HUSSMANN®

MagPak Packaged Unit for Walmart© Stores

Installation & Operation Manual

MANUAL- I/O PACKAGE UNIT

August 2018

HUSSMANN CORPORATION • BRIDGETON, MO 63044-2483 U.S.A.

P/N 2H16933001_B

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BEFORE YOU BEGIN

Read these instructions completely and carefully.

ANSI Z535.5 DEFINITIONS

- DANGER – Indicate[s] a hazardous situation which, if not avoided, will result in death or serious injury.

- WARNING – Indicate[s] a hazardous situation which, if not avoided, could result in death or serious injury.

- CAUTION – Indicate[s] a hazardous situation which, if not avoided, could result in minor or moderate injury.

• NOTICE – Not related to personal injury – Indicates[s] situations, which if not avoided, could result in damage to equipment.

Environmental Concerns

Hussmann recommends responsible handling of refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those that contain Hydrogen, Chlorine, Fluorine, and Carbon (HCFCs). Only certified technicians may handle these refrigerants. All technicians must be aware and follow the requirements ser forth by the Federal Clean Air Act (Section 608) for any service procedure being performed on this equipment that involves refrigerant. Additionally, some states have other requirements that must be adhered to for responsible management of refrigerants.

⚠ WARNING

PERSONAL PROTECTION EQUIPMENT (PPE)

Only qualified personnel should install and service this equipment. Personal Protection Equipment (PPE) is required whenever servicing this equipment. Always wear safety glasses, gloves, protective boots or shoes, long pants, and a long-sleeve shirt when working with this equipment. Observe all precautions on tags, stickers, labels and literature attached to this equipment.

This warning does not mean that Hussmann products will cause cancer or reproductive harm, or is in violation of any product-safety standards or requirements. As clarified by the California State government, Proposition 65 can be considered more of a 'right to know' law than a pure product safety law. When used as designed, Hussmann believes that our products are not harmful. We provide the Proposition 65 warning to stay in compliance with California State law. It is your responsibility to provide accurate Proposition 65 warning labels to your customers when necessary. For more information on Proposition 65, please visit the California State government website.

⚠ CAUTION

Contractors shall strictly adhere to specifications provided by the Engineer of Record (EOR), as well as US Environmental Protection Agency regulations, OSHA regulations, and all other federal, state and local codes. This work should only be done by qualified, licensed contractors. There are numerous hazards, not limited to, but including: burns due to high temperatures, high pressures, toxic substances, electrical arcs and shocks, very heavy equipment with specific lift points and structural constraints, possible acid exposure, food and product damage, public safety, noise, and possible environmental damage. Never leave operating compressors unattended during the manual soft-start process. Always power rocker switches off when unattended.

⚠ WARNING

Field Wiring and Grounding is Required! Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. Failure to follow code could result in death or serious injury. Follow requirements for field wiring and grounding as described in NEC and local/state electrical codes. Wiring is to be performed only by qualified technicians.

⚠ CAUTION

This manual was written in accordance with originally perscribed equipment that is subject to change. Hussmann reserves the right to change all or part of the equipment for future stores such as, but not limited to, controllers, valves and electrical specifications. It is the installers responsibility to reference the refrigeration drawings supplied for each installation, as directed by the Engineer of Record.

⚠ WARNING

— LOCK OUT / TAG OUT —

To avoid serious injury or death from electrical shock, always disconnect the electrical power at the main disconnect when servicing or replacing any electrical component. This includes, but is not limited to, such items as controllers, electrical panels, condensers, lights, fans, and heaters.

⚠ WARNING

Proper Field Wiring and Grounding Required! Failure to follow code could result in death or serious injury. All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state electrical codes.

SYSTEM DESCRIPTION

OVERVIEW

The MagPak Package System is an outdoor rated refrigeration system featuring Microchannel condensers using variable speed fan motors.

Each unit consists of a single-suction group with loop piping. Each unit is pre-piped and pre-wired in an outdoor enclosure for mounting on the store roof.

Each unit has field connections to display cases and walk-ins. A variable frequency drive (VFD) located inside the enclosure provides digital control of the condenser fans for minimum energy consumption.

Outdoor enclosures contain factory-installed unit power, control systems, panels, fuses, switching and mechanical components that can be accessed and serviced. Large exterior panel doors on the enclosures can be fully opened for compressor replacement.

Additional Features:

- A sheet metal condensate pan piped to an isolation valve
- First compressor on each suction group has Copeland Digital capacity control with IDCM Digital Compressor Controller
- VFD controller for condenser fans with keypad and display
- Suction and discharge service valves provided on all compressors
- Suction and liquid piping stubbed out near the curb chase.
- Single point, 460V, 3ph electrical connection to the building main switchgear to enclosure
- All units use R407A refrigerant.

LOW TEMPERATURE PACKAGE SYSTEM

Low temperature units feature scroll compressors and may be applied for saturation suction temperatures ranging from -25°F to -10°F.

The lead compressor is digitally controlled to minimize energy consumption and match refrigeration capacity to demand.

Liquid subcooling is achieved via vapor injection at the interstage port of each compressor.

Low temperature compressors feature liquid injection for compressor cooling.

A liquid line branch (upstream of the sub-cooler) supplies a distribution header to an injection valve on each compressor.

MEDIUM TEMPERATURE PACKAGE SYSTEM

Medium temperature units feature reciprocating compressors and may be applied for saturation suction temperatures ranging from 10°F to 30°F.

The lead compressor is digitally controlled to minimize energy consumption and match refrigeration capacity to demand. Certain models also feature compressor unloaders for additional capacity modulation.

Medium temperature units are self-subcooled, using the available capacity of the system.

UNIT INSPECTION

Upon delievery of the unit(s), verify that the correct unit and equipment is received by comparing the information on the unit serial plate with the ordering and submittal documents.

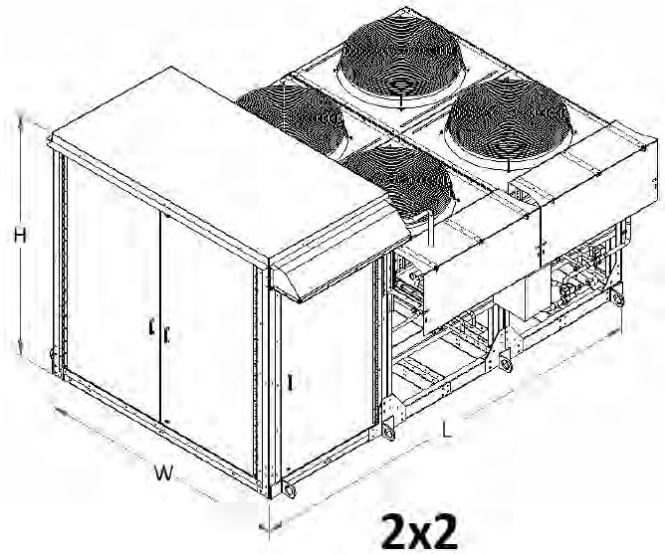
All equipment should be thoroughly examined for shipping damage before and during unloading.

This equipment has been carefully inspected at our factory. Any claim for loss or damage must be made to the carrier. The carrier will provide any necessary inspection reports and/or claim forms.

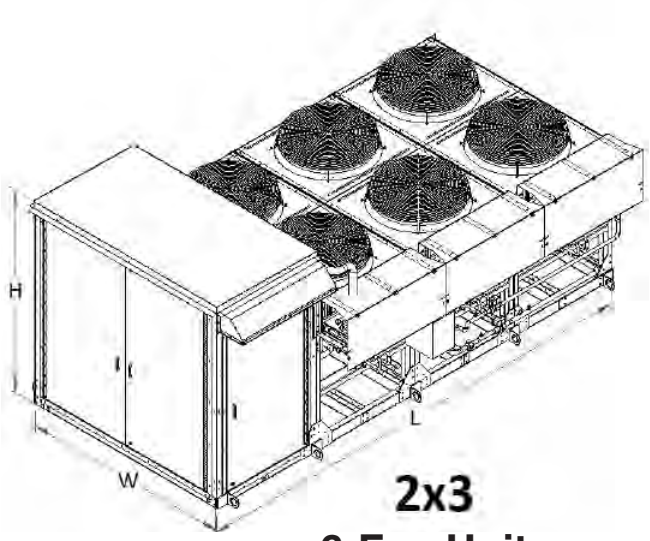
Apparent Loss or Damage
If there is an obvious loss or damage, it must be noted on the freight bill or express receipt and signed by the carrier's agent; otherwise, carrier may refuse claim. The carrier will supply necessary forms.

Concealed Loss or Damage
When loss or damage is not apparent until after equipment is uncrated, a claim for concealed damage is made. Upon discovering damage, make request in writing to carrier for inspection within 15 days and retain all packing. The carrier will supply inspection report and required claim forms.

WEIGHTS AND DIMENSIONS



2x2
4-Fan Unit

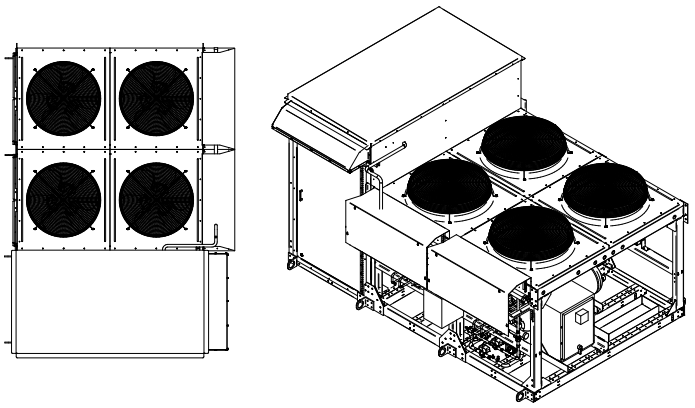


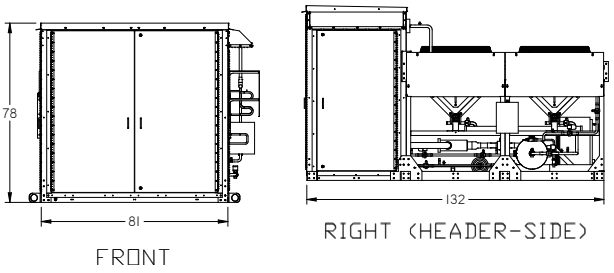
2x3
6-Fan Unit

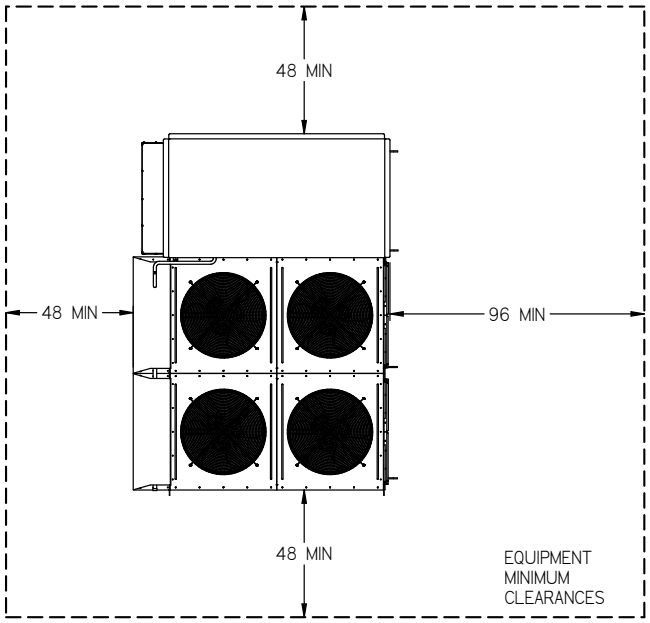
MODEL	STYLE	OVERALL DIMENSIONS [INCHES]			OPERATING WEIGHT [LB]	CAPACITY -25°F SST, 110°F AMBIENT [MBH]
		L	W	H		
70LT	2x2	132	81	78	4,183	67.2
85LT	2x2	132	81	78	4,279	89.4
110LT	2x2	132	81	78	4,344	111.8
130LT	2x2	132	81	78	4,409	134.1
150LT	2x3	176	81	78	5,203	156.7

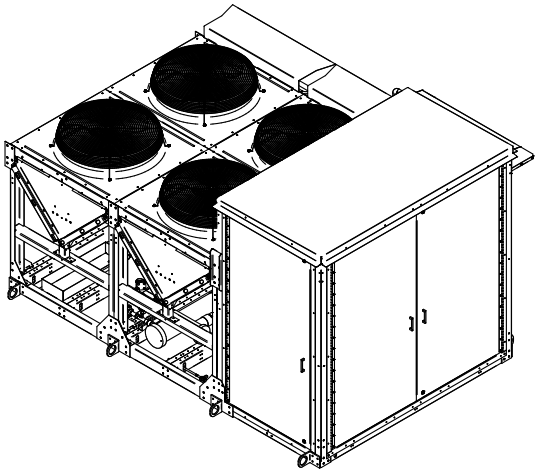
MODEL	STYLE	OVERALL DIMENSIONS [INCHES]			OPERATING WEIGHT [LB]	CAPACITY 15°F SST, 115°F AMBIENT [MBH]
		L	W	H		
175MT	2x2	132	81	78	5,158	182.3
220MT	2x2	132	81	78	5,158	242.9
250MT	2x2	132	81	78	5,229	260.5
300MT	2X3	176	81	78	6,071	312.3
350MT	2x3	176	81	78	6,071	390.7

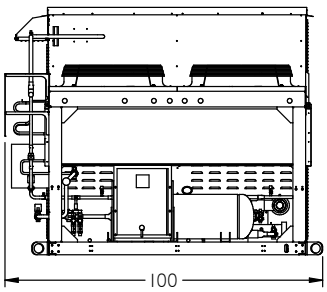
2X2 PACKAGE UNIT FOOTPRINT
(Dimensions in inches)

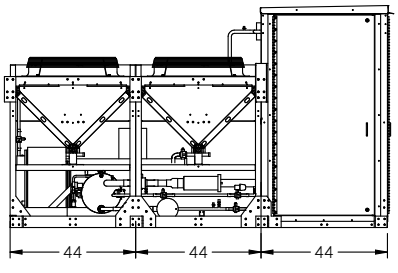




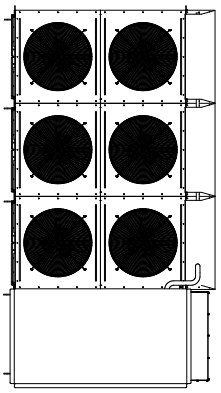


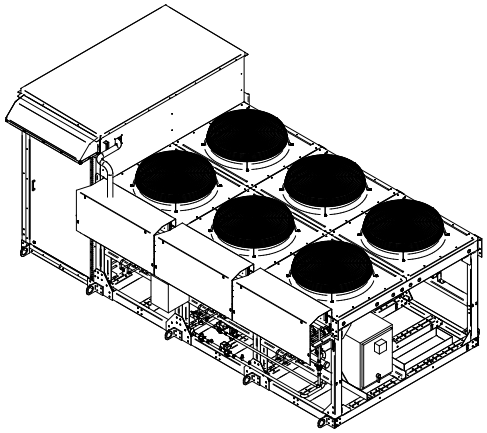


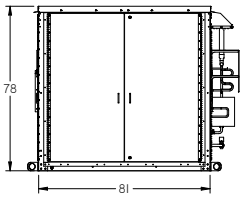




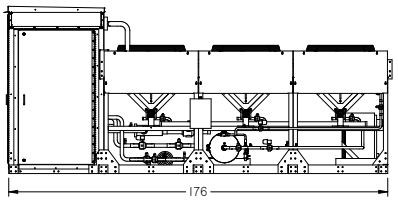
2X3 PACKAGE UNIT FOOTPRINT



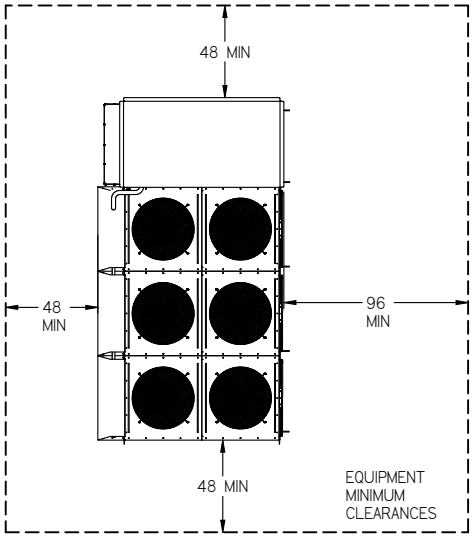


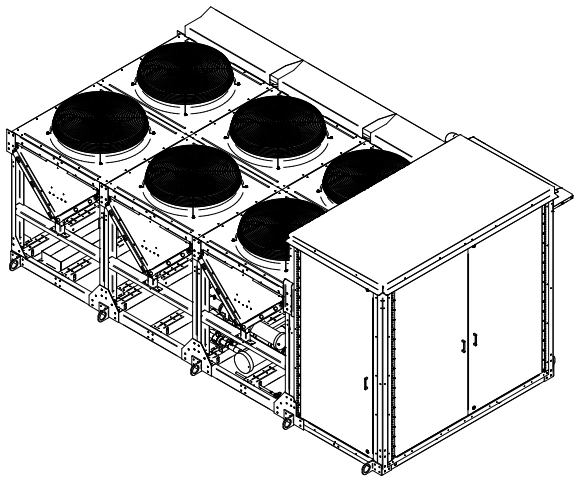


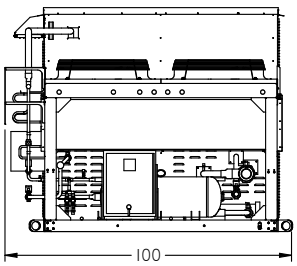
FRONT



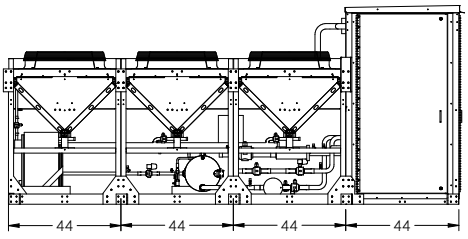
RIGHT (HEADER-SIDE)







REAR



LEFT-SIDE

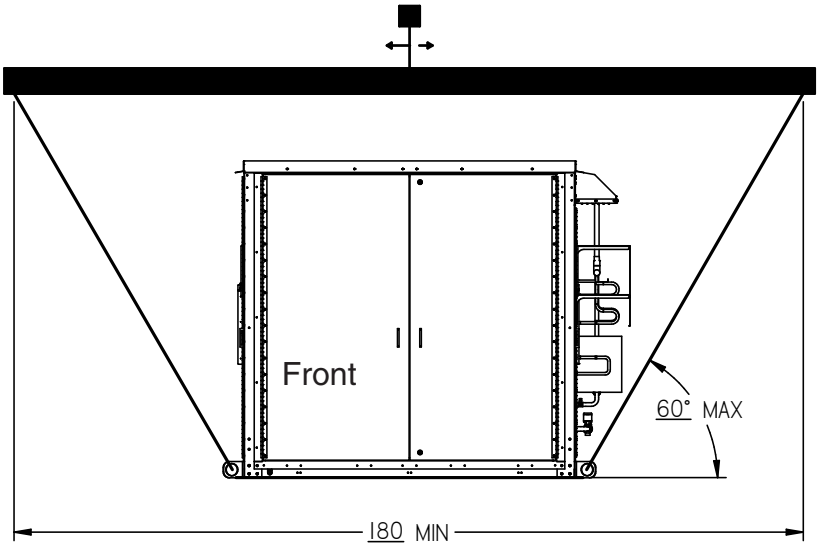
UNIT LIFTING POINTS

It is critical to use all the lifting points provided at the base frame in order to avoid damaging the unit due to the unit's modular construction.

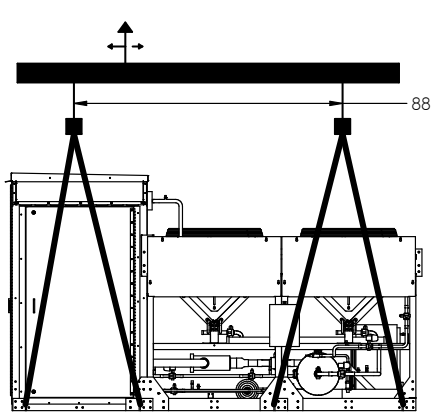
The spreader bars shown are required to avoid damaging the condenser headers and piping. Spreader bars are supplied by crane operator. Crane operator must have shackles and straps. Provide weights to the operator as well as where the unit will be placed from the edge of the rooftop to the final location. Ensure refrigeration contractor provides this info to crane opeator in order to select the proper crane to be used.

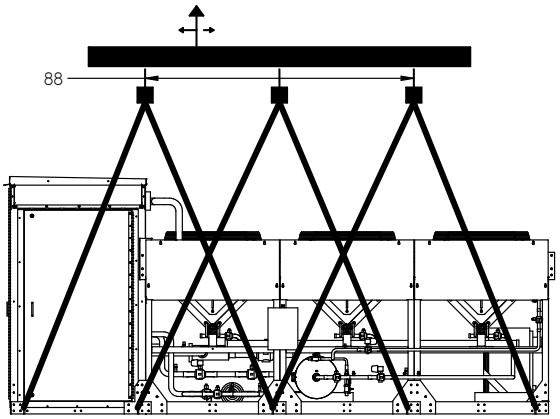
2x2 UNITS	
MODEL	SHIPPING WEIGHT (LB)
70LT	3,883
85LT	3,979
110LT	4,044
130LT	4,109
175MT	4,858
220MT	4,858
250MT	4,929
USE THREE SPREADER BARS AS SHOWN	

2x3 UNITS	
MODEL	SHIPPING WEIGHT (LB)
150LT	4,903
300MT	5,771
350MT	5,771
USE FOUR SPREADER BARS AS SHOWN	



Side View





USE ALL LIFTING POINTS PROVIDED

CURB

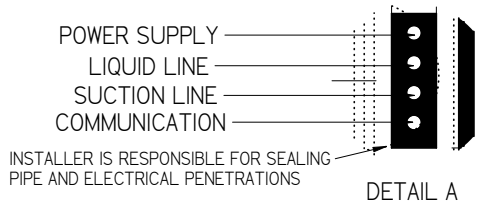
A minimum of 7ft clearance is required on the left side in the event that a condenser slab replacement is necessary. For the other sides a minimum 4ft clearance is required, measured from the base of the unit. It is the curb manufacturer's responsibility to ensure the curb structure is sufficient to support the operating weights specified. The curb manufacturer must also provide appropriate mounting clips to secure the equipment to the curb following all local and national code.

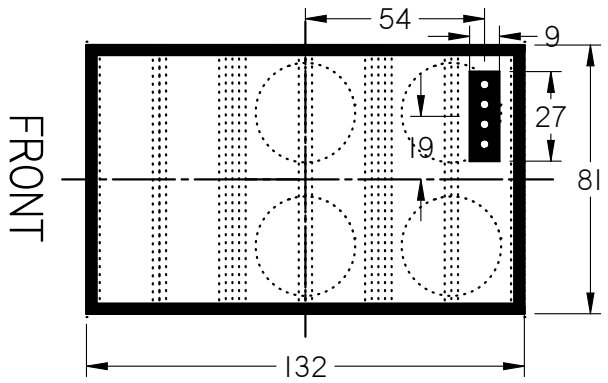
MODEL	OPERATING WEIGHT (LB)	SUCTION	LIQUID	MOPD
70LT	4,183	2-1/8"	7/8"	70
85LT	4,279	2-1/8"	7/8"	80
110LT	4,344	2-5/8"	7/8"	100
130LT	4,409	2-5/8"	1-1/8"	100
175MT	5,158	2-5/8"	1-3/8"	100
220MT	5,158	2-5/8"	1-3/8"	125
250MT	5,229	3-1/8"	1-3/8"	150

MODEL	OPERATING WEIGHT (LB)	SUCTION	LIQUID	MOPD
150LT	5,203	2-5/8"	1-1/8"	125
300MT	6,071	3-1/8"	1-3/8"	150
350MT	6,071	3-1/8"	1-5/8"	225

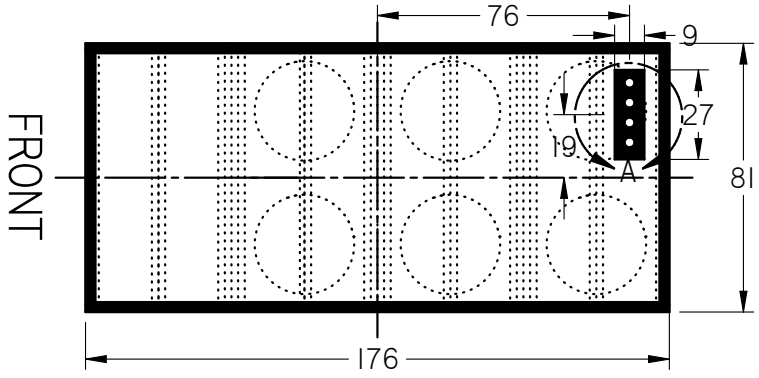
CHASE SIZE AND LOCATION

A 9 inch x 27 inch chase shall be provided for piping and electrical penetrations through the curb at the location specified. It is the installers responsibility to ensure all penetrations are sealed and watertight according to all applicable local and national codes.





PLAN VIEW



5

SEQUENCE OF OPERATION

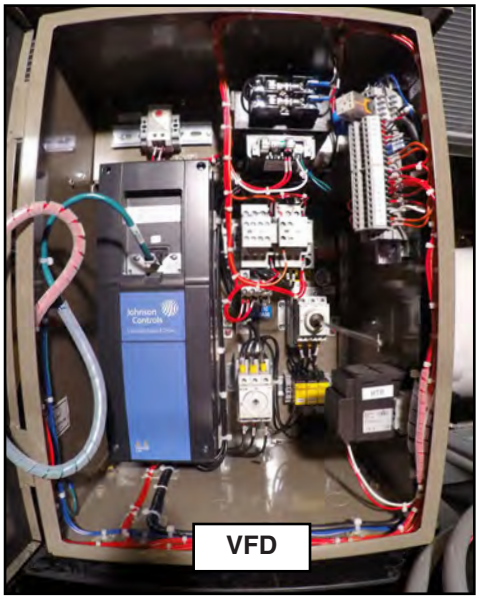
GENERAL OVERVIEW OF SEQUENCE:

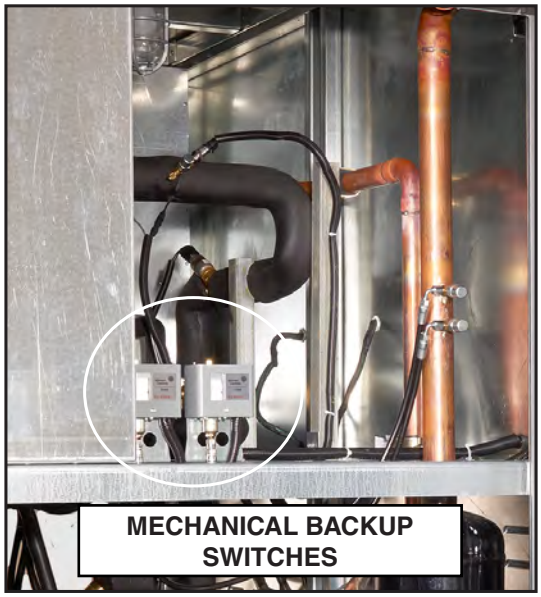
1. System Inputs & Control:

The unit-mounted rack controller monitors system inputs, controls system outputs, and provides alarm functionality, with electro-mechanical safety devices serving as back up should the controller fail. The rack controller shall receive a Run/Stop command, as well as the saturated suction temperature (SST) operating point, via the BAS controller. The SST operating point input must be within the allowable range for each unit. (see setpoint chart) An invalid SST input operating point will not be accepted, and the rack controller will revert instead to the last valid operating point assigned.


CONTROL TRANSFORMER WITH COVER

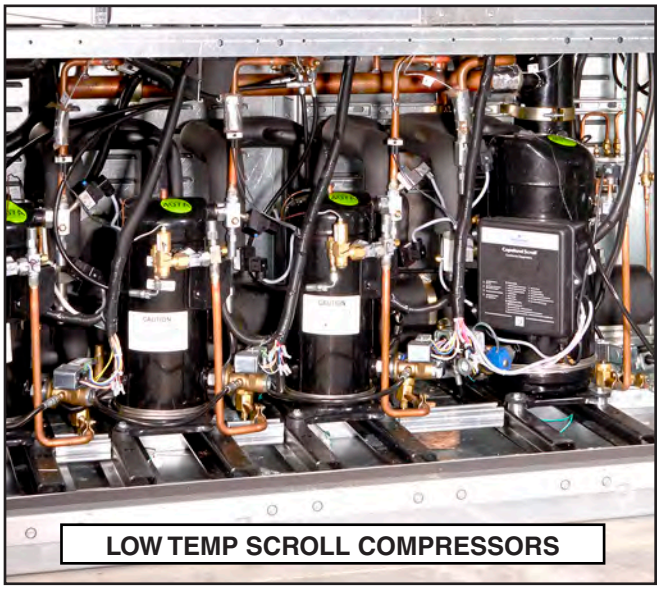
Refrigeration rack control is accomplished using an electronic controller (or similar rack controller) that is wired in series with mechanical safety switches for oil pressure and head pressure. The controller maintains refrigeration temperatures and pressures in the system at the unit, condenser, cases and walk-ins by adjusting electronic regulating valves, digital compressors and the variable frequency drive (VFD) condenser fans. If the controller fails, backup mechanical switches allow the unit and condenser to maintain basic refrigeration function.


VFD

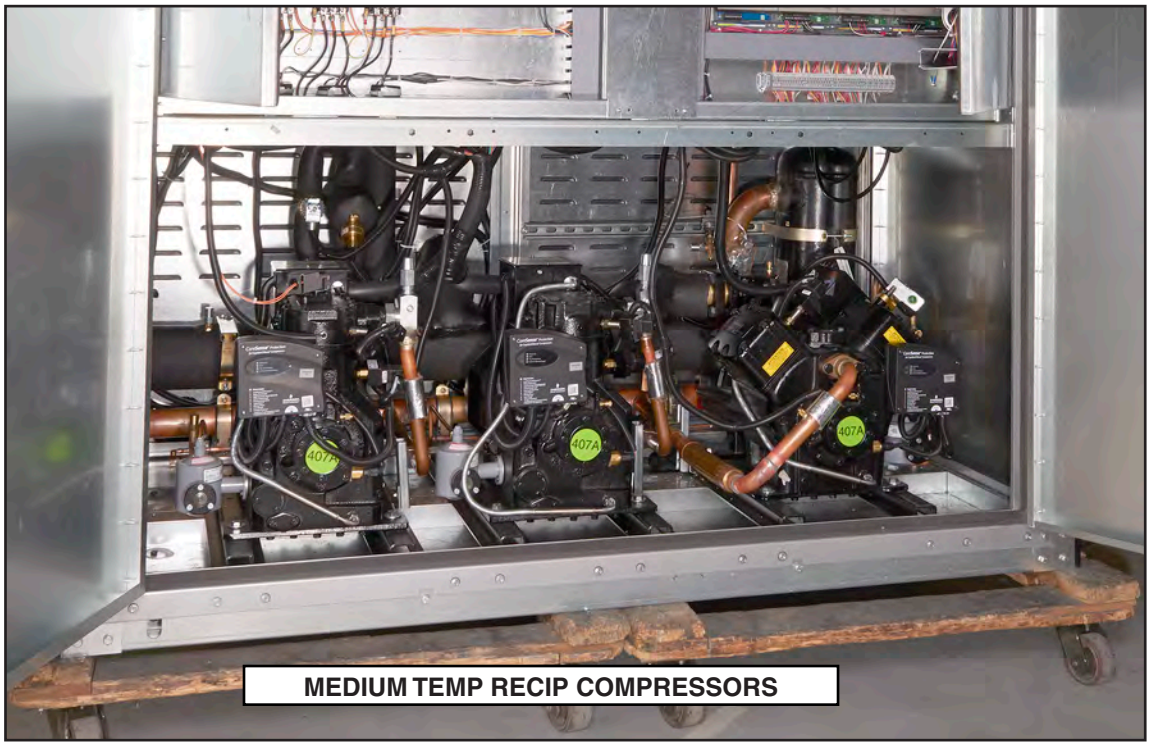

MECHANICAL BACKUP SWITCHES

2. Compressors:

Compressor staging shall be achieved thru a control point (suction pressure setpoint) located in the corresponding return suction header. Compressors are operated under the direction of the rack controller, having outputs wired in series with individual compressor safety devices – including a compressor high-pressure switch for high discharge pressure protection, low-pressure switch for backup control and/or low suction pressure protection, and other electronic safeties for individual compressor oil differential pressure and/or oil-level monitoring. (refer to CoreSense/ OMB oil protection) The compressor safety devices provide emergency compressor shut-down and/ or backup to the unit controller. The unit control system operates and alarms before the electro-mechanical safeties operate.



LOW TEMP SCROLL COMPRESSORS



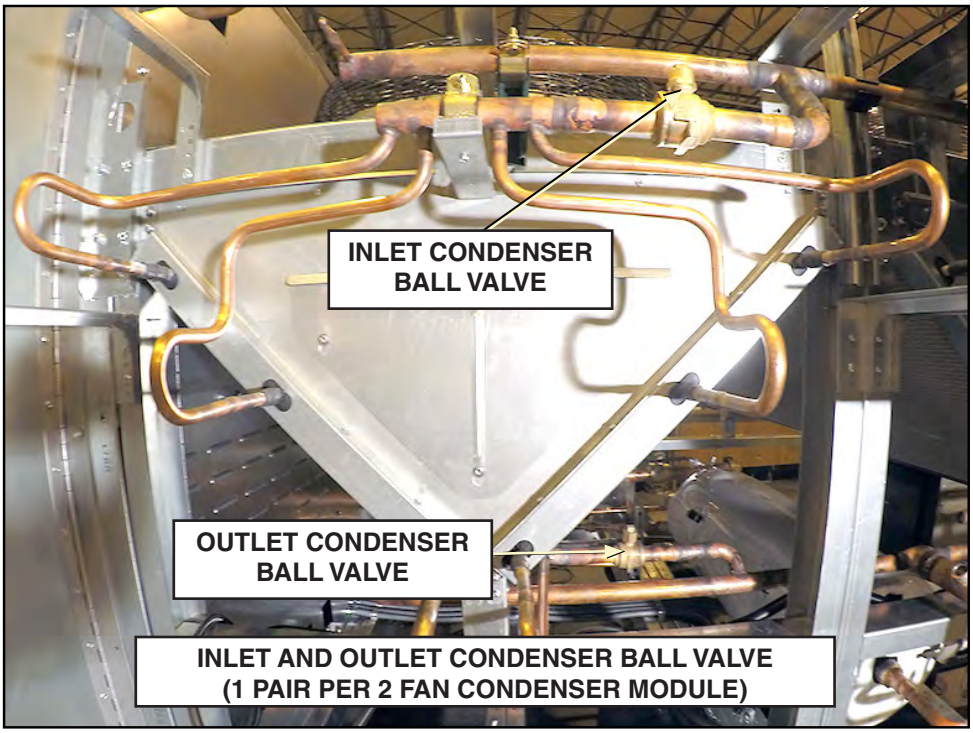
MEDIUM TEMP RECIP COMPRESSORS

3. Condenser Operation:
Condenser operation is based on a temperature difference (TD) control strategy, via the drop leg pressure and ambient temperature. The unit-mounted controller modulates the speed of the condenser fans through a variable frequency drive (VFD). VFD cycles fan on/off in order to control the head pressure with the unit controller serving as a control backup should the VFD system fail. Should the unit controller fail as well, backup electro-mechanical pressure switches will control fan cycling.


MICROCHANNEL CONDENSERS

3a. Microchannel Condenser
Outdoor ambient temperature, condenser outlet pressure and equivalent saturation temperature are continuously measured and used as inputs to control fan speed and on/off fan cycling. In the event of controller failure, backup electrome-chanical pressure switches are used for fan cycling to maintain acceptable condensing pressure.

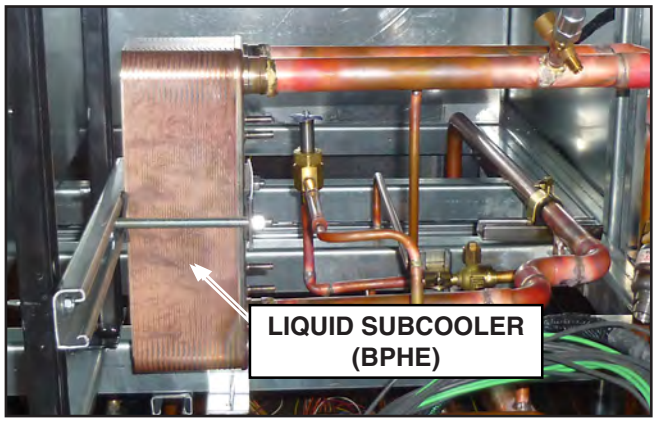

CONDENSER WITH DOOR REMOVED



4. Subcooling:
The liquid supply is subcooled thru a brazed-plate heat exchanger (BPHE) in order to maintain a target liquid supply temperature. Medium-temperature systems feature reciprocating compressors which utilize the available refrigeration capacity to cool the liquid, with suction gas returning to the main suction header. Low temperature systems feature vapor-injected scroll compressors, operating in a similar manner, but the suction gas returns instead to a vapor-injection header, which feeds the suction gas back to the "inter-stage" vapor-injection ports located on each compressor.

Temperature control is achieved via the electronic expansion valve (EEV) and electronic evaporator pressure regulator (EEPR), which together regulate the flow of refrigerant thru the evaporator side of the BPHE, thereby absorbing heat from the main liquid line.

The rack subcooler control modulates both valves, based on the pressure and/or temperature of the suction gas exiting the BPHE. The EEPR is used to maintain a target suction pressure, while the EEV maintains a target



superheat condition. Liquid supplied to the EEV originates from the main subcooled liquid supply line. (downstream extraction) A liquid line solenoid valve is installed in the liquid extraction line of each unit, upstream of the EEV, and shall close upon any of the following conditions:

• Subcooling satisfied: Liquid supply temp < Lower-limit

• Power failure: Safeguarding against liquid floodback to the compressors upon restart

• No compressors running: Safeguarding against liquid floodback to the compressors upon restart

COMPRESSOR STAGING

1. General Control Strategy

The control point for compressor staging is suction pressure in the common return header. The strategy employed for staging compressors shall control the system suction pressure via load- matching. (not fixed-steps) All systems feature a single "lead" variable-capacity compressor. The lead compressor is a first-on, last-off compressor. The other compressors employed each have a fixed-capacity. In certain medium-temp systems, which utilize reciprocating compressors, one of the compressors may also feature an unloader – effectively providing two stages of capacity. The rack controller modulates the variable-capacity compressor and cycles the other compressors/ unloaders on & off to maintain the target suction pressure within the control limits.

Typical sequence for increasing load. The variable-capacity lead compressor shall be cycled on first at minimum capacity. If the suction pressure climbs above its set point by more than the programmed setting, the unit controller will modulate the compressor until it has reached full capacity. Once the lead compressor is running at full capacity, the unit controller will cycle on another compressor. Before cycling on another compressor, all of the following conditions must be met:

- variable-capacity compressor is at its maximum capacity
- stage-on time delay has elapsed
- system suction pressure is still above its set point

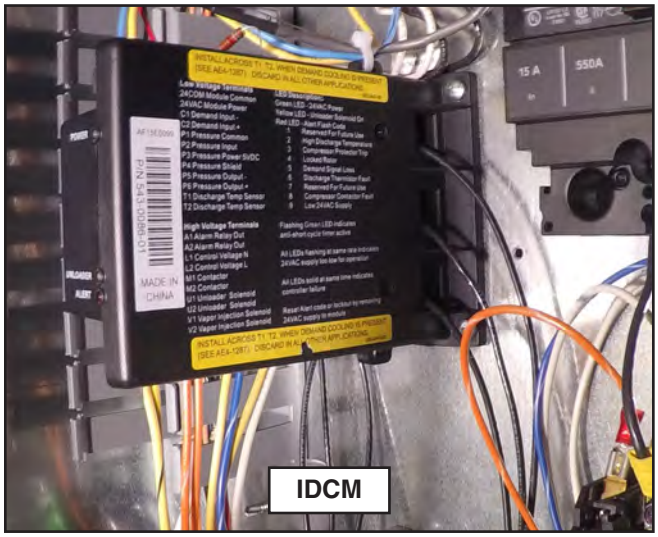
Typical Sequence for decreasing load. Before cycling off a compressor, the following conditions must be met:

- variable-capacity compressor is at minimum capacity
- lower control suction pressure set point has been reached
- stage-off time delay has elapsed
- system suction pressure is still not approaching its set point. The variable-capacity digital compressor shall stage off last.

Floating setpoint. The rack controller shall adjust ("float") the suction pressure setpoint and control limits based on the setpoint signal as received from the building automation system (BAS)

2. Variable-Capacity Digital Compressor Module (IDCM)

Each system includes one variable capacity compressor. The Digital Compressor Controller (IDCM) is the electronics interface between the Copeland Digital compressor and the unit controller, and provides control, protection, and diagnostics for the digital compressor system. The unit controller shall communicate the target compressor capacity via an analog signal to the IDCM. The unit Controller Demand signal shall be a 1-5VDC output where 1.0VDC is 0% capacity and 5.0VDC is 100% capacity. When the signal falls below 10% capacity (1.25VDC on decreasing demand) the IDCM will shut down the compressor. When the signal rises above 10% capacity (1.44VDC on increasing demand) the IDCM will start the compressor. Loss of the rack controller analog signal shall shut down the digital compressor. The alarm condition is communicated to the rack controller via the run proof.



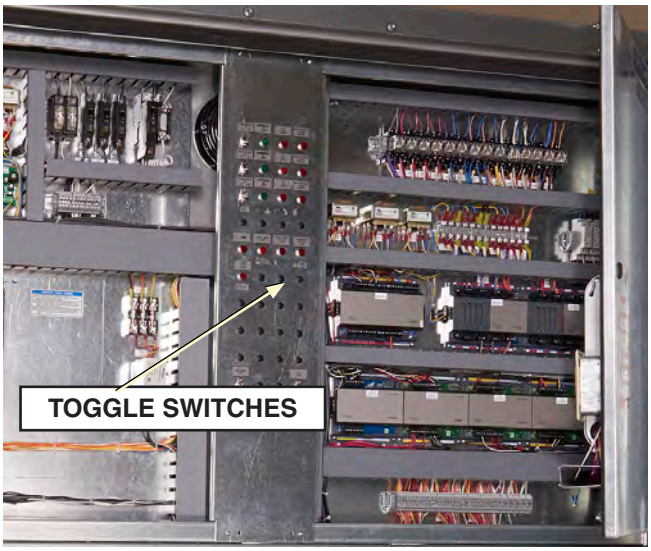
3. Blocked Suction Unloaders (MT Units)
Blocked suction unloaders may be applied to four-cylinder compressors, providing an additional stage of compressor capacity, helping to maintain the target system suction pressure condition. The unit controller shall energize to unload a four-cylinder compressor to 50% capacity. Unloaders, when applied, shall be incorporated into the capacity control strategy.

COMPRESSOR SAFETIES

The compressor safeties are an integral part of the control sequence for safe & reliable compressor operation.

1. Control Circuit Toggle Switch

Individual toggle switches are provided for each compressor. With the compressor toggle switch in the 'ON' position, compressor cycling shall be controlled via the individual unit controller. Assuming all compressor safeties are in a non-tripped state, a run command from the unit controller will close the on-board controller relays, thereby closing the compressor pilot relay contacts, which will then energize the compressor contactor coil and energize the compressor windings. Digital compressors shall require the toggle switch to be in the 'on' position, and, an analog signal must be present at the IDCM module, for compressor operation.



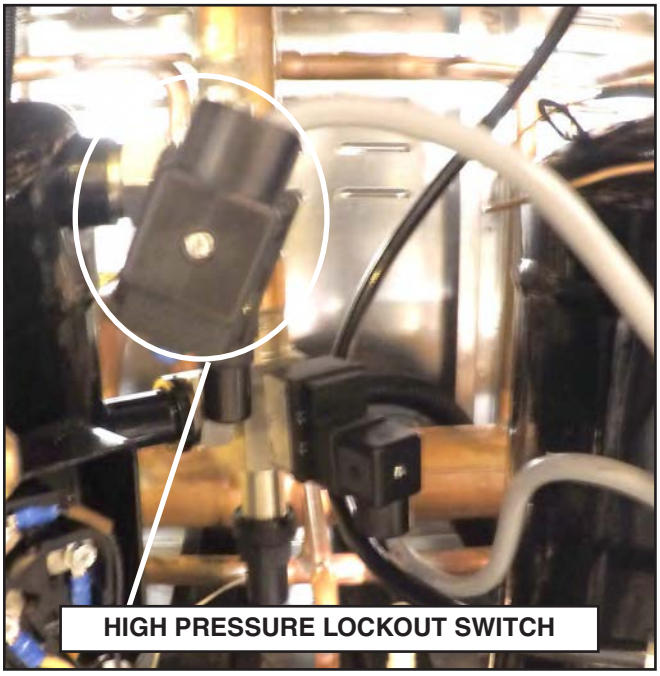
2. Oil Failures
Each low-temp scroll compressor features the OMB optical oil level control which shall monitor and maintain proper oil level at the compressor. In the event of low oil level conditions, following a two- minute internal delay, the oil control shall signal an oil failure condition, and de-energize the compressor control circuit.

Each medium-temp reciprocating compressor includes a mechanical oil-level float, with the pressure of the common oil supply regulated via the Y-825 oil pressure reducing valve. The CoreSense module provided with each compressor shall monitor oil pressure at the compressor oil pump. In the event of oil pressure loss, following a two-minute internal delay, the oil pressure control shall signal an oil failure condition, and de-energize the compressor control circuit. One general oil failure alarm is provided on each system, and shall be tied to the rack controller via the 485 network communications for alarm visibility.

Refer to the compressor run-proof status of each compressor to identify the individual compressor in question. Upon manual reset, assuming the oil failure condition has been corrected and the rack controller is calling for the compressor to run, the oil failure device (OMB/CoreSense) shall re-energize the compressor control circuit.

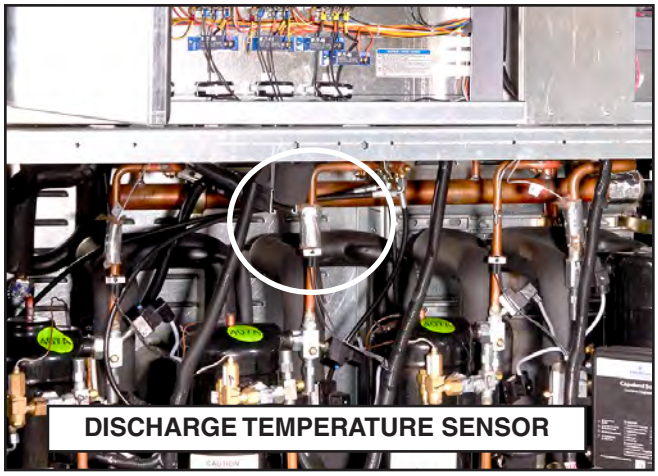
3. High Pressure Lockout Switch

Each compressor includes a manual reset high pressure switch that, in the event of an over-pressure event at the individual compressor, shall lock out the compressor control circuit. The high pressure switch requires manual intervention and will not be resettable until the pressure has dropped below the switch differential (cut-in) setpoint. The unit controller shall have a virtual HP switch setting that, in the event of a high pressure event, shall open the compressor control circuit prior to the mechanical switch intervention. The virtual HP setting shall be lower than that of the mechanical switch setting.


HIGH PRESSURE LOCKOUT SWITCH

4. Discharge Temperature Sensor

Each compressor is equipped with a temperature sensor located on the discharge line, located 6” from the compressor discharge port. Upon reaching the maximum temperature setpoint, the rack controller will open the compressor control circuit, shutting-down the compressor. A manual reset is required via the rack controller.


DISCHARGE TEMPERATURE SENSOR

5. Circuit Breaker

Individual 460 volt compressor circuit breakers shall be provided per compressor. Circuit breaker shall open on a fault and stop 460 volt power from entering the line side of the compressor contactor. Circuit breakers shall trip on overcurrent, short circuit, overheating etc. In the event of a Circuit breaker trip, a run proof alarm will be generated.

6. Thermal Overloads

Four-cylinder reciprocating compressors — Motor winding overheating shall be monitored by the CoreSense module, utilizing a PTC sensor. Excessive temperature-rise in the motor windings will signal the CoreSense module to open the compressor control circuit and stop the compressor.

Overload conditions shall be communicated to the rack controller. Motor winding trips shall auto- reset once the winding temperatures have dropped below the design threshold.

Three-cylinder reciprocating compressors and K5E scroll compressors — Motor winding overheating is detected via internal compressor overloads. In the event of excessive temperature-rise in the motor windings, the internal overload shall directly open the high voltage power feeds to the motor windings and stop the compressor. The CoreSense module shall communicate the run proof alarm condition to the unit controller. Motor winding trips shall auto-reset once the winding temperatures have dropped below the design threshold.

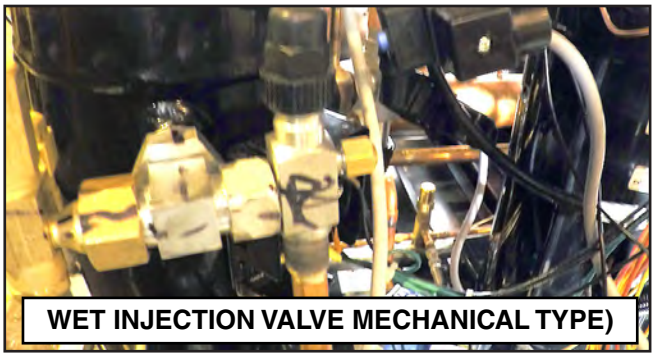
KVE scroll compressors — Motor winding overheating is detected via internal compressor overloads. In the event of excessive temperature-rise in the motor windings, the internal overload shall directly open the high voltage power feeds to the motor windings and stop the compressor. No CoreSense module is equipped on the KVE compressors. In the event of a thermal-overload trip, a run proof alarm will be generated. Motor winding trips shall auto-reset once the winding temperatures have dropped below the design threshold.

7. Run Proof

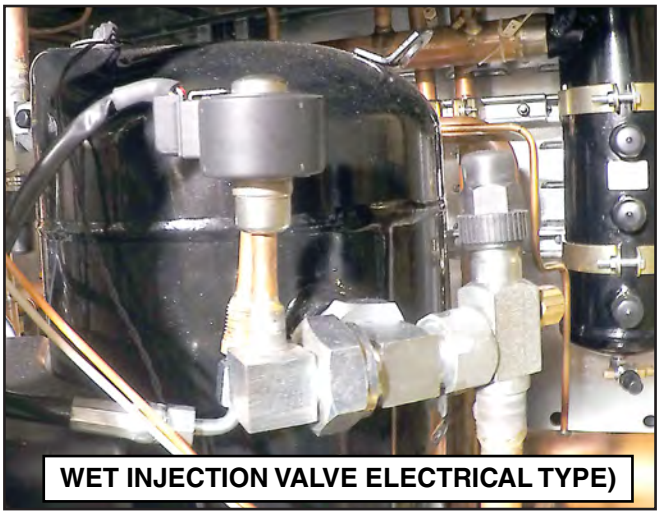
Upon delivering a compressor run command, the rack controller shall monitor the panel-mounted compressor current transformer for a run proof signal. Lack of run proof (amperage) input shall produce an alarm and lock out the compressor control circuit. NOTE: a run proof alarm may be generated by multiple possible alarm conditions listed in the 'compressor safeties' section above.

8. Wet Injection Compressor Cooling (LT Units)

To ensure proper compressor cooling, each low-temp scroll compressor is equipped with a wet- injection temperature control valve, located at the interstage injection port. Liquid refrigerant is extracted from the main liquid line, upstream of the subcooler, and introduced to each valve. Depending on the compressor type/size, either a mechanical (temperature-responsive) valve or electrical "stepper" valve may be applied. The function of these valves is to regulate the flow of liquid refrigerant to the compressor, based on the individual compressor discharge temperature. Liquid solenoid valves are provided upstream of the stepper valves, shutting off flow in the event of a power failure. In the event that proper discharge temperatures are not maintained, refer to the 'High-Temp Sensor' sequence above.



WET INJECTION VALVE MECHANICAL TYPE)



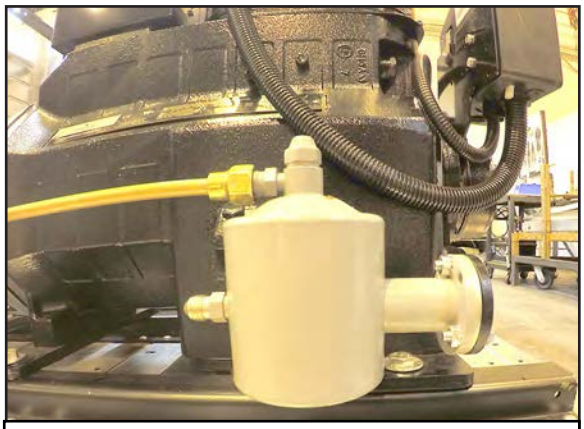
WET INJECTION VALVE ELECTRICAL TYPE)

OIL SYSTEM

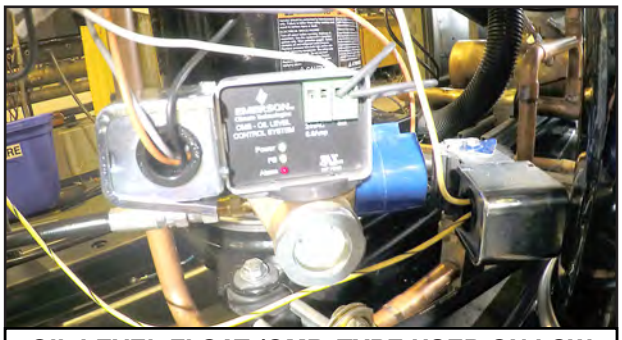
Proper compressor lubrication is required under all operating conditions. Components included in the oil return system include:

- Turba-shed Oil Separator/Reservoir
- Oil Filter
- Y-825 Oil Pressure Reducing Valve (MT Units Only)
- Oil Level Regulators
    - OMB (LT Scroll Compressors)
    - Mechanical Floats (MT Reciprocating Compressors)

The Turba-shed Oil Separator/Reservoir separates oil from the refrigerant passing thru the main discharge line. The oil filter is provided at the oil outlet of the oil separator/reservoir, in the common oil supply line, to prevent any system contaminants/debris from returning to the compressors. Each compressor is equipped with an oil level regulator, which shall be preset to maintain the crankcase oil level, as required by the compressor manufacturer.



OIL LEVEL FLOAT (MECHANICAL TYPE USED ON MEDIUM TEMP RECIP COMPRESSORS



OIL LEVEL FLOAT (OMB TYPE USED ON LOW TEMP SCROLL COMPRESSORS

In the case of low-temp scroll compressors, oil is supplied at full discharge pressure to individual (electronic) OMB controls. Low Temperature units feature OMB oil level regulators to maintain proper oil levels at all times.

In the case of medium-temp reciprocating compressors, the oil supply pressure is first reduced via the Y-825 pressure reducing valve, before being metered to the individual mechanical floats. The Y-825 valve shall be set to maintain oil supply pressures equivalent to 20-25 psig above the system suction pressure.

Refer to the 'Compressor Safeties' section above, for the sequence pertaining to oil failures.

Y-825 VALVE

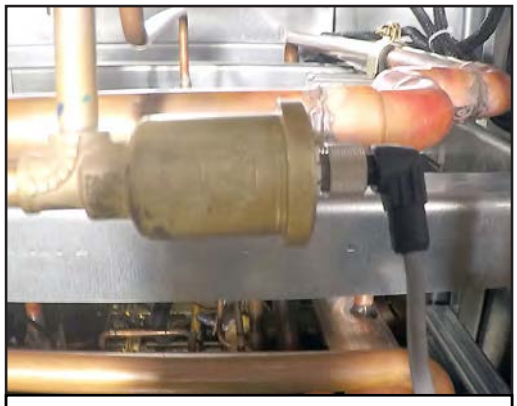
MECHANICAL SUBCOOLING

The Brazed Plate Heat Exchanger (BPHE) functions as the liquid subcooler. It is equipped with a solenoid valve located on the evaporator-side inlet, opening/closing in response to the main liquid outlet/supply temperature. Additional components supporting the functionality of the subcooling system include the electronic expansion valve (EEV) located on the evaporator-side inlet (modulating to control evaporator superheat), the electronic evaporator pressure regulating valve (EEPR) located on the evaporator-side outlet (modulating to control evaporator suction pressure), the electronic liquid pressure regulating valve (ELPRV) located on the main liquid supply line, downstream of the subcooler, (modulating to control the main liquid supply pressure), and the normally-open ELPRV bypass solenoid valve, which provides a bypass around the ELPRV in the event of excessively high liquid supply temperatures or loss of power to the subcooler control board.

The following temperature & pressure inputs are utilized for the purpose of subcooler control:

- Subcooler Liquid Inlet Temperature
- Subcooler Liquid Outlet Pressure
- Subcooler Liquid Outlet Temperature
- Subcooler Suction Pressure
- Subcooler Outlet Suction Temp

Reference the setpoint chart for the EEPR pressure setting, ELPRV pressure setting, EEV superheat setting, and liquid line solenoid cut-in/cut-out temperatures.



ELECTRONIC EXPANSION VALVE (EEV)

The subcooler sequence will not initiate unless the system is operational with a minimum of one compressor running. Entering liquid temperature shall be the control point for the subcooler operation. The rack controller shall open the subcooler liquid line solenoid and enable the subcooler controller when the entering liquid temperature is above the subcooler cut-in temperature. The rack controller shall close the subcooler liquid line solenoid when the entering liquid temperature is below the subcooler cut-out temperature. The unit mounted controller shall modulate the position of the EEV to control the superheat condition exiting the BPHE suction line. Final subcooled liquid temperature shall be controlled by the unit controller modulating the EEPR.

ELECTRONIC EVAPORATOR PRESSURE REGULATING VALVE (EEPR)

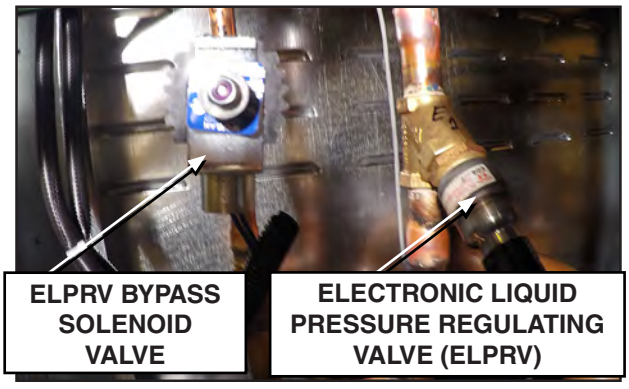
In the case of low-temp units utilizing scroll compressors, suction gas returns to each low-temp compressor via a vapor-injection solenoid, which is open if the compressor is running. The solenoid valve is energized via a current-sensing relay, and closes when the compressor stops – shutting off the vapor- injection supply to the compressor. For medium-temperature compressors, suction gas returns to the main suction header.

ELECTRONIC LIQUID PRESSURE REGULATOR

During normal operation, the unit controller shall modulate the ELPRV to maintain a liquid supply pressure equivalent to 10 °F of liquid subcooling, given the liquid supply temperature specified. The unit controller shall energize (close) the ELPRV bypass solenoid valve when the exiting sub-cooled liquid temperature is below the bypass cut-in temperature. In the event of subcooler failure, the unit controller shall modulate open the ELPRV and de-energize (open) the ELPRV bypass solenoid valve, if the sub-cooled liquid temperature is above the bypass cut-out temperature for a time greater than the bypass response delay. Flood Back Safety. If the BPHE suction superheat calculated by the unit controller falls below its safety setpoint, the unit controller shall:

1. Close the cold-side (DX) solenoid valve for a period of 60 seconds

2. De-energize (open) the ELPRV bypass solenoid valve and modulate open the ELPRV valve
Once the flood back safety time has elapsed (60 seconds), and assuming the BPHE inlet liquid temperature is above the control point, the rack controller shall again initi ate the DX side solenoid valve, energize (close) the ELPRV bypass solenoid valve, and allow the ELPRV to again modulate in order to maintain the liquid supply pressure. Loss of unit controller. Upon loss of the unit/subcooler controller, the subcooler (DX) solenoid valve shall close, the ELPRV bypass solenoid valve shall be de-energized (open), and the 'enable' signal shall force the subcooler EEV closed, if available at time of failure.



• Control relays shall be provided for the purpose of fan-cycling during VFD control and in the event of VFD failure. Fan motors may be cycled either individually or in pairs.

• The condenser fans shall include current transformers (CTs) for fan-motor proofing and power monitoring.

• The condenser shall include electro-mechanical pressure switches for failsafe/backup fan-cycling.

• The main drop leg from the condenser shall be equipped with an electronic inlet pressure regulating valve (refrigerant holdback). The primary function of the holdback valve is to control the minimum condensing pressure.

• Minimum receiver pressure is maintained via the receiver pressure-regulating line, with originates from the main system discharge line. The pressure-regulating line is equipped with an electronic outlet pressure regulating valve, which will only operate (modulate open) in the event of low receiver pressure.

• The receiver shall include a self-regulating receiver heater to maintain a minimum refrigerant temperature.

• The receiver shall include a liquid level probe utilized to monitor receiver level.

The inputs required to control the condensing pressure control system include: discharge header pressure, drop leg pressure, receiver pressure, and ambient air temperature. Reference the setpoint table for design TD, minimum condensing pressure, maximum condensing pressure, and minimum receiver pressure.

CONDENSING PRESSURE CONTROL

Condensing pressure control encompasses many components with various functions whose primary requirement is to produce a functional condensing pressure across extreme minimum and maximum ambient and load conditions. Additionally, the control strategy shall provide energy savings by minimizing condensing pressures, minimizing fan speeds, and potentially reduce the overall refrigerant charge requirements by attempting to minimize refrigerant accumulation in the condenser.

• The air-cooled condenser shall be equipped with inverter-duty rated fan motors. A unit-mounted VFD shall provide the means of variable fan speed control. The fan control strategy shall be controlled on a temperature difference (TD) strategy by the rack controller. The primary function of the VFD is to mod-ulate airflow across the condenser to either increase or decrease the system's ability to reject heat.

• Control relays shall be provided for the purpose of fan-cycling during VFD control and in the event of VFD failure. Fan motors may be cycled either individually or in pairs.

• The condenser fans shall include current transformers (CTs) for fan-motor proofing and power monitoring.

• The condenser shall include electro-mechanical pressure switches for failsafe/backup fan-cycling.

• The main drop leg from the condenser shall be equipped with an electronic inlet pressure regulating valve (refrigerant holdback). The primary function of the holdback valve is to control the minimum condensing pressure.

Minimum receiver pressure is maintained via the receiver pressure-regulating line, with originates from the main system discharge line. The pressure-regulating line is equipped with an electronic outlet pressure regulating valve, which will only operate (modulate open) in the event of low receiver pressure.

• The receiver shall include a self-regulating receiver heater to maintain a minimum refrigerant temperature.

• The receiver shall include a liquid level probe utilized to monitor receiver level.

The inputs required to control the condensing pressure control system include: discharge header pressure, drop leg pressure, receiver pressure, and ambient air temperature. Reference the setpoint table for design TD, minimum condensing pressure, maximum condensing pressure, and minimum receiver pressure.

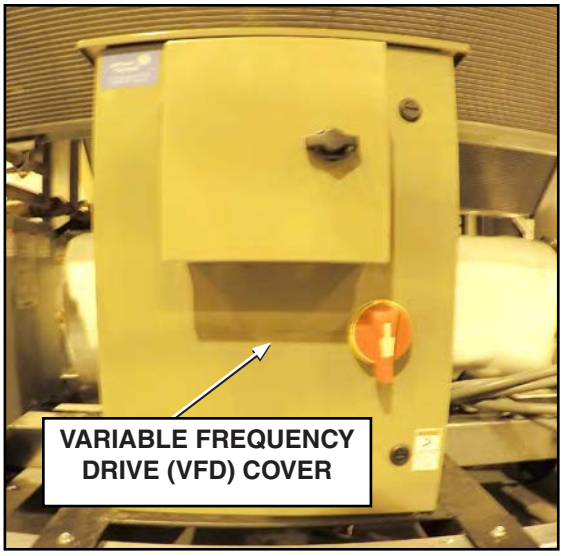
a) Variable Frequency Drive (VFD)
The unit controller shall calculate the actual condenser temperature-difference (TD) by monitoring the ambient temperature and drop leg pressure (converted to temperature). The target condensing temperature (pressure) shall be 10°F above the drop leg pressure (converted to temperature).

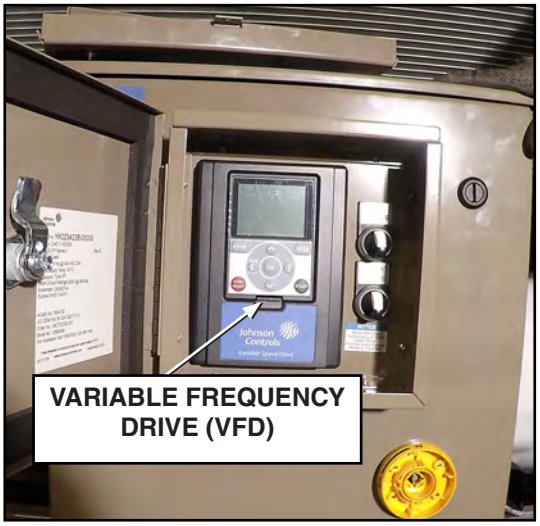
The rack controller shall modulate the VFD to control all fans simultaneously at speeds between 15Hz minimum and 60Hz maximum, in an effort to maintain the TD setpoint. Following a decrease in condenser TD, with a decreasing ambient temperature or heat-of-rejection requirement, when the VFD has reached the minimum speed of 15Hz, the rack controller shall stage off a pair of fans in an effort to maintain the TD setpoint.

The VFD shall not increase again from 15Hz until all fans have cycled back on. The lead (#1) fan shall not cycle off, as long as the unit is powered. On a continuing decrease of condenser TD, the next pair of fans shall cycle off. This sequence shall continue until the last controllable fan (#2) is off. Following an increase in condenser TD, with an increasing heat-of-rejection requirement and/or ambient temperature, the rack controller shall cycle on the last 'off' fan (#2).

Upon a continuing increase in condenser TD, the rack controller shall cycle on the next pair of fans. Assuming the condenser TD continues to rise above the setpoint, this sequence shall continue until all fans have cycled back on, with the VFD still operating at 15Hz. Once all fans are on, if the condenser TD continues to increase from the setpoint, the rack controller shall ramp up the VFD speed, as needed, up to 60Hz maximum.

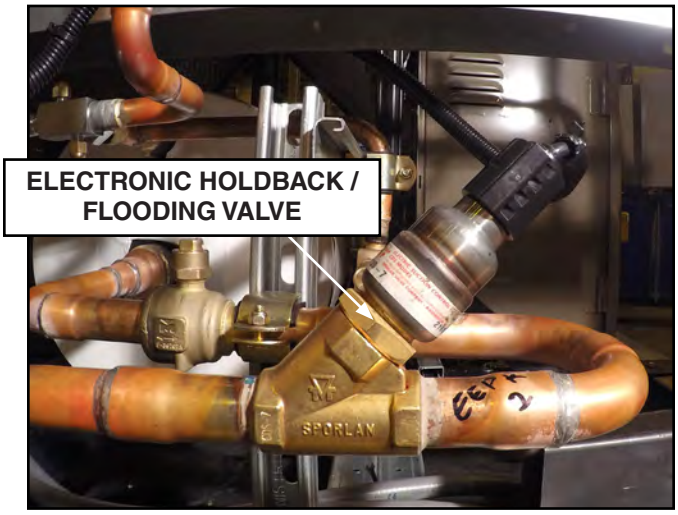
NOTE: Fan-cycling (on/off) may occur at any ambient temperature. Fan motor run proofs shall be validated thru fan motor CTs. Refer to the setpoint chart for maximum and minimum condensing pressures.



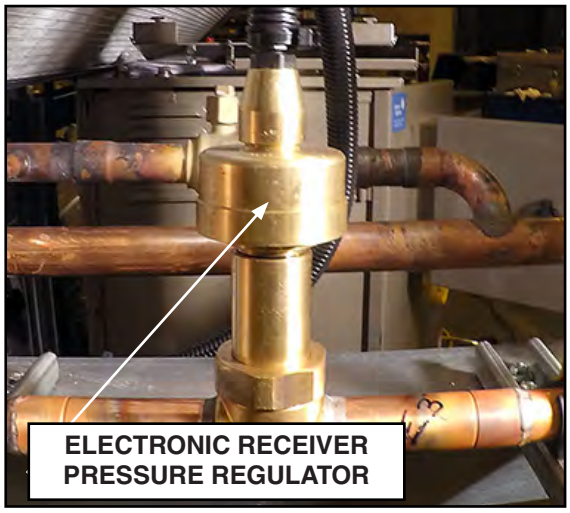


b) Electronic Holdback/Flooding Valve

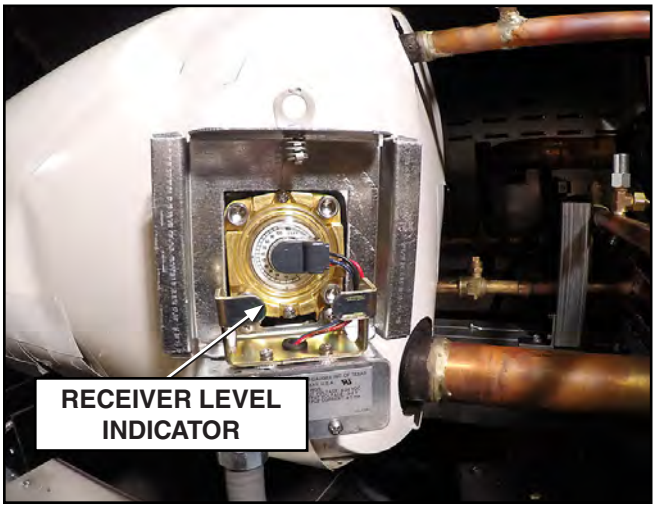
The system shall be equipped with an electronic pressure regulating valve located in the drop leg line leaving the condenser. The unit controller shall monitor the condenser drop leg pressure and modulate the holdback valve to maintain the minimum condensing pressure setpoint. (modulating closed to increase the condenser pressure) See setpoint chart for minimum allowable condenser pressures.



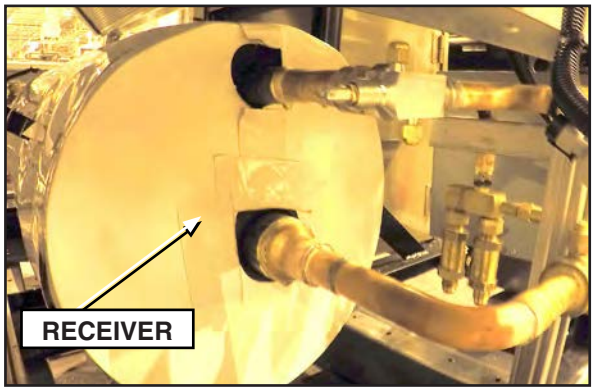
c) Electronic Receiver Pressure Regulator
Adequate receiver pressure is necessary for proper system operation. The unit controller shall utilize a differential control strategy between discharge and receiver pressures, to prevent low receiver pressure conditions. The minimum allowable receiver pressure will vary as the discharge pressure varies, and the controller shall modulate the receiver pressure regulating valve accordingly. See setpoint chart.



d) Heated Receiver
The receiver shall include self-regulating heating cable, connected to a GFCI, to maintain the minimum refrigerant temperature.

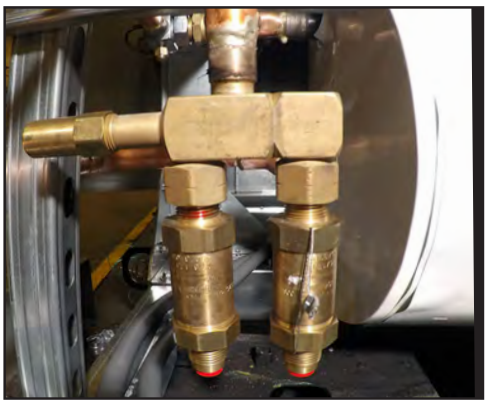


e) Receiver Level Indicator
The receiver shall be equipped with a liquid-level indicator that supplies an analog signal to the unit controller, proportional to the liquid level. The liquid level indicator shall produce a 0.5 Vdc signal@ 0% receiver level and shall be linear to 4.0 Vdc @ 100 % receiver level. See setpoint chart.



SYSTEM SAFETIES

1. Pressure Relief
Dual pressure relief valves sized for 407A shall be provided at the receiver, to prevent the system from encountering pressures which exceed allowable levels.



2. Compressor Backup Controls

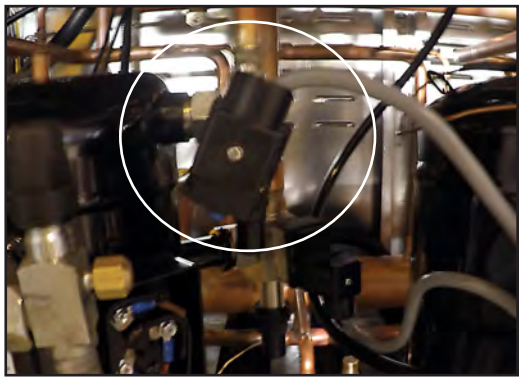
Backup provisions shall be incorporated into the compressor control circuits, to provide basic system operation in the event that the rack controller is unable to govern system operation. The compressor control circuit power shall be applied such that a failsafe mechanical relay will bypass the individual controller relays and allow control power to be run through the individual low-pressure electro- mechanical switches and individual compressor time delays. The low pressure switches shall be preset to maintain adequate suction pressure control, and the time delays shall be preset to prevent multiple compressors from starting at the same time. (refer to setpoint chart)

Example scenarios where such backup control may be initiated include:

• During the initial power-on sequence, as the rack controller may remain "off-line" until its startup sequence has been established.

• Failure of the rack controller
(loss of communication)

All electro-mechanical compressor safeties outlined previously are still incorporated in the compressor control circuit. When backup controls are engaged, time delays will only delay the start of the compressor once, and will be locked 'on' to allow the low pressure switches to control the staging of individual compressors.



3. Condenser Backup Controls

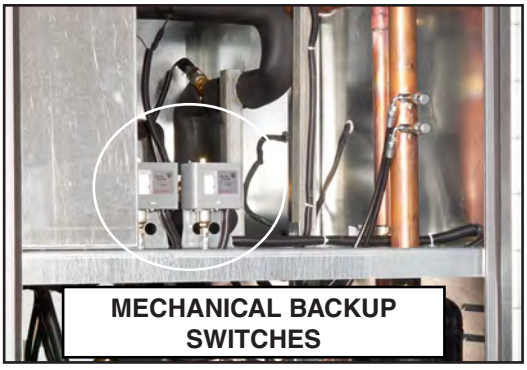
Condenser VFD Failure. The rack controller shall monitor VFD status via com loop. Upon VFD failure, confirmation of bypass shall be via the unit controller. On VFD failure / bypass the unit controller shall revert to the unit controller fan cycling strategy. Fan-cycling upon VFD failure shall utilize setpoints defined in the setpoints chart.

Sensor Failure

In the event that either the ambient temperature sensor or the drop leg pressure transducer fails, the unit controller will revert to a fan-cycling strategy based on discharge pressure. Refer to the setpoint chart for details. If the discharge pressure transducer also fails, unit control will revert to "switchback" operation, as if the rack controller itself has failed. (see next line item)

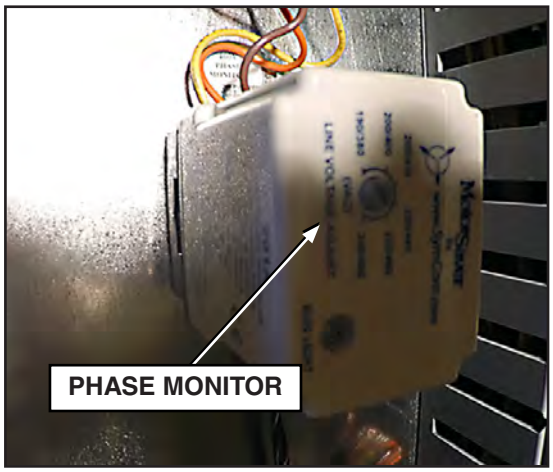
Unit Controller Failure

Upon failure of the unit control system, a relay shall bypass the rack controller fan relays and engage unit-mounted electro-mechanical pressure switches. These pressure switches shall be preset to maintain basic condenser operation, controlling fan-cycling based on discharge pressure. See setpoint chart for cut-in/cut-out pressures.



4. Phase Monitor
Each unit is equipped with a phase monitor that will interrupt the power supply to the compressor and condenser control circuits, preventing operation of all 460V loads. The phase monitor will issue a single, general alarm to the rack controller in any of the following conditions:

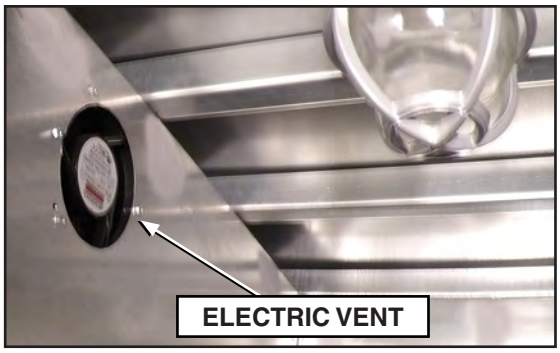
- Over/under voltage
- Phase loss
- Phase reversal
- Voltage imbalance



4a. Ventilation System
Ventilation fans are provided to maintain proper operational temperatures within the enclosure. See setpoint chart for cut-in/cut-out temperatures.

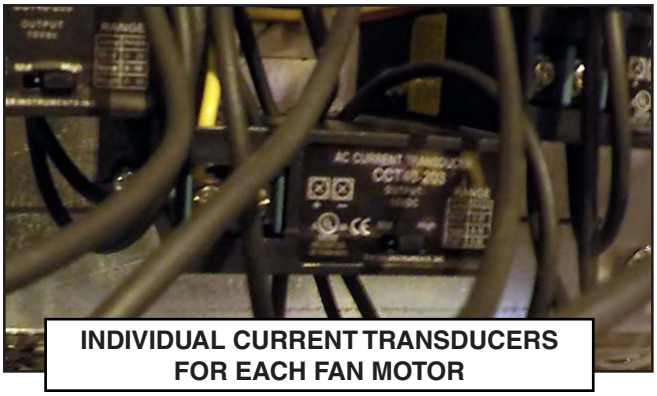
CABINET VENTILATION

Ventilation for the electric panels



Ventilation for the cabinet enclosure

POWER MONITORING & DATALOGGING
Refer to controller specification.

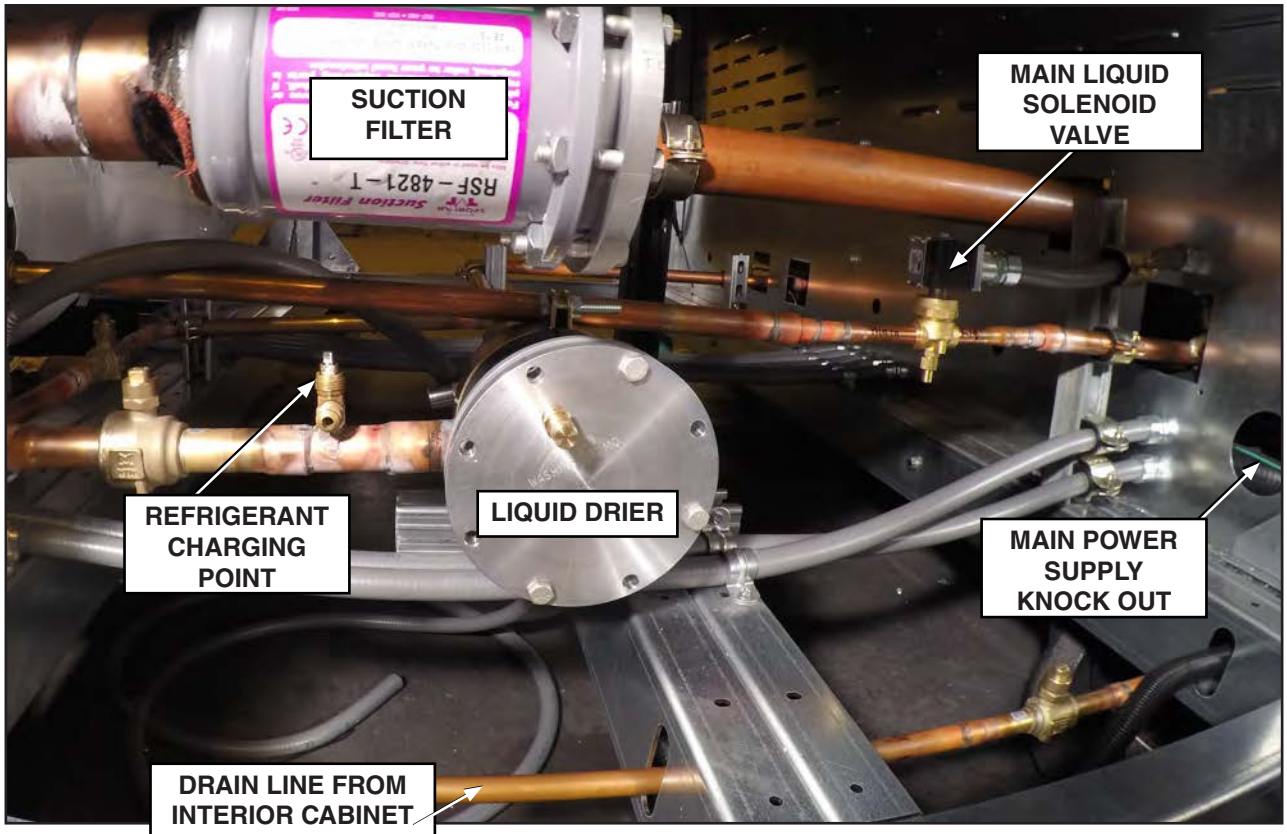


INDIVIDUAL CURRENT TRANSFORMERS FOR EACH COMPRESSOR MOTOR

FILTER / DRIER

A replaceable core liquid line filter/drier is located downstream of the receiver with isolation and by-pass ball valves for service. A 3/8" angle liquid charging port is upstream of the filter/drier and downstream of the receiver to allow for system charging.

This permits the refrigerant charge to pass through the filter/drier with the receiver outlet ball valve closed in a pump down mode at start-up. A large combination full view sight glass with moisture indicator is located downstream of the filter/drier.



MagPak Microprocessor Control System

Overview

Hardware

XCM-20R: The heart of the MagPak control system is the XCM-20R (“XCM”). The XCM is the “main brain” of the MagPak control system. It hosts the control algorithms, history logs, alarms, user interface graphics, and more. The front cover of the XCM contains an LCD touchscreen, available for service people and others to obtain information about the operation of the system. The LCD is sufficient for most service functions. However, if a more robust user interface is desired, the XCM’s built-in web browser interface can be used via a laptop computer. The XCM has several communication ports, through which it interacts with Input/Output point modules and a condenser VFD (variable frequency drive) using industry standard BACnet protocol.

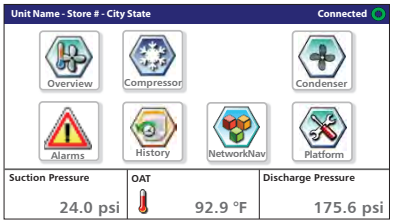
Input/Output Point Modules: Several Input/Output modules are included as part of the MagPak control system. Temperature, pressure, and other sensors are connected to the input modules, and the output modules control on/off and modulating devices like solenoids, contactors, modulating valves, and more.

Input/Output Control Modules

Software

As mentioned above, there are two ways to locally monitor and adjust the control system, the LCD touchscreen and a web browser interface using a laptop computer. Both of these software interfaces will be described in detail later in this document.

xcm.LCD - Home Screen

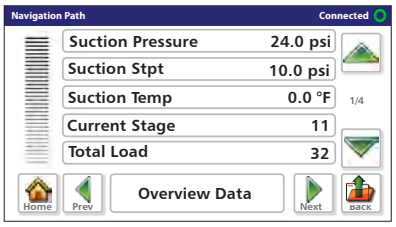


OVERVIEW

Home Screen Icons

- Rack Data Overview
- All Circuits
- Condenser Status'
- All Alarms
- Point Data History
- Network Navigation
- xcm.LCD settings

Rack Data Overview at a Glance



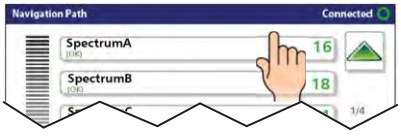
Shows Status of the Rack

OVERVIEW

Choose Overview from the home screen

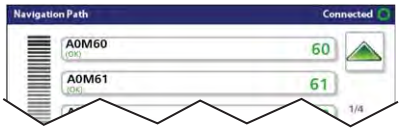
Verify Module Communication

HOW TO



Choose NetworkNav from the Home screen

Choose the Module's Network

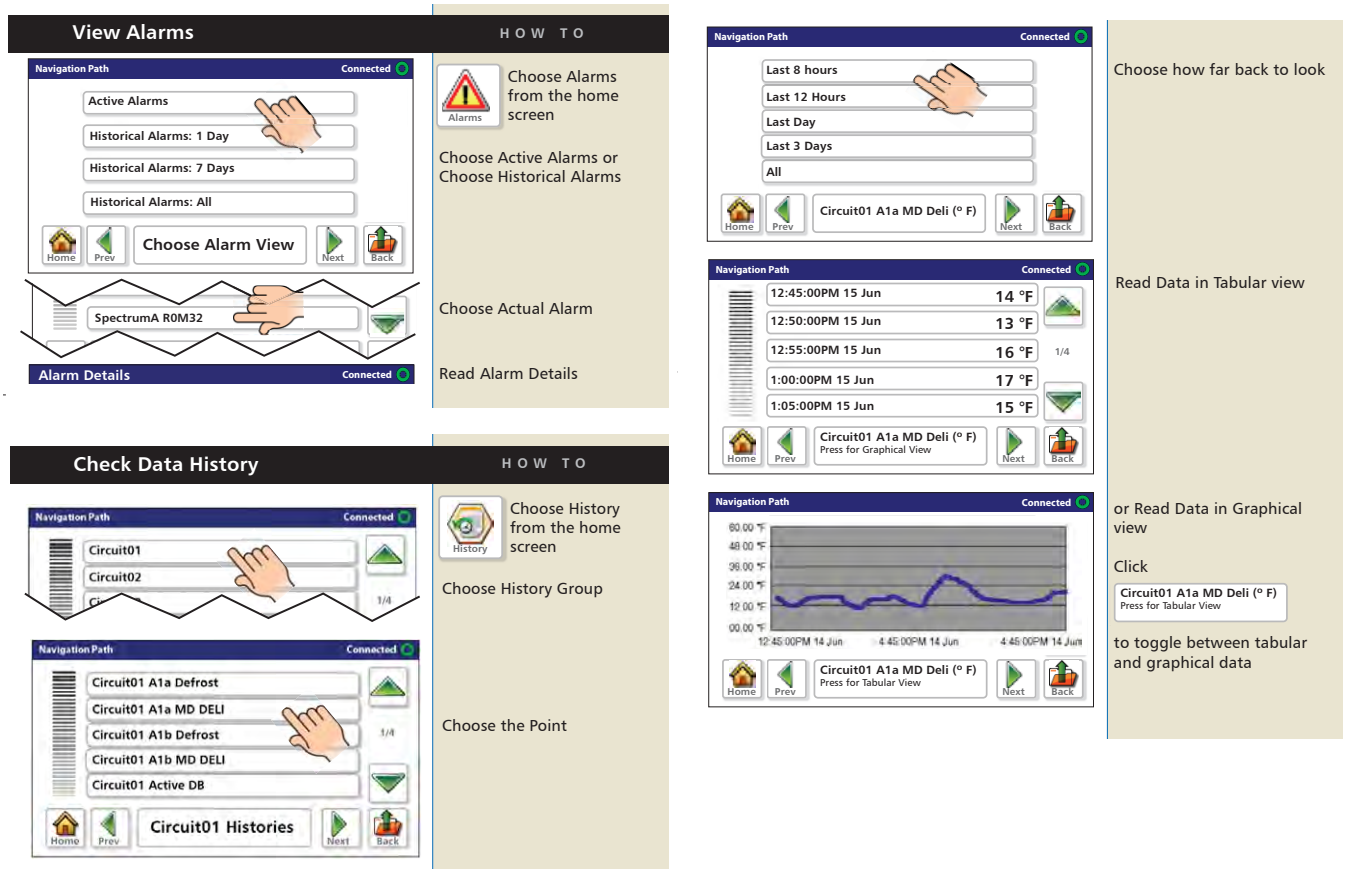


Each device will be listed by name with address and status
(OK)
(Down)

Browser Interface:

One method of interfacing with the XCM is via a browser using a laptop computer, using the following procedure:

1) Use Firefox.
2) Use a standard Ethernet cable to connect the Ethernet port of your laptop computer with the **LAN-2** port of the XCM.
3) Your computer must have an IP address that is on the same domain as the XCM. Use this procedure to temporarily change your computer's IP address:
    a. Go into your computers Control Panel and click on "Network and Sharing Center"
    b. Click on "Local Area Connection"
    c. Click on the button for "Properties"
    d. Double-Click on "Internet Protocol Version 4 (TCP/IPv4)"
    e. Write down the IP address setting that is currently in the computer
    f. Click on "Use the following IP address" and type in _____ .



g. Click on OK to save this address, then close the other pop-up windows.

4) Open your browser, and in the command line, type in _____.

5) When it prompts you for user name and password, use the credentials supplied to you by Walmart. If they did not supply you with credentials, use “startup” and “1234” for the user name and password.

6) The very first time you connect, several Java plug-in programs must load. This can take several minutes. After this is complete, subsequent connections will be faster.

7) Upon a successful connection, the Home Page will load. Refer to the section “Browser Software Interface” for a description of the screens.

Common Problems using the Browser Interface:

1) **Computer Ports**: The browser interface requires ports 80 and 1911 to be open on your computer. Most computers already have these open by default. If not, opening these ports goes beyond the scope of this document. You can either search Google or contact your IT support group to learn how to unlock these ports.

2) **Computers Version of Java Software**: After entering the user name and password, if it never connects with the XCM you may have a version of Java that does not contain up-to-date security features. **To obtain a Java update, you must be on the Internet.** Go to Oracle.com, and search for Java Update V 1.8.0_45 and install it on your computer.

3) **Browser Memory Cache**: After loading the most current version of Java, if it still does not work you may need to clear out the Java memory cache. To do this, refer to the instructions for clearing FireFox cache on the next page.

4) **Cryptography Extension**: If you receive an error message while trying to connect in regard to needing a Cryptography extension, you must also be on the Internet and go to Oracle.com to obtain it. The on-screen message should provide more details on how to obtain the extension.

5) **Trusted Site**: Some corporate IT groups limit the type of web sites that the computers can access. You may need to go into your browser’s Internet Options, click on the Security tab and save 192.168.15.200 as a “Trusted Site”.

Clear Firefox Cache

Files, images, scripts and other data are stored on computers during browing sessions. Clearing those files may be necessary to get the Browser Display to function.

Steps for clearing the cache:

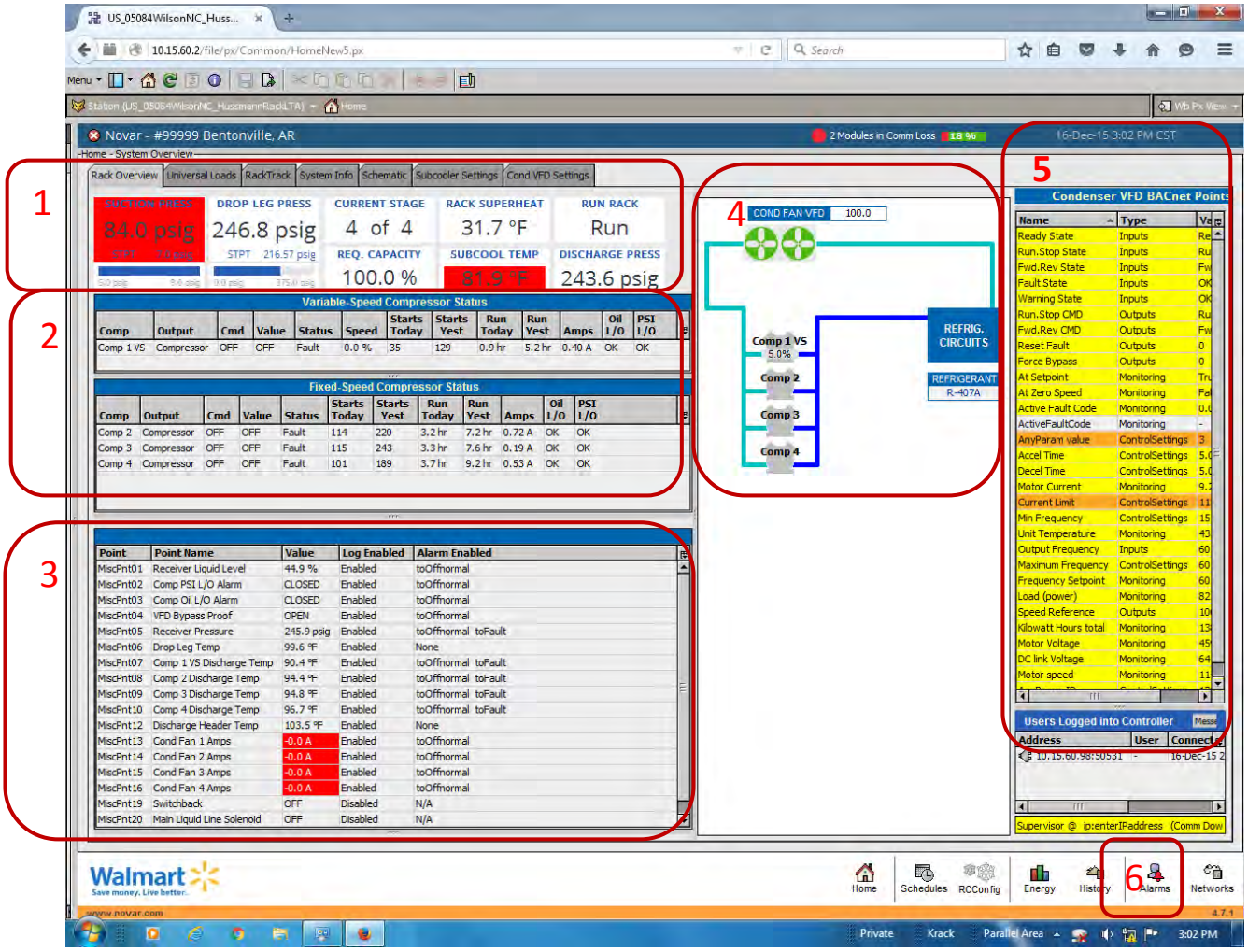
1. In the Firefox browers, click on the **Firefox** button and select **Options**.
2. Select the **Advanced** Tab and then click on the **Network** Tab.
3. Click **Clear Now** in the **Cached Web Content** Section.
4. Click **OK** in the **Options** Window.

Steps for clearing the browsing history:

1. At the top of the **Firefox** browser, click the **Firefox** button, mouse over the **History Menu** and select **Clear Recent History**.
2. Select the time frame for how much history you want to clear by clicking the **Time Range to Clear** to choose how much of your history Firefox will clear.
3. Click the **Details** arrow to select the information that is to be cleared.
4. Click the **Clear Now** button, and the selected items will be cleared from the history

Web Browser Screen Descriptions

1) Tab 1 - "Rack Overview"



Area 1: The most important rack status information is displayed in this area: suction pressure, discharge pressure, etc.

Area 2: Compressor Status Information – Variable speed compressor information is on top, fixed speed compressor information on bottom. It shows the command, status feedback, number of starts, run time, and the status of associated sensors.

Area 3: Displays the status of miscellaneous sensors and output devices.

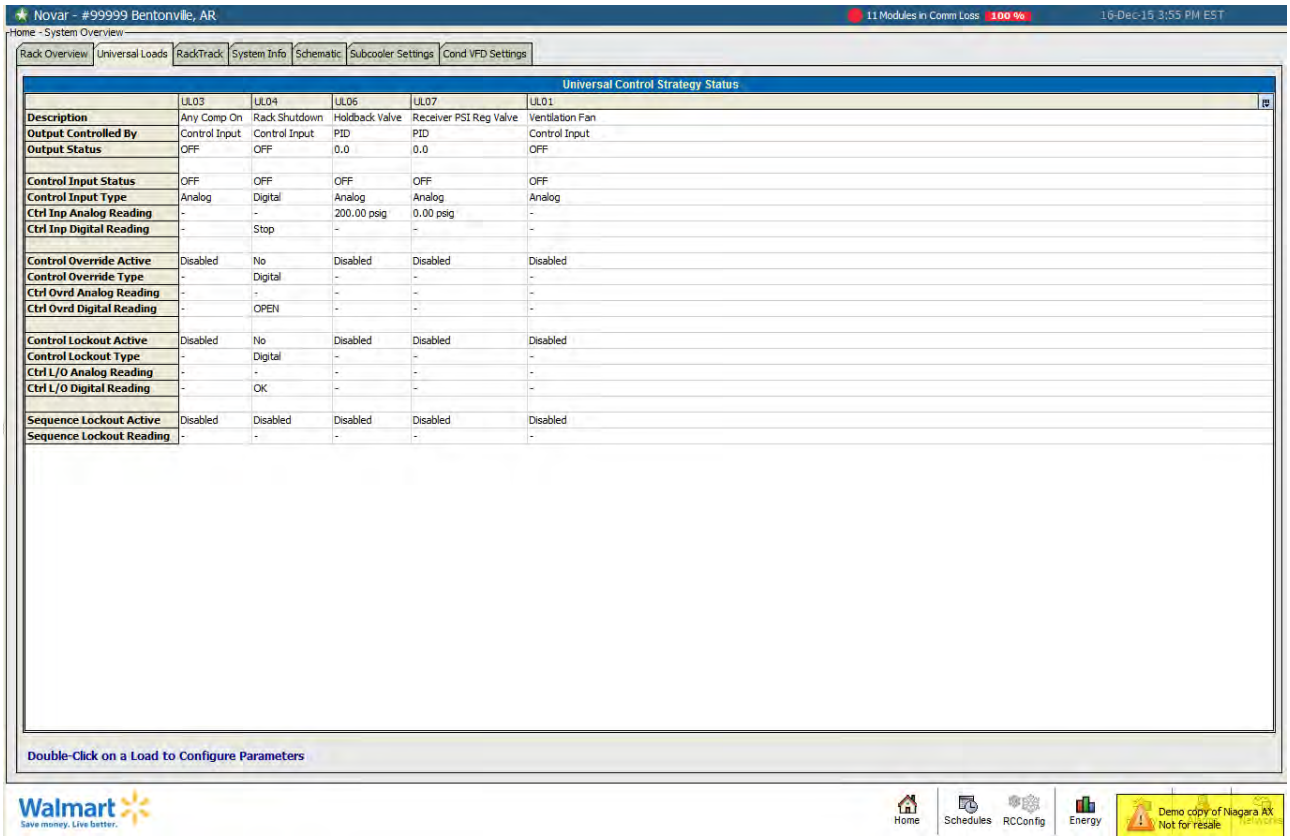
Area 4: Provides a small graphical representation of the compressors and condenser fans. Grey is Off, Green is On, and Red means it is in Fault.

Area 5: This area displays BACnet data from the condenser variable frequency drive.

Area 6: Alarms - click on the Alarms button to open the Alarm Console window. When this opens, you must click on the Refresh button to pull in the active alarms. You can continue to click on individual alarms to obtain greater detail.

Viewing Data Log Points: There are 2 ways to view data log (history) points. The first is to click on the tab labeled "Rack Track" for a graphical representation of the main rack information. The second method is that if you position the cursor over some of the data values on the Home page and the cursor changes to a "hand", you can click on that point to receive more information regarding associated alarms and data logs.

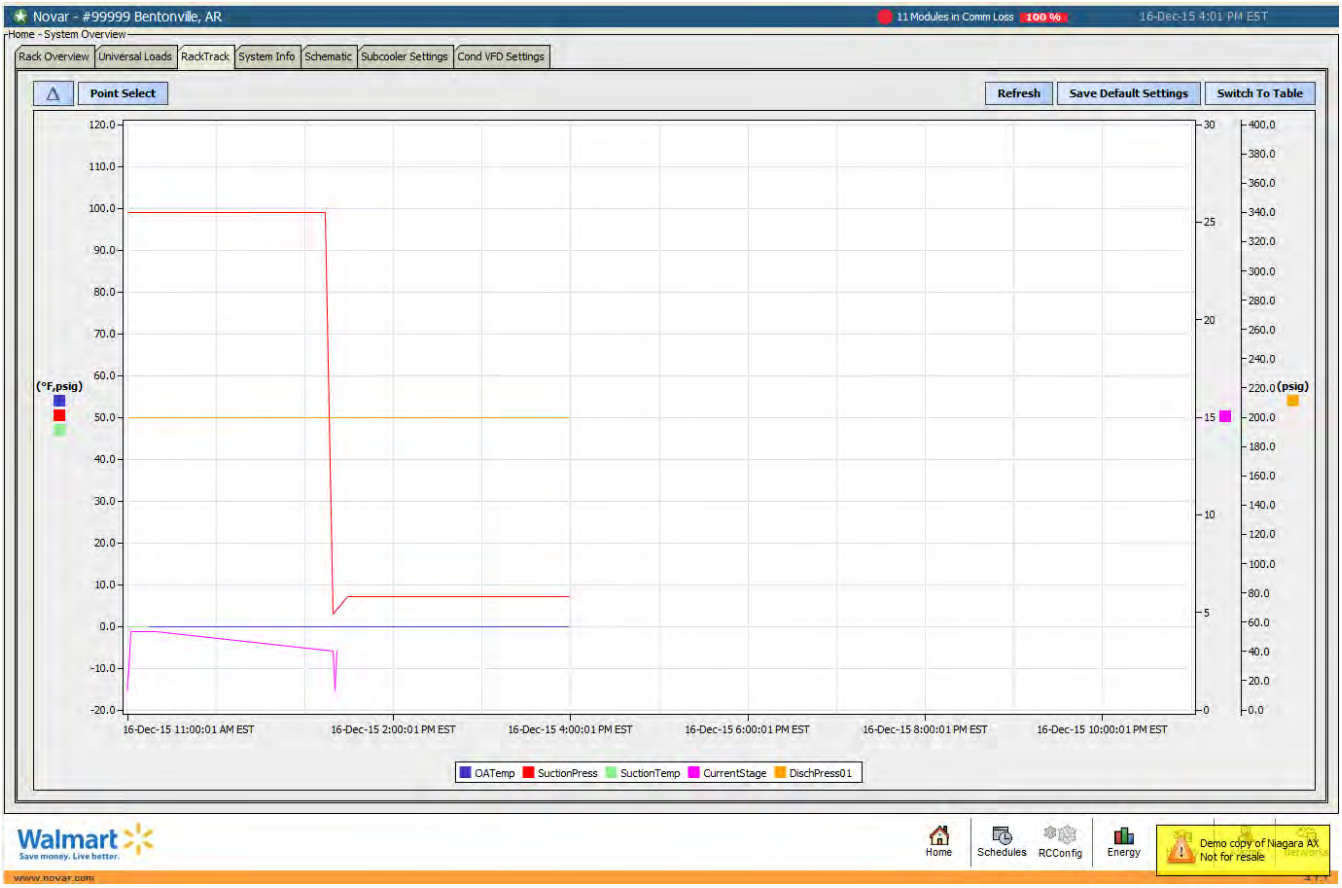
2) Tab 2 – Universal Loads



	UL03	UL04	UL06	UL07	UL01
Description	Any Comp On	Rack Shutdown	Holdback Valve	Receiver PSI Reg Valve	Ventilation Fan
Output Controlled By	Control Input	Control Input	PID	PID	Control Input
Output Status	OFF	OFF	0.0	0.0	OFF
Control Input Status	OFF	OFF	OFF	OFF	OFF
Control Input Type	Analog	Digital	Analog	Analog	Analog
Ctrl Inp Analog Reading	-	-	200.00 psig	0.00 psig	-
Ctrl Inp Digital Reading	-	Stop	-	-	-
Control Override Active	Disabled	No	Disabled	Disabled	Disabled
Control Override Type	-	Digital	-	-	-
Ctrl Ovrd Analog Reading	-	-	-	-	-
Ctrl Ovrd Digital Reading	-	OPEN	-	-	-
Control Lockout Active	Disabled	No	Disabled	Disabled	Disabled
Control Lockout Type	-	Digital	-	-	-
Ctrl L/O Analog Reading	-	-	-	-	-
Ctrl L/O Digital Reading	-	OK	-	-	-
Sequence Lockout Active	Disabled	Disabled	Disabled	Disabled	Disabled
Sequence Lockout Reading	-	-	-	-	-

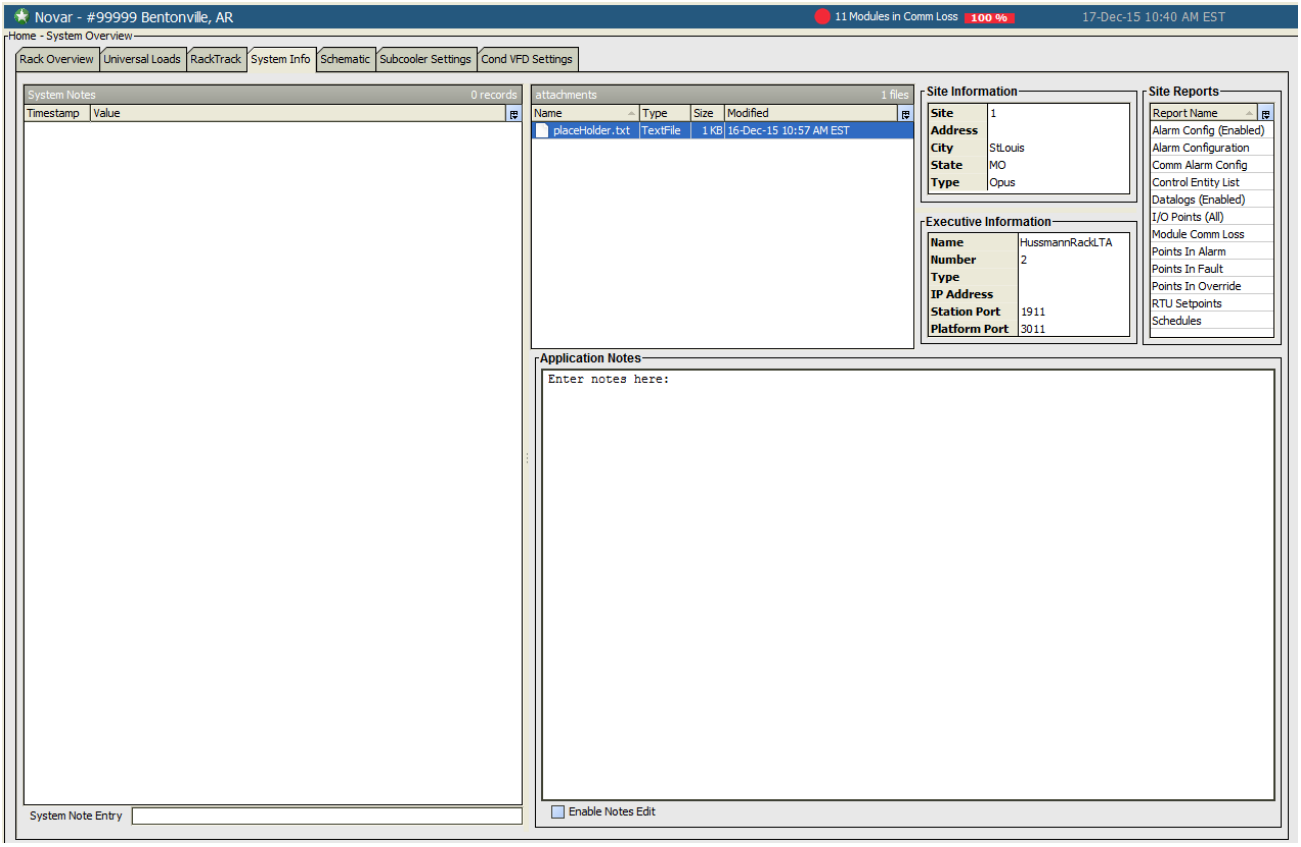
Miscellaneous control points beyond compressors and condenser fans may be displayed on this tab. Each "load" is displayed in a separate column. The row labelled "Output Status" is the most useful. You can double-click on any column to bring up the details of how the load is programmed, but no changes should be made in the field on how these loads are programmed. Contact Hussmann if there are any issues with the programming of these loads.

3) **Tab 3 - RackTrack**



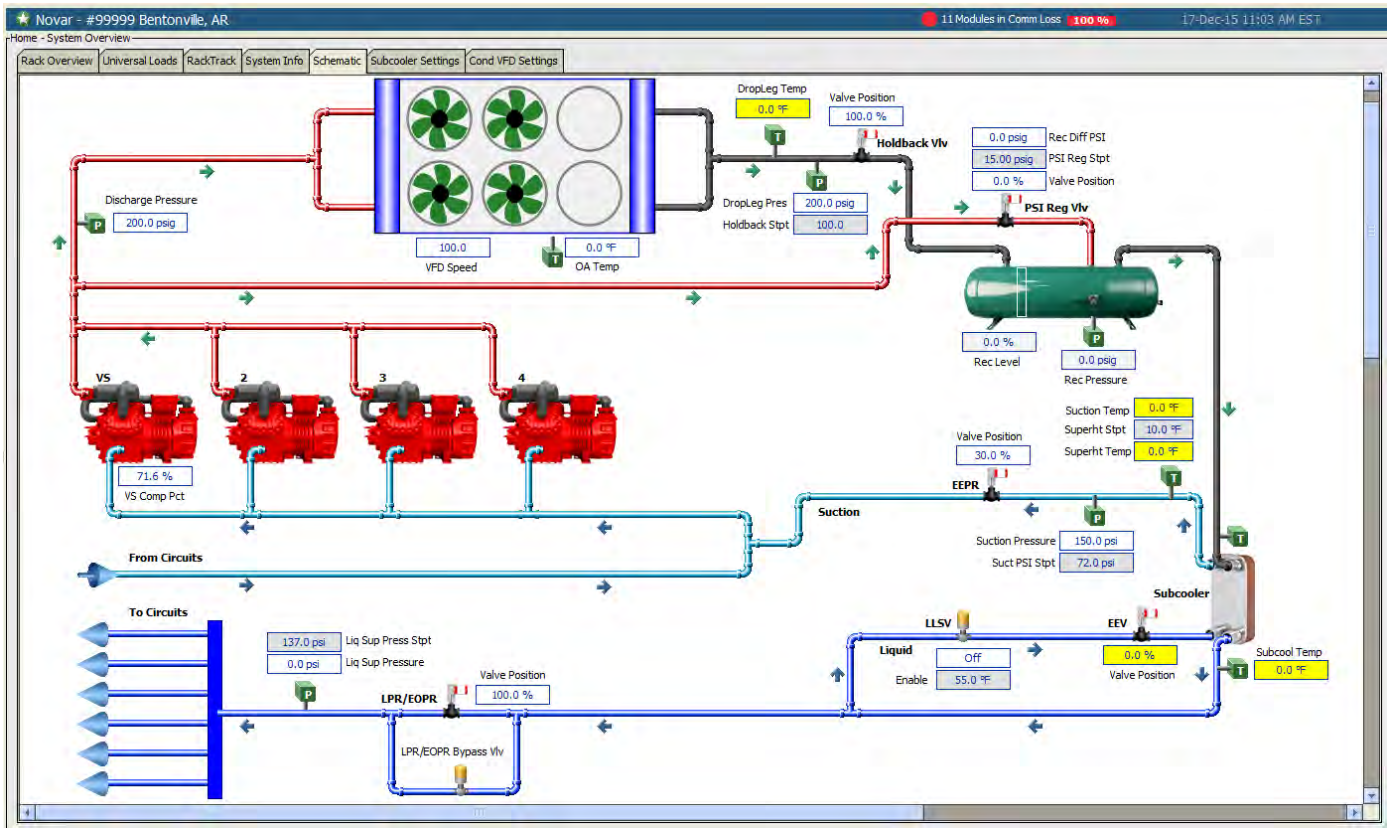
RackTrack displays a graphical representation of the most important rack data points. You can change the data display to a table by clicking on the button in the upper right corner. You can click and drag (either vertically or horizontally) on a portion of the graphical display to expand a section of it for greater detail. This can be done repeatedly to drill into greater detail.

4) **Tab 4 – System Info.**



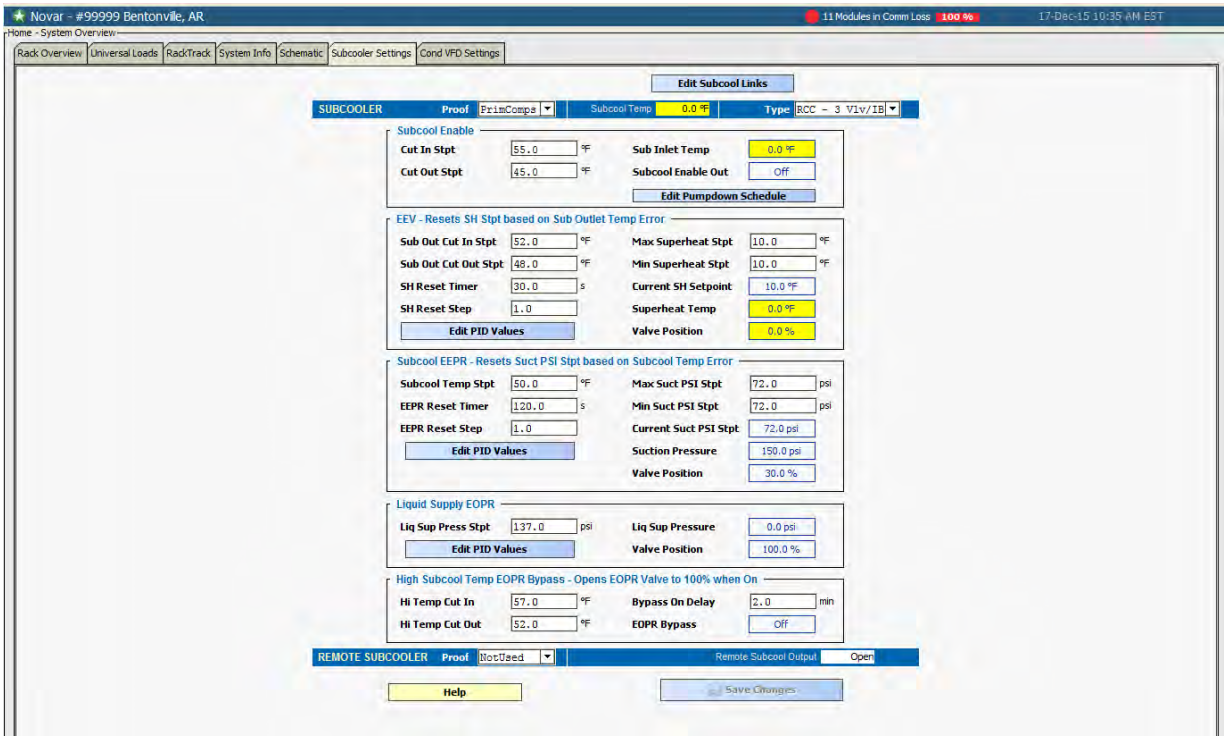
The System Info. screen contains miscellaneous data in regard to service, application, usage, etc. Essentially anything can be typed into these fields and it will be retained to others to view.

5) **Tab 5 - Schematic**



A representation of the rack piping and components. This screen is for monitoring and diagnostics only. No changes can be made on the Schematic. Several of the data points can be clicked upon to open a window with information about the associated alarms and history points.

6) **Tab 6 – Subcooler Settings**



"SubCool Temp" displayed at the top is the current temperature of the liquid leaving the subcooler.

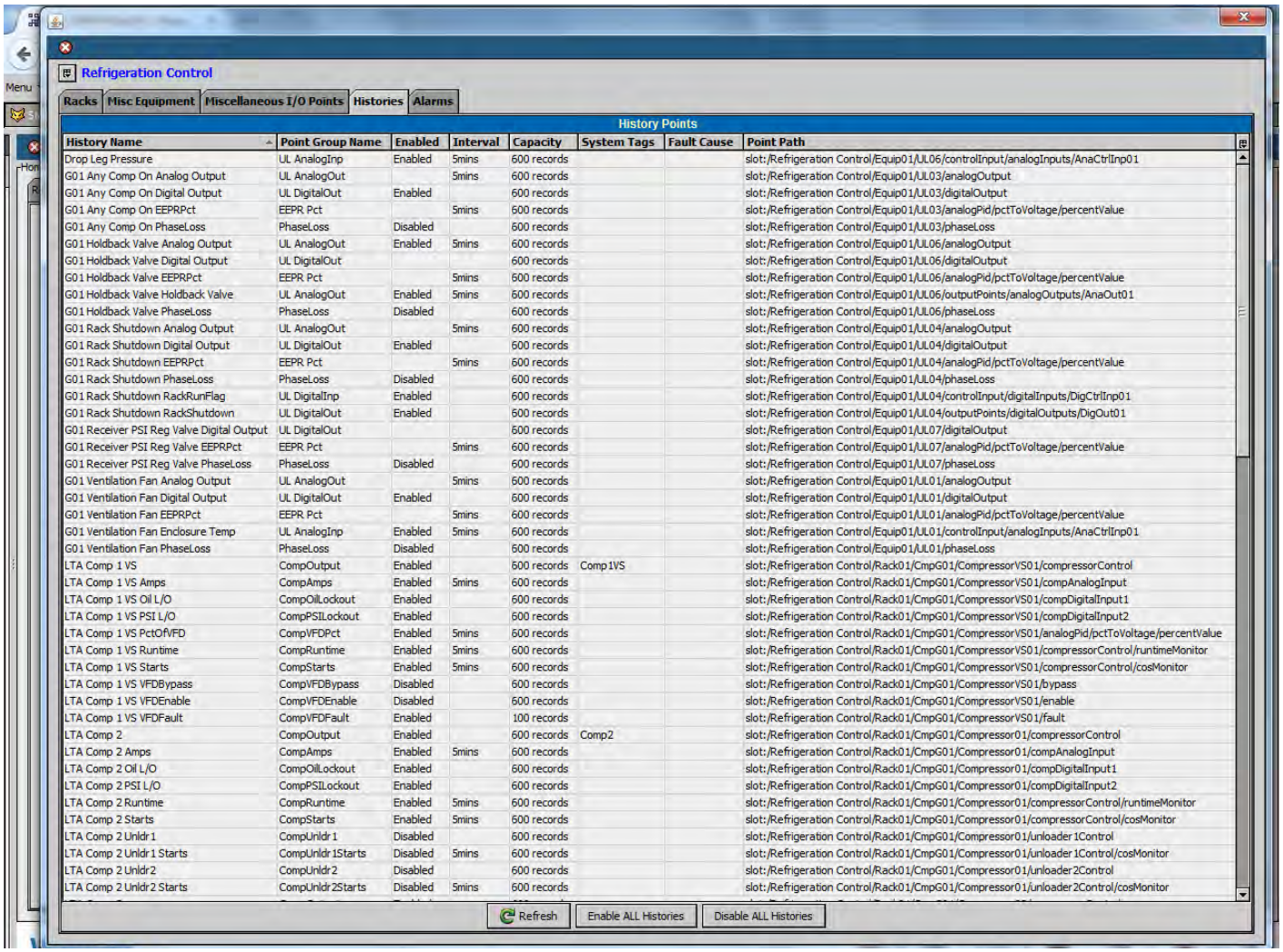
Only the following setpoints should be changed:

- SubCool Temp Stpt – the setpoint for the liquid leaving the outlet of the subcooler.
- Cut-In Setpoint – if the temperature of the liquid entering the subcooler rises above this point, the subcooler will be enabled.
- Cut-out Setpoint – if the temperature of the liquid entering the subcooler drops below this point, the subcooler will be disabled.
- **The other setpoints are for factory use only and should not be changed in the field.**

7) **Tab 7 – Cond VFD Settings**: ALL SETPOINTS ARE FOR FACTORY USE ONLY. If necessary, you can **Reset VFD faults** using the Reset Button, or **View Fault Code History** by pressing the button with that label.

8) **Viewing Data Log Points (Histories)** - As mentioned earlier, several data points on the Rack Overview and Schematic screens can be clicked on to view alarm and history information. To view a summary of all history points, at the bottom of the screen is a button labeled “RCConfig”. Clicking on this button will open the configuration screen for refrigeration control. No adjustments should be made in this window, as the rack control program has already been configured at the factory and should not be changed.

   The only function to perform in this window is to view history points by clicking on the tab labelled “Histories”, as shown below. Scroll thru the list to find the history point that you want to display and double-click on it. This will pop-up another window with a graphical display of historical data for the point selected. **NOTE:** Only “Enabled” data log points will display data. If you click on a Disabled point, it will show an error message that says “Cannot Load Plugin”.



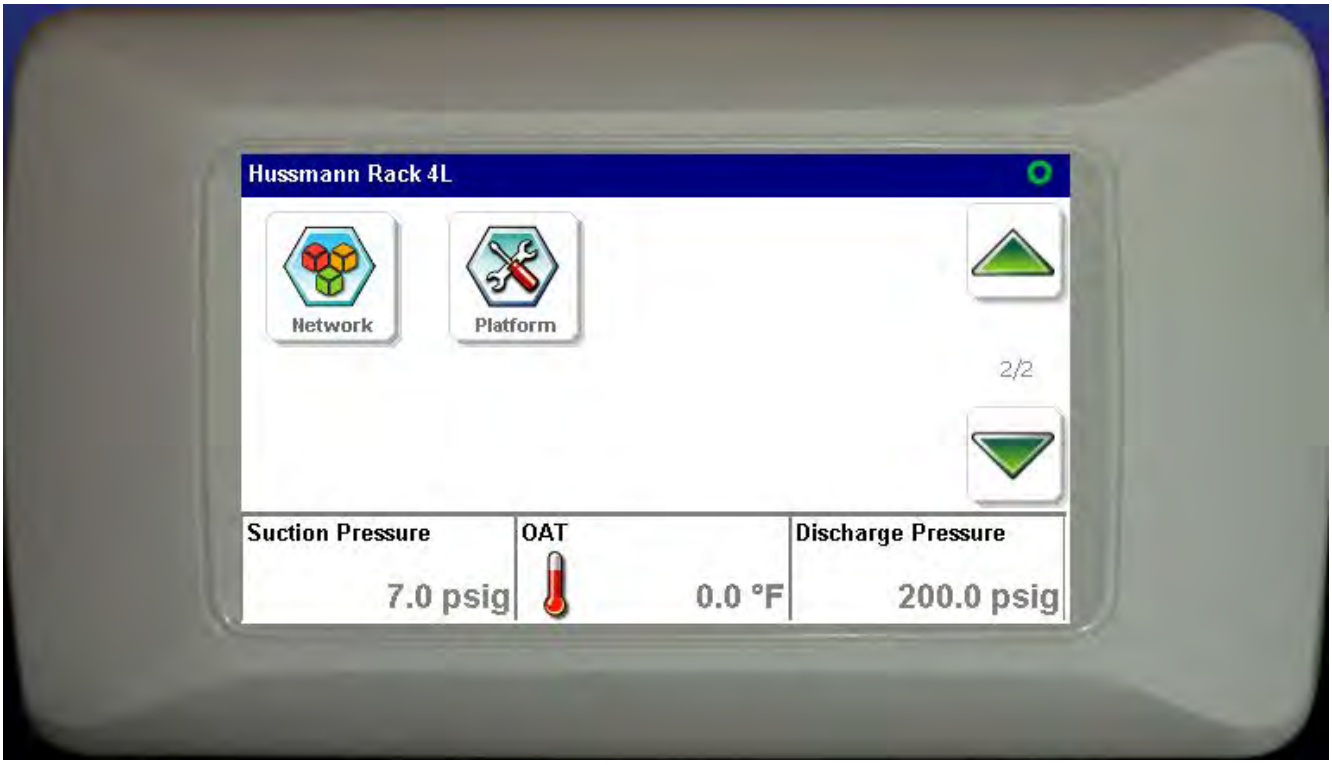
History Name	Point Group Name	Enabled	Interval	Capacity	System Tags	Fault Cause	Point Path
Drop Leg Pressure	UL AnalogInp	Enabled	5mins	600 records			slot:/Refrigeration Control/Equip01/UL06/controlInput/analogInputs/AnaCtrlInp01
G01 Any Comp On Analog Output	UL AnalogOut		5mins	600 records			slot:/Refrigeration Control/Equip01/UL03/analogOutput
G01 Any Comp On Digital Output	UL DigitalOut	Enabled		600 records			slot:/Refrigeration Control/Equip01/UL03/digitalOutput
G01 Any Comp On EEPRPct	EEPR Pct		5mins	600 records			slot:/Refrigeration Control/Equip01/UL03/analogPid/pctToVoltage/percentValue
G01 Any Comp On PhaseLoss	PhaseLoss	Disabled		600 records			slot:/Refrigeration Control/Equip01/UL03/phaseLoss
G01 Holdback Valve Analog Output	UL AnalogOut	Enabled	5mins	600 records			slot:/Refrigeration Control/Equip01/UL06/analogOutput
G01 Holdback Valve Digital Output	UL DigitalOut			600 records			slot:/Refrigeration Control/Equip01/UL06/digitalOutput
G01 Holdback Valve EEPRPct	EEPR Pct		5mins	600 records			slot:/Refrigeration Control/Equip01/UL06/analogPid/pctToVoltage/percentValue
G01 Holdback Valve Holdback Valve	UL AnalogOut	Enabled	5mins	600 records			slot:/Refrigeration Control/Equip01/UL06/outputPoints/analogOutputs/AnaOut01
G01 Holdback Valve PhaseLoss	PhaseLoss	Disabled		600 records			slot:/Refrigeration Control/Equip01/UL06/phaseLoss
G01 Rack Shutdown Analog Output	UL AnalogOut		5mins	600 records			slot:/Refrigeration Control/Equip01/UL04/analogOutput
G01 Rack Shutdown Digital Output	UL DigitalOut	Enabled		600 records			slot:/Refrigeration Control/Equip01/UL04/digitalOutput
G01 Rack Shutdown EEPRPct	EEPR Pct		5mins	600 records			slot:/Refrigeration Control/Equip01/UL04/analogPid/pctToVoltage/percentValue
G01 Rack Shutdown PhaseLoss	PhaseLoss	Disabled		600 records			slot:/Refrigeration Control/Equip01/UL04/phaseLoss
G01 Rack Shutdown RackRunFlag	UL DigitalInp	Enabled		600 records			slot:/Refrigeration Control/Equip01/UL04/controlInput/digitalInputs/DigCtrlInp01
G01 Rack Shutdown RackShutdown	UL DigitalOut	Enabled		600 records			slot:/Refrigeration Control/Equip01/UL04/outputPoints/digitalOutputs/DigOut01
G01 Receiver PSI Reg Valve Digital Output	UL DigitalOut			600 records			slot:/Refrigeration Control/Equip01/UL07/digitalOutput
G01 Receiver PSI Reg Valve EEPRPct	EEPR Pct		5mins	600 records			slot:/Refrigeration Control/Equip01/UL07/analogPid/pctToVoltage/percentValue
G01 Receiver PSI Reg Valve PhaseLoss	PhaseLoss	Disabled		600 records			slot:/Refrigeration Control/Equip01/UL07/phaseLoss
G01 Ventilation Fan Analog Output	UL AnalogOut		5mins	600 records			slot:/Refrigeration Control/Equip01/UL01/analogOutput
G01 Ventilation Fan Digital Output	UL DigitalOut	Enabled		600 records			slot:/Refrigeration Control/Equip01/UL01/digitalOutput
G01 Ventilation Fan EEPRPct	EEPR Pct		5mins	600 records			slot:/Refrigeration Control/Equip01/UL01/analogPid/pctToVoltage/percentValue
G01 Ventilation Fan Enclosure Temp	UL AnalogInp	Enabled	5mins	600 records			slot:/Refrigeration Control/Equip01/UL01/controlInput/analogInputs/AnaCtrlInp01
G01 Ventilation Fan PhaseLoss	PhaseLoss	Disabled		600 records			slot:/Refrigeration Control/Equip01/UL01/phaseLoss
LTA Comp 1 VS	CompOutput	Enabled		600 records	Comp1VS		slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/compressorControl
LTA Comp 1 VS Amps	CompAmps	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/compAnalogInput
LTA Comp 1 VS Oil L/O	CompOilLockout	Enabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/compDigitalInput1
LTA Comp 1 VS PSI L/O	CompPSILockout	Enabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/compDigitalInput2
LTA Comp 1 VS PctOfVFD	CompVFDPct	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/analogPid/pctToVoltage/percentValue
LTA Comp 1 VS Runtime	CompRuntime	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/compressorControl/runtimeMonitor
LTA Comp 1 VS Starts	CompStarts	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/compressorControl/cosMonitor
LTA Comp 1 VS VFDBypass	CompVFDBypass	Disabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/bypass
LTA Comp 1 VS VFDEnable	CompVFDEnable	Disabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/enable
LTA Comp 1 VS VFDFault	CompVFDFault	Enabled		100 records			slot:/Refrigeration Control/Rack01/CmpG01/CompressorVS01/fault
LTA Comp 2	CompOutput	Enabled		600 records	Comp2		slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/compressorControl
LTA Comp 2 Amps	CompAmps	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/compAnalogInput
LTA Comp 2 Oil L/O	CompOilLockout	Enabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/compDigitalInput1
LTA Comp 2 PSI L/O	CompPSILockout	Enabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/compDigitalInput2
LTA Comp 2 Runtime	CompRuntime	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/compressorControl/runtimeMonitor
LTA Comp 2 Starts	CompStarts	Enabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/compressorControl/cosMonitor
LTA Comp 2 Unldr 1	CompUnldr 1	Disabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/unloader 1Control
LTA Comp 2 Unldr 1 Starts	CompUnldr 1Starts	Disabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/unloader 1Control/cosMonitor
LTA Comp 2 Unldr 2	CompUnldr 2	Disabled		600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/unloader 2Control
LTA Comp 2 Unldr 2 Starts	CompUnldr 2Starts	Disabled	5mins	600 records			slot:/Refrigeration Control/Rack01/CmpG01/Compressor01/unloader 2Control/cosMonitor

Testing Rack Operation via the LCD Touchscreen

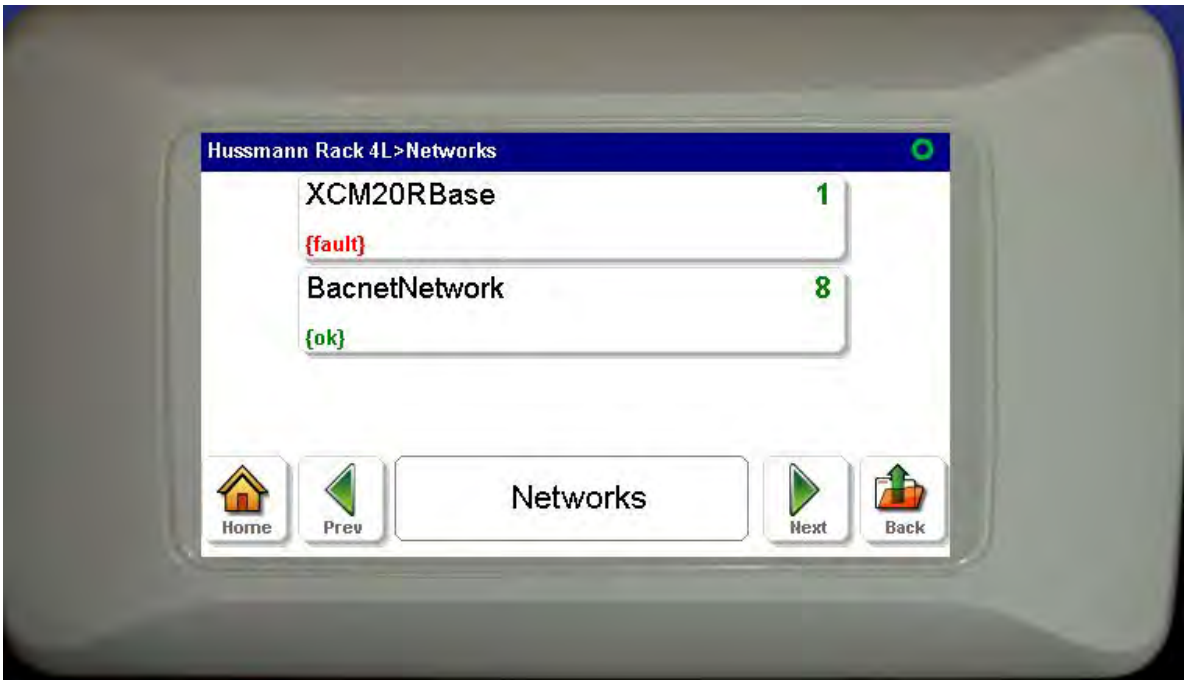
The LCD can be used to read all sensor values and to force outputs (either analog or digital) to desired states. This could be done to verify wiring connections, to test the operations of compressors, fans, etc, or to force modulating loads to desired states.

NOTE: Overriding outputs to desired states should only be a temporary operation. Return all to the "Auto" position when testing is completed.

Procedure to Force Outputs to Desired States:



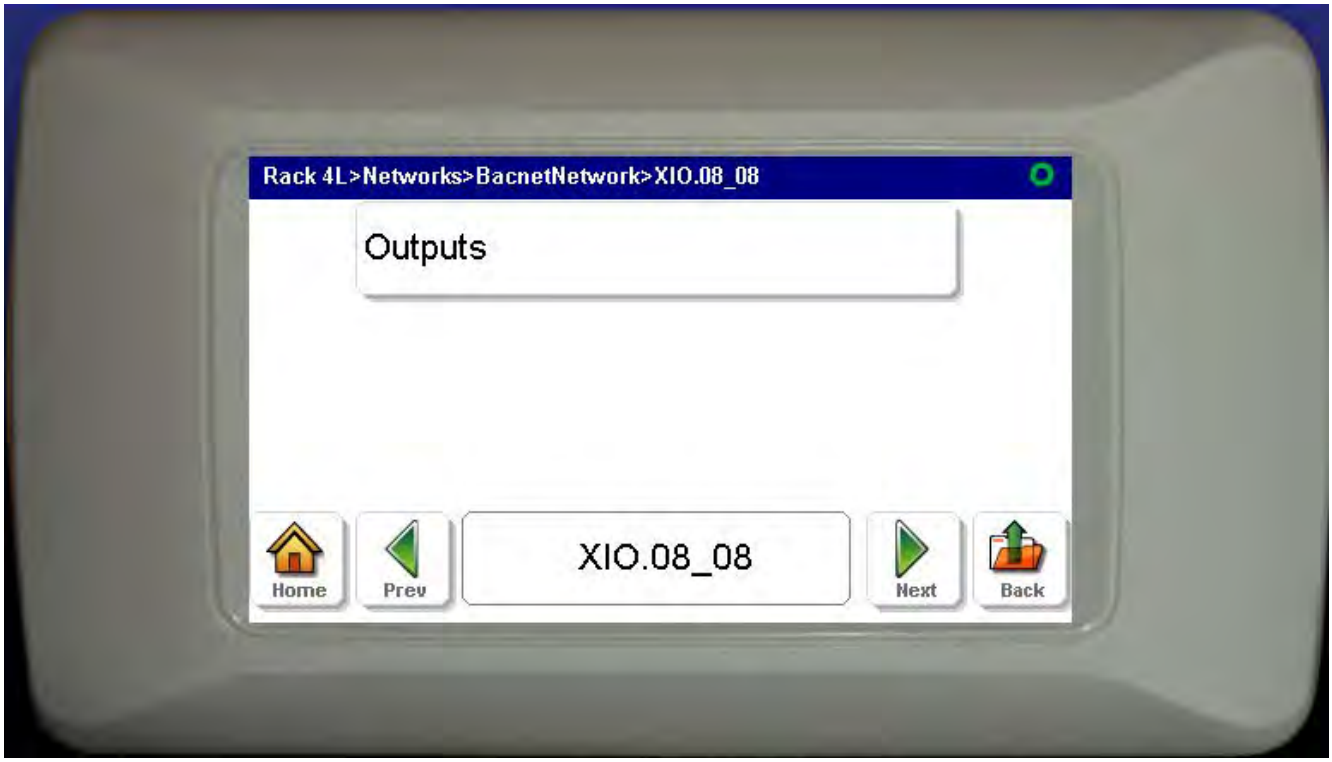
On the LCD Home Screen (page 2) touch "Network"



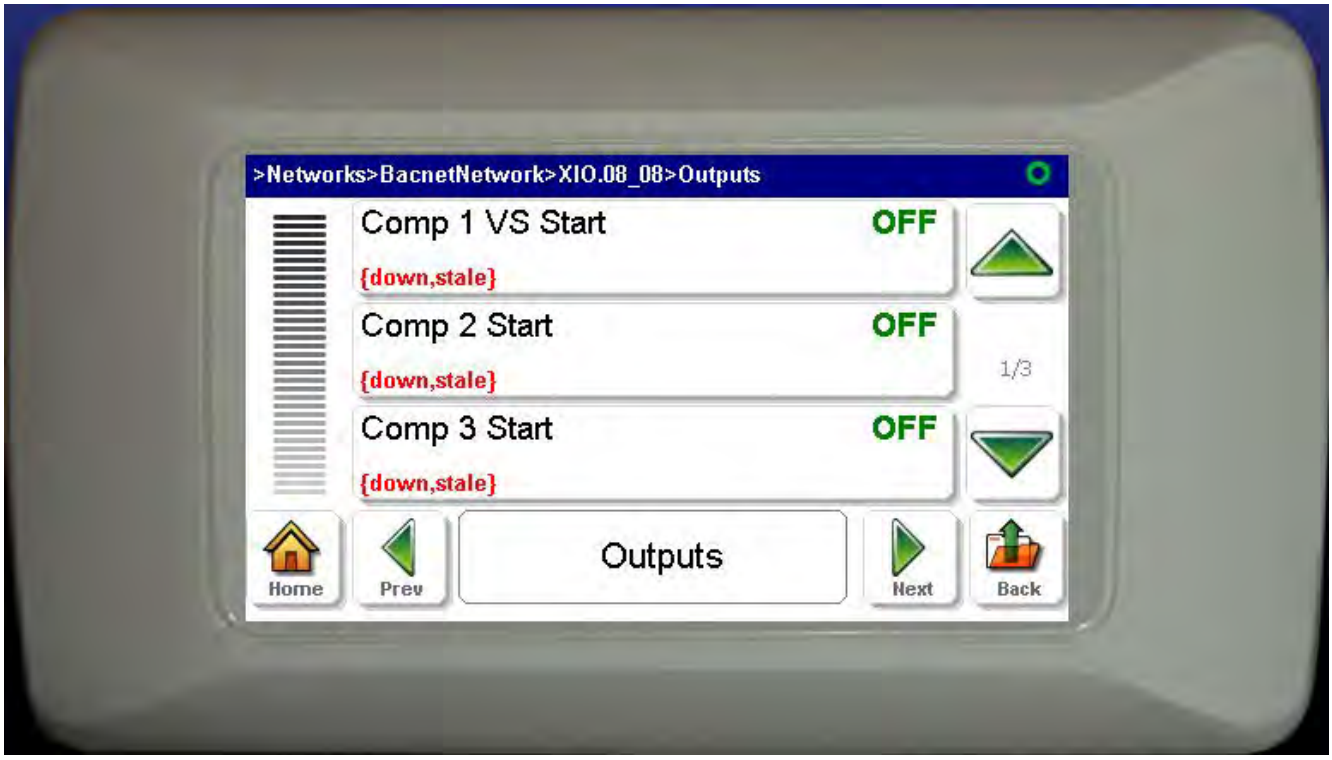
Touch “BacnetNetwork”

Touch the control module the contains the outputs that you want to override. In this example, an “XIO.08” is a controller with 8 outputs. The number listed at the end is the module address on the network (07, 08, 09, etc.).

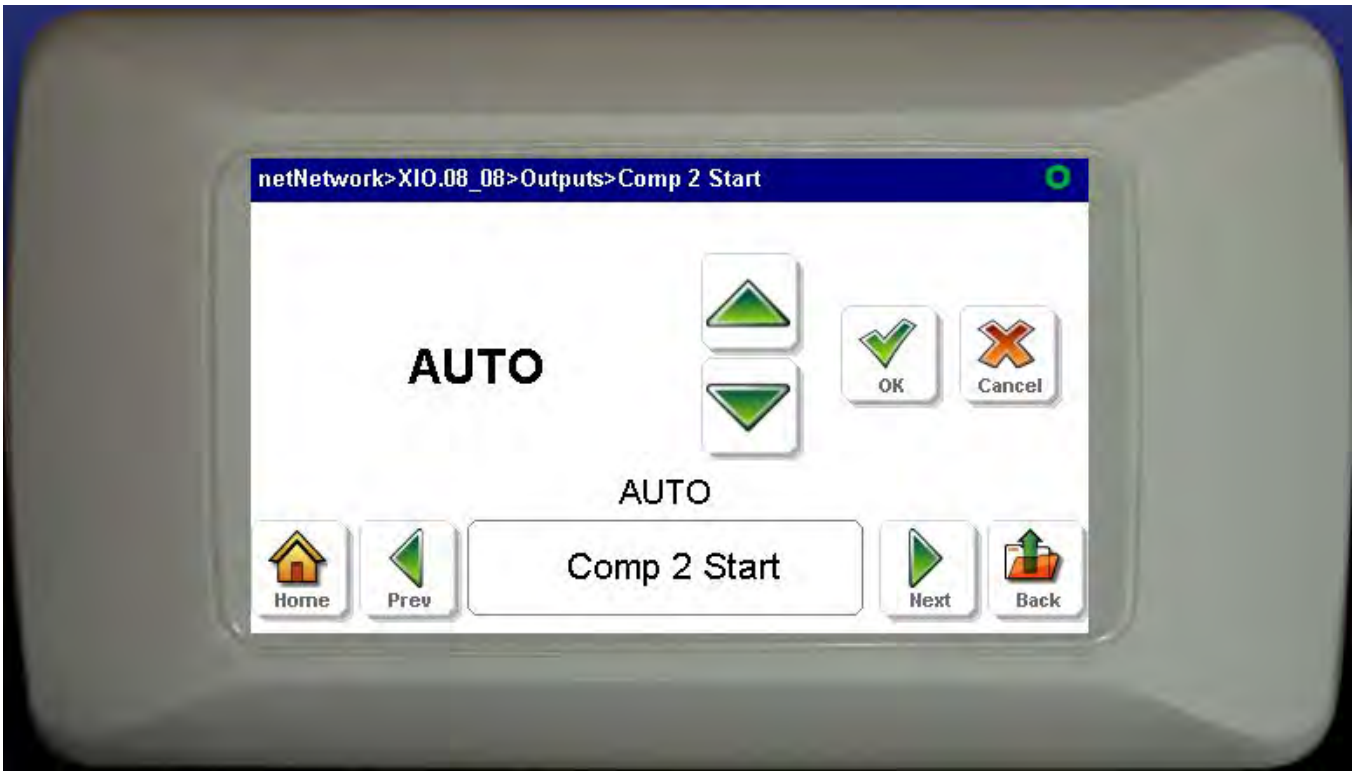
NOTE: This screen also displays the communications “health” of the controllers. If they are “Down” (as in this example) you will not be able to force output states.



Touch “Outputs”

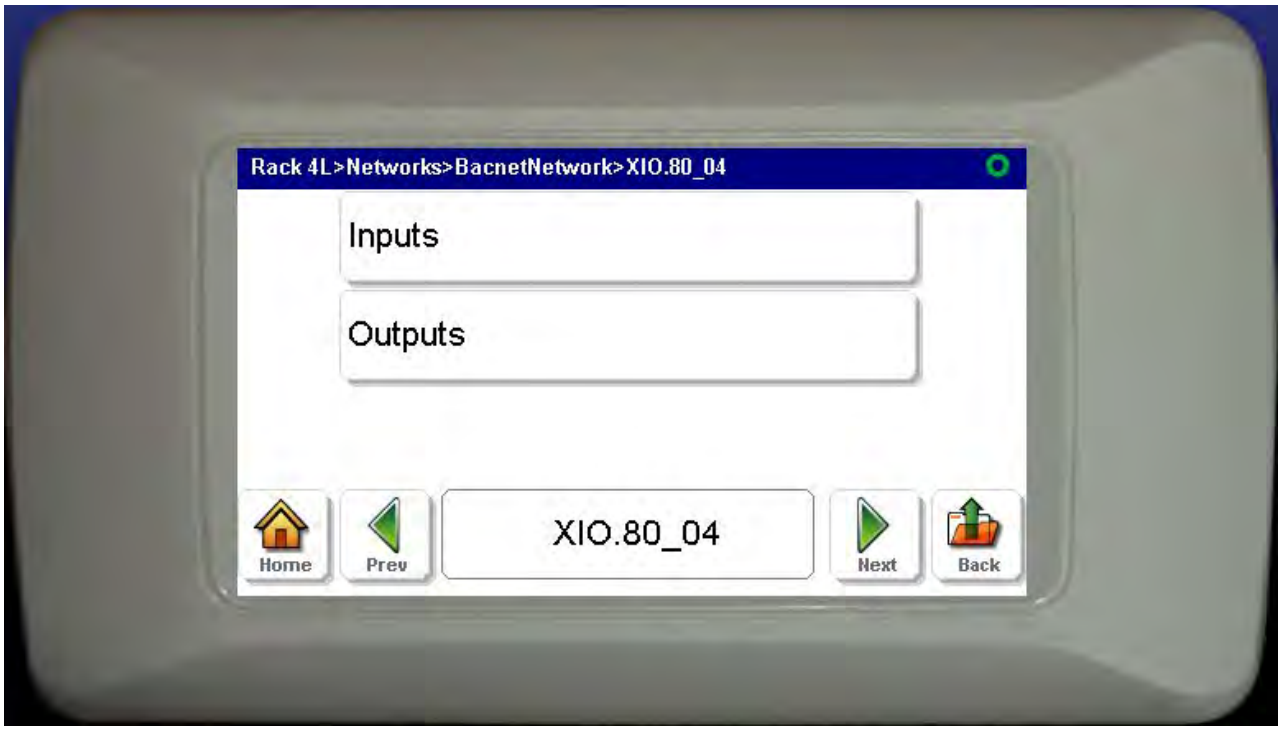


Scroll up/down to locate the output of your choice. Touch it.

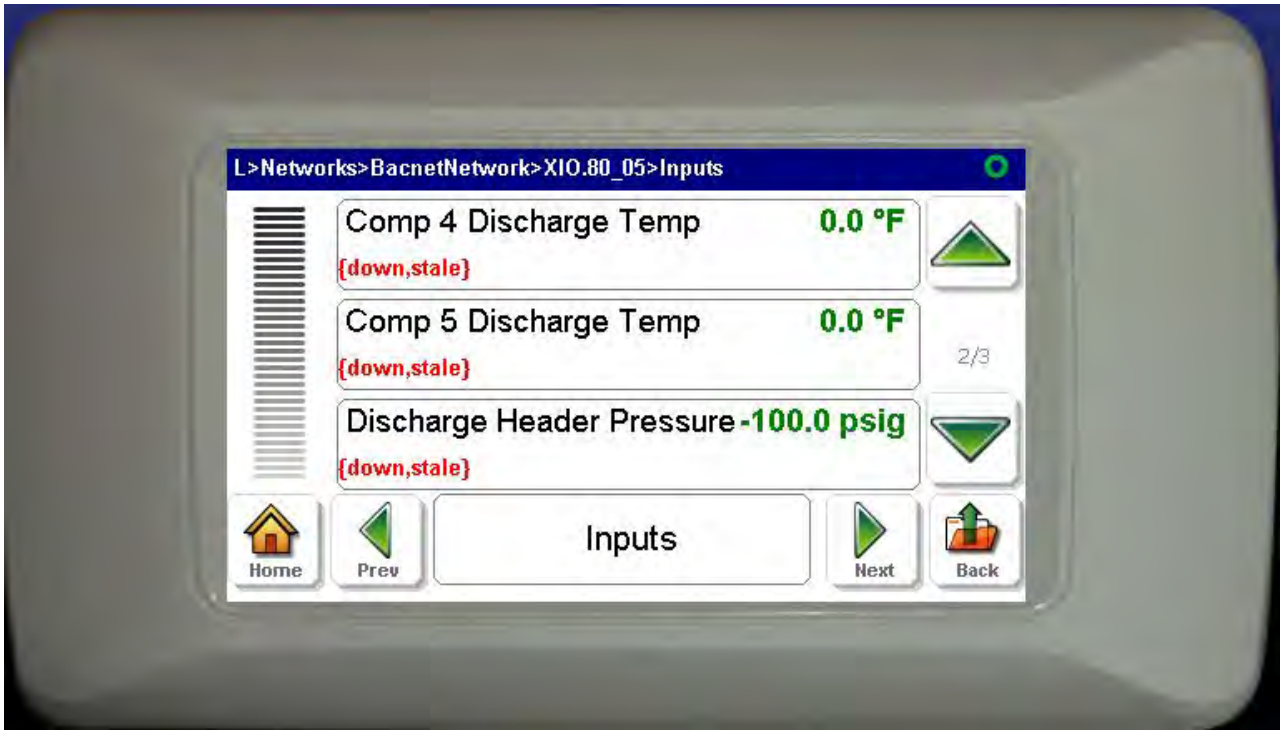


To override an output, you must first enter an access code. Contact Walmart for the access code. After entering the code, use the up and down arrow keys to force the output on, or off, or to return it to Automatic operation. If you are overridding a modulating output, you can use the up/down arrow keys to force the 0-10V output to the desired control voltage. **NOTE:** When done, return all outputs to Auto.

Procedure to View all Sensors:



After selecting control module of your choice (see above), touch “Inputs”



You can scroll up or down to view the sensor readings. NOTE: In this example, the communication network is down, so sensor readings would not be true. You can only trust the readings when communications is healthy.

PRE-STARTUP

⚠ CAUTION

Contractors shall strictly adhere to specifications provided by the Engineer of Record (EOR), as well as US Environmental Protection Agency regulations, OSHA regulations, and all other federal, state and local codes. This work should only be done by qualified, licensed contractors. There are numerous hazards, not limited to, but including: burns due to high temperatures, high pressures, toxic substances, electrical arcs and shocks, very heavy equipment with specific lift points and structural constraints, possible acid exposure, food and product damage, public safety, noise, and possible environmental damage. Never leave operating compressors unattended during the manual soft-start process. Always power toggle switches off when unattended.

All pressure transducers must be valved off prior to any pressure testing or evacuation. The intent is to isolate all transducers from positive pressure dry nitrogen (oxygen free) leak testing, and from evacuation procedures to prevent damage to transducers.

Turn the power off at the main disconnect before pressure testing. The line side screw connections of the main circuit breaker may be hot (electrified), since the voltage source originates in the building Main Switch Board.

Proceed with Caution
The primary objectives of the Manual/Soft Start are to:
Test basic operation of key components

Transfer new POE oil to the system

Transfer refrigerant to the receiver.

Prior to beginning the soft start, contractors should be completely familiar with site-specific and component documents, including but not limited to the following:

Engineer of Record Documents: drawings, specifications, set-point schedules, addenda, etc.

Hussmann Submittal Documents: drawings, schedules, schematics, cutsheets

Component Reference Manuals for all major components including:

Emerson Copeland Bulletin AE8-1368 R2 CoreSense Diagnostics for Discus Compressors

Refrigerated Display Case Manufacturer Installation Manuals and Data Sheets

Sporlan Stepper Motor Pressure Regulating Valve High and Low Side Applications

Sporlan Crankcase Oil Regulator and Emerson OMB oil level control

Sporlan Y-825 pressure Differential Valve

Henry TurbaShed Discharge Oil Separator/ Reservoir

Pre-Charge Testing

Once all refrigeration equipment has been set and is secured, and all field piping and final connections are complete, leak testing can begin. A positive pressure leak testing and system stair step evacuation must be performed per the Engineer of Record (EOR) specifications. A micro leak detection solution liquid may be used to detect standing leaks (system off). Isolate the rack when performing leack check. Hand ball valve spindle packing nuts and hand angle valve stem packing nuts should be checked for tightness and leak checked. All metallic valve caps have cap seals which should be in place, and the caps should be tightened snugly and leak checked. Schrader valve cores should be tightened and the brass cap o-rings should be in place with the cap hand tightened and then leak checked. All bolts related to gasketed joints should be tightened, and the gasket edges and bolt head areas should be leak checked.

Once it is established the system is leak tight, and the standing timed pressure and/or vacuum test is underway, all screw terminal electrical connections should be checked for tightness. All voltage sources should be switched off and voltmeter measurements at every connection should confirm the absence of any voltage before tightening any screws. Never over tighten screw terminal connections which could distort and damage the electrical conductors.

Replaceable liquid line filter/drier cores should be installed immediately prior to the final evacuation step.

The EOR specified final vacuum of 500 microns held for 24 hours should be measured with a calibrated, temperature-compensated, digital vacuum gauge such as the AccuTools BluVac micron gauge (or equivalent tools).

Oil Charge

Prior to the final vacuum time test is completed, polyolester (POE) oil should be charged into the system while under vacuum to accelerate the charging process and protect the compressors. POE oil is extremely hygroscopic, and highly reactive to moisture, forming acids in a chemical reaction with water. It is also difficult to remove moisture from POE oil once it has been absorbed. Some POE oils absorb up to 20 times more moisture than ordinary mineral oils.

Hussmann ships loose one gallon containers for the racks (total oil charge depending on system size). Containers should not be opened until oil is actually dispensed from each container to prevent moisture contamination. A hand pump connected directly to the oil container should be used to oil charge the lubrication management system. need a chart
Byron

Oil Charging

1) Install the pump hose on the ¼" male flare access on the angle service valve at the lower side connection of the oil separator/reservoir assembly and open the valve fully including hose port.

2) For medium temp compressors charge oil through Schrader valve on front of oil pump. Low temp Scroll compressors using TRAX/ OIL OMB charge oil through suction or access Schrader on bottom side of compressor. Charge each compressor according to the manufacturer's specifications.

3) Open all individual compressor oil supply line valves located in the oil distribution header.

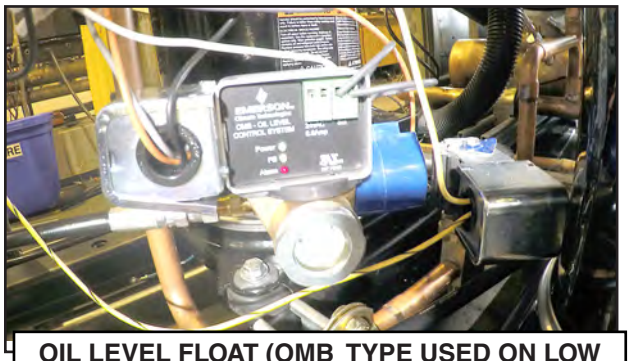
4) Oil should be added until the red ball is floating at the top of the lower oil separator sight glass (likely over one gallon).

5) Hook up to each one of the compressors. Fill the compressor sight glass to the halfway level.

6) The oil charge should continue until the sight glass on each compressor float is one-half full.

7) An accurate written log of oil charge inventory should be maintained.

During normal operation, the red ball on the middle sight glass should not be floating. The third or upper sight glass has no red ball, is located above the internal baffle, and oil should never be visible there.



OIL LEVEL FLOAT (OMB TYPE USED ON LOW TEMP SCROLL COMPRESSORS)

Pre-Charge Checklist

Once oil has been added to the system, the rack must be prepared to receive refrigerant charge. The following steps should be taken prior to adding any refrigerant.

The discharge and suction service valves on each compressor should be open fully (back seated position).

Power and verify operation of all evaporator fans.

Power and verify operation of evaporator fans on single deck Low Temperature (LT) cases. Low Temperature Island cases are equipped with a fan delay thermostat that will prevent fan operation until the coil temperature is lowered to 20˚F, so these case fans can NOT be checked unless that is bypassed. Reach-In cases will operate with power applied.

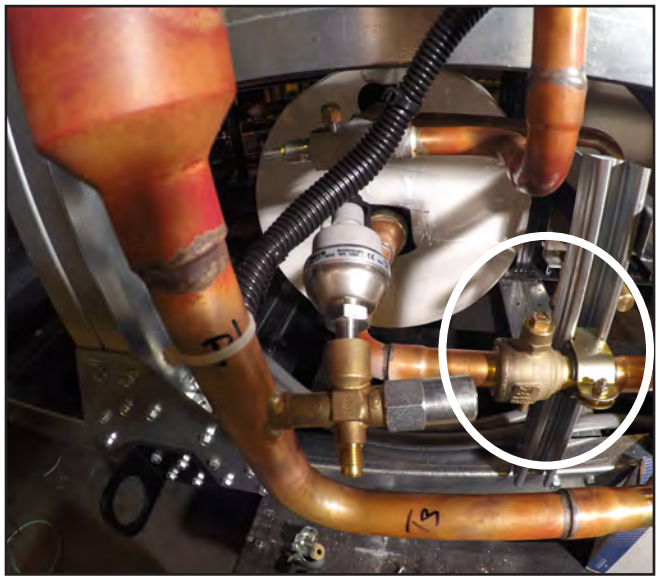
LT walk-in freezer fan delay thermostats will prevent evaporator fan operation until the coil temperature is lowered to 25˚F. Since the room is initially far above 25˚F, the fan delay thermostat may not close ("make circuit") for an extended period of time.

R-407A is a Zeotropic blend of HFC refrigerants R-32, R-125 and R-134a. Components in HFC blends vaporize at different temperatures and pressures, and therefore must always be charged as a liquid to prevent "Fractionation". Fractionation is the change in the composition of a refrigerant blend as it changes phase from liquid to vapor. Vapor in the virgin refrigerant cylinder is not the same blend as the liquid in the cylinder, so charging must not be done using the vapor port on the cylinder. If a charge to the low pressure side of a system is necessary, then charging must be done from the cylinder liquid into liquid side of case closest to rack.

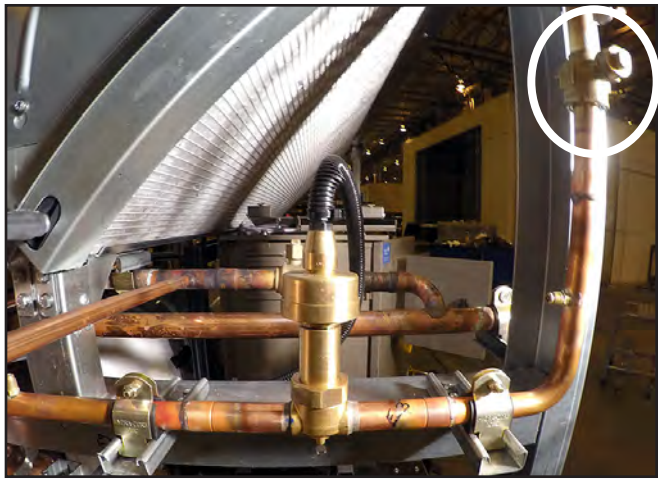
Receiver Refrigerant Charging

Once the checklist is completed, the charging may begin using 100 pound (lb) returnable cylinders of R-407A as follows:

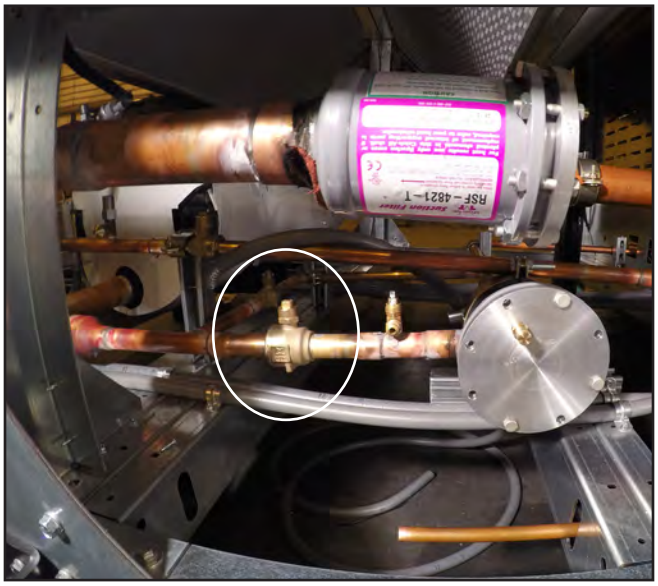
1. Close the receiver inlet ball valve.



2. Close the ball valve at the inlet to the receiver pressure regulating valve



3. Open the Filter/Drier inlet ball valve.



4. Close the Filter/Drier outlet ball valve.

5. Close the Filter/Drier by-pass valve.

6. Fully backseat the angle isolation valve located downstream of V2. Connect a charging line equipped with a pressure gauge and a permanent throw away 16 cubic inch Filter/Drier to the ¼" male flare service access port. Rotate stem clockwise and front seat the valve to flow liquid refrigerant into the receiver. Monitor receiver pressure with the charging line pressure gauge.

7. Charge liquid refrigerant into the system until the liquid level indicator is full.

8. Fully backseat the angle isolation valve and put the cap back on the access port.

Pre-Start Refrigeration Charge
Pre-start Mechanical Steps

1. Move the liquid refrigerant charging line on the cylinder to the 3/8" angle access valve located immediately upstream of the filter/drier. This will flow all virgin refrigerant charge through the filter/drier.

2. Keep the receiver outlet ball valve closed for pump-down mode.

3. Open the receiver inlet ball valve.

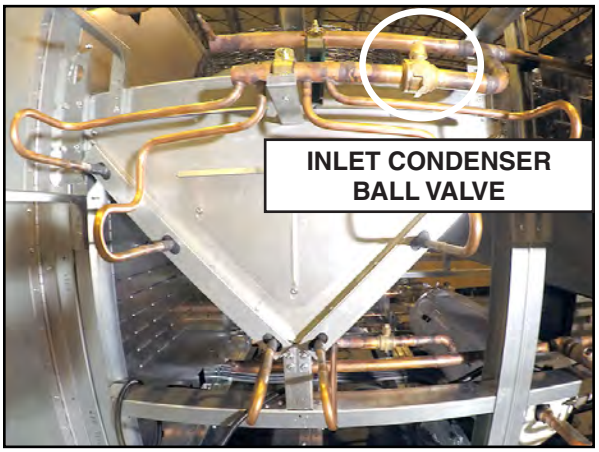
4. Keep the filter/drier inlet ball open.

5. Open the filter/drier outlet ball valve.

6. Open the inlet ball valve.

7. Open all ball valves on the liquid header of the condenser (1 valve per condenser module)

8. Open the receiver inlet ball valve.



9. Close liquid line ball valve.

10. Open the suction line ball valve.

11. Manually shut down operation of the subcooler circuit. In the case of MT units, this is done by closing the ball valve downstream of the subcooler EEPR. For LT units this is done by closing the rotolock valves at the vapor injection ports of each compressor.

12. Confirm that the inlet ball valves are open at each condenser module. main discharge ball valve (not shown) is open at rack.

13. Confirm the factory-installed main liquid line solenoid valve is energized to allow refrigerant flow to the evaporators.

14. Cases need to be in an operational state with liquid solenoids (if applied) open.

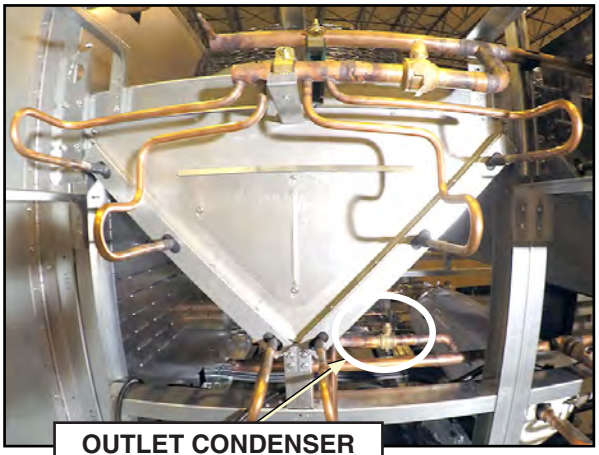
15. The field installed circuit Electric Evaporator Pressure Regulators (EEPR) (if applied) valves must be manually driven open to allow refrigerant to return to the compressors, subcooler EPR, Holdback, LPR and RPV. This can be acheived via the SMA, or through the controller.

Each of these Sporlan CDS valves may be disconnected at the controller board. The four-wire Phoenix plug may be temporarily disconnected from the ESR board and a Sporlan SMA-12 hand-held device with phoenix plug adapter can be used to drive the CDS valve to the 100% open position. The valve should remain disconnected from the ESR until the Startup is complete.

16. The Sporlan CDS Electronic Inlet Pressure Regulator (EIPR) under the condenser must also be manually driven open using the procedure described above for EEPRs.

17. For LT units, confirm the liquid injection ball valves are open.

Refrigerant hand ball valves are open, starting with the inlet to the dedicated filter, up to each LT compressor Demand Cooling expansion valve.



Pre-start Electrical Steps

18. All individual ON/OFF compressor control toggle switches should be switched to the OFF position to prevent compressor operation.

19. The system should be placed in the switch-back mode which is accomplished by pulling COM power on board 2 where the switch-back relay is located. The green LED to the left of the switch is illuminated only when the switch is ON, so that light should remain off through the startup.

20. All circuit breakers should be switched to ON.

21. The model 201A Motor Saver voltage monitor RUN light should be illuminated solid green without any blinks.

22. The main condenser circuit breaker should be switched ON.

23. The 15A control power circuit breaker should be switched ON.

24. Air cooled condenser fans may be manually switched ON at the controller board.

The fans should be checked for proper rotation which is clockwise facing the shaft. Amperage readings should measured at the load side of each contactor and compared to nameplate data. Log results and confirm there are no defective fan motors.

25. Confirm the operation of the crankcase heater on each compressor with an Amp probe. Locate crankcase fuses in compressor panel.

Compressor Startup

26. Install a service manifold low pressure gauge on the access schrader valve on the suction filter.

27. Install a portable temperature sensor near the same location to monitor the refrigerant return temperature.

28. Once charging commences and compressors are operating, compare the actual measured temperature to the equivalent saturation temperature from a P/T chart based on the pressure gauge reading to confirm superheat and the absence of liquid refrigerant flood-back. During the entire Initial charging process, visually inspect all exposed surfaces on the suction side for evidence of refrigerant flood-back.

29. Open the charging cylinder's liquid valve and flow refrigerant into the system. Open the liquid line ball valve.

30. Install service gauge manifold high and low pressure gauges on Compressor #1 and switch ON the toggle switch for this compressor. (Note: Never leave operating compressor unattended during the manual soft-start process. Always power toggle switches off when unattended.)

31. Measure and log the operating amperage at the load side of the compressor contactor on Compressor #1. Log service gauge pressure and temperature readings as well.

32. Additional new cylinders of refrigerant should be connected as the liquid charging pressure decreases in cylinders where the refrigerant has been depleted.

33. Once Compressor #1 is checked, the refrigerant return pressure should be high enough to switc on and operate compressor #2, using additional service manifold gauges to monitor compressor pressures. Measure and log operating amperages, temperatures, and gauge pressures. Repeat this step for all compressors.

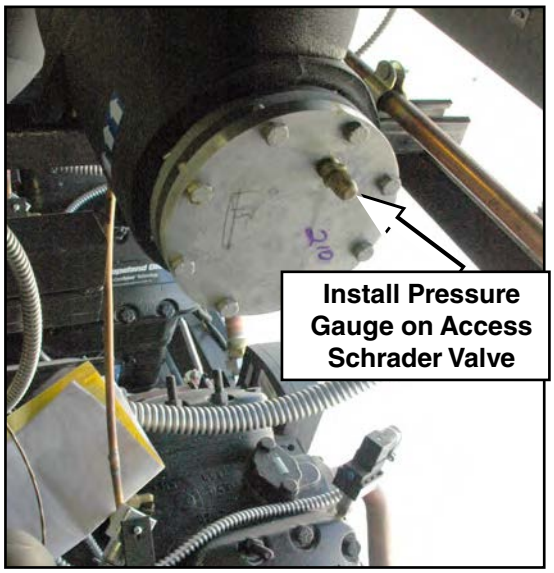
34. Measure and log the operating amperage at the load side of the compressor contactor on Compressor #1. Log service gauge pressure and temperature readings as well. Refer to legend total amp draw at the compressor. See startup sheet.

35. Additional new cylinders of refrigerant should be connected as the liquid charging pressure decreases in cylinders where the refrigerant has been depleted.

36. Once Compressor #1 is checked, the refrigerant return pressure should be high enough to switc on and operate compressor #2, using additional service manifold gauges to monitor compressor pressures. Measure and log operating amperages, temperatures, and gauge pressures. Repeat this step for all compressors.

37. Due to initial conditions, it may be necessary to manually switch off an already operating compressor when starting the next compressor in order to maintain a suction pressure above the individual compressor preset cut-out set points. Please refer to the Mechanical Setpoint Schedule for preset low and high pressure safety switch settings.

38. Once a receiver level of 80% is reached the liquid charging should cease. Valve off the refrigerant cylinder and turn off all compressor toggle switches.



EQUIPMENT STARTUP

Once the system is operational with an adequate receiver refrigerant charge, a final leak check should be performed to pinpoint operating pressure dependent leaks using an R407A-specific portable halogen high sensitivity electronic leak detector. It is particularly important to leak check all transducers with the system fully charged since these devices are intentionally isolated during positive pressure and stair step vacuums to safeguard against permanent damage.

Electronic/Hard Start

⚠ CAUTION

Contractors shall strictly adhere to specifications provided by the Engineer of Record (EOR), as well as US Environmental Protection Agency regulations, OSHA regulations, and all other federal, state and local codes. This work should only be done by qualified, licensed contractors. There are numerous hazards, not limited to, but including: burns due to high temperatures, high pressures, toxic substances, electrical arcs and shocks, very heavy equipment with specific lift points and structural constraints, possible acid exposure, food and product damage, public safety, noise, and possible environmental damage. Never leave operating compressors unattended during the manual soft-start process. Always power rocker switches off when unattended.

Proceed with caution:
Prior to beginning the hard start, contractors should be completely familiar with site-specific and component documents, including but not limited to the following:

Engineer of Record Documents: drawings, specifications, set-point schedules, addenda, etc.

Hussmann Submittal Documents: drawings, schedules, schematics, etc

Component Reference Manuals for all major components including:

Emerson Copeland Bulletin AE8-1368 R2 CoreSense Diagnostics for Copeland Discus Compressors

Sporlan Stepper Motor Pressure Regulating Valve High and Low Side Applications

Sporlan Subcool Control Electric Expansion Valve Controller Emerson Variable Speed Drive Condenser Fan Control

Sporlan Crankcase Oil Regulator 26WA

Sporlan Y-825 pressure Differential Valve

Henry TurbaShed Discharge Oil Separator/Reservoir

All Applicable Refrigerated Display Case Manufacturer Installation Manuals

Hussmann has pre-programmed the Rack controller, the Copeland CoreSense protection, the Sporlan Subcool Controller and the VSD condenser fan controller and has performed Factory Functional Performance Tests on this electronic equipment.

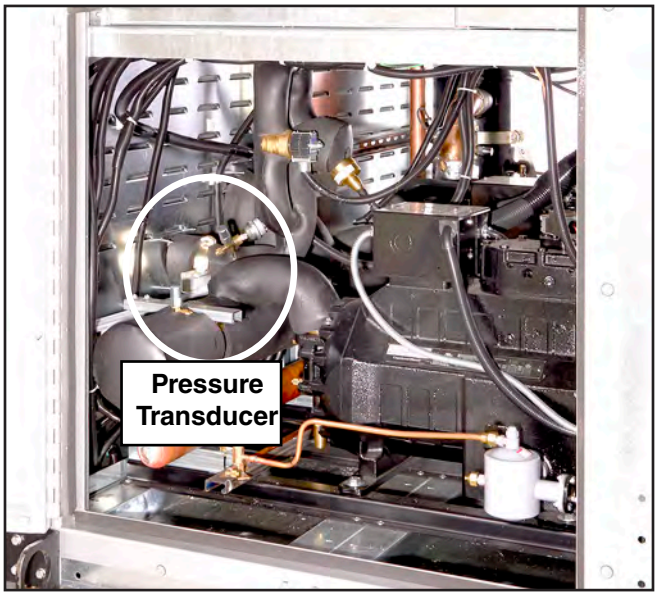
Pressure Transducer Check
Each unit is equipped with pressure transducers. An accurately calibrated, hand held, R407A/ POE compatible, refrigeration gauge should be used to verify transducer accuracy. Each transducer reading should be compared to the digital gauge. If the pressure variance is greater than two psig, the transducer should be replaced. It is recommended that offsets not be programmed to compensate for defective transducers.

Indoor Environmental Conditions
Refrigerated Merchandisers (display cases) are manufactured to meet ANSI/National Sanitation Foundation Standard 7 (NSF-7) requirements. These merchandisers are designed for displaying products in conditioned stores where temperature is maintained at or below the ANSI/NSF-7 specified level and relative humidity is maintained at or below 55%. During store construction, these indoor design conditions may not be met if outside doors are propped open or if mechanical equipment has not been commissioned. In that case, compressor racks may become over-loaded, suffer excessive evaporator icing, and may be unable to pull down to the suction pressure setpoint. These problems may require manual intervention by the refrigeration system technician.

Sales Floor and Back of House Walk-Through
Before initiating hard start, the following items down inside the store need to be checked.

Confirm discharge air is flowing throughout the entire length of each display case line-up. All refrigerated merchandiser deck and display pans, and shelves in multi-deck cases should be properly in place to establish normal discharge air patterns from evaporator coils.

Confirm all condenser fans are operating on every unit cooler evaporator coil.



Mechanical Steps

Once the walk-through is complete, the following sequence of steps must be followed to ensure a successful start:

1) Receiver outlet ball valve should remain closed in the manual pump-down mode.

2) The liquid line filter/drier by-pass ball valve should remain closed.

3) Manually shut down operation of the subcooler circuit. In the case of MT units, this is done by closing the ball valve downstream of the subcooler EEPR. For LT units this is done by closing the angle isolation valves at the vapor injection ports of each compressor.

4) The main liquid line ball valve should remain closed.

6) All compressor suction and discharge service valves should be open.

7) All remaining ball valves should be open to permit refrigerant flow throughout the entire system.

Pre-start Electrical Steps

Once the mechanical steps are complete, the following sequence of electrical steps must be followed:

1) All individual ON/OFF compressor control toggle switches should be switched to the OFF position to prevent compressor operation.

2) All line voltage and control voltage circuit breakers should be switched to the ON position.

3) The model 201 A Motor Saver voltage monitor RUN light should be illuminated solid green without any blinks.

4) Confirm the power toggle switch inside the controller is switched to the ON position and the green LED is illuminated.

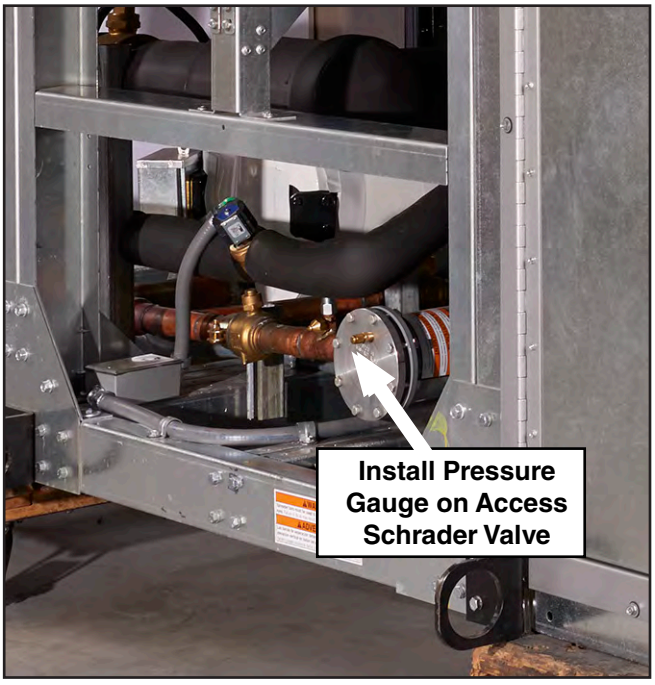
5) Consider inhibiting scheduled defrost cycles during the initial temperature pull-down process to maximize individual circuit refrigeration run time.

Refrigerant Flood Back

1) Install a service manifold low pressure gauge on the access schrader valve on the suction filter.

2) Install a portable temperature sensor near the same location to monitor the refrigerant return temperature.

3) Once compressors are operating, compare the actual measured temperature to the equivalent saturation temperature (supereheat from a P/T chart based on the pressure gauge reading to confirm actual superheat and the absence of liquid refrigerant flood-back. During the entire start-up process, visually inspect all exposed surfaces on the suction side of the system for evidence of refrigerant flood-back.



4) Confirm the power toggle switch inside the controller is switched to the ON position and the green LED is illuminated.

5) Consider inhibiting scheduled defrost cycles during the initial temperature pull-down process to maximize individual circuit refrigeration run time.

Monitor Oil Levels
Continuously monitor oil levels frequently during the entire Hard Start process. Observe the oil return sight glass for oil movement. The sight glass should not constantly appear to be clear (empty). When the oil separator/reservoir return line has oil movement, an intermittent oil flow perhaps with some foaming action may be observed in the sight glass. When full flow is evident, the piping may be warm or even hot to the touch. The oil system will need to be adjusted, but at least one compressor must be in operation for the oil system to function. If there is no oil flow, stop the compressors and investigate.

Compressor Start-up
1. Open receiver outlet ball valve to release refrigerant from the receiver through the main liquid line piping up to the main liquid line ball valve.

2. Other valves under the condenser remain open (with the exception of the liquid drier bypass, which should remain closed).

3. Install service gauge manifold high and low pressure gauges on compressor #1 and switch the toggle switch to the ON position.

4. Open the main liquid line ball valve to allow refrigerant to flow out to the evaporators.

5. When compressor #1 cycles ON, measure and record the operating suction and discharge pressures and amperage on each line at the load side of the compressor contactor.

6. Repeat Step 5 for each of the remaining compressors.

7. Closely monitor the oil control system. For medium temp recip compressors monitor the CoreSense Diagnostics for any alarms. For low temp Scroll compressors, monitor the OMB oil level control for any alarms. Confirm oil level for all compressors via the oil sight glass.

8. Check that the refrigerant level is adequate at the receiver with the condenser fans operating normally before allowing the system to operate unattended.

9. Confirm functionality of all back up pressure control switches located on each compressor before allowing compressors to operate unattended.

10. Confirm operating temperatures of the evaporators are low enough to allow operation of the evaporator fans without any manual override assistance.

Compressor Crankcase Oil Level Regulator (Medium Temp Recip Compressors)
The Sporlan oil level regulator is factory preset to maintain the oil level at the centerline of the regulator sight glass.

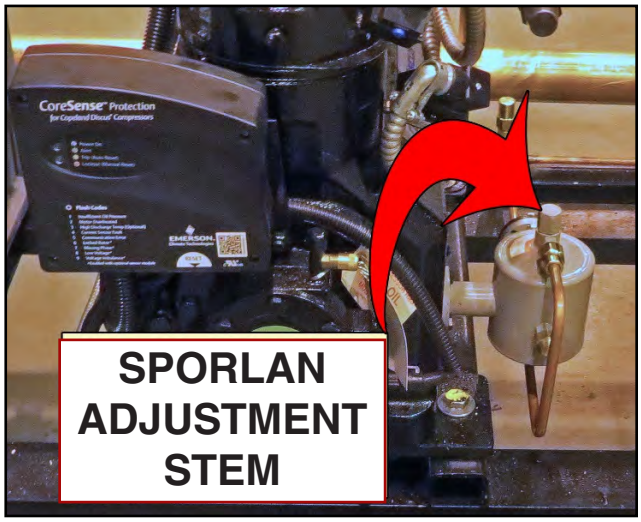
1) Gently turn the adjustment stem clockwise until the top stop is reached.

2) Count and record the number of turns to reach the top stop.

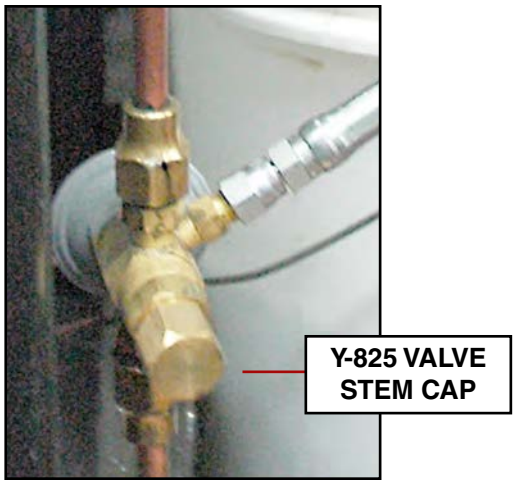
3) Then adjust the oil level down to the desired height by turning the stem clockwise. Clockwise lowers the ball. Each full turn will represent about .05 inches change in oil level.

4) Do not exceed nine turns from the top or the regulator may be permanently damaged.

5) Switch the compressor control rocker switch to the ON position.



Sporlan Y-825 Adjustment
Once the refrigerant charge is adequate to circulate liquid refrigerant to all thermostatic expansion valves (TXV), the oil pressure differential valve setting must be checked.



1) Close the oil regulator service valve to each compressor regulator located in the oil return header piping.

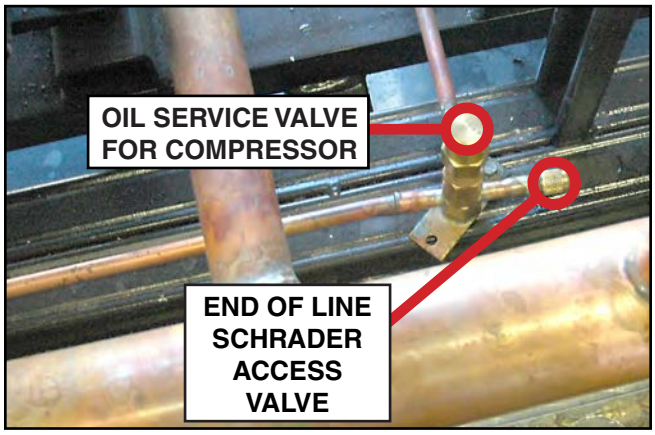
2) Connect a service manifold low pressure gauge to an angle valve located on the suction header.

3) Connect another service manifold low pressure gauge to the schrader access valve connection at the end of the oil supply distribution header.

4) Connect the center hose of the service manifold to another angle valve on the suction header.

5) Open the low side valve hand wheel on the service manifold for a few seconds and then close it. The oil header pressure should be 20 PSIG above the suction header pressure.

6) Subtract the suction header pressure from the oil header pressure to determine the operating pressure differential across the Y-825 valve.



7) If adjustment is needed, remove the valve stem cap from the Y-825, and turn the square stem with a standard refrigeration ratchet wrench. To increase the differential, turn the stem clockwise and to reduce the differential, turn the stem counter-clockwise. One rotation is about 4 PSIG. Once again open the low side valve wheel on the service manifold and then close it and recalculate the differential after each adjustment.

8) Remove all gauges from the system.

9) Reopen all oil regulator service valves to each compressor.

Filter Replacement
Replace liquid line filter/drier cores, suction filter cores, and the oil system filter element after 24 hours of system operation. A second replacement should occur after 48 hours of system operation. It is recommended to measure the operating refrigerant pressure drop across the filter/drier. If the pressure drop across the filter/drier exceeds 5 PSIG replacement is required. The Sporlan See-All combination moisture and liquid indicator should be closely monitored after all filter/drier replacements to confirm the system is dry.

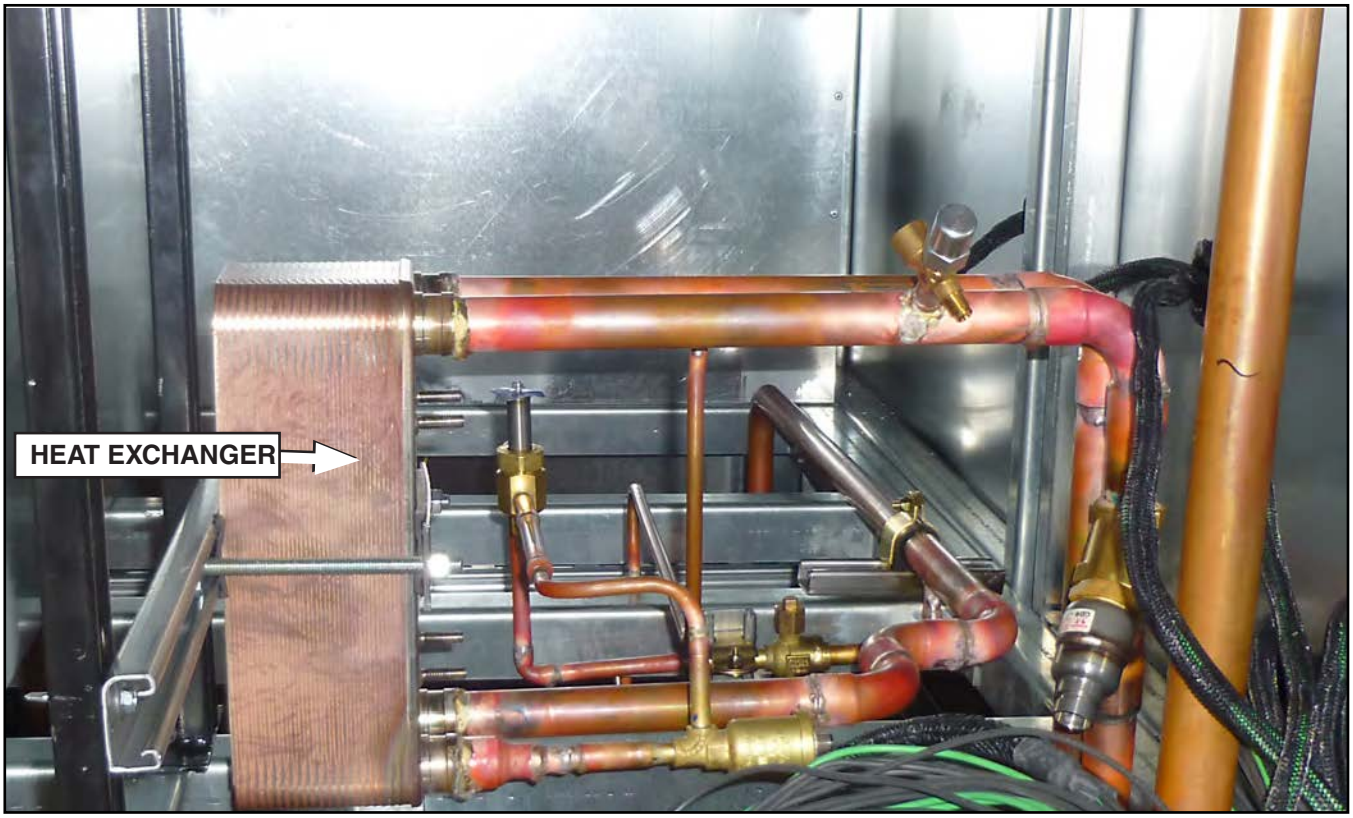
Sub-Cooler Start-Up
Please refer to the Sequence of Operation for the subcooler sequence.

Connect a service manifold low pressure gauge to the schrader access valve immediately upstream of the BPHE cold side electronic evaporator pressure regulator (EEPR).

• Install a portable temperature sensor near the location of the gauge to measure the operating superheat of the cold side and verify these readings with the subcool controller's readings.

• Install a portable temperature sensor near the sensor subcooled liquid outlet temperature and verify the readings.

• Manually open the subcooler circuit. In the case of MT units, this is done by opening the ball valve downstream of the subcooler EEPR. For LT units this is done by opening the angle valve at the vapor injection ports of each compressor.



Subcooler problems could include any of the following:

- the Subcool Control Board fails to power up or communicate
- no subcooling is occurring
- subcooling is above or below setpoint
- operation is unstable

Never allow the Subcooler to operate unattended until all problems are corrected and proper operation has been confirmed. The BPHE is an extremely close-coupled evaporator circuit, so problems must be addressed immediately. Destructive liquid refrigerant flood back may occur rapidly without warning.

Thermostatic Expansion Valve Check
For each refrigerated merchandiser and walk-in, confirm the Thermostatic Expansion Valve (TXV) sensing bulb location is correct and securely fastened to a clean horizontal section of the evaporator outlet with good thermal contact. Confirm all TXV strainers and/or local filter/driers are free of restrictive contaminants.

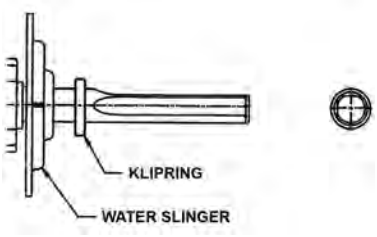
Do not attempt to evaluate TXV superheat until the Subcooler has achieved setpoint and the merchandiser or space temperature is within 10 degrees of setpoint. Once stable conditions have been established, confirm the evaporator coil is either clear or only slightly frosted.

TXV valves are factory set by Hussmann for operation. Consult pressure chart for specific TXV adjustment procedures to check adjustment settings. Some manufacturers use a "Temperature Difference" method to approximate operating superheat. Unit cooler evaporator superheat should be determined using conventional superheat measurement methods using the dew point temperature for the R-407A refrigerant blend.

Refer to the Sequence of Operation and confirm field functionality of all sections of the sequence.

Krack Air Cooled Condenser Fan Blades
When a fan blade is removed from the direct drive motor shaft for any reason it must be correctly refitted to the motor shaft to provide design air flow.

The position of the fan blade with respect to the fan section horizontal pan orifice edge is about 1/3 above and 2/3 below. There is also a klipring on the motor shaft which acts as a stop to properly position the fan blade.



SERVICE

Compressor Replacement

The compressors are mounted on supporting rails, which span the drain pans located on the base of the enclosure. To remove a compressor, first revmove the four bolts located at the base of the compressor. Weld nuts are provided at these locations, so there is no need to connect a wrench to the nut.

General Instructions:

Step 1: Close the suction, discharge and oil supply valves; Reclaim refrigerant in compressor

Step 2: Drain oil from the compressor using drain plug (provided) on the compressor body.

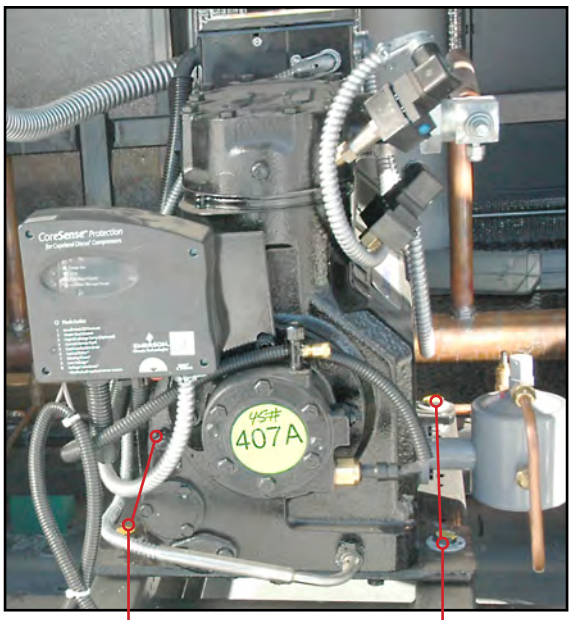
Step 3: Remove the oil level regulator

Step 4: Switch out the compressors

Step 5 : Reinstall hardware and oil level regulator

Step 6: Rewire compressor

Step 7: Open the supply valve; add oil to the system if required.



Remove bolts from Copressor Housing

Medium temp recip compressor mounting assembly uses multiple flat washers as shims to aid in the compressor removal and reinstallation process. The shims are installed between each compressor mounting foot and the rack compressor support channels. These spacers will allow vertical height adjustment to ensure the compressor is level and connected piping is not under stress. Some compressors have a vertical suction pipe connection to the compressor. During replacement, removing the shims will allow the compressor to be lowered down from the pipe connection without stressing the piping.

Low Temp Scroll compressors are mounted on special rubber grommets that must be reused with the new compressor. Drain all oil from the compressor, drain the OMB. Do not bend any copper tubing to make clearance for compressor removal. Slight rotation of the compressor may be necessary to remove the old compressor and install the new compressor.

Non-Condensable Gases

Abnormally high condensing temperatures are often expected in older refrigeration systems where condenser coil surfaces are dirty and fan motors are failing. However, elevated condensing temperatures can also occur as a result of non-condensable gases (NCG), even in new refrigeration systems. Air is the most common NCG that enters a refrigeration system during installation and field service. Nitrogen is the second most prevalent NCG since it directly used during the installation process.

NCGs have extremely low boiling points, so they will remain in a gas phase and increase condenser pressure, reducing refrigeration capacity. To completely evacuate a refrigeration system, all sections of the system must be open to the vacuum pump by opening all ball valves and by energizing all normally-closed solenoid valves.

Also, all pressure regulating valves must be opened, so that trapped air located in isolated remote piping sections is removed by the vacuum pump. If this procedure is not followed, some NCG will remain in the system. Then, once refrigerant charging begins, NCG will be circulated throughout the entire system until it arrives at the air cooled condenser. NCGs will be trapped there in the discharge piping inverted trap which is the highest elevation of the system. NCGs may also be trapped in the highest elevation condenser coil tube circuits, which reduces the condenser's internal heat transfer surface area. The NCGs will increase operating condensing pressures by two separate but related causes.

The first is the effect of Dalton's Law of Partial Pressures which states that the total pressure of two gases (refrigerant and air) equals the sum of the partial pressures that constitute the mixture. Secondly, condenser tubes with trapped air are no longer available to condense the refrigerant. The NCGs must be removed by manually purging or releasing the system pressure through the field installed angle valve located at the top of the inverted discharge trap of the air cooled condenser inlet.

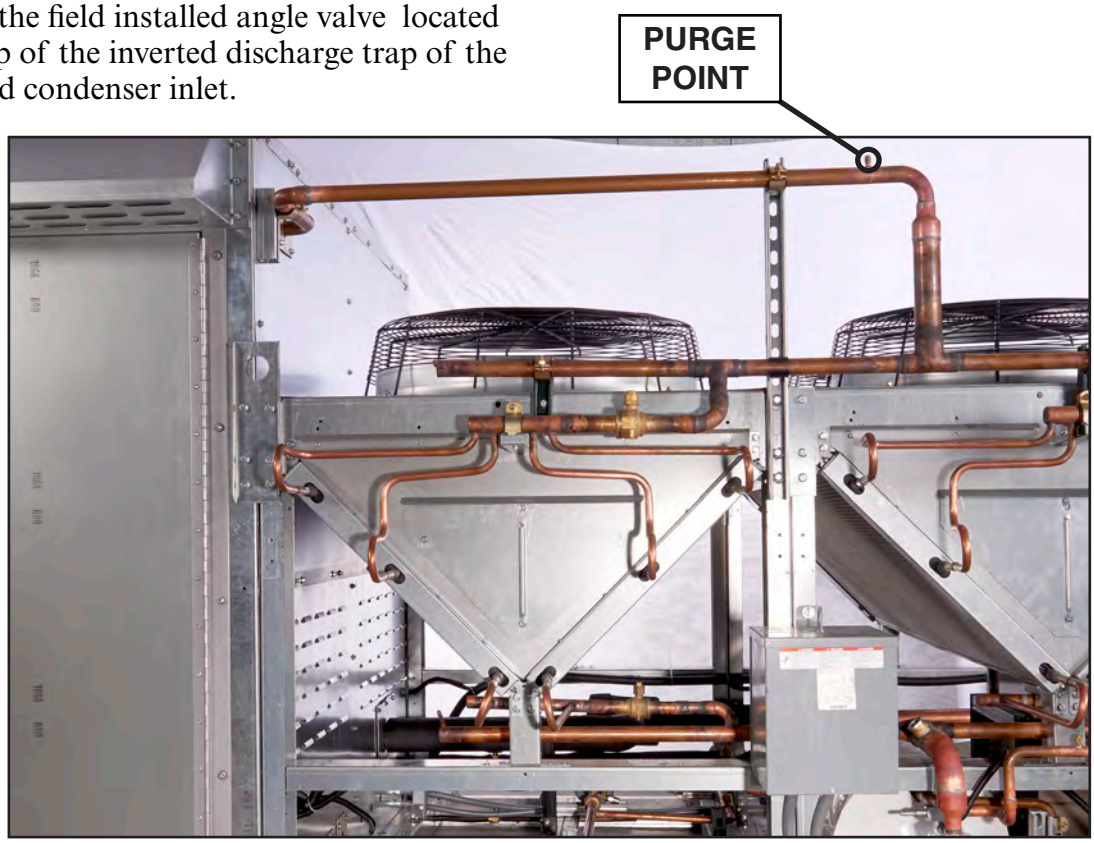
Liquid line filter/driers cannot remove NCGs from the system. The NCG purge procedure is as follows:

- Once a rack is in steady state operation, turn all compressor rocker switches to the OFF position.

- Turn ON all condenser fan motors.

- Install a service manifold high side gauge on the angle valve at the inverted trap on the condenser.

- Install a portable temperature sensor at the inlet and outlet condenser coil connections, as well as one in the entering air stream to the condenser coil. When all three sensors are reading the same temperature, compare the measured pressure saturation temperature from the system refrigerant P-T chart. If the system pressure saturation temperature is within two degrees of the three temperature sensors, NCGs are not present in significant amounts. If the system pressure is higher than the pressure corresponding to the temperature readings, then NCGs are present.



• If NCGs are present, connect the center hose of the service manifold to a recovery cylinder. Open the high side gauge hand wheel to allow refrigerant/NCG mix to flow from the system to

the recovery cylinder for about one minute and then close the hand wheel. Check the pressure, which should be reduced, and continue this process until the pressures are equivalent.

• When done, remove all portable temperature sensors and the service manifold gauge set.

• Restart compressors one at time.

Testing Refrigerant and POE Oil

Annual laboratory testing of refrigerant and POE oil is a vital component of refrigeration system health management. Some sites may need more frequent testing if problems recur. All testing should be conducted by an accredited laboratory skilled in this testing. The first refrigerant and lubricant test should occur upon completion of the installation, after preliminary start-up filter and drier changes have been completed. In addition to annual tests, refrigerant and POE oil samples should also be tested post compressor burnout, after all clean-up filter/drier changes have been made.

Refrigerant testing is the most accurate means of testing moisture content since the refrigerant sample is always under pressure in a sealed metal container. In addition, refrigerants decompose when exposed to excess system heat, and this is another key metric obtained from testing. Laboratory test pricing is currently about $200 per kit plus HazMat shipping costs.

POE oil samples are primarily tested for moisture, acid, and color. Oil testing for moisture is less accurate than refrigerant testing, since the oil sample absorbs moisture when exposed to air during collection process. Color analysis describes both the visual color and the ASTM D-1500 index number.

Visually clean POE is straw colored. Additional tests for anti-wear oil additive depletion, presence of bearing wear metals and other system contaminants can also be conducted.

Laboratory test pricing for POE oil is currently about $75 per kit which typically includes the shipping costs.

Refrigerant and POE Oil Contamination

The commercial refrigeration industry has transitioned from traditional R-22 systems with mineral oil to R-407A systems with Polyolester Oil (POE). POE oil is a wax free oil required for use with Hydroflourocarbon (HFC) refrigerants, and is 100 times more hygroscopic than mineral oil. Hygroscopic substances readily absorb and hold moisture from air. POE oil is unavoidably exposed to air during initial oil fill, but this exposure must be minimized. Some POE oil producers recommend the maximum exposure to air be limited to ten minutes. In addition, incomplete system evacuation may leave air and moisture in the system. In the presence of water, POE oils decompose into partial esters, alcohol and organic acid causing the formation of precipitous sludge which fouls components and reduces the oil's ability to lubricate the compressor. The speed at which the hydrolysis occurs is dependent upon temperature and the acid content, as the acids act as a catalyst.

Moisture can also cause TXV freeze-up. Strong, inorganic, mineral oil acids may also be present due to the breakdown of the phosphorus anti-wear additives contained in POE lubricants. Inorganic, hydrofluoric acid forms from the decomposition of HFC refrigerants at high temperatures in the presence of moisture. Copper plating is the result of an acid etching of internal compressor components. Refrigerants are highly effective solvents which circulate acids, sludge and contaminants throughout the system and severely damage key system components.

Sludge and varnish can plug solenoid ports, equalizing holes and other small orifices contained in compressors and valves. Protective mesh screens found in TXVs and compressor suction chamber screens can become completely clogged or at least partially restricted thereby affecting functionality. POE oil breakdown deposits can become attached to all system internal surfaces causing TXV and all other control valves to stick or become unreliable.

Any substance or materials other than refrigerant and compressor lubricating oil are foreign ingredients that cause chemical reactions or change the chemical composition of elements within the refrigeration system. Free water or moisture, air or other NCGs enter the system during field installation and must be thoroughly removed.

NCGs trapped in air cooled condensers causes higher than normal condensing temperatures and may lead to oil being carbonized resulting in even more varnish and sludge. Hussmann has implemented numerous production practices to ensure the racks are free of contaminants when leaving the factory, but field brazing is needed to connect store fixtures to the system. Any copper oxidation that occurs during field brazing will be flushed by the refrigerant flow into system filters. The oxides are solid particles which will eventually deposit in TXV screens, compressor suction chamber mesh screens, and restrict or prohibit refrigerant flow. Contaminants must be removed to protect compressors, TXVs, control valves and solenoid valves. Filters must be maintained regularly to ensure contaminants are removed.

Control Valve Contamination
Contamination seriously affects the functionality of control valves. Sporlan reports the reliability and life of electric stepper motor valves is extended when acid levels remain low. If contaminants are suspected, Sporlan recommends driving the valve to the full open position to purge foreign materials.

Most Sporlan electric stepper motor valves may be disassembled for inspection and cleaning once the valve is isolated and the refrigerant in that section is reclaimed per US EPA rules and regulations.

Contamination Control Components
HEPRs are designed and fabricated with filters and driers to prevent or limit contamination of refrigerant, oil, valves, compressors and other items.

Replaceable Core Liquid Line Filter/Drier
Moisture and acid do not increase pressure drop across the liquid line filter/drier like foreign materials and debris. An oil sample must be tested by a qualified lab to assess the level of contamination. A filter/drier cannot remove moisture in a single pass - hours of pass time are required to remove moisture and neutralize the acid. Once a filter/drier has been saturated, the drier will hold the moisture it has captured but will not capture any additional moisture. Consequently the remaining water in the system will continue to form acid until the filter/drier media is replaced. Filter/driers are not intended to remove NCGs, those must be purged from the system at high points.

In addition to recovering refrigerant prior to opening the piping system, each and every time a section of the system is opened to the atmosphere, that section must be evacuated to 500 microns and the system filter/drier cores must be replaced. These procedures are unnecessary if an unintentional refrigerant release occurs, such as due to a loose flare nut or any connection that is simply tightened to eliminate refrigerant exfiltration. In those case, no air could enter the system, so it is not necessary to replace filter cores.

The replaceable suction filter shell is used with a replaceable pleated filter element. It also may used with desiccant cores for clean-up after a compressor burnout.

Lubrication System Replaceable Filter Element
The Sporlan ROF-413T replaceable oil filter has an OFE-1 Filter Element that must be changed at scheduled filter element changes and when cleaning up of highly contaminated systems. Sporlan describes design benefits as follows: "POE oil suspends and recirculates a high concentration of 2-20 micron sized particles, with the largest percentage between 2-10 microns. Although some particles are smaller than bearing tolerances, studies have shown bearing life can still be affected. Bearing wear depends upon the size, hardness, and concentration of particles in circulation. The OF Series Oil Filters are designed to be 99% efficient in removing 3 micron sized particles, and yet have sufficient flow capacity at a low pressure drop. Clean oil ensures proper operation of the oil level control and minimizes compressor wear."

TXV Inlet Strainers
Some TXVs are equipped with integral mesh strainers, either 12x12 or 16x16, or some OEM series TXVs utilize 60x50 mesh strainers. These are intended to protect against obstructing the closure of the TXV pin and seat by solder and scale particles. Liquid piping downstream of the filter/drier may contain contaminants until a complete pass occurs, and so TXV inlet strainers are subject to contaminant fouling. Once fouled, the strainer will limit liquid refrigerant feed to the TXV, resulting in the inability of cases or coolers to achieve temperature setpoints. If the strainers are too large to stop the contaminants, the smaller size debris will pass through the strainer and may deposit within the TXV, fouling operation.

Sporlan offers an optional secondary replaceable mesh screen tube that inserts into the center of the replaceable core filter/drier core. This screen filter captures microscopic particles down to 20 microns. Essentially, the standard core filter removes larger size particles and the secondary screen filters remove the smaller particles.

The secondary screen filter would be permanently removed with the initial drier core replacement. Additional pass time with a secondary mesh filter may be useful to clean up a highly contaminated system.

Microchannel Condensers
Long life and satisfactory performance of any equipment is dependent upon the care it receives. Coil maintenance, including cleaning, enhances the unit's operating efficiency by minimizing compressor amperage draw and head pressure.

Periodic maintenance is essential to ensure long-lasting life and strong performance of condensing units. One of the advantages to owning this particular V-shaped condenser is that it is very accessible. A service technician can get to the center of the coils and clean out accumulated dirt and debris thoroughly.
The first step is to locate the main power source. Remove the screws to gain access to the power control panel.

A great way to measure the effectiveness of cleaning these condensers is by measuring the pressure before and after cleaning. To do this a pressure gauge is applied to the pressure transducer. If the transducer is not located in the control panel on the roof, check the transducer at the rack. Before cleaning the condenser, power must be shut off to the condenser and fan. This can be achieved in two steps.
First, turn off the power at the main disconnect. Next, the fuses should be removed if there is no type of EMS board with dip switches that can be used to turn off the power. Double check to make sure the power is turned off. Pull the motor fuses that are to be serviced. Reset the main disconnect so power is restored to the other fans on the condenser.

Now that power is turned off, remove the end covers to access the condenser. A short-handled broom like this one can be used to remove the heaviest dirt and dust from the outside of the coils. Do not use a wire brush.

Always brush with the fins to prevent them from being bent. Wear gloves to prevent any injury from the sharp coils. Safety glasses and an air mask are also strongly recommended for this procedure to prevent ingesting any dirt or getting dirt or dust in the eyes. Once the condenser has been brushed, turn the fan back on and brush it again with the fan running.

Next, a garden hose with a concentrated spray nozzle is used to wash the coils from the inside out. Start at the top and wash up and down with the fins. You can see the dirt coming out of the other side of the coil. Continue doing this until you get a clear stream of water. The coils also now look noticeably clean. Always spray up and down with the coil, never side to side. Do not spray water directly into or on the motors, especially while they are off. High pressure washers are not recommended, because if you place a wand in the opening and to not shoot the water straight at the fins you could fold over and damage the fins.

The condensing unit can be accessed from both sides. On the header side of the condenser, you will have to remove the metal guard that is over the piping. There is a divider between the slabs so you will be able to service each fan section. Replace the end covers and panels that were removed earlier. Return power to the section you were working on.

After the cleaning is complete, restore power to the condenser. Check the pressure again at the transducer, and observe the change in pressure. You will see a difference once you have completely cleaned all the slabs of the rack. Pressure will drop depending on how dirty the coils were. The condenser is running more efficiently – using less energy to cool.

Condenser cleaning may be needed more or less frequently depending upon the environmental factors of the region where the equipment is located.

Hussmann recommends following the ACCA Standards for Maintenance Tasks for Parallel Racks with Direct Expansion.

ACCA. A free PDF version of the underlying standard – ANSI/ACCA 14 QMref – 2015 (Quality Maintenance of Commercial Refrigeration Systems) – can be downloaded from www.acca.org/quality.

Follow Checklist 5.9 Parallel Rack Direct Expansion

REPLACEMENT PARTS LIST

MECHANICAL PARTS											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
2H09182001	ADAPTER TRAXOIL 066650	■	■	■	■	■					
1H74889001	ADAPTER TRAXOIL K5 SCROLL 066077			■	■	■					
1H54058001	COMPRESSOR 3DB3R12MLTFDC23						■				
1H54084001	COMPRESSOR 3DBDR12MLTFDC23						■				
1H54066001	COMPRESSOR 3DS3R17MLTFDC23							■	■		
1H54086001	COMPRESSOR 3DSDR17MLTFDC23							■	■		
1H54229001	COMPRESSOR 4DBNR20MLTSKC23									■	
1H57714001	COMPRESSOR 4DBXR20MLTSKC23									■	
1H54230001	COMPRESSOR 4DCNR20MLTSKC23 W/UNLDR								■	■	
1H54011001	COMPRESSOR 4DJNR28MLTSKC23										■
1H57717001	COMPRESSOR 4DJXR28MLTSKC23										■
1H54012001	COMPRESSOR 4DRNR28MLTSKC23										■
1H54241001	COMPRESSOR ZF25KVETFD262 460V KANBN	■	■	■	■	■					
1H54247001	COMPRESSOR ZF49K5ETFD260 460V			■	■	■					
1H76271001	COMPRESSOR ZFD25KVETFD261	■	■	■	■	■					
0708459	DRIER LIQUID .875 C487G	■	■								
0256162	DRIER LIQUID 1.125 C489G			■	■	■					
2H17436001	DRIER LIQUID 1.375 C4811G						■				
0706888	DRIER LIQUID 1.625 C9613G							■	■		
0708463	DRIER LIQUID 2.125 C19217G									■	■
0411239	ENCLOSURE CCH 4-6 SCROLL 998702400	■	■	■	■	■					
1H74892001	ENCLOSURE CCH 7-15 K5 998702900			■	■	■					
2H05583001	FILTER AIR INTAKE SC162-P15/60	■	■	■	■	■	■	■	■	■	■
0422107	FILTER OIL 1.625 ROF413-T	■	■	■	■	■	■	■	■	■	■
0340740	FILTER SUCTION 2.125 RSF4817T	■	■								
0408995	FILTER SUCTION 2.625 RSF4821T			■	■		■				
0422112	FILTER SUCTION 2.625 RSF9621T					■					
0422113	FILTER SUCTION 3.125 RSF9625T							■	■	■	■
0369213	FINGER GUARD (VENT FAN) 551199	■	■	■	■	■	■	■	■	■	■
0262071	FLANGE 1.375 A5074								■	■	■
0264795	GASKET 3D&4D 020048900								■	■	■
1H74886001	GROMMET MOUNT KIT (K5E) 998017800			■	■	■					
0396335	GROMMET MOUNT KIT (KVE) 527015700	■	■	■	■	■					

MECHANICAL PARTS											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
1H53895001	HAND VALVE .375 SLDR A14840	■	■	■	■	■					
1H85081001	OIL SEPARATOR 2.625X2.125 S5608C							■	■	■	■
2H20528001	RECEIVER 14X42 HORIZONTAL S8790T	■	■	■	■	■	■	■	■	■	■
1H27673001	REGULATOR OIL 2D&3D OL60TH2 UNIV F						■	■	■		
1H27636001	REGULATOR OIL 4D&6D OL60TH1 UNIV F								■	■	■
0708436	REGULATOR TRAXOIL 065766 OMBJB1	■	■	■	■	■					
1H61459001	SEPARATOR OIL S-5604	■	■	■	■	■	■				
0417482	SIGHT GLASS .875 AMI2S7			■	■	■	■	■	■	■	■
0319342	SIGHT GLASS .875 SA17S	■	■								
0712033	SIGHT GLASS OIL LINE SAK83	■	■	■	■	■	■	■	■	■	■
1H52658001	SUBCOOLER B10THX20 0155970.0	■									
1H52662001	SUBCOOLER B10THX30 0155971.0		■								
2H15438001	SUBCOOLER B10THX40 0155972.0			■							
2H00630001	SUBCOOLER B35HX30 15822-030										■
0705715	SUBCOOLER B80X18 ART12765				■	■					
0705716	SUBCOOLER B80X20 ART12765						■				
0705717	SUBCOOLER B80X28 ART12765							■			
0705718	SUBCOOLER B80X34 ART12765								■		
0705720	SUBCOOLER B80X46 ART12765									■	
0712657	TAPE APPLICATION 4E521	■	■	■	■	■	■	■	■	■	■
0705713	TUBE ULTRACAP 36" SEC99AD36D	■	■	■	■	■	■	■	■	■	■
1H29584001	TUBING KIT DIGITAL SOLENOID 998006600	■	■	■	■	■					

REPLACEMENT PARTS LIST

MECHANICAL PARTS											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
0370747	VALVE .375MPTX.375FL 0917470730	■	■	■	■	■	■	■	■	■	■
0705563	VALVE 3WAY MPTF B35165 SWEAT	■	■	■	■	■	■	■	■	■	■
0705545	VALVE ANGLE .25F UNASSEMBLY B35161	■	■	■	■	■	■	■	■	■	■
0705546	VALVE ANGLE .375F UNASSEMBLY B35160	■	■	■	■	■	■	■	■	■	■
0417379	VALVE BALL FULL-PORT .375 AP17860C	■	■	■	■	■	■	■	■	■	■
0303933	VALVE BALL FULL-PORT .625 AP17862C	■	■	■	■	■	■	■	■	■	■
0303934	VALVE BALL FULL-PORT .875 AP17864C	■	■	■	■	■	■	■	■	■	■
0417711	VALVE BALL FULL-PORT 1.125 AP17865	■	■	■	■	■	■				
0417712	VALVE BALL FULL-PORT 1.375 A17866		■	■	■	■	■	■	■	■	■
0417713	VALVE BALL FULL-PORT 1.625 A17867				■	■	■	■	■	■	■
0417714	VALVE BALL FULL-PORT 2.125 A17868	■	■					■	■	■	■
0421879	VALVE BALL FULL-PORT 2.625" A17869			■	■	■	■				
0706229	VALVE BALL FULL-PORT 3.125 A17870							■	■	■	■
0709193	VALVE CHECK .875 A17939							■	■	■	■
2H12489001	VALVE DTC 250F SET268F 998050011	■	■	■	■	■					
1H69625001	VALVE EEPR .625 SDR3X10S	■									
1H12403002	VALVE EEPR .875 CDS4		■								
1H12403005	VALVE EEPR .875 CDS7	■	■								
0713063	VALVE EEPR .875 SDR410S	■	■	■	■	■	■	■	■	■	■
1H12403003	VALVE EEPR 1.125 CDS7			■							
0703227	VALVE EEPR 1.125 CDS9				■	■					
1H87977001	VALVE EEPR 1.375 CDS16 20'						■	■	■		
1H29801001	VALVE EEPR 1.375 CDS7				■	■	■	■	■		
1H25243001	VALVE EEPR 1.375 CDS9									■	■

REPLACEMENT PARTS LIST

MECHANICAL PARTS											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
1H27102001	VALVE EEPR 2.125" CDS17									■	■
2H08117001	VALVE EXPANSION SERB 3X4ODF 10'-S	■	■								
2H08118001	VALVE EXPANSION SERC 3X4ODF 10'-S			■	■	■	■				
2H08119001	VALVE EXPANSION SERD-S 5X7ODF 10'-S							■	■	■	■
2H09433001	VALVE KIT LIQUID INJECTION 998034000			■	■	■					
0422919	VALVE OIL LINE W/STEMS B34282	■	■	■	■	■	■	■	■	■	■
0260318	VALVE REGULATOR OIL Y8252						■	■	■	■	■
0705564	VALVE RELIEF 450 .5 AJ15504	■	■	■	■	■	■	■	■	■	■
0365826	VALVE ROTOLOCK .5 DISCH 091103310015	■	■	■	■	■					
1H25408001	VALVE ROTOLOCK .875 091403310015G	■	■	■	■	■					
1H80329001	VALVE ROTOLOCK 1.125 ICPPP10015	■	■	■	■	■					
0422993	VALVE ROTOLOCK 1.625 510059800			■	■	■					
0067449	VALVE SOLENOID .375 A3S1			■	■	■					
0318176	VALVE SOLENOID .5 E6S140	■	■								
1H33805002	VALVE SOLENOID .5 E9S240			■							
1H33805003	VALVE SOLENOID .625 E10S250	■	■	■	■	■	■				
0318180	VALVE SOLENOID .625 E14S250		■	■				■	■		
2H06174001	VALVE SOLENOID .625 OE14S250		■	■							
1H38484002	VALVE SOLENOID .875 E19S270				■	■				■	■
0427308	VALVE SOLENOID .875 OE19S270				■	■					
0701241	VALVE SOLENOID 1.125 E25S290						■	■	■		
0324737	VALVE SOLENOID 1.125 OE25S290						■	■	■		
1H38484005	VALVE SOLENOID 1.375 E35S1110									■	■
0324738	VALVE SOLENOID 1.375 OE35S1110									■	■
2H20042001	VALVE SOLENOID OE10S150-HP 4358-00	■									
0705547	VALVE TRANSDUCER UNASSEMBLY B35162 UA	■	■	■	■	■	■	■	■	■	■
0044833	VIBRATION ELIMINATOR 1.375 VAF10								■	■	■

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REPLACEMENT PARTS LIST

ELECTRICAL PARTS											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
1H29308001	AUXILIARY CONTACTOR 9999DD11	■	■	■	■	■	■	■	■	■	■
0385456	BASE BREAKER 2P QON2L40	■	■	■	■	■	■	■	■	■	■
0416906	BLOCK FUSE GLASS 12P 6X32812	■	■	■	■	■	■	■	■	■	■
0700740	BLOCK FUSE J 3P 61038J 100A	■	■								
0700742	BLOCK FUSE J 3P 62003J 200A			■	■	■					
0410738	BLOCK FUSE M 3P 30313 BM6033SQ	■	■	■	■	■	■	■	■	■	■
0700746	BLOCK POWER 63193	■	■	■	■	■	■	■	■	■	■
0706782	BLOCK TERMINAL 1X4 9080LBA362104	■	■	■	■	■	■	■	■	■	■
0706146	BLOCK TERMINAL 1X8 9080LBA364108	■	■	■	■	■					
2H16944001	BOARD 8 CH CURRENT INPUT XIO-CTIB	■	■	■	■	■	■	■	■	■	■
2H16946001	BOARD 8 CH DIGITAL OUTPUT XIO-8DO-B	■	■	■	■	■	■	■	■	■	■
2H16947001	BOARD 8 CH UNIVERSAL INPUT XIO-8U-B	■	■	■	■	■	■	■	■	■	■
1H24522001	BOARD INTERFACE IB2 SPORLAN983188	■	■	■	■	■	■	■	■		
1H34015001	BOARD INTERFACE IB3 SPORLAN952956	■									
0709920	BOARD INTERFACE IB6 SPORLAN959957	■	■	■	■	■	■	■	■	■	■
0417079	BOX WEATHERPROOF 2X4 DIH31LM	■	■	■	■	■	■	■	■	■	■
1H40880010	BREAKER 100A 3P 600V HGL36100			■	■		■				
1H90276001	BREAKER 125A 3P 600V HGL36125					■		■			
2H17479001	BREAKER 150A 3P 600V JGL36150								■	■	
0427267	BREAKER 15A 1P 208V QOU115	■	■	■	■	■	■	■	■	■	■
1H40880001	BREAKER 15A 3P 600V HGL36015	■	■	■	■	■					
0427268	BREAKER 20A 1P 208V QOU120	■	■	■	■	■	■	■	■	■	■
1H87995001	BREAKER 20A 2P 600V HGL26020	■	■	■	■	■	■	■	■	■	■
1H40880002	BREAKER 20A 3P 600V HGL36020	■	■	■	■		■	■	■		
1H90285001	BREAKER 225A 3P 600V JGL36225										■
0427269	BREAKER 30A 1P 208V QOU130	■	■	■	■	■	■	■	■	■	■
1H40880003	BREAKER 30A 3P 600V HGL36030			■	■	■	■			■	■
1H40880004	BREAKER 40A 3P 600V HGL36040							■	■		
1H40880005	BREAKER 50A 3P 600V HGL36050								■	■	
1H40880006	BREAKER 60A 3P 600V HGL36060										■
1H40880007	BREAKER 70A 3P 600V HGL36070	■									
1H40880008	BREAKER 80A 3P 600V HGL36080		■								
0417325	BREAKER EPD 15A 1P 208V QO115EPD	■	■	■	■	■	■	■	■	■	■

ELECTRICAL PARTS											
Item	Description	70LT	85LT	110LT	130LT	150LT	175MT	220MT	250MT	300MT	350MT
2H17512001	CABLE HEAT (RECEIVER) 120V 6W/FT 4E511	■	■	■	■	■		■	■	■	■
1H28192001	COIL 115V 023005808	■	■	■	■	■					
0251532	COIL 120V 50/60H MKC2	■	■	■	■	■	■	■	■	■	■
0252264	COIL 120V AMG 057331								■	■	■
1H29512002	COIL 120V DIG RECIP 923008401						■	■	■	■	■
0146826	COIL 120V MKC1 50/60H JAM	■	■	■	■	■					
1H27073001	COIL 120V MKC-1-120/50-60CAM									■	■
0347138	COIL 120V MKC2-CAM 45	■	■	■	■	■	■	■	■		
1H93389001	COIL 120V OMKC1-CAM 311106	■								■	■
2H00628001	COIL 120V OMKC2-CAM 312809		■	■	■	■	■	■	■		
0712655	CONNECTNG POWER KIT HEAT TAPE (RECEIVER) 4E519	■	■	■	■	■	■	■	■	■	■
0365963	CONTACTOR 30A 3P 120V 8910DPA33V02	■	■	■	■	■	■	■	■	■	■
0369284	CONTACTOR 40A 3P 120V 8910DPA43V02									■	
0426969	CONTACTOR 60A 3P 120V 8910DPA63V02										■
2H16948001	CONTROLLER BASE XCM20R-BPL	■	■	■	■	■	■	■	■	■	■
2H16949001	CONTROLLER RACK XCM20R-C-BFSUM	■	■	■	■	■	■	■	■	■	■
2H16945001	CONTROLLER SUBCOOLER RCC.1081	■	■	■	■	■	■	■	■	■	■
0700741	COVER BLOCK FUSE 61038JC	■	■								
0700743	COVER BLOCK FUSE 62003JC			■	■	■					
0700224	COVER DRY TGT 2X4 DIH41LM DCCB	■	■	■	■	■	■	■	■	■	■
0005215	COVER LBA362 9080LB23	■	■	■	■	■	■	■	■	■	■
0706780	COVER LBA364 9080LB43	■	■	■	■	■					
2H16937001	CURRENT TRANSDUCER FAN 1-10VDC CCT40-203	■	■	■	■	■	■	■	■	■	■
0421813	CURRENT TRANSFORMER SOLID 100:5 24" LEAD 2AL101	■	■	■	■	■	■	■	■	■	■
0709784	FAN (VENTILATION) UF15PC12-BWHR/CC-S	■	■	■	■	■	■	■	■	■	■
0417318	GROUND BAR PK15GTA	■	■	■	■	■	■	■	■	■	■
0365959	GROUND LUG LAMA1/014Q = DA0	■	■	■	■	■	■	■	■	■	■

REPLACEMENT PARTS LIST

ELECTRICAL PARTS											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
0706790	HEATER CRANKCASE 100W 120V 918002800										
1H79904001	HEATER CRANKCASE 120V 70W 7.00D										
1H79905001	HEATER CRANKCASE 120V 90W 9.00D										
0404826	HIGH-PRESSURE CONTROL (COMPRESSORS) 097997 SPDT 395 MANUAL										
0422262	HIGH-PRESSURE CONTROL (FANS) P70JA50D SPDT 395 AUTO										
0715065	LAMP 120V GEL60AS130PK212130										
0426639	LIGHT 1205TF2LGX1 305031138340										
0700330	LIGHT 120V5TF2LRN1 305031138310										
0704573	LIGHT HORIZONTAL WHITE 15W/120V										
1H28714001	LIGHT VAPORTIGHT VTB15012 B/M										
1H65351001	LIQUID LEVEL INDICATOR HM844300101 14/1										
1H78324001	LOW-PRESSURE CONTROL PSC-A1S 097849										
0005212	LUG PDC6HD6										
0005213	LUG PDC6JD4										
1H63158001	MODULE IDCM 4D DISCUS 943008800										
1H27828001	MODULE IDCM 943008600										
0397726	PHASE MONITOR 201A										
0425980	RECEPTACLE GFIC IVR120V20A LEV8899I										
0333202	RELAY BASE DPDT PTF08AE										
1H28448001	RELAY CURRENT SENSING CUHECSNOFSCY1										
0333204	RELAY DPDT 120V LY2AC110/120										
0405301	RELAY SOCKET OT08PC NEDCO 600V										
1H99233001	SENSOR CMS/TS 10K 811000400										
1H93276001	SENSOR TEMP 2K RCCST2K8TJ										
2H20386001	SENSOR TEMP A/20K-BP-20CL2P										
1H29519001	SENSOR TEMP DIG COMPRESSOR 085010907										
0148435	SWITCH TOGGLE DPST 78130TQ										
1H78592001	THERMOSTAT DISCH 998702205										
1H37401001	TIME DELAY 24V-240V SPDT TRL04										
1H44505001	TRANSDUCER PRESSURE 0-500# NSK-BE034M-U284										
1H93277001	TRANSDUCER PRESSURE 150PSIG RCCSP1505										
0427514	TRANSFORMER 115/230V 24V 6VA 4074024										
0388962	TRANSFORMER 115/230V 24V 80VA 4496024										
0704584	TRANSFORMER 115/230V 24V30VA 4076024										
0427513	TRANSFORMER 115/230V 24V56VA 4077024										
0427524	TRANSFORMER 5KVA 480V120/240 5S40F										
2H16935001	VFD 10HP 3R 480V YK016423B0000										
2H16936001	VFD 15HP 3R 480V YK023423B0000										

REPLACEMENT PARTS LIST

CONDENSER ASSEMBLY											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
E205492IN	1.5 HP 230/460/60/3 INVERTER-DUTY 1140 RPM										
E208056	FAN BLADE 30" DIAMETER REVCOR ZS3003-24										
E209813001	FAN GUARD 30" LEV-SM-PC										
E208055	MOTOR MOUNTING BRACK FAN UNIT (2/MOTOR)										
80034	MOTOR MOUNTING RING FAN UNIT (1/MOTOR)										
E209106001	COIL MX MICROCHANNEL ***UNCOATED***										
E209107001	COIL MX MICROCHANNEL ***ELECTROFIN***										
E205383	VALVE BALL (OUTLET) FULL-PORT 1.125 AP17865A										
E205385	VALVE BALL (INLET) FULL-PORT 1.375 592W-13ST										

CONSUMABLES											
Item	**Description**	**70LT**	**85LT**	**110LT**	**130LT**	**150LT**	**175MT**	**220MT**	**250MT**	**300MT**	**350MT**
0417585	CORE DRIER RCW48 GOLD										
0340741	CORE FILTER SUCTION RPE48BD										
0426465	FILTER CORE OIL OFE1										
0703596	FUSE .75A 250V GDL3/4 313075										
0704585	FUSE 1/16A 250V GDL1/16										
0704586	FUSE 1/8A 250V GDL1/8										
0426783	FUSE 110A 600V AJT110										
0426710	FUSE 150A 600V AJT150										
0402638	FUSE 5AMP 600V ATQR5 FNQR5										
0426724	FUSE 80A 600V AJT80										
0426725	FUSE 90A 600V AJT90										
0704592	OIL POE COPELAND 998E02201										

SET POINT CHART

Alarm/Notice Name	Reference Sensor	Alarm Error Code	Alarm Description	Threshold / Setpoint	Alarm/Notice Time Delay	Notes	Resulting Action
Invalid SST Setpoint Notice		N11	Operating SST Setpoint from Building Controller Not Within Operating Parameters (VI)	LT units: < -25 or > -10 MT units: < 10 or > 30	No Delay	Per Unit	Ignore Invalid SST Setpoints, Maintain System Control Based on the Last Acceptable Setpoint
Suction Pressure Notice	P1	N12	Insufficient Control of Suction Pressure (AI)	+/- 2 °F Relative to SST Setpoint	15 Minutes	Per Unit	Notification Only
Return Gas High Temp Notice	T1	N13	High Return Gas Temp (AI)	> 65 °F	15 Minutes	Per Unit	Notification Only
Phase-Loss Alarm	PL1	A14	General Phase Monitor Fault (DI)	Digital Input Closes Upon Fault Condition	No Delay	Per Unit	SHUT-DOWN
Discharge Pressure Alarm	P2	A15	High System Discharge Pressure (AI)	> 375 psig (Reset at 300psig)	1 Minute	Per Unit	All Compressors 'Off', Bypass VFD, All Condenser Fans 'On'
Floodback Notice	T1 & P1	N16	Low Superheat Detected at Suction Header (multiple AIs)	compressor suction superheat < 15 °F (reset at 20 °F)	10 Minutes	Per Unit	Notification Only
Floodback Alarm	T1 & P1	A17	Low Superheat Detected at Suction Header (multiple AIs)	compressor suction superheat < 10 °F	10 Minutes	Per Unit	SHUT-DOWN
Comp High Pressure Alarm		A18	High-Pressure at Compressor Discharge, Safety Device (DI)	395 psig	No Delay	Per Unit	Lockout Compressor, Manual Reset Required Below 335 psig
Comp Oil Pressure Alarm (MT Units)		A19	Inadequate Oil Pressure-Differential at Compressor, CoreSense (VI)		No Delay	Per Unit	Lockout Compressor, Manual Reset Required
Comp Oil Level Alarm (LT Units)		A20	Low Oil Level at Compressor, OMB (DI)		No Delay	Per Unit	Lockout Compressor, Manual Reset Required
Comp Discharge Temp Notice	T11/T12/….T15	N21	High-Temperature at Compressor Discharge Temp Sensor (AI)	230 °F (6" from discharge port)	No Delay	Per Compressor	Notification Only
Comp Discharge Temp Alarm	T11/T12/….T15	A22	High-Temperature at Compressor Discharge Temp Sensor (AI)	250 °F (6" from discharge port)	No Delay	Per Compressor	Lockout Compressor, Manual Reset Required
Comp Run Proof Alarm	CT11/CT12/….CT15	A23	Lack of Amperage Detected at Comp Current Transformer, In the Presence of a 'Run' Command (AI)	< 0.15 A	No Delay	Per Compressor	Lockout Compressor, Manual Reset Required
Comp Amperage Out-of-Range Notice	T1 & P1 & P2 & CT11/CT12/….CT15	N24	Compressor Amperage Out of Range, Based on Compressor Performance Data (multiple AIs)	+/- 20%	1 Minute	Per Compressor	Notification Only

SET POINT CHART

Alarm/Notice Name	Reference Sensor	Alarm Error Code	Alarm Description	Threshold / Setpoint	Alarm/Notice Time Delay	Notes	Resulting Action
Cond Fan Run Proof Notice	CT21/CT22/….CT26	N25	Lack of Amperage Detected at Cond Fan Current Transformer, in the Presence of a 'Run' Command (AI)	< 0.15 A	No Delay	Per Fan Motor	Notification Only
Cond Fan Amperage Outlier Notice	CT21/CT22….CT26	N26	Fan Motor Amperage Not Consistent with Other Motors in Operation (multiple AIs)	+/- 20% (comparing max amps to min amps, excluding 'OFF' motors)	1 Minute	Per Fan Motor	Notification Only
VFD/Bypass Discharge Pressure Alarm	P2	A27	VFD Bypass Due to High Discharge Pressure (AI)	>335 psig (reset at 290 psig)	2 Minute	Per Unit	Bypass VFD, All Fans 'On'
VFD/Bypass Com-Loss Alarm		A28	VFD Bypass Due to Com-Loss with Drive (VI)		2 Minute	Per Unit	Bypass VFD, Transition to Controller-Managed Fan-Cycling, Still Based on Target Condenser TD
VFD/Bypass General Fault Alarm		A29	VFD Bypass Due to General Fault Condition Detected at Drive (VI)	Fault Code Received	2 Minute	Per Unit	Bypass VFD, Transition to Controller-Managed Fan-Cycling, Still Based on Target Condenser TD
Receiver Liquid-Level Notice 1	LL1	N30	Receiver Liquid Level Below Threshold (AI)	< 20% for > 6 hours	30 Minutes	Per Unit	Notification Only
Receiver Liquid-Level Notice 2	LL1	N31	Receiver Liquid Level Below Threshold (AI)	< 10% for > 30 minutes	30 Minutes	Per Unit	Notification Only
Liquid-Level Float Alarm	LL1	A32	Receiver Liquid Level Float Position Unchanged for > 4 Hours (AI)	No Detectable Change in Liquid Level Input Signal	4 Hours	Per Unit	Notification Only
Receiver Pressure Notice	P4	N33	Inadequate Receiver Pressure (AI)	< 95 psig	15 Minutes	Per Unit	Notification Only
Subcooler Com-Loss Alarm		A34	Communication Loss with Subcooler Control (VI)	Loss of Communication	No Delay	Per Unit	De-energize Liquid Line Solenoid Feeding Subcooler, Auto-Reset & Re-Initiate in 15 Minutes
Subcooler Superheat Alarm	T6 & P6	A35	Inadequate Subcooler Superheat (multiple AIs)	< 2 °F	2 Minutes	Per Unit	De-energize Liquid Line Solenoid Feeding Subcooler, Auto-Reset & Re-Initiate in 15 Minutes
Subcooler Liquid Temp Alarm	T5	A36	High Liquid Supply Temp (AI)	>60 °F for LT units, >85°F for MT units	15 Minutes	Per Unit	Fully-Open Electronic Liquid Pressure Regulator ELPRV
Rack Controller Com-Loss Alarm		A37	Controller Communication Fault (VI)	Loss of Communication	No Delay	Per Unit	Transition to System Operation Via Electro-Mechanical (Backup) Pressure Switches
Sensor Fault Alarm	All Sensors	A38	Analog Sensor Fault - Applies to All Temp Sensors Pressure Transducers, and Current Transformers (multiple AIs)	Short/Open/Fault	No Delay	Per Sensor	Refer to Sequence-of-Operations for Required Actions, Based on the Specific Sensor in Question
Enclosure High Temp Notice	T8	N39	Temperature within enclosure is high. Possible failure of ventialation fan(s).	> 140 °F	No Delay	Pef Unit	Notification Only

MagPak Alarms
20-Nov-15

	Item Name	Control Point	Setpoint	Note/Comment
LT Units	Low-Pressure SwitchComp#1	Suction Pressure	CI 8 psig, CO 3 psig	Backup Pressure Control
	Low-Pressure SwitchComp#2	Suction Pressure	CI 10 psig, CO 5 psig	Backup Pressure Control
	Low-Pressure SwitchComp#3	Suction Pressure	CI 12 psig, CO 7 psig	Backup Pressure Control
	Low-Pressure SwitchComp#4, if applicable	Suction Pressure	CI 14 psig, CO 9 psig	Backup Pressure Control
	Low-Pressure SwitchComp#5, if applicable	Suction Pressure	CI 16 psig, CO 11 psig	Backup Pressure Control
MT Units	Low-Pressure SwitchComp#1	Suction Pressure	CI 34 psig, CO 29 psig	Backup Pressure Control
	Low-Pressure SwitchComp#2	Suction Pressure	CI 37 psig, CO 32 psig	Backup Pressure Control
	Low-Pressure SwitchComp#3	Suction Pressure	CI 40 psig, CO 35 psig	Backup Pressure Control
LT Units	Time Delay Comp#1	TIME	3 seconds	Startup Time Delays / Controller Failure / Power Loss
	Time Delay Comp#2	TIME	30 seconds	Startup Time Delays / Controller Failure / Power Loss
	Time Delay Comp#3	TIME	60 seconds	Startup Time Delays / Controller Failure / Power Loss
	Time Delay Comp#4, if applicable	TIME	120 seconds	Startup Time Delays / Controller Failure / Power Loss
	Time Delay Comp#5, if applicable	TIME	180 seconds	Startup Time Delays / Controller Failure / Power Loss
MT Units	Time Delay Comp#1	TIME	3 seconds	Startup Time Delays / Controller Failure / Power Loss
	Time Delay Comp#2	TIME	30 seconds	Startup Time Delays / Controller Failure / Power Loss
	Time Delay Comp#3	TIME	60 seconds	Startup Time Delays / Controller Failure / Power Loss
	FCPC Cond Fan#1		Always 'ON'	Backup Condenser Fan-Cycling Pressure Control
	FCPC Cond Fan#2	Discharge Pressure	CI 235 psig, CO 175 psig	Backup Condenser Fan-Cycling Pressure Control
	FCPC Cond Fan#3 & Fan#4	Discharge Pressure	CI 240 psig, CO 180 psig	Backup Condenser Fan-Cycling Pressure Control
	FCPC Cond Fan#5 & Fan#6 (if applicable)	Discharge Pressure	CI 245 psig, CO 185 psig	Backup Condenser Fan-Cycling Pressure Control
	HP Per Compressor	Discharge Pressure	CI 335 psig, CO 395 psig	Manual Reset Available Below 335psig
MT Units	Y-825 Oil Pressure Regulating Valve	Suction Pressure	20-25 psig Above Suction Pressure	One per suction group

SUCTION HEADER TEMP (T1)	SUCTION HEADER PRESSURE (P1)
DISCHARGE HEADER TEMP (T2)	DISCHARGE HEADER PRESSURE (P2)
DROP LEG TEMP (T3)	DROP LEG PRESSURE (P3)
SUBCOOLER LIQUID INLET TEMP (T4)	RECEIVER PRESSURE (P4)
SUBCOOLER LIQUID OUTLET TEMP (T5)	SUBCOOLED LIQUID OUTLET PRESSURE (P5)
SUBCOOLER OUTLET SUCTION TEMP (T6)	SUBCOOLER SUCTION PRESSURE (P6)
AMBIENT AIR TEMP (T7)	
CABINET/ENCLOSURE AIR TEMP (T8)	
DISCHARGE TEMP COMPRESSOR (T11 / T12 / T13...T15)	
COMPRESSOR CURRENT TRANSFORMER (CT11 / CT12 / CT13...CT15)	
FAN MOTOR CURRENT TRANSFORMERS (CT21 / CT22 / CT23 / CT24...CT26)	
PHASE LOSS (PL1)	
RECEIVER LIQUID LEVEL INDICATOR (LL1)	

Controller Action	Reference Input / Control Point	Setpoint	Range	Threshold	Note / Comment
Load-Match Compressor-Cycling	P1	SST Input from Building Controller	LT Units: +/- 2.0 psig ; MT Units: +/- 2.5 psig	4 psig Minimum Below , 15 psig Above	Turn All Compressors 'Off' at Threshold Minimum, Stage All Compressors 'On' at Threshold Maximum
Initiate Compressor Switchback Upon Loss of Sensor P1		Revert to Compressor-Cycling Via Electro-Mechanical Low-Pressure Switches			
VFD Speed Reference & Condenser Fan-Cycling, Normal Operation	P3(Convert_to_Temp)-T7	Differential Control = 10 °F ; Maximum: 280 psig ; MT Minimum: 125 psig ; LT Minimum: 115 psig	Floating Setpoint with Max/Min Pressures		Turn All Controllable Fans 'Off' at Threshold Minimum, Stage All Fans 'On' at Threshold Maximum
Condenser Fan-Cycling Upon Loss of Sensor(s) P3 &/or T7	P2	150 psig	+/- 10 psig		Disable VFD, Cycle Fans Based Only on Discharge Pressure
Initiate Condenser Switchback Upon Loss of Rack Controller		Revert to Fan-Cycling Via Electro-Mechanical High-Pressure Switches			
Modulate Condenser Holdback Valve	P3	MT Units: 110 psig ; LT Units: 100 psig	+/- 2 psig	MT Units: < 100 psig ; LT Units: < 90 psig	
Modulate Receiver Pressure Regulating Valve	P2-P4	Differential Control, 15 psig	+/- 2 psig		
High-Pressure Stage-Off Comp#1	P2	CO 370 psig, CI 360 psig			Lock out compressor, auto reset below CI
High-Pressure Stage-Off Comp#2	P2	CO 360 psig, CI 350 psig			Lock out compressor, auto reset below CI
High-Pressure Stage-Off Comp#3	P2	CO 350 psig, CI 340 psig			Lock out compressor, auto reset below CI
High-Pressure Stage-Off Comp#4, if applicable	P2	CO 340 psig, CI 330 psig			Lock out compressor, auto reset below CI
High-Pressure Stage-Off Comp#5, if applicable	P2	CO 330 psig, CI 320 psig			Lock out compressor, auto reset below CI
Modulate Subcooler EEV	T6-P6(Covert_to_Temp)	Differential Control = 10 °F (Superheat)	+/- 2 °F	< 2 °F	
Modulate Subcooler EEPR	P6	72 psig	+/- 2 psig	+/- 10 psig	
Open/Close Subcooler DX Solenoid	T4	LT Units: CI >55, CO<45 ; MT Units: CI>80, CO<70	+/- 2 °F		Disable Upon Subcooler Floodback Condition (Low Superheat) or When No Compressors are Running
EEV Reset/Calibration	Time Clock	24-Hour Cycle			EEV Reset/Calibration & Subcooler Enable
Modulate ELPRV	P5	MT Units: 190 psig ; LT Units: 125 psig	+/- 2 psig	+/- 10 psig	Enable with ELPRV Bypass Solenoid
Open/Close Solenoid Valve for ELPRV Bypass	T5	LT Units: CI >57, CO<52 ; MT Units: CI >82, CO<57	+/- 2 °F		2 minute delay required to open/bypass
Cycle Ventilation Fans	T8	CI >80, CO <50	+/- 2 °F		
Monitor Drop Leg Temp	T3				Monitoring/Logging Purposes Only
Monitor Discharge Header Temp	T2				Monitoring/Logging Purposes Only

HUSSMANN®

To obtain warranty information or other support, contact your Hussmann representative. Please include the model and serial number of the product.

Hussmann Corporation, Corporate Headquarters: Bridgeton, Missouri, U.S.A. 63044-2483 01 October 2012

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