spare parts list see CO2 Spare Parts List

24 Hours after start-up

- Replace Liquid Drier Cores

Monthly

- Visually inspect for physical damage of the unit.
- Check for adequate free area for service and operation.
- Check catch pans for debris and clean accordingly.
- Inspect the ECU fans and motors for damage and proper operation:
  - Ensure that the condenser fan turns freely.
  - Look for excessive or unusual vibration of fan blades or sheet metal panels when in operation, take corrective action as required.
  - Check all fan blades for signs of stress or wear.
  - Inspect all motors, check volts, amps, and if required, rotation.
- Inspect the ECU coil for cleanliness:
  - Check the air passages through the finned surface.
  - Look for signs of corrosion on fins, cabinet, copper tubing, and solder joints.'
- Exercise ECU to confirm operation
- Inspect electrical wiring and components:
  - Look for wear, kinks, bare areas, and discoloration of wiring.
  - Replace any wiring found to be damaged.
  - Verify that all electrical and ground connections are secure and tighten if necessary.
- Check operation and calibration of all relays, pressure controls, and safety controls
- Inspect the Liquid Vapor Separator sight glasses to verify liquid CO2 level.
- Inspect Liquid Level Switches and compare with sight glass readings to verify level switch operation
- Inspect refrigerant piping for signs of leaks, like oil stains.
- Inspect Generac Inverter and Battery Cabinet
  - Look for signs of visible damage
  - Check inverter screen for active alarms

- Check Battery charge level to ensure charge is being maintained
- Switch Remote Battery Shutdown switch to ensure proper operation, inverter should go into shutdown mode

Quarterly

- Inspect electrical wiring, components, and connections. Verify that all connections are tight and complete as required.
- Check contactors and relays for proper operation; replace if points are worn.
- Visually inspect the equipment for oil stains (leaks) on inter-connecting piping, solder joints, condenser and evaporator coil finned area.
- Check and tighten all flare connections.
- Check hand valve packing for leaks and tighten if needed.
- Check ECU coil surface and clean if needed.
- Check for unusual noise and look for pump pulsation or line vibration.
- Check all safety and operating controls for proper settings and operation. Settings are listed on wiring diagram.
- Check CO2 Supply and Return temperature readings
- Check pressure drop across driers (replace as required).
- Verify that superheat conforms to specifications.
- Electric heaters in unit panels should be inspected.
- Catch pans should be inspected and cleared of any debris.

Annually

- Take amperage readings on pumps. Amperage is listed on the wiring diagram. (Pump amps may not match RLA depending on speed and system differential pressure but should not exceed listed RLA)
- Leak check refrigerant and carbon dioxide circuits.
- Charge line and pump discharge drier cores should be changed at minimum every 3 years.

Cleaning instructions

At times it may be necessary to clean the Secondary CO2 unit. This may be as simple as rinsing it down with a hose, but in some cases, it may require the use of chemicals. When cleaning the unit, it is important that no electrical components are sprayed. This could potentially damage components, which may include: motors, electrical boxes, conduit fittings, etc. Components that dissipate heat should not burn when touched. Before cleaning, make sure that the unit is off and has had sufficient time to cool down. Components that may require extra attention to detail are noted below:

Catch Pan

- The catch pans may over time accumulate debris. Debris blocking the drain connection may cause the pans to overflow and lead to possible damage of flooring below the catch pan or cause slipping hazards.

Coil

- There is a potential for dirt and debris to build up and clog the entering air side of the ECU coil. This can cause a negative impact on unit performance and should be cleaned out as necessary. The coil should be sprayed from top to bottom in order to backwash any debris that has built up over time. It is important not to use too high of a pressure when cleaning the coil. Avoid spraying water on any electrical components of the ECU. This has the potential to damage the fins and negatively impact performance. Any chemicals designed for coil cleaning may be utilized but are not necessary.

Piping and Components

- The insulated components should be lightly rinsed during cleaning. Soapy water may be used but is not necessary. DO NOT spray the pump electrical box, or other electrical components with water. It is important to remember that the pump should be cooled off before cleaning. In some cases, an oil leak could require the use of degreaser.

WARNING: When using chemicals for cleaning, follow the cleaner manufacturer's directions. A solution that is too strong can compromise the finish and even reduce the life of components.

Troubleshooting

Problem	Possible Causes	Possible Corrective Steps
Pump will not run	a. Main switch open b. Main Fuse blown c. Defective Circuit Breaker d. System shut down by controller alarm e. Faulty Pump Motor f. Loose wiring g. Proof of flow is not made h. Low LVS Level Switch is not made	a. Close switch b. Check electrical circuits and motor winding for shorts or grounds; investigate for possible overloading; replace fuse or reset breaker after fault is corrected. (15A for 460V units, 20A for 208V units) c. Repair or replace circuit breaker. d. Determine type and cause of shutdown and correct it before resetting alarms e. Check motor for opens, short circuit or burnout f. Check all wire junctions, tighten all terminal screws

		g. Check valve positions and pressure transducer readings and wiring h. Check level switches and sight glasses to confirm operation and proper liquid level
Pump noisy or vibrating	a. Lack of proper NPSH b. Improper piping support on discharge or suction line c. Worn pump	a. Check valve positions b. Relocate, add, or remove pipe bracing. c. Replace pump
ECU will not run	a. 15A ECU Fuse blown b. Defective contactor or coil c. Defective high-pressure switch d. Motor electric trouble e. Loose wiring f. Battery back-up system has faulted g. ECU is not enabled by the Carel or high-pressure switch	a. Check electrical circuits and motor winding for shorts or grounds; investigate for possible overloading; replace fuse or reset breaker after fault is corrected. b. Repair or replace contactor or coil c. Check system pressure, repair or replace high pressure switch d. Check motor for opens, short circuit or burnout e. Check all wire junctions, tighten all terminal screws f. Check Generac inverter for proper function g. None
Liquid Vapor Separator temperature will not pull down / High Liquid Vapor Separator Pressure	a. Thermosiphon function is being interrupted. b. Unit flowrate does not match demand c. Superheat is too high d. Subcooling is too low e. EEV malfunction f. EEV Temp or Pressure sensor error g. Fouled heat exchanger h. Refrigerant SST too high	a. Check/Reset unit flowrate and bypass valve position. b. Check/Reset unit flowrate and bypass valve position c. Check superheat setting in controller Short refrigerant Check refrigerant type in controller Check EEV temp sensor location is at 4 or 8 o'clock Confirm transducer valve is open d. Check condensing unit fans Short refrigerant

		e. Replace EEV or EEV wiring f. Replace sensor or sensor wiring g. Clean or replace BPHE Clean strainer h. Check rack

Warranty

RAE Corporation Express Limited and Extended Express Limited Warranty

The Express Limited Warranty and Extended Express Limited Warranty are only available to customers if the Start-up paperwork is completed and returned to RAE Corporation Service Department pursuant to the requirements below. The Start-up documents are included with each product sold, or can be obtained by contacting RAE Corporation. The Start-up paperwork must be;

(1) Completed at the time of start-up.
(2) Signed and Dated by the start-up technician.
(3) Mailed or emailed to the RAE Corporation Service Department for warranty validation within 10 days of equipment startup.

1. Express Limited Warranty

Subject to the terms, limitations, and disclaimer provisions set forth herein, RAE Corporation, and its divisions, hereinafter referred to as RAE, warrants to the original Purchaser that products manufactured by RAE shall be free from defects in material and workmanship under normal use and service. This limited warranty, which covers material and workmanship, has a limited duration which is as follows: the limited warranty commences on the date that RAE issues its invoice to the Purchaser for the equipment, and extends thereafter until the limited warranty expiration date. The limited warranty expiration date is the earlier of the following: eighteen (18) months from and after the issuance of RAE's invoice to the Purchaser, or twelve (12) months from and after the start-up of the equipment that is the subject of the invoice. If startup paperwork, or notification of delayed start, has not been received by RAE within six (6) months of shipment, the start date will default to three (3) months from shipment. In no event shall any warranty exceed eighteen (18) months from the date that RAE Issues its invoice to Purchaser.

This warranty is issued only to the original Purchaser, or to a single Bearer (User) authorized in writing by the original Purchaser on RAE's approved form and in accordance with the instructions therein, and may not be transferred to subsequent purchasers. This warranty applies only to a unit installed within the United States of America, its territories or possessions and Canada, and is in lieu of all other warranties expressed or implied. RAE neither assumes, nor authorizes any other person to issue or assume for RAE, any obligations

or liabilities not herein stated.
It is agreed that in the event of breach of any of the express warranties described herein, the liability of RAE shall be limited to RAE repairing or replacing the non-conforming goods. RAE will repair or replace, free of cost to Purchaser, F.O.B. RAE factory, any part or parts that have been found, after inspection by RAE or RAE approved vendor, to be defective under normal use and service. Upon RAE authorization, the said part or parts should be returned to RAE, transportation prepaid by purchaser, for inspection and warranty judgment. RAE assumes no responsibility for the expense of labor or materials necessary to remove a defective part or install repaired or new parts. RAE reserves the right to deny warranty for any components that, after inspection by RAE or RAE approved vendor, to have failed due to abuse, neglect, or operation outside of design conditions.

The Express Limited Warranty is subject to the terms and conditions described herein.

2. Extended Express Limited Warranty

An Extended Express Limited Warranty ("Extended Warranty") may be purchased at the time of equipment purchase. The warranty runs until an additional number of years after expiration of the Express Limited Warranty. The Extended Warranty must be purchased prior to the startup date. RAE, at its sole discretion, may authorize the purchase of an extended warranty after the unit is initially started, based on approval of the provided startup documentation. The Extended Warranty is limited to the original purchaser, or to a single Bearer (User) authorized in writing by the original Purchaser on RAE's approved form and in accordance with the instructions therein, and may not be transferred to subsequent purchasers.

3. General Disclaimers and Limitations on Warranty

RAE CORPORATION, HEREAFTER REFERRED TO AS RAE, DISCLAIMS, AND MAKES NO WARRANTY OF MERCHANTABILITY AND NO WARRANTY OF FITNESS FOR ANY PARTICULAR PURPOSE, NOR DOES IT MAKE ANY WARRANTY, EXPRESS OR IMPLIED, OF ANY NATURE WHATSOEVER WITH RESPECT TO PRODUCTS SOLD BY RAE OR THE USE THEREOF EXCEPT AS IS SPECIFICALLY SET FORTH ON THE FACE HEREOF. THIS WARRANTY, WHICH IS GIVEN EXPRESSLY AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED CONSTITUTES THE ONLY WARRANTY MADE BY THE SELLER. **THIS LIMITED WARRANTY DOES NOT COVER OR PROTECT AGAINST THE CONSEQUENCES OR EFFECTS OF ANY MISUSE, NEGLECT, OR USE OF THE EQUIPMENT OUTSIDE OF THE PURPOSES OR PARAMETERS FOR WHICH THE EQUIPMENT WAS DESIGNED.**
RAE SHALL IN NO EVENT BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, CONSEQUENTIAL OR PENAL DAMAGES. RAE MAKES NO WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, TO 'CONSUMERS' AS THAT TERM IS DEFINED IN SEC. 101 OF PUBLIC LAW 93-637, THE MAGNUSON-MOSS WARRANTY-FEDERAL TRADE COMMISSION IMPROVEMENT ACT. RAE SHALL NOT BE LIABLE FOR ANY DAMAGE OR DELAYS OCCURRING IN TRANSIT, FOR ANY DEFAULT OR DELAYS IN PERFORMANCE CAUSED BY ANY CONTINGENCY BEYOND ITS CONTROL INCLUDING WAR, GOVERNMENT RESTRICTIONS OR RESTRAINTS, STRIKES, SHORT OR REDUCED SUPPLY OF RAW MATERIALS, FIRE, FLOOD OR OTHER ACTS OF GOD, NOR FOR DAMAGE OR LOSS OF ANY PRODUCTS, REFRIGERANT, PROPERTY, LOSS OF INCOME OR PROFIT DUE TO MALFUNCTIONING OF SAID UNIT.

ANY AND ALL CONTROVERSIES, ISSUES, CLAIMS OR DISPUTES RELATING TO THIS PURCHASE AND SALE TRANSACTION, INCLUDING BUT NOT LIMITED TO, ANY CONTROVERSIES, ISSUES, CLAIMS AND DISPUTES CONCERNING THE INTERPRETATION OR ENFORCEMENT OF ANY WARRANTY (OR ANY LIMITATION OR OTHER ASPECT THEREOF), SHALL BE GOVERNED BY OKLAHOMA LAW.

THE LIABILITY OF RAE, OR ANY OF ITS SUBSIDIARIES AND AFFILIATES, OR ANY OF THEIR EMPLOYEES, OFFICERS, MANAGERS, DIRECTORS, RESELLERS, SUPPLIERS, PARTNERS, AGENTS AND DISTRIBUTORS ARISING FROM THE SALE OF THE PRODUCT OR UNDER THE TERMS OF THIS WARRANTY SHALL NOT IN ANY CASE EXCEED THE NET FACTORY SALE PRICE (NFSP) OF THE ORIGINAL PRODUCT ORDER.

4. Specific Limitations to Warranty

Parts Only

This warranty is limited to repair or replacement of defective parts only and does not include labor. RAE, at its sole discretion, may preauthorize the inclusion of limited labor expense for one person to perform the act of repair. No claim for labor charges will be allowed without a written preauthorization from RAE Service Department.

Replacement parts for any warranted parts must be obtained directly from RAE, or a RAE manufacturer's representative. Claims for replacement parts obtained locally will be disallowed unless accompanied by a RAE purchase order for such replacement parts. RAE, at its sole discretion, may offer coverage of locally bought parts "at cost" when supplied with actual receipts for the purchase price of the parts.

Orders for warranty replacement parts will be shipped ground transportation prepaid using the most appropriate transportation method. Any premium transportation service will be at the cost of the requestor.

Export Equipment

Equipment exported outside the United States will be covered under the same parts only warranty as non-exported equipment; provided that all warranty transactions must take place within the territorial United States.

Parts covered under warranty must be paid for in advance of any parts shipment. The customer will be reimbursed upon return of the warranty part and after the part has been inspected and determined defective. All exporting paperwork and shipping costs, including crating, customs fees, and other export costs, will be the responsibility of the party ordering the part.

Initial Inspection

RAE will not be responsible for shipping damage, or for parts lost in transit, or for any claims of concealed damage. It is the responsibility of the receiving party to thoroughly inspect the equipment upon delivery for damage, refrigerant leaks or dry nitrogen pressure loss in transit, and to verify that any loose parts have been included in the shipment. The bill of lading will indicate if parts are shipped loose in the unit. If shipping damage has occurred, or loose parts are missing, the receiving party must resolve the issue through the claim process with the company transporting the equipment.

Refrigerant

Refrigerant is excluded from the warranty. No payment will be made for any leak that occurs at a threaded mechanical joint (defined as flare joints, pipe thread joints or rotolock joints). It is the responsibility of the installing contractor to check these joints upon arrival of the equipment and/or prior

to charging the system. Any claim for refrigerant reimbursement must be pre-authorized by RAE Service Department and a purchase order issued. Any claims received without a RAE purchase order, or without written coverage statements from RAE Service Department, will be disallowed. Should an obligation be approved by RAE, RAE specifically reserves the right to provide the refrigerant, or replace the refrigerant in a like quantity to the user. RAE, at its sole discretion, may preauthorize the inclusion of refrigerant "at cost" when provided with receipts for the purchase price of the refrigerant.

5. DOA (Dead on Arrival) Warranty Issues

In the event of a DOA issue, the purchaser must notify the RAE Service Department and provide the equipment Model Number, Serial Number, complete problem description and backing documentation as required by RAE Service Department.
If repairs are authorized by RAE, the RAE Service Department may:

A. Authorize the job site contractor to make the repairs by requesting a quote from the contractor and providing a work authorization document.
B. Select a different contractor to make the repairs.
C. Dispatch a factory technician to make the repairs.
D. Provide replacement parts only.

If field repair labor is authorized, a RAE work authorization will be issued in the amount of the approved estimated repair cost (including parts, material and labor per any agreed pricing and coverage), and repairs can be performed. In no event shall RAE be responsible for any costs beyond the approved estimated repair cost. Upon completion of repairs, the contractor is to send the invoice referencing the work authorization number to the service department with supporting documentation, including a service report and parts/material receipts. No back charges or service billings will be accepted without prior authorization by the service department.

A DOA problem is a defect in material or workmanship that prevents a successful startup of the unit. The problem will be discovered prior to or at the time of start-up. A DOA claim is not valid after the date of initial unit start up. Shipping damage is not a DOA issue or a warranty issue.

6. Compressor Replacements

In the event a compressor fails, RAE Service Department must be notified by telephone or e-mail within 24 hours of discovering the compressor failure. The customer must provide RAE Service Department with the Unit Model Number, Unit Serial Number, Compressor Model Number, and Compressor Serial Number before any replacement will be provided.
RAE reserves the right to determine the source of the replacement compressor. The failed compressor body core must be returned to the vendor, re-manufacturer, distributor, or wholesale house as determined by RAE Service Department before the compressor will be replaced pursuant to this warranty. If the core is not returned, the customer will be invoiced for the compressor and the warranty claim will be rejected. Although RAE will replace the compressor, RAE is not responsible for any labor, travel, crane, lift, hoist, jig, tax expense, or any other cost or expense. Moreover, RAE assumes no responsibility for additional parts, refrigerant or other expenses incurred in making the unit operational.

7. Notice to RAECorporation

To contact and/or notify RAE Corporation Service Department the following contact information must be used:

Address: RAE Corporation, 4492 Hunt St., Pryor, OK 74361 Office Phone: 918-825-7222
Fax: 918-471-2944
After Hours Emergency Cell Phone: 918-633-2838 Email: service@rae-corp.com

Appendix A – Temperature-Pressure Charts

˚F	R-404a	R-507	R-407a	R-407c	R-407f	R-448a	R-449a	R-134a	R-410a	R-22	R-744
-40	4	5	1	-2	0	0	0	-7	11	1	146
-38	5	6	0	-2	1	1	1	-7	12	1	152
-36	6	8	1	1	1	2	2	-6	13	2	158
-34	7	9	1	0	2	3	3	-6	15	3	164
-32	8	10	2	1	3	3	3	-5	16	4	171
-30	10	11	3	2	4	4	4	-5	18	5	178
-28	11	12	4	3	5	5	5	-4	19	6	185
-26	12	13	5	3	6	6	6	-4	21	7	192
-24	13	15	6	4	7	8	8	-3	23	8	200
-22	15	16	7	5	9	9	9	-2	25	9	207
-20	16	18	8	6	10	10	10	-2	26	10	215
-18	17	19	10	8	11	11	11	-1	28	11	223
-16	19	21	11	9	12	12	12	0	30	13	231
-14	20	22	12	10	14	14	14	0	32	14	240
-12	22	24	13	11	15	15	15	1	34	15	248
-10	24	26	15	12	16	16	16	2	36	17	257
-8	25	27	16	14	18	18	18	3	39	18	267
-6	27	29	18	15	19	19	19	4	41	19	276
-4	29	31	19	16	21	21	21	5	43	21	286
-2	31	33	21	18	23	23	23	5	46	22	296
0	33	35	23	19	24	24	24	6	48	24	306
2	35	37	24	21	26	26	26	7	51	26	316
4	37	39	26	23	28	28	28	9	54	27	327
6	39	41	28	24	30	30	30	10	57	29	338
8	41	43	30	26	32	32	32	11	59	31	349
10	43	46	32	28	34	34	34	12	62	33	360
12	45	48	34	30	36	36	36	13	65	35	372
14	48	51	36	32	38	38	38	14	69	37	384
16	50	53	38	34	40	40	40	16	72	39	397
18	53	56	40	36	43	42	42	17	75	41	409
20	55	58	42	38	45	45	44	18	79	43	422
22	58	61	45	40	48	47	47	20	82	45	435
24	61	64	47	42	50	49	49	21	86	48	449

26	63	67	50	45	53	52	52	23	90	50	462
28	66	70	52	47	55	55	54	24	93	52	476
30	69	73	55	50	58	57	57	26	97	55	491
32	72	76	58	52	61	60	60	28	101	58	506
34	75	79	60	55	64	63	63	30	106	60	521
36	79	82	63	57	67	66	66	31	110	63	536
38	82	86	66	60	70	69	69	33	114	66	552
40	85	89	69	63	73	72	72	35	119	69	568
42	89	93	73	66	77	75	75	37	123	72	584
44	92	96	76	69	80	79	78	39	128	75	601
46	96	100	79	72	84	82	82	41	133	78	618
48	100	104	83	76	87	85	85	43	138	81	635
For blend refrigerants the Dew Point is used for 50°F and below.											
Pressure in PSIG											

°F	R-404a	R-507	R-407a	R-407c	R-407f	R-448a	R-449a	R-134a	R-410a	R-22	R-744
50	104	108	86	79	91	89	89	45	143	84	653
52	109	112	108	101	114	112	110	48	148	87	671
54	113	116	112	105	118	116	114	50	154	91	690
56	117	120	116	109	123	120	118	52	159	94	709
58	121	125	120	113	127	124	122	55	165	98	728
60	126	129	125	117	132	129	127	57	171	102	748
62	130	134	129	122	136	134	131	60	177	105	768
64	135	138	134	126	141	138	136	63	183	109	789
66	139	143	139	131	146	143	141	65	189	113	810
68	144	148	143	135	151	148	146	68	195	117	831
70	149	153	148	140	156	153	150	71	202	121	853
72	154	158	153	145	162	158	156	74	208	126	875
74	159	163	159	150	167	163	161	77	215	130	898
76	164	169	164	155	173	169	166	80	222	134	921
78	169	174	169	160	178	174	172	83	229	139	945
80	175	180	175	165	184	180	177	87	237	144	970
82	180	185	180	171	190	186	183	90	244	148	995
84	186	191	186	176	196	192	189	93	252	153	1020
86	192	197	192	182	202	198	194	97	259	158	1046
88	198	203	198	188	209	204	201	101	267	163	1074
90	204	209	204	194	215	210	207	104	275	168	1116
92	210	216	211	200	222	216	213	108	284	174	1158
94	216	222	217	206	228	223	219	112	292	179	1200
96	223	229	224	212	235	230	226	116	301	185	1242
98	230	235	230	218	242	236	233	120	310	190	1284
100	236	242	237	225	249	243	240	124	319	196	1326
102	243	249	244	232	257	250	247	128	328	202	1367
104	250	256	251	238	264	257	254	133	337	208	1410

106	257	264	258	245	272	265	261	137	347	214	1451
108	265	271	266	253	279	272	268	142	356	220	1493
110	272	279	273	260	287	280	276	146	366	226	1535
112	280	287	281	267	295	288	284	151	377	233	1577
114	287	295	289	275	303	296	291	156	387	239	1619
116	295	303	297	282	312	304	299	161	398	246	1661
118	303	311	305	290	320	312	308	166	408	253	1703
120	312	319	313	298	329	320	316	171	419	260	1745
122	320	328	322	306	338	329	324	176	431	267	1786
124	328	337	331	314	347	338	333	182	442	274	1828
126	337	345	339	323	356	347	342	187	454	282	1870
128	346	355	348	331	365	356	351	193	466	289	1912
130	355	364	357	340	375	365	360	199	478	297	1954
132	364	373	367	349	385	374	369	205	490	305	1996
134	374	383	376	358	395	384	378	211	503	313	2038
136	383	393	386	367	405	393	388	217	516	321	2080
138	393	403	396	377	415	403	398	223	529	329	2122
140	403	413	406	386	425	413	408	229	543	337	2164
For blend refrigerants the Dew Point is used for 50°F and below.											
Pressure in PSIG											