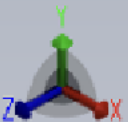
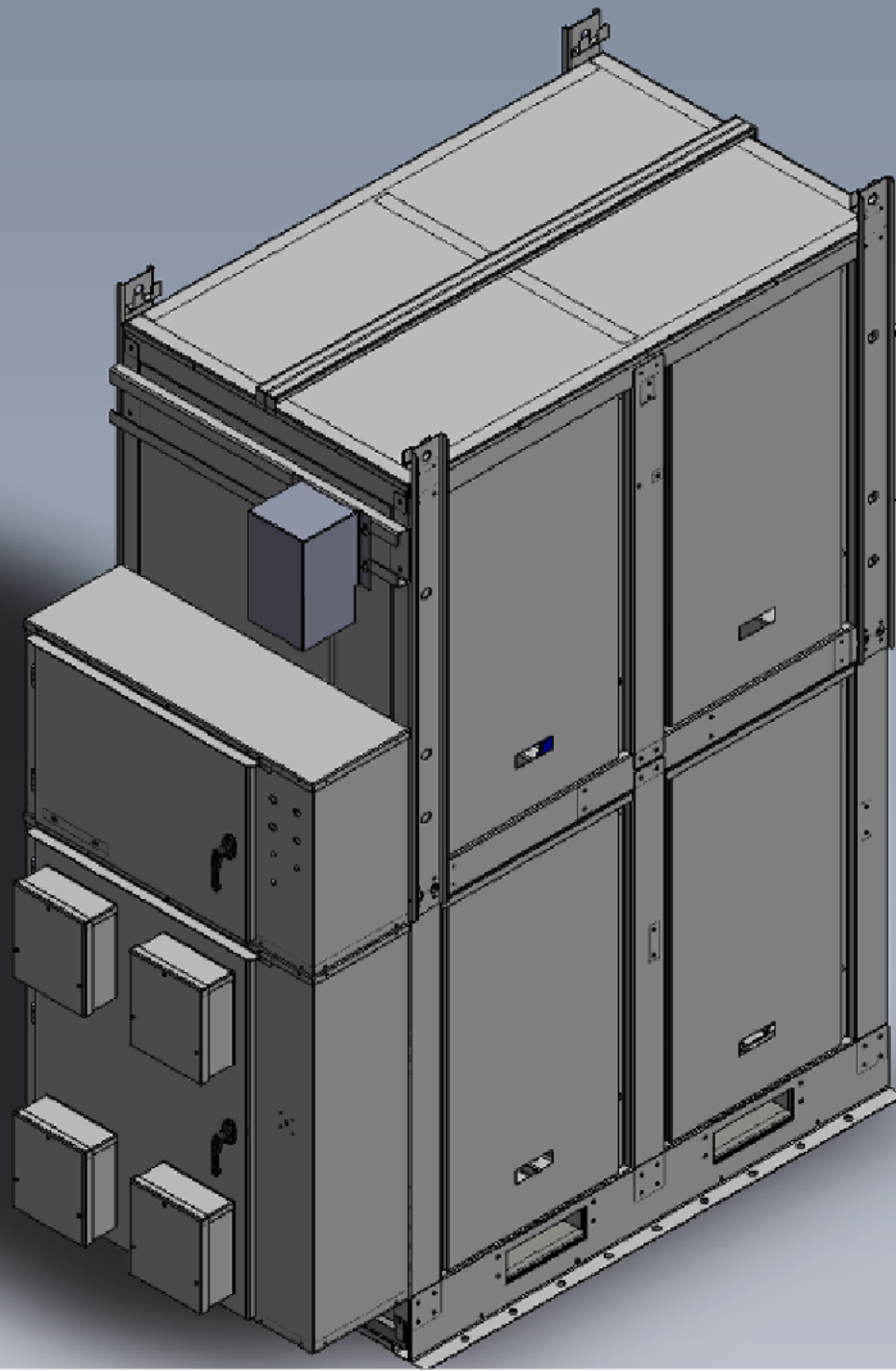


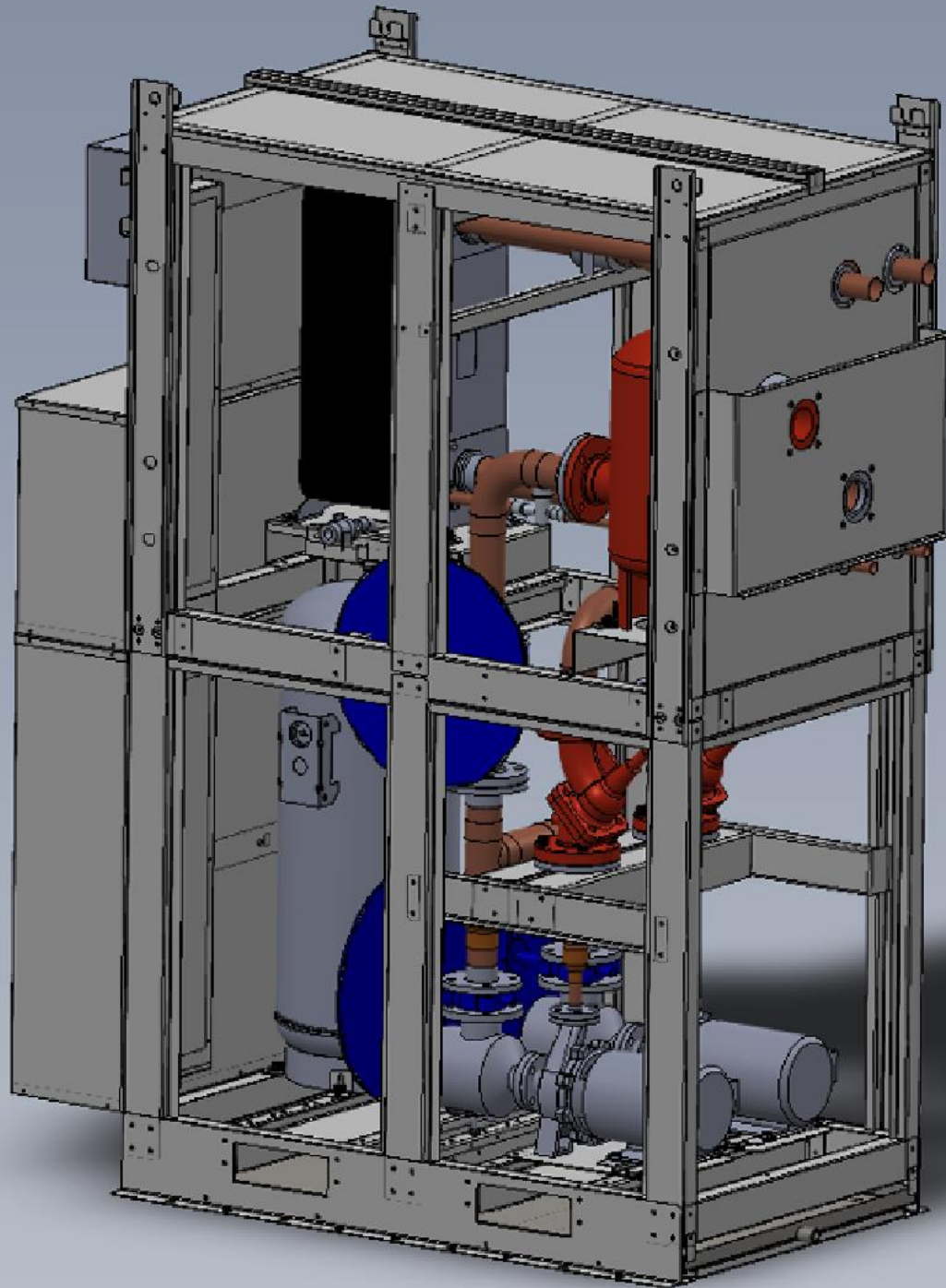


ANATOMY: GLYCOL

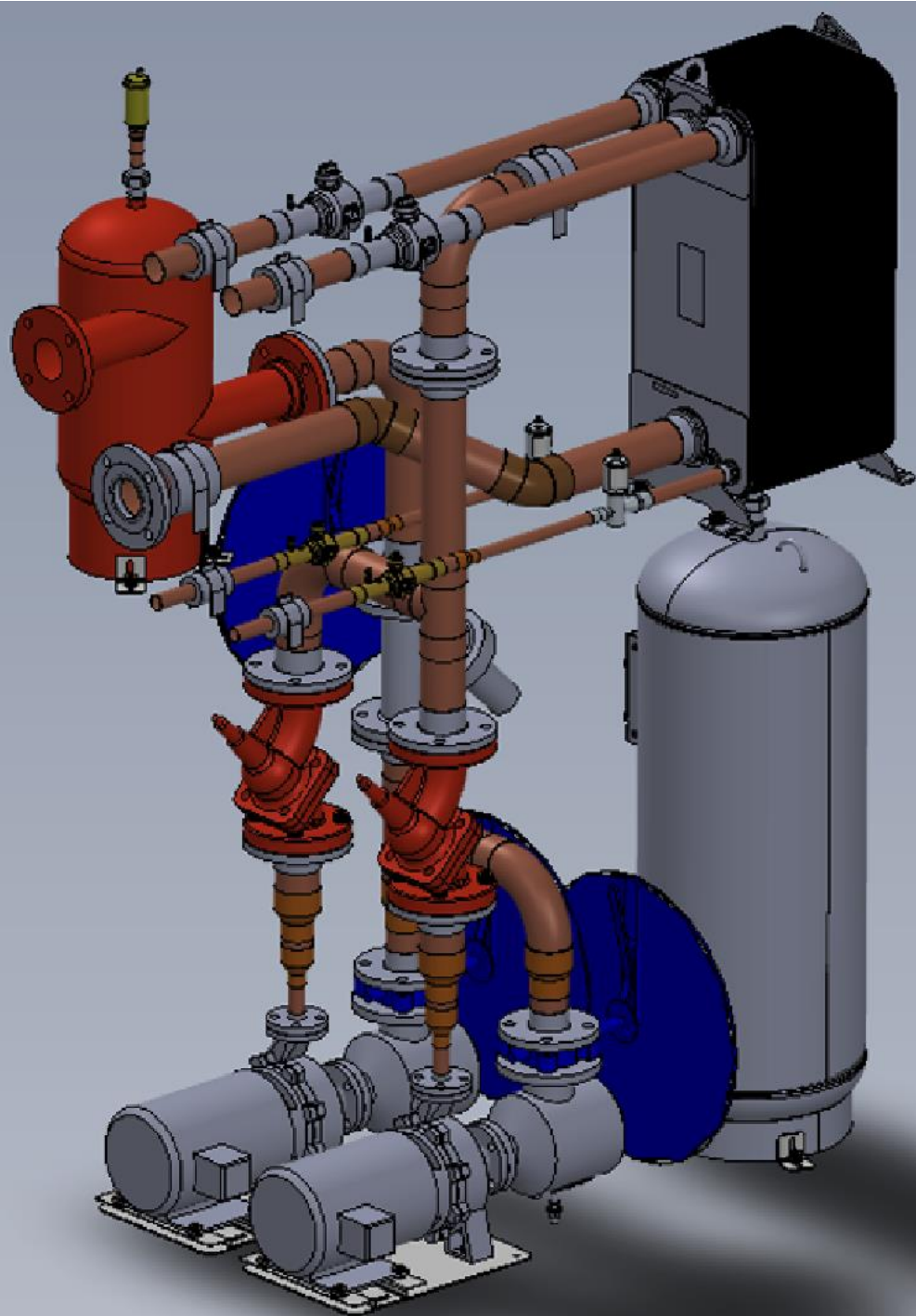
ANATOMY: Glycol



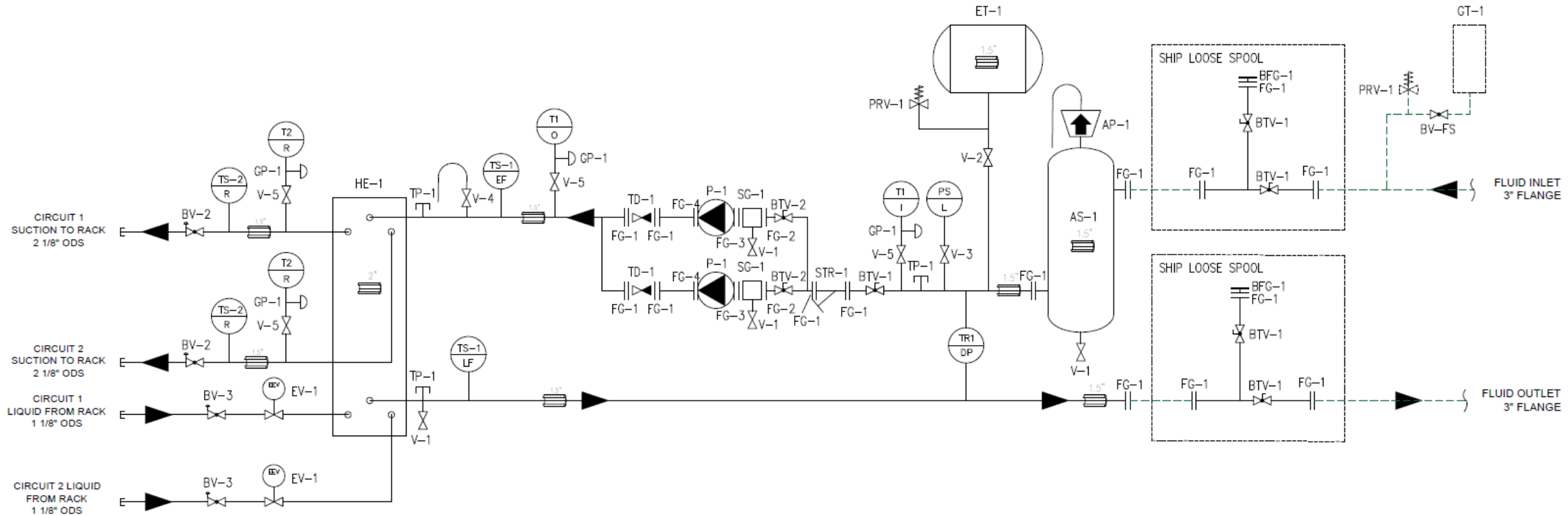
ANATOMY: Glycol



ANATOMY: Glycol



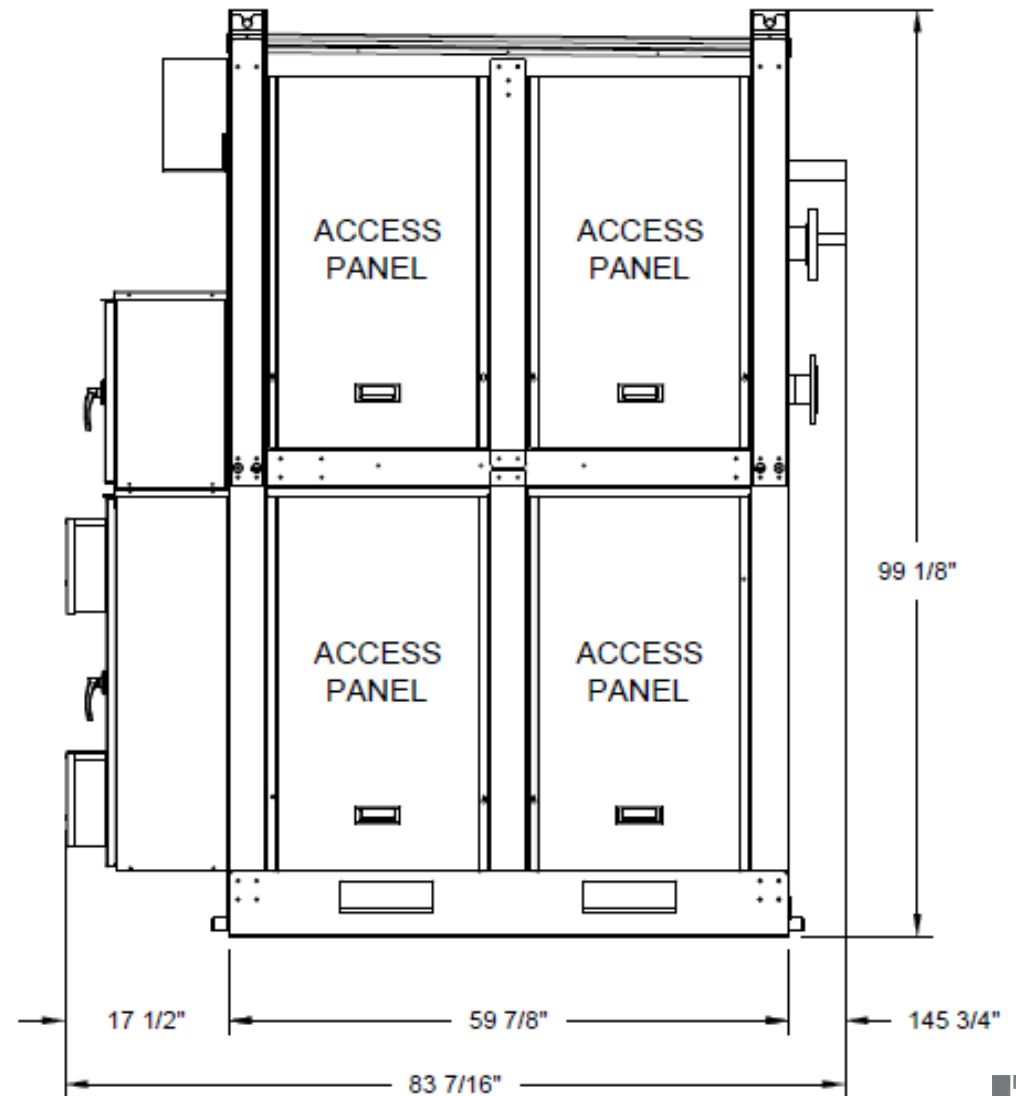
Overview: Glycol P&ID



Unit Installation



- Full perimeter curb support recommended
- Removeable stainless steel catch pan
 - $\frac{3}{4}$ " connection only on one side
 - Flat construction
- Access panels for easy service



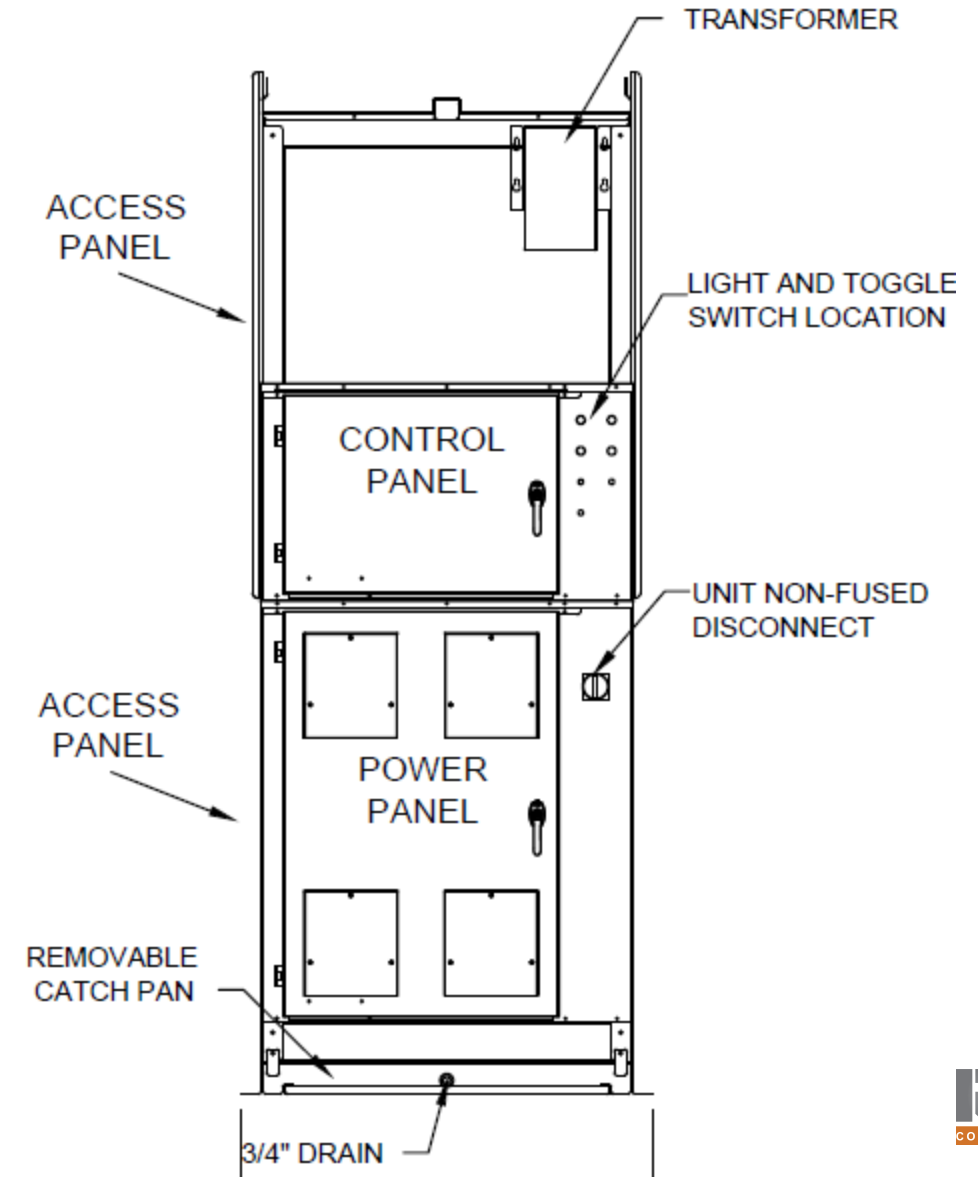
Power and Controls

- Control Enclosure

- All low voltage (**24V**)
- External indicator lights
- Carel™, Emerson™ EXD, UPS, etc.

- Power Enclosure

- Anything **greater than 24V**
- Power entry, transformers, panel heater, VFD, etc.
- External disconnect provided



Glycol Feeder

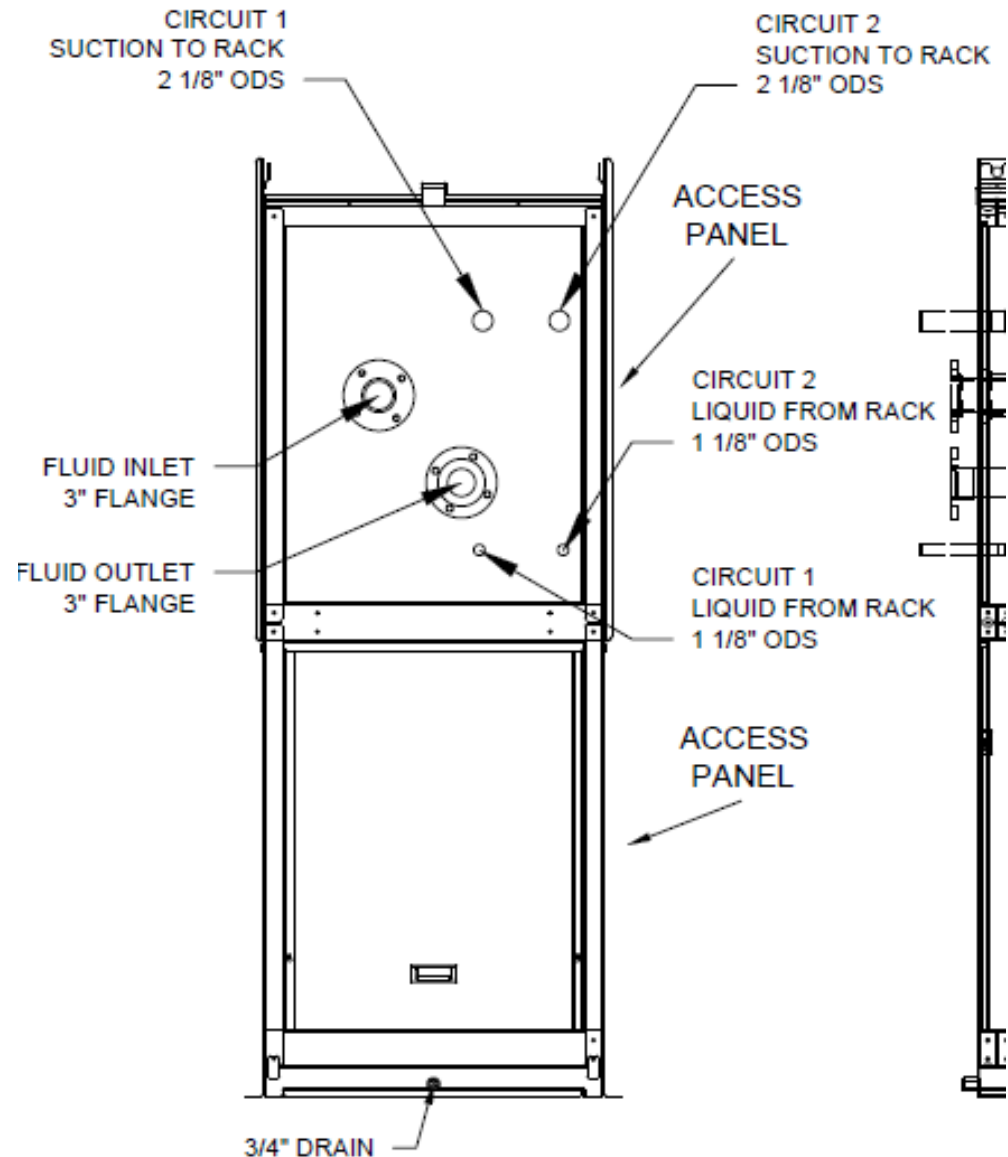
Walmart 

- 115V Power
3/4" connections
- Shipped loose to be installed indoors
- Manual toggle switch installed
- Typically installed in loading dock



Piping/Connections

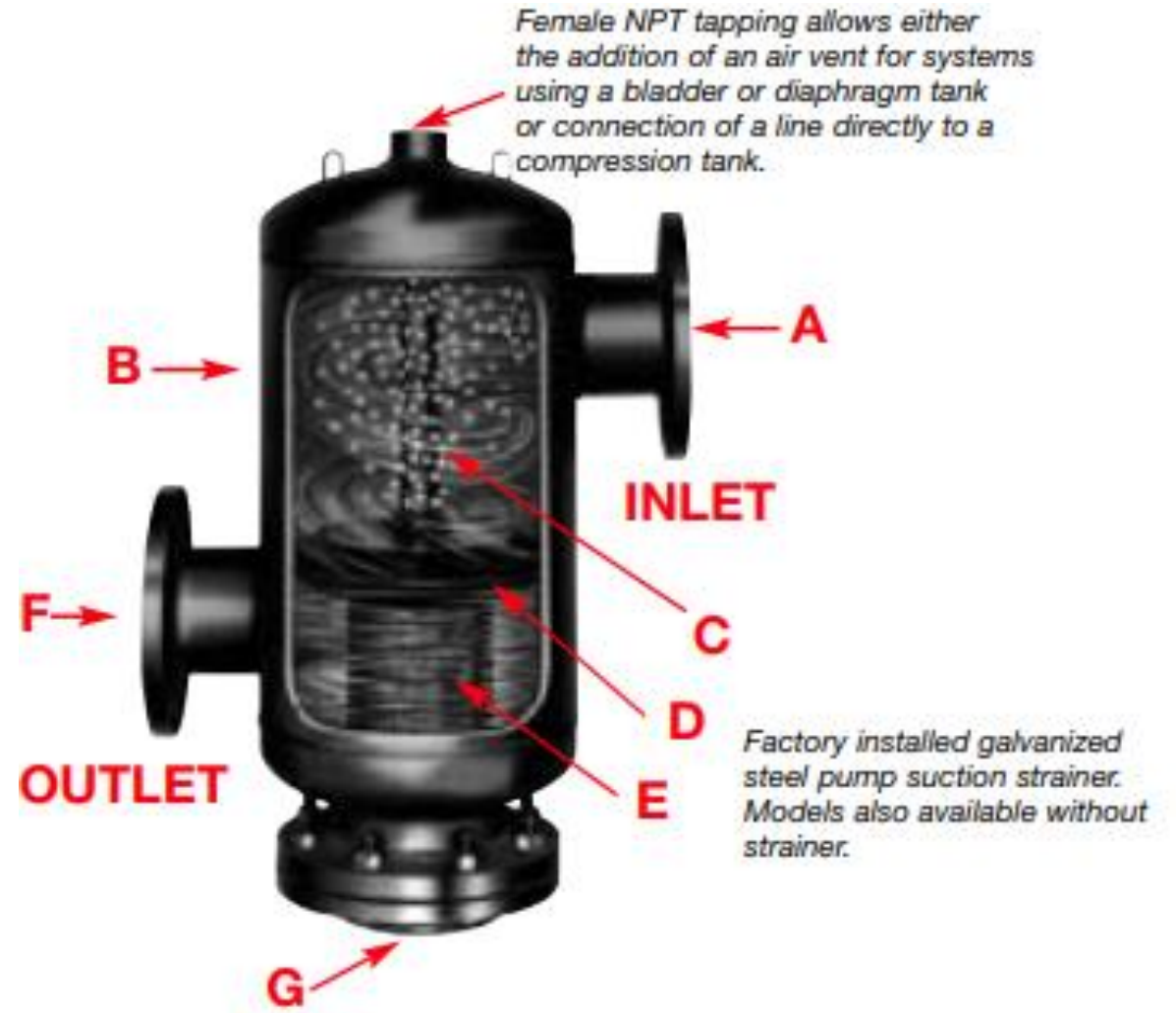
- Spools provided with butterfly valves and emergency connections.
 - Shipped loose.
- Drain valves with $\frac{3}{4}$ " hose bib connections
- Garlock Blue-Gard 3000 Full Face Gasket
 - Shipped Loose.



Air Separator

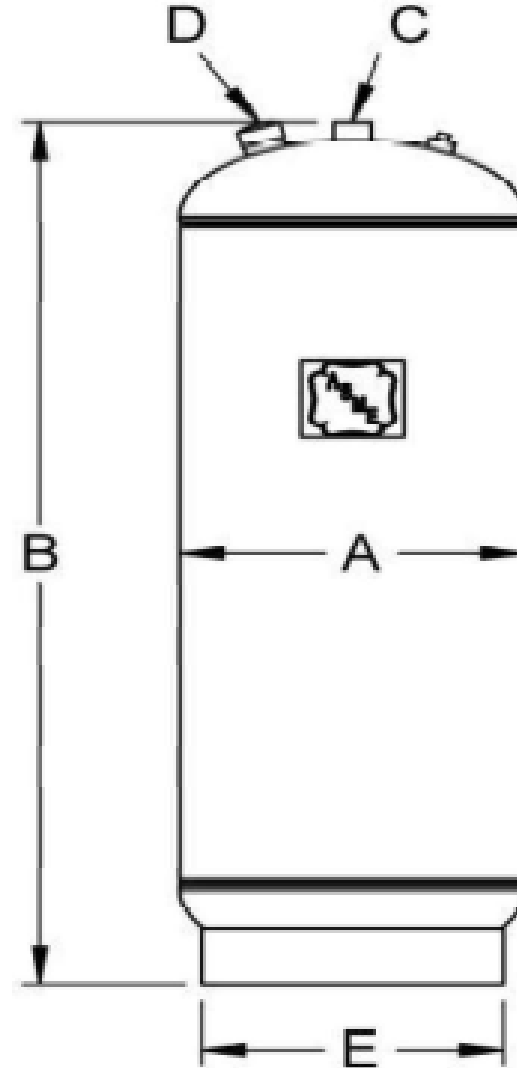
- Auto air vent
- Air removal efficiency increases as flow decreases

- A. Tangential Flow Through Design
- B. Vessel Shell is 3 times the inlet/outlet diameter.
- C. Stainless Steel Air collector tube.
- D. Baffle
- E. Vertical strainer with bottom access.
- F. NPT/Flanged Connections



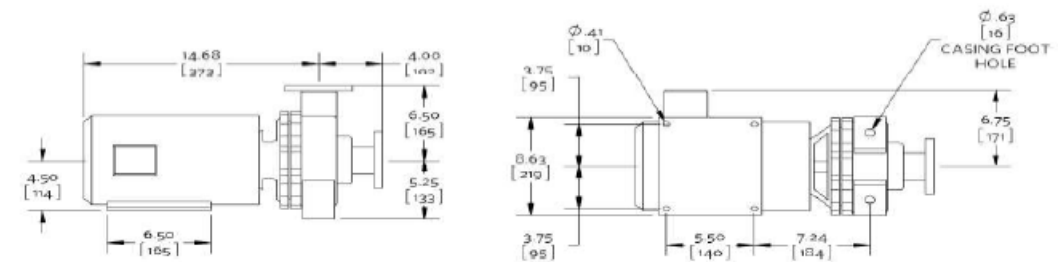
Expansion Tank

- Comes from factory isolated and pre-charged at 40psi
 - Contractor can change depending on site requirements.
- 125psi PRV installed in-line with vent piped to the floor
- Fixed Diaphragm
 - Bladder rupture indicator provided



Pumps

- Centrifugal close coupled end suction pump
 - No couplings or alignment required
- Same pump utilized on both skid sizes
 - Different pump motor (5hp and 7.5hp)
- Suction guide provided with screen installed
- VFD used for pump speed control



Inverter motor type: Inverter duty

Weight: 158 lb [71.67 kg], Units of measure: inches [millimeters]

- Not to scale
- Tolerance of ± 0.125 inch (± 3 mm) should be used
- For certified dimensions, please contact your Armstrong representative
- Pump equipped with casing drain plug and $\frac{1}{4}$ inch NPT suction and discharge gauge ports

Connection details

Connection	Size	Rating	OD	Bolt quantity*	BCD	Bolt size
Inlet	1.5	ANSI-125	5.00	2	3.88	0.5
Outlet	1	ANSI-125	4.25	2	3.13	0.5

*Equally spaced straddling centreline

Triple Duty Valve

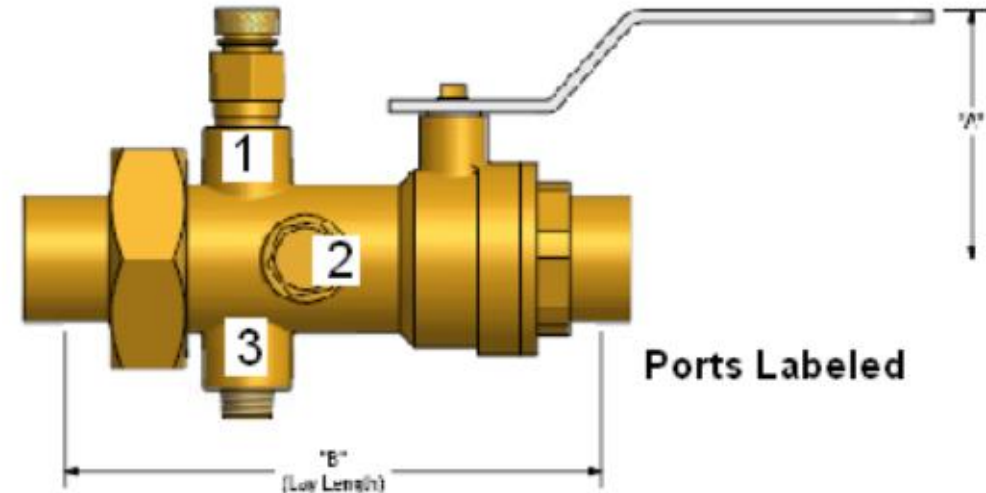
- Utilized as check and isolation valve only
 - Not meant for flow control
 - Factory shipped **100% open**



-
- LIFTING LUGS ARE DELIVERED UNASSEMBLED
- 11.4"
- 6.97"
- S1
- S4.2
- S4 (4X) 3/8"-16 UNC x 25
- 4.33"
- 7.09"
- 5.43"
- 8.11"
- 7.56"
- 20.7"
- 7.58"
- 8.07"
- 5.83"
- 9.59"
- 7.17"
- S3.1
- S2
- S3.2
- 4.33"
- 7.87"
- 11.30"
- 1.71"
- 2x (3/8"-16 UNC x 25)
- 3.44"
- 0.76"
- 0.33"
- 1.73"
- 10.06"
- 9.59"
- 5.83"
- 5.43"
- (4X) 3/8"-16 UNC x 25
- T1 T2 T3.1 T3.2 T4.1 T4.2 locations on back side correspond to S1 S2 S3.1 S3.2 S4.1 S4.2 on front side
- FEET ARE DELIVERED UNASSEMBLED

End of Line Bypass

- Manual valve supplied for end-of-line bypass
- Field adjusted
 - Set to minimum flow to protect pump
 - Connect $\frac{1}{4}$ " probes to obtain DP
 - Determine required DP from Venturi chart
 - Throttle valve until required DP is achieved
 - Tighten memory stop nut to set valve



DP Transmitter

- Differential pressure transmitter mounted on each skid
- Factory calibrated
 - 0-50 PSID
 - 4-20mA
 - Designed for fluid flow in one direction only
 - Factory set at 20 psig



Insulation: Glycol

- All refrigerant and glycol piping is insulated with 1½" thick closed cell foam insulation to minimize condensation



END OF ANATOMY: GLYCOL





APPLICATION: GLYCOL

What are we Doing?

- State, Federal and Global regulation is driving industry change.
- Walmart's decarbonization initiative to **reduce greenhouse gas emissions by 1B Metric Tons** from global value chain by **2030.**



How does our equipment align with this initiative?

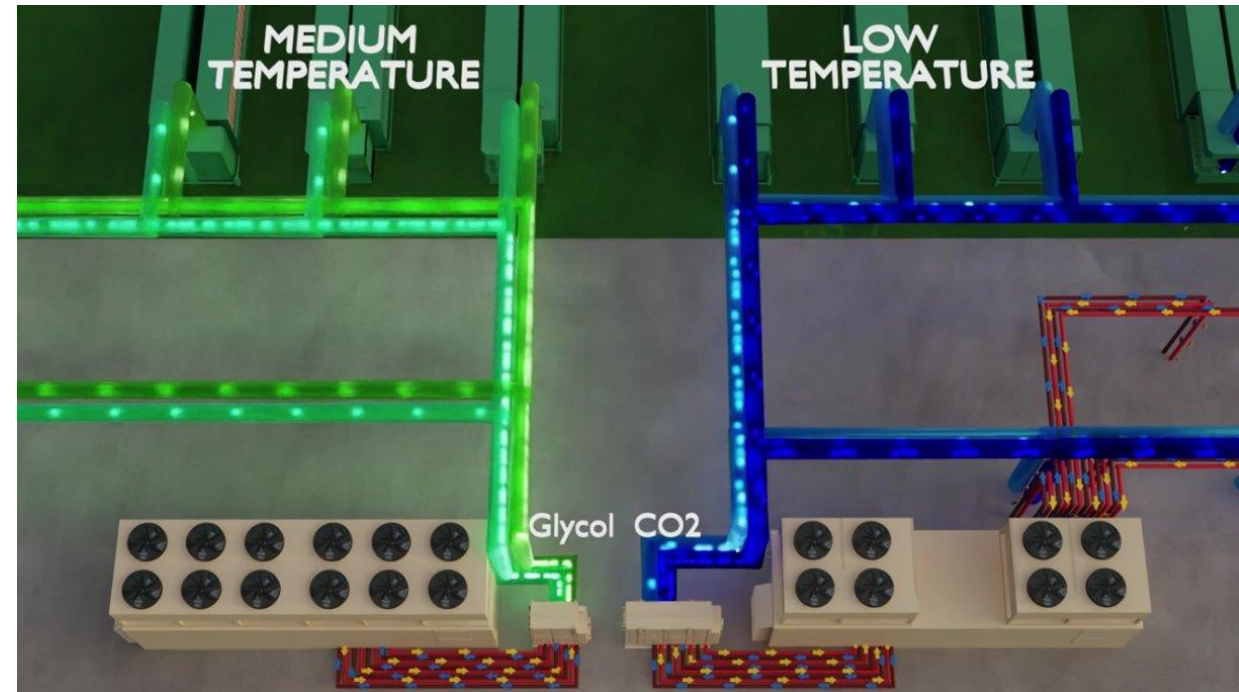
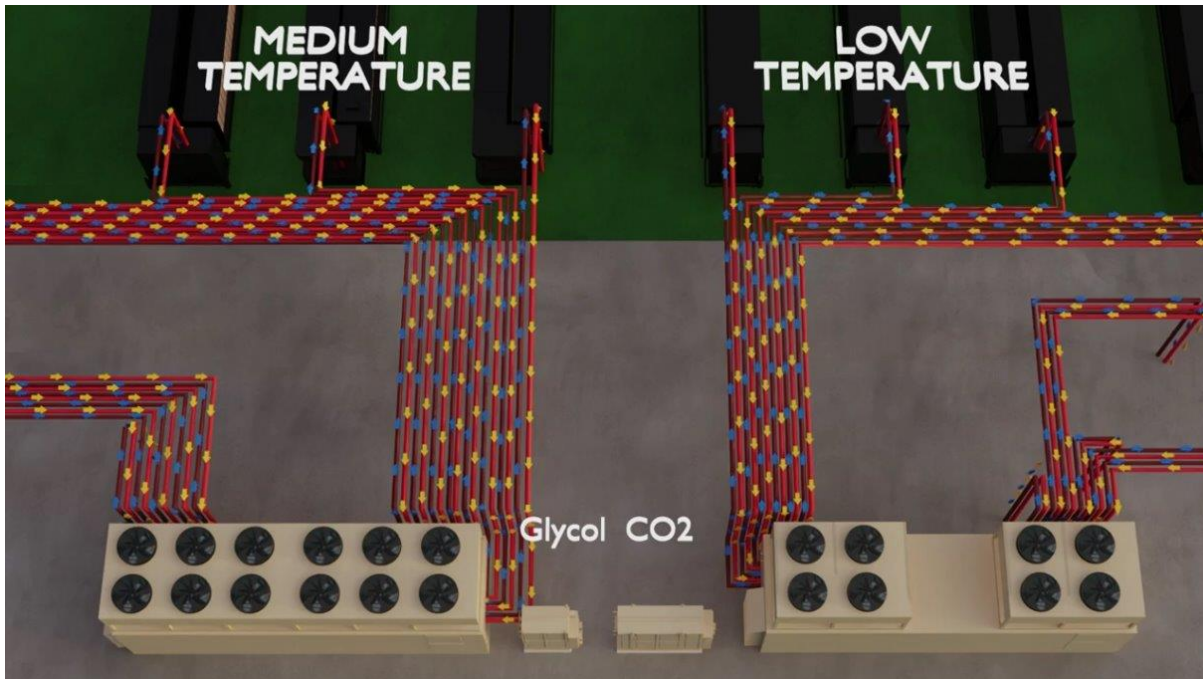


- Reducing the HFC refrigerant volume by **90%+** at each store
- Replacing existing refrigerants with **R448a** that has a **Global Warming Potential [GWP] of 1397** compared to R407a at a 2100 and R404a at 3920. (GWP of CO₂ = 1)

Utilizing existing equipment so it is familiar and cost effective

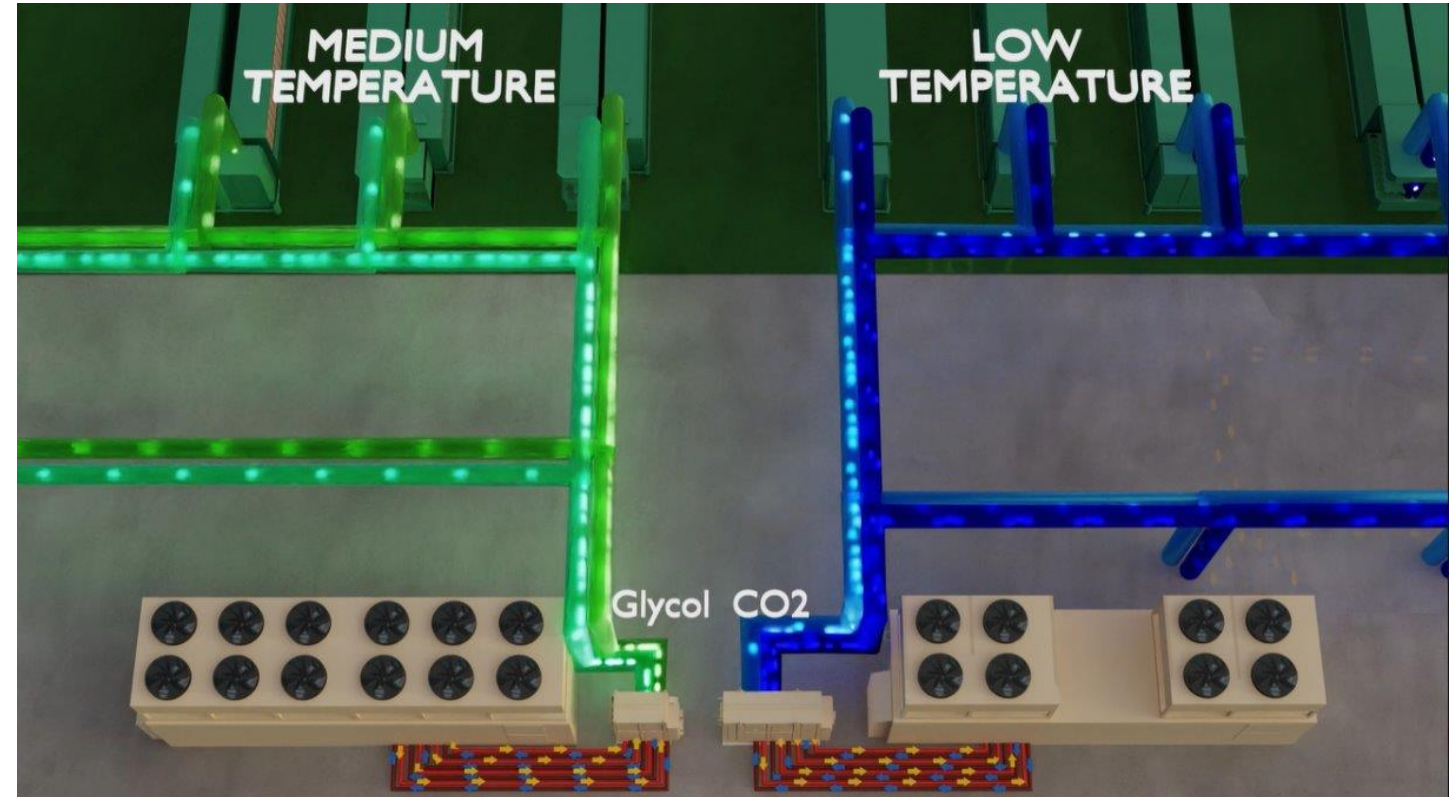


- Existing equipment is phased out with natural end-of-life use.



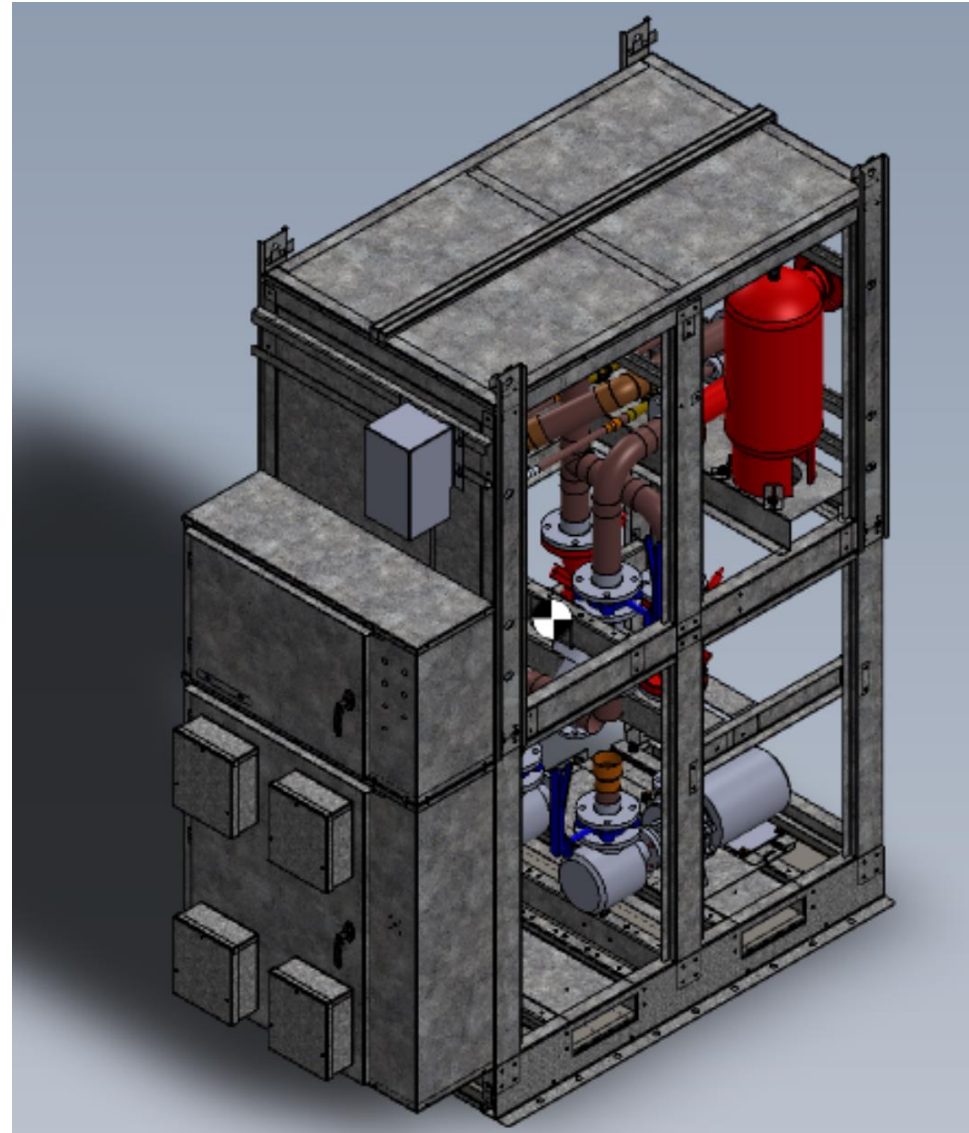
How does it work?

- Pumped fluid is sent to cases rather than HFC refrigerants, **reducing refrigerant volume by 90%+**



Secondary Glycol

- Used for medium temperature cases
 - 20°F supply fluid temperature.
 - 3°F approach temperature.
 - Ex. 20°F supply fluid requires 17°F suction temperature.
- Two skid sizes:
 - WMT-SEC-GLY-20-95
 - WMT-SEC-GLY-32-160



Design Fluid Temperature and Flow



- Capacity range and unloading

Unit Model	(Dual CKT) Flow Rate GPM		(Dual CKT) R448A *Design Cap. (MBH)		Capacity % min (Single CKT) to max (Dual CKT)	(Dual CKT) R448A Outlet Velocity (Ft./Sec.)		HTX Margin %		HTX Glycol Flow Rate Head (FT-H2O)		Pump HP	Pump KW	Head (FT) Max
	Minimum	Maximum	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum			
WMT-SEC-GLY-20/95	55	95	182	308.2	21.1	18.2	31	13.6	9.22	2.31	7.83	5	3.73	100
WMT-SEC-GLY-32/160	85	160	282.9	532.5	20	11.4	21.5	32.5	0.736	3.26	7.9	7.5	5.59	100
	(Single CKT) Flow Rate GPM		(Single CKT) R448A *Design Cap. (MBH)			(Single CKT) R448A Outlet Velocity (Ft./Sec.)		HTX Margin %		HTX Glycol Flow Rate Head (FT-H2O)				
	Minimum	Maximum	Minimum	Maximum		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum			
WMT-SEC-GLY-20/95	20	55	64.9	182		13	18.2	30.2	13.6	0.917	3.49			
WMT-SEC-GLY-32/160	32	85	106.5	282.9		13.9	22.9	49.4	2.48	2.21	3.26			

APPLICATION: Glycol



- Two circuit HX with individual Suction and Liquid Connections
- Two EEVs per unit driven by individual valve drivers

Suction Line per Circuit @ (Full Load)

SUCTION LINE PRESSURE DROP DATA
(Using NIST RefProp DLL)

Refrigerant R- R448A
Evaporator Temperature (°F): 17 Equivalent Length (ft): 50
Liquid Temperature (°F): 90 Line Capacity (tons): 22.2

Vapor Volume (ft³/lbm): 0.9554 Vapor Flow Rate (lbm/min): 69.7
Abs Viscosity (lbf-s/ft²): 2.361e-007

Tube OD (in)	Tube ID (in)	Reynolds Number	Velocity (ft/min)	ΔP (psi)	ΔT (°R)
2-1/8	1.9850	1.177e+006	3098	1.1	0.98

Suction Line per Circuit @ (Min Load)

SUCTION LINE PRESSURE DROP DATA
(Using NIST RefProp DLL)

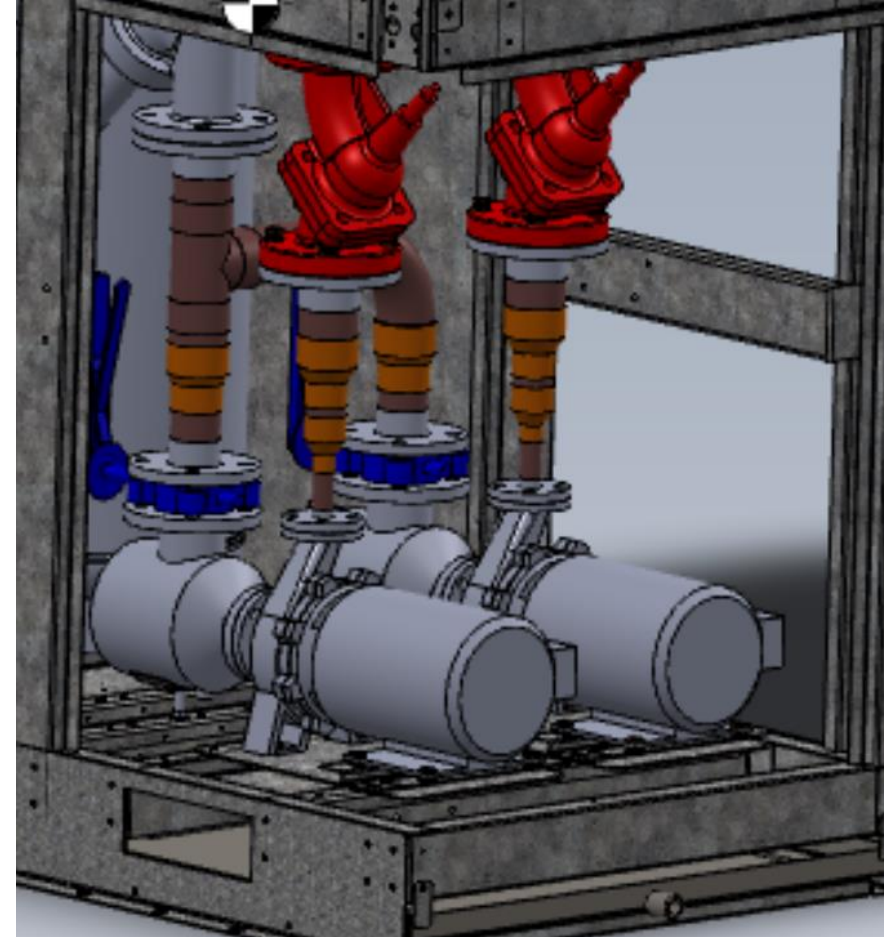
Refrigerant R- R448A
Evaporator Temperature (°F): 17 Equivalent Length (ft): 50
Liquid Temperature (°F): 90 Line Capacity (tons): 14.5

Vapor Volume (ft³/lbm): 0.9554 Vapor Flow Rate (lbm/min): 45.5
Abs Viscosity (lbf-s/ft²): 2.361e-007

Tube OD (in)	Tube ID (in)	Reynolds Number	Velocity (ft/min)	ΔP (psi)	ΔT (°R)
2-1/8	1.9850	7.686e+005	2023	0.49	0.44

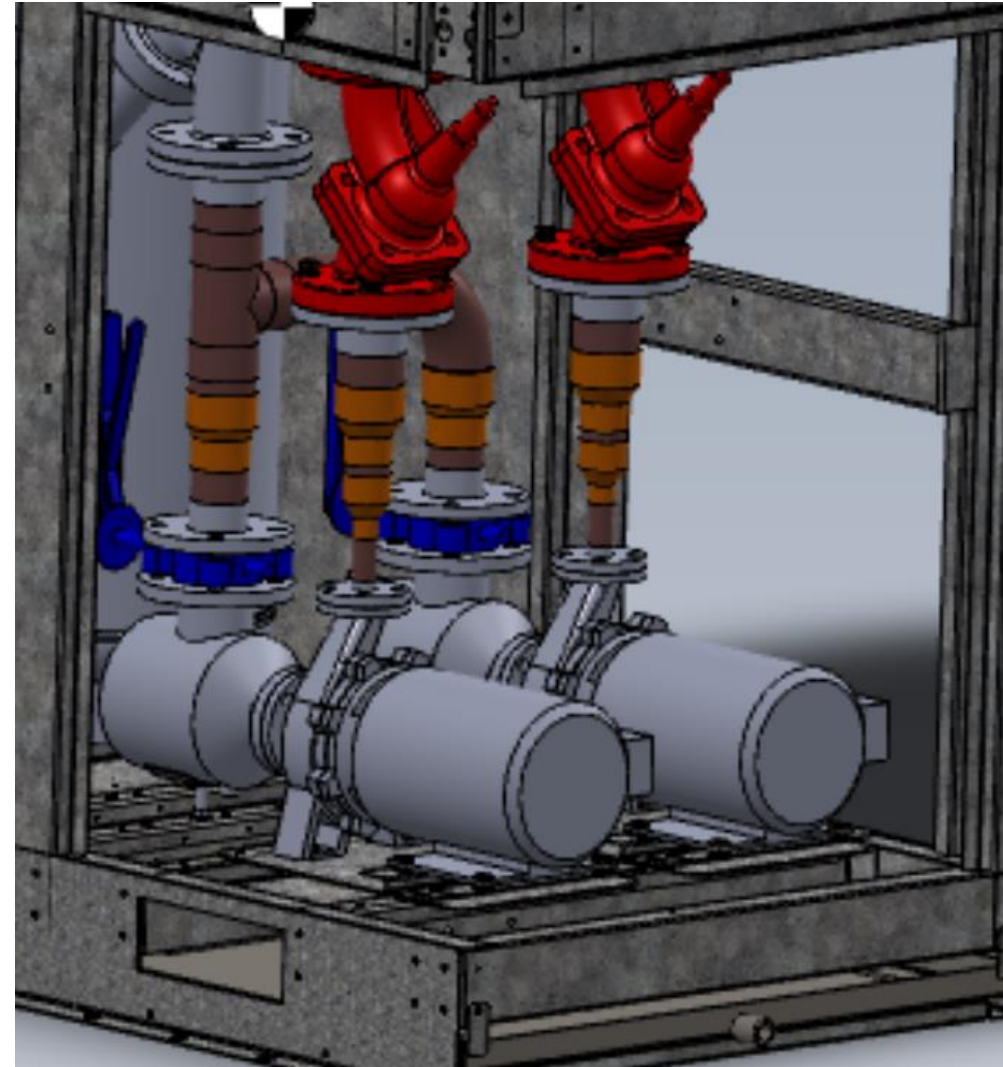
Dual Pump Configuration Provides Redundancy

- Primary standby pump logic unless both pumps are needed to meet flow requirements.
 - Typically, 135gpm maximum flow per pump on the 32-160 skid, but system DP dependent.
 - When demand is greater than 135gpm, second pump is brought on.
 - 20-95 skid is fully redundant across the full flow range.



Flow Control

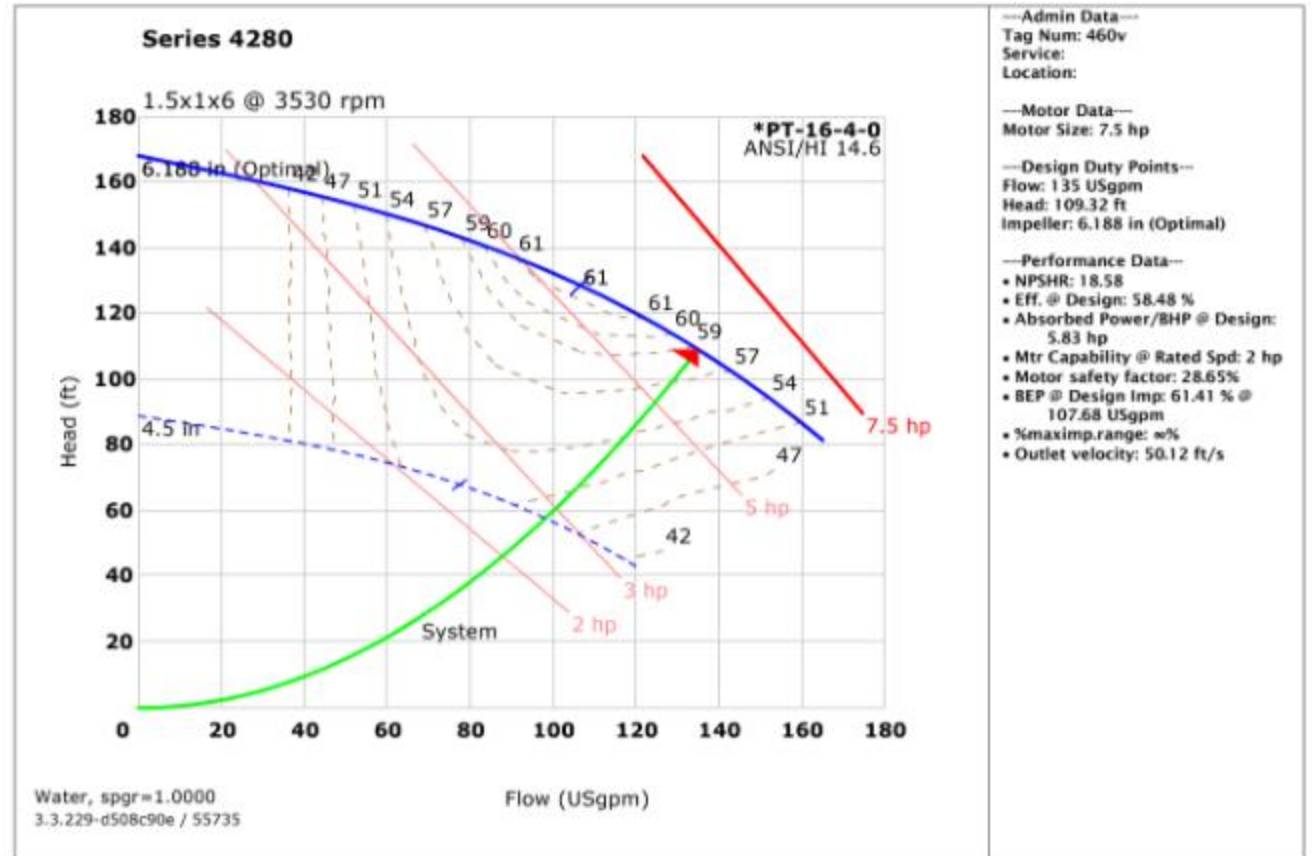
- Pump VFD is driven based on system differential pressure
 - As cases close off, DP rises and pump ramps down.
- Fixed position end of line bypass is used to avoid deadheading pump.



Flow Control

- 32-160 skid and 20-95 skid both use a 1.5x1x6 pump with different motor sizes.
 - 20-95 skid has a smaller 5 hp motor.
- Minimum flows of 32gpm and 20gpm respectively are driven by the heat exchanger performance.

Performance curve



Setting Flow

Automatic Flow Setting Routine

1. Open Cases 100%
2. Close EOL Bypass
3. Enter desired GPM on Carel Display
 - o GPM can be determined by looking at the RS Schedule
 - o The Carel Controller will automatically set the VFD speed and Differential Pressure set point.
4. Open EOL Bypass to 100%
5. Close Case solenoids
6. Start closing EOL bypass until you see the minimum GPM of the skid (20 or 32 depending on skid model) on the Carel Display.
7. Set the Stop Nut on the EOL Bypass Valve
8. Open Cases back up

```
Step 1 - Set dP
All Loads On
Close Bypass
TargetFlow      75.09pm
Spd      66% dP  24.7Psi
Flow      75.79pm
Step/Time      1.0%   3s
Start          NO
```

```
Step 2 - Set MinSpeed
All Loads Off Except
Smallest
dPSetpoint      24.8Psi
dP      24.7Psi
Speed          67%
Start          NO
```

```
Step 3 - Set Bypass
Open Bypass
All Loads Off
Close Bypass Until
Flow =      209pm
Flow      48.09pm
Speed          42%
MinSpeed      42%
```

Expansion Tank

- Connects to system on the suction side of the pumps.
- Fixed Diaphragm separates air and glycol
- Pre-Charged to 40psig
- Acceptance Volume of 28 gallons on the 32/160 skid and 20.2 gallons on the 20/95 skid.
- System pressure should be greater than the initial diaphragm pressure



Application: Glycol



- Designed for **R448a**, but compatible with R404a/R407a at reduced performance
- We are Wind and Snow Certified for the continental US
 - Wind speeds up to 175 mph and snow loads up to 100 psf



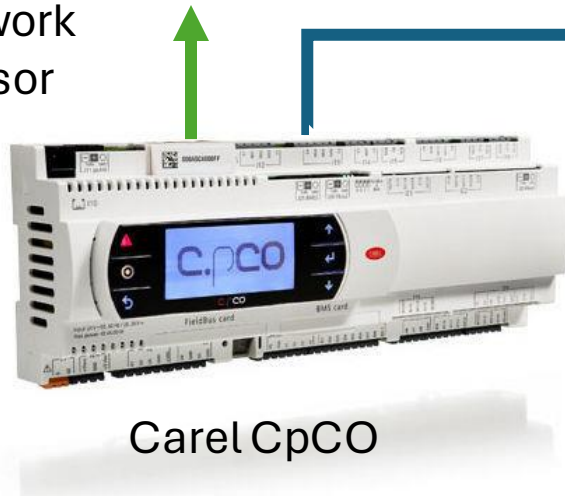
END OF APPLICATION: GLYCOL





CONTROLS: GLYCOL

BACnet/IP to
Store Network
or Supervisor



Carel CpCO

Modbus RTU – RS485

<-EEV Position
<- Pressure
<- Temperature
<- SST
<- Superheat
Superheat Setpoint->



Emerson EXD-SH1

Digital Inputs

Enable Switch
Pump VFD Fail (per pump)

Analog Inputs

Pump Suction Pressure
Pump Discharge Pressure
Return/Inlet Fluid
Temperature
Supply/Outlet Fluid
Temperature
Loop Differential Pressure

Output

Pump VFD Enable
EEV Enable
Pump Speed 0-10V

Analog Inputs

Rack-side Suction Pressure
and Temperature

Menu Navigation [1.0]

- Quick Menu



Power



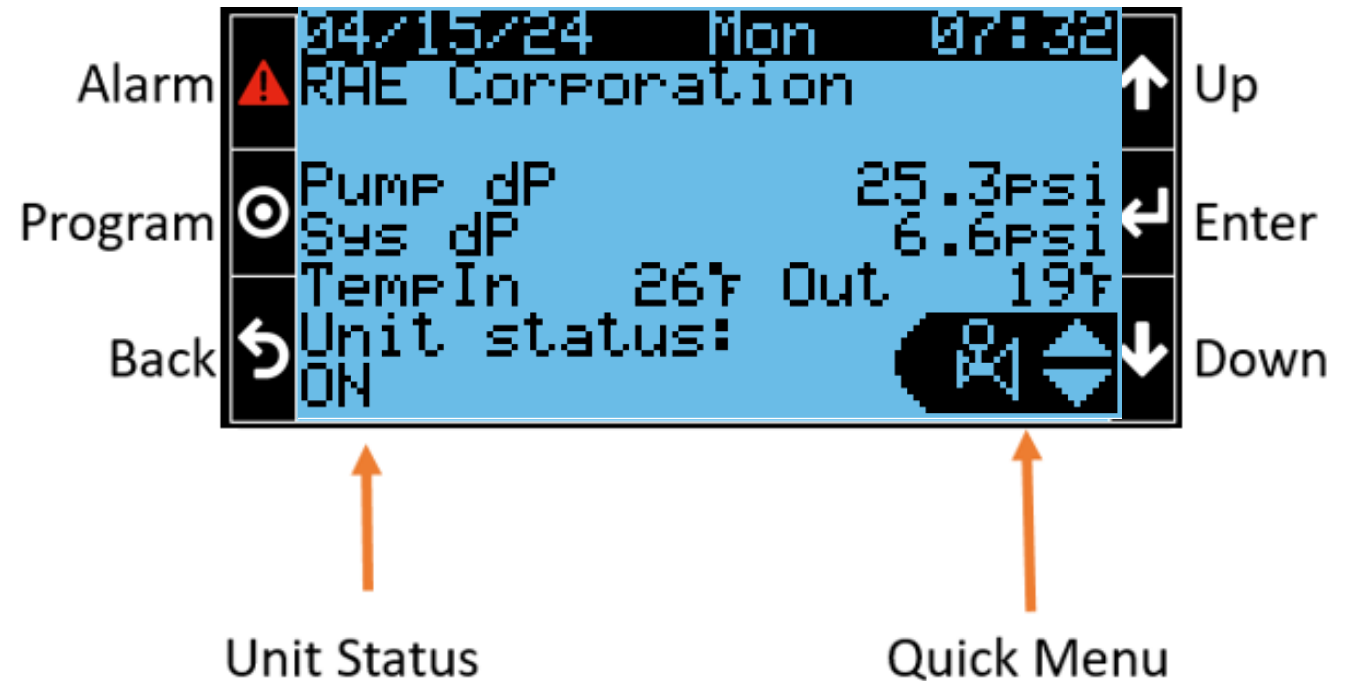
Pump Variables



Evaporator Variables

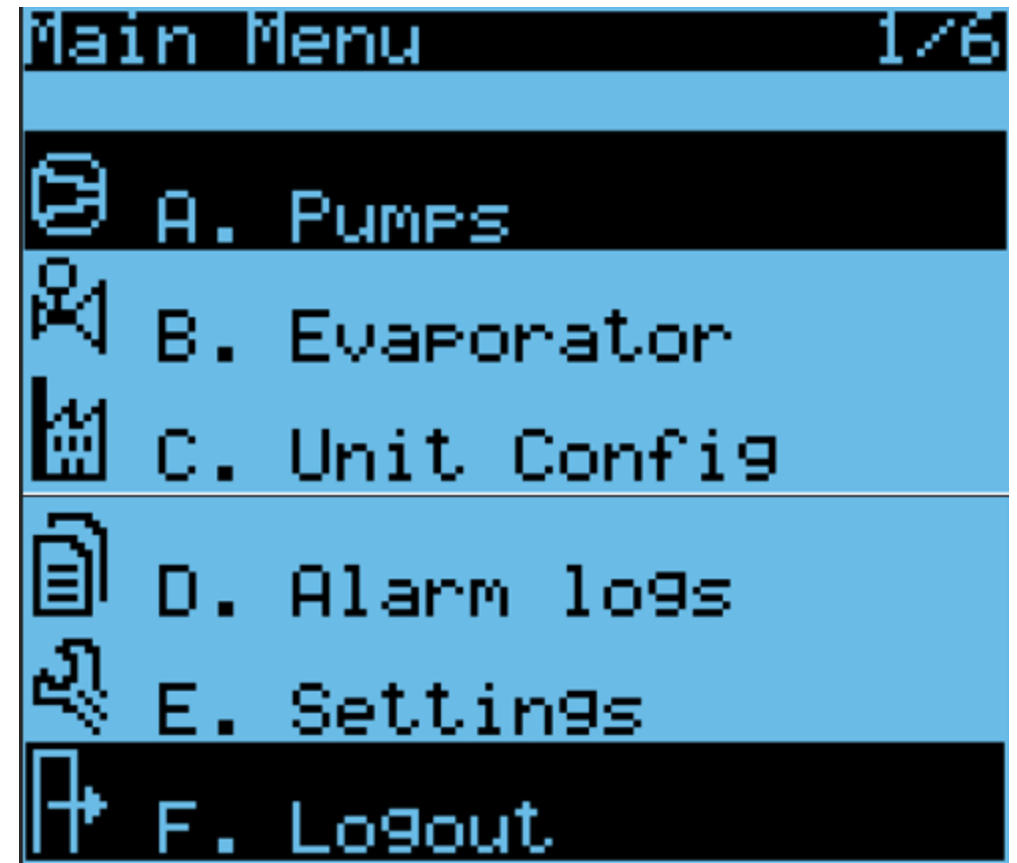


Controller info



Menu Navigation [1.1]

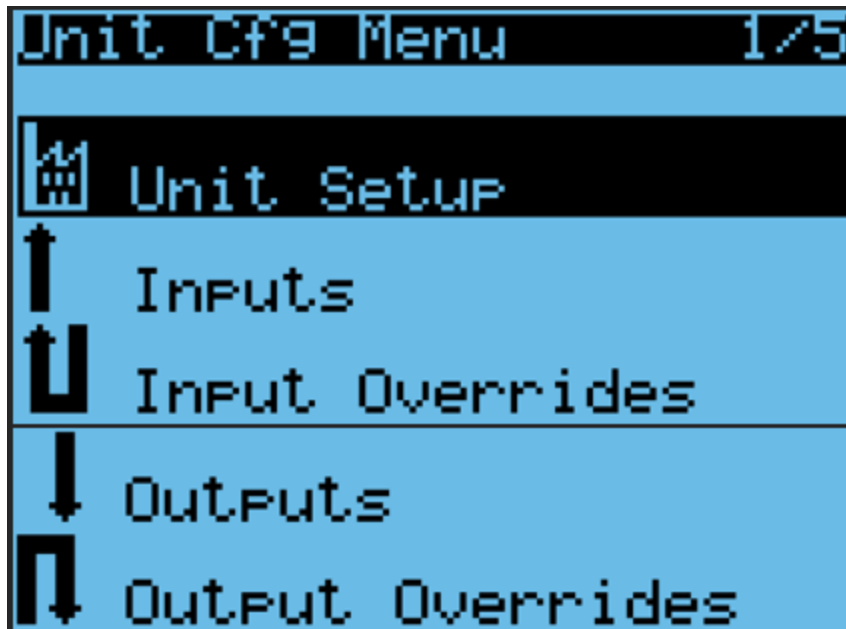
- Main Menu
 - Pump Parameters
 - Evaporator Parameters
 - Unit Configuration
 - Settings



Menu Navigation [1.2]

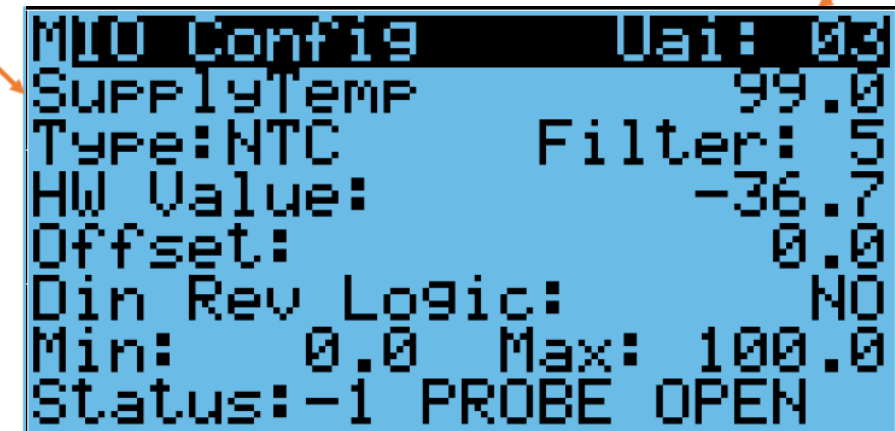


- Unit Configuration



Sensor Description

IO Channel



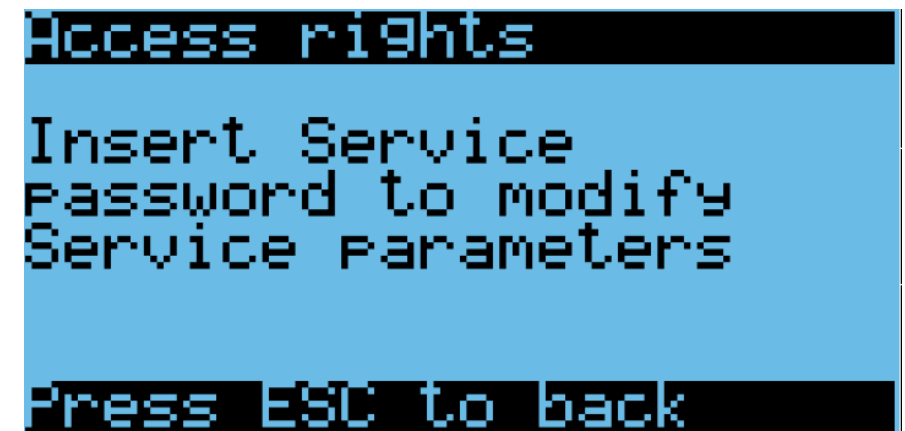
Menu Navigation [1.3]



Login

- User: 0001
Can view all screens but can only make changes to setpoints
- Service: 0002
Can change all setpoints, parameters, comms settings, but not deep level configuration
- Manufacturer
Can change all

Controller will tell you what level is required if you aren't logged in at or above that level



Sequence of Operation [1.0]



- Pump

The following MUST be true to enable pump operation.

1. Enabled by switch AND controller keypad
2. Proof of compressor operation via rack suction pressure
3. At least one (1) pump VFD must be powered and in a non-fault state
4. Pump suction pressure criteria satisfied

Refrigerant circuit suction pressure

- Used to verify rack operation
- HX Suction Pressure Cut-out (default 70psig - 40°F)
HX Suction Pressure Cut-in (default 60psig - 32°F)

Rack side suction pressure is read via communications with the EEV controller

Sequence of Operation [1.1]

- Pump

Pump Suction and Discharge Pressure

- Pump Suction Pressure Cut-out (default 10psig), Pump Suction Pressure Cut-in (default 15psig). Prevents cavitation.
- Five (5) On/Off cycles on pump suction pressure within 24 hours will result in an alarm and a lockout requiring user reset.
- Flow proof is determined by differential pressure. Failure to establish flow within **30 seconds** will trigger a rotation to the lag pump. Continued failure to establish flow after repeated rotations will result in an alarm and lockout which will automatically reset 24 hours after the first of the 5 cycles, or if power is cycled to the controller.
- Pump Run indicator light will illuminate once flow proof is established

Pump Speed

- VFD ramped to meet end-of-loop differential pressure setpoint
- If lead pump at full speed cannot meet DP setpoint in 5 minutes, enable lag pump. If 2 pumps at minimum speed cannot meet DP setpoint in 5 minutes, disable lag pump.

Sequence of Operation [1.2]



- Refrigeration

To enable refrigerant circuit operation:

1. Proof of flow (and therefore all criteria required to operate pump)
2. Fluid inlet temperature > 22°F

When refrigeration is enabled, circuits will stage up and down to maintain outlet fluid temperature within a 4°F band centered around the supply fluid setpoint. Staging sequence rotates so that each circuit gets an equal share of low-load operation.

Alarms

Automatic Reset

- Sensor Failures
 - Differential Pressure
 - Supply/Outlet Temperature
 - EEV Controller Suction Pressure and Temperature
 - Pump Suction and Discharge Pressure
- EEV Controller Offline
- Pump flow (30 seconds of no flow)
- Pump VFD Fail
- Freeze (low inlet temperature)
- High outlet temperature
- Low Pump Suction (low glycol), Pump Short Cycle (5 low suction alarms in 24 hours)
- Low Superheat
- Rack Disabled (high suction pressure)

User Reset

- Freeze (low suction pressure)
- Pump flow (5 minutes of no flow)

END OF CONTROLS: GLYCOL

