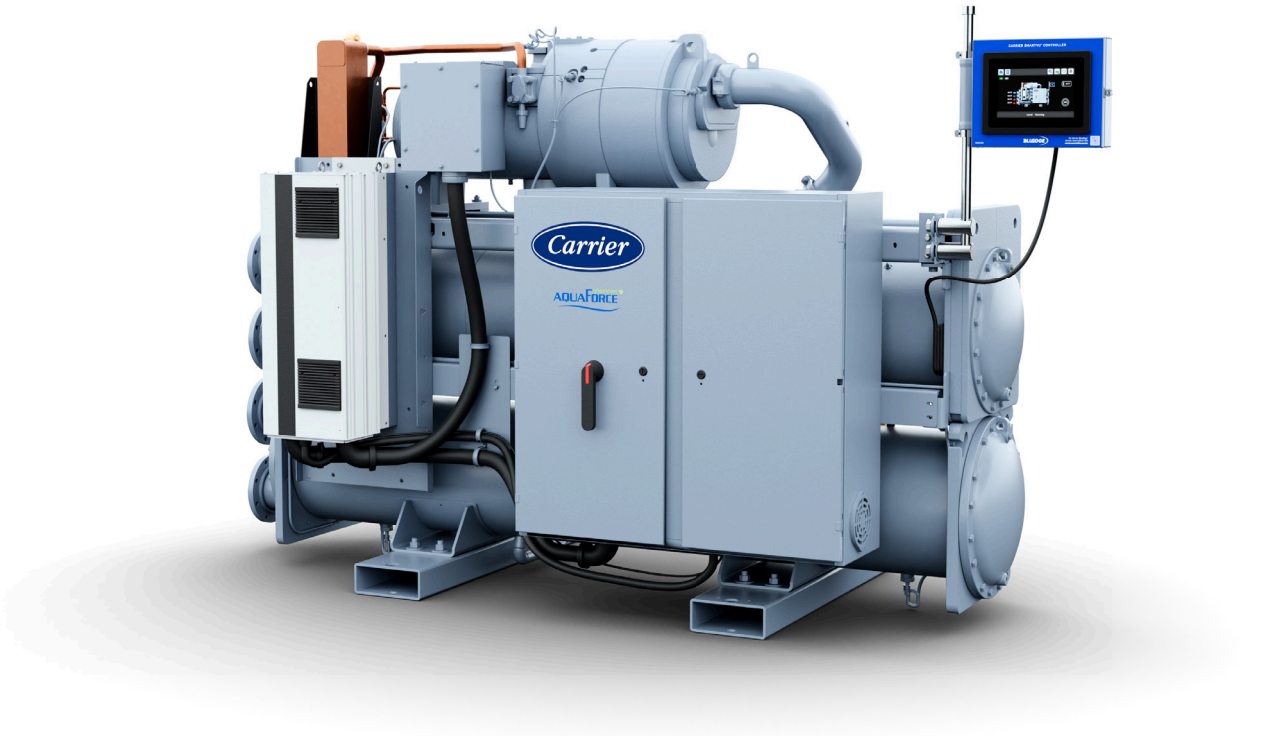
Product Data

AquaForce® High-Efficiency Variable Speed Screw Chiller or Heat Pump

75-200 Nominal Tons

(299-703 Nominal kW)



23XW/XQ
High-Efficiency Variable Speed Screw Chiller or Heat Pump with Greenspeed® Intelligence

Features/Benefits

Quality design and construction make AquaForce 23XW/XQ chillers & heat pumps, the best choice for modern, efficient chilled water plants.

Carrier's AquaForce® 23XW/XQ chiller with Greenspeed® intelligence is an integrated variable speed, water-cooled screw chiller. It incorporates significant breakthroughs in water-cooled chiller technology to provide excellent reliability and achieve superior efficiencies at true operating conditions without compromising the environment.

The 23XW/XQ chiller or heat pump provides:

- SmartVu™ touchscreen controls with PIC6.1
- Heat pump capability up to 140°F (60°C) on 23XQ and 120°F (48.9°C) on 23XW for heat recovery.
- Variable speed, positive displacement screw compressor
- Optimized for Low GWP R-515B or Ultra Low GWP PUREtec™ R-1234ze(E)
- An ideal solution for constant and variable flow pumping systems.
- Five year refrigerant warranty (Domestic and Canada only)

Product reliability

The 23XW/XQ chiller or heat pump uses proven technology from Carrier's existing line of AquaForce chillers or heat pumps along with innovations that increase reliability. The 23XW/XQ compressors are designed for extremely high reliability. The advanced compressor features a balanced rotor geometry and shorter screw lengths, resulting in vastly reduced compressor bearing loads and a minimum L10 compressor bearing life of 50 years when operated at AHRI conditions.

Variable speed capacity control eliminates slide valves, their associated losses, and their potential failure modes. Component count (both rotating and total) has been minimized, assuring maximum reliability under a wide range of operating conditions.

High efficiency

Per AHRI 550/590, chillers operate at design conditions less than one percent of the time. As a result, superior part load efficiency is required for today's chilled water applications. The AquaForce® 23XW/XQ screw chiller or heat pump maximizes efficiency by optimizing compressor operation. Electric power consumption drops dramatically when the motor speed slows. The AquaForce chiller or heat pump efficiency levels meet or exceed energy efficiency requirements of ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) 90.1-2022.

Respect for the environment

Carrier has long been committed to the environment and its sustainability. Carrier's decision to utilize non-ozone depleting Ultra-Low GWP R-1234ze(E) or low GWP R-515B refrigerant provides our customers with a safe and environmentally balanced solution without compromising efficiency.

Quality design

Small footprint

The AquaForce 23XW/XQ chiller or heat pump's positive pressure design reduces the chiller size by up to half compared to negative-pressure designs. Extremely high compression efficiencies allow for compact, high-efficiency chillers that require less mechanical room floor space.

Constant or variable evaporator flow

The 23XW/XQ chiller or heat pump combines the advantages of positive displacement compression with variable speed capacity control. This process provides a chiller that reacts substantially better than chillers equipped with inlet guide vanes or slide valves. This allows for easier transition when bringing additional chillers on line in multiple chiller plants and eliminates any possibility of surge, regardless of the changes in the system.

ASHRAE 90.1 COMPLIANT

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Features/Benefits (cont)

Low harmonic distortion option

The AquaForce 23XW/XQ chiller will generate less than 5% total harmonic distortion with the use of a freestanding harmonic filter. This assures the VFD alone cannot exceed IEEE-519 standard for distortion at the point of common coupling. Ultra-low harmonics can eliminate need for complicated harmonic system studies.

Low starting current (inrush)

The inrush current is limited to the chiller full load amps (rated load amperes). No other starting means can equal this level of starting current. The combination of low current and ultra-low harmonics can reduce backup generator size requirements.

Semi-hermetic motor

The AquaForce 23XW/XQ chiller or heat pump utilizes motors that are hermetically sealed from the machine room. Cooling is accomplished by spraying liquid refrigerant on the motor windings. This highly efficient motor cooling method results in cooler-running motors than could be realized with air-cooled designs of the same type.

In addition, Carrier's semi-hermetic design eliminates:

- Compressor shaft seals that require maintenance and increase the likelihood of refrigerant leaks.
- Machine room cooling requirements of 100 Btu/hr/ton (29.3 w/kW) and 4.6 cfm/ton (0.00212 cu m/sec/kW) associated with air-cooled motors, which dissipate heat to the mechanical room.
- High noise levels common with air-cooled motors, which radiate noise to the machine room and adjacent areas.
- Shaft alignment problems that occur with open-drive designs during start-up and operation, when equipment temperature variations cause thermal expansion.

Positive pressure design

Positive pressure designs eliminate the need for costly low pressure containment devices, reducing the initial cost of the system. The AquaForce® 23XW/XQ chiller or heat pump's positive pressure design ensures that air, moisture, and other performance-degrading contaminants are not sucked inside the chiller. Purge units and their associated maintenance are no longer necessary.

Optional refrigerant isolation valves

The optional refrigerant isolation valves allow the refrigerant to be stored inside the chiller during shipment from the factory, minimizing start-up time. During servicing, the "in-chiller" storage reduces refrigerant loss and eliminates time-consuming transfer procedures. As a self-contained unit, the AquaForce 23XW/XQ chiller or heat pump does not require additional remote storage systems.

Modular construction

The evaporator, condenser, and compressor assemblies are bolted together, making AquaForce 23XW/XQ chillers or heat pumps ideally suited for replacement jobs where ease of disassembly and reassembly at the jobsite are essential.

Single point power

The 23XW/XQ chiller or heat pump features internal control power transformers to provide low voltage power (115 v and 24 vdc) for machine controls. Simply connecting the three input power leads to the VFD provides all unit power.

Features/Benefits (cont)

Marine container shipment

The compact design allows for open-top container shipment to export destinations, ensuring quality while reducing shipping cost.

Heat exchanger combinations

The AquaForce 23XW/XQ chillers or heat pumps are available with a complete line of heat exchangers, ensuring the best combination of chiller components to meet project specific tonnage and efficiency requirements. One, 2, and 3-pass arrangements are available to meet a wide variety of flow conditions. Nozzle-in-head and marine waterboxes are available to meet 150 psig (1136 kPa) and 300 psig (2170 kPa) piping requirements.

Heat exchanger features

ASME certified construction

An independent agency certifies the design, manufacture, and testing of all heat exchangers to American Society of Mechanical Engineers (ASME) standards, ensuring heat exchanger safety, reliability, and long life. The ASME 'U' stamp is applied to the refrigerant side of the evaporator and condenser and is applied to the water side of heat exchangers when 300 psig (2170 kPa) marine water boxes are provided.

High performance tubing

Carrier's AquaForce 23XW/XQ chillers or heat pumps utilize advances in heat transfer technology, providing compact, high-efficiency heat exchangers. Tubing with advanced internally and externally enhanced geometry improves chiller performance by reducing overall resistance to heat transfer while reducing fouling.

Evaporator tube expansion

Tube wall thickness is greater at the expansion location, support sheets, and end tube sheets in order to provide maximum strength and long tube life.

Double-grooved end tube sheet holes

This design provides a more robust seal than single rolled joints, reducing the possibility of leaks between the water and refrigerant sides of the chiller.

Condenser baffle

The baffle deflects hot discharge gas before it contacts condenser tubes, reducing tube vibration and wear while distributing refrigerant more evenly over the length of the vessel for improved efficiency.

Closely spaced intermediate support sheets

Support sheets prevent tube sagging and vibration, thereby increasing heat exchanger life.

Oil filter isolation valves

These valves allow filter replacement without pumping down the chiller, reducing service time and expense.

Flow control

The variable flow control system regulates refrigerant flow according to load conditions, providing a liquid seal at all operating conditions, eliminating unintentional hot gas bypass. 23XW/XQ units are controlled by an electronic expansion valve.

Microprocessor control features:

Direct digital Product Integrated Control (PIC6.1) provides unmatched flexibility and functionality. Each unit integrates directly with the Carrier Comfort Network® (CCN) system, providing a system solution to controls applications. The PIC6.1 control can be configured to display units in English or metric, and provides unparalleled ease of operation.

The PIC6 display offers an "all-in-one" view of key chiller operational data, simplifying the interaction between the chiller and user.

Features include:

- Display of over 125 operating, status, and diagnostic messages for improved user experience
- Monitoring of over 100 functions and parameters to protect the chiller from abnormal conditions
- Modular pull-out/plug-in design, reducing wiring requirements and providing easy installation
- Low-voltage (24 v) design, providing the ultimate assurance of personal safety and control integrity

The display modes include 3 standard languages:

- English
- Chinese
- Portuguese

Automatic capacity override

This function unloads the compressor whenever key safety limits are approached, increasing unit life. This feature also allows the machine to operate at reduced capacity, rather than shut down, when key safety limits are approached.

Leaving liquid temperature reset

Reset can be accomplished manually or automatically from the building management system. For a given capacity, reset allows operation at slower compressor speeds, saving energy when warmer chilled liquid or cooler hot liquid can be used.

Demand limiting

This feature limits the power draw of the chiller during peak loading conditions. When incorporated into the Carrier Comfort Network® building automation system, a red line command holds chillers at their present capacity and prevents any other chillers from starting. If a load shed signal is received, the compressors are unloaded to avoid demand charges whenever possible.

Ramp loading

Ramp loading ensures smooth pulldown of liquid loop temperature and prevents a rapid increase in compressor power consumption during the pulldown period.

Automated controls test

The test can be executed prior to start-up to verify that the entire control system is functioning properly.

365-day real time clock

This feature allows the operator to program a yearly schedule for each week, weekends, and holidays.

Occupancy schedules

Schedules can be programmed into the controller to ensure that the chiller operates when cooling is required and remains off when not needed by the tenants or process.

Extensive service menu

Unauthorized access to the service menu can be prevented through password protection. Built-in diagnostic capabilities assist in troubleshooting and recommend proper corrective action for preset alarms, resulting in greater working time.

Alarm file

This file maintains the last 25 time-and date-stamped alarm messages in memory. This function reduces troubleshooting time and cost.

Alert file

This file maintains the last 25 alert messages in memory. This function provides prognostic information and corrective actions that can avoid unit shutdown.

Features/Benefits (cont)

Configuration data backup

Non-volatile memory provides protection during power failures and eliminates time-consuming control reconfiguration.

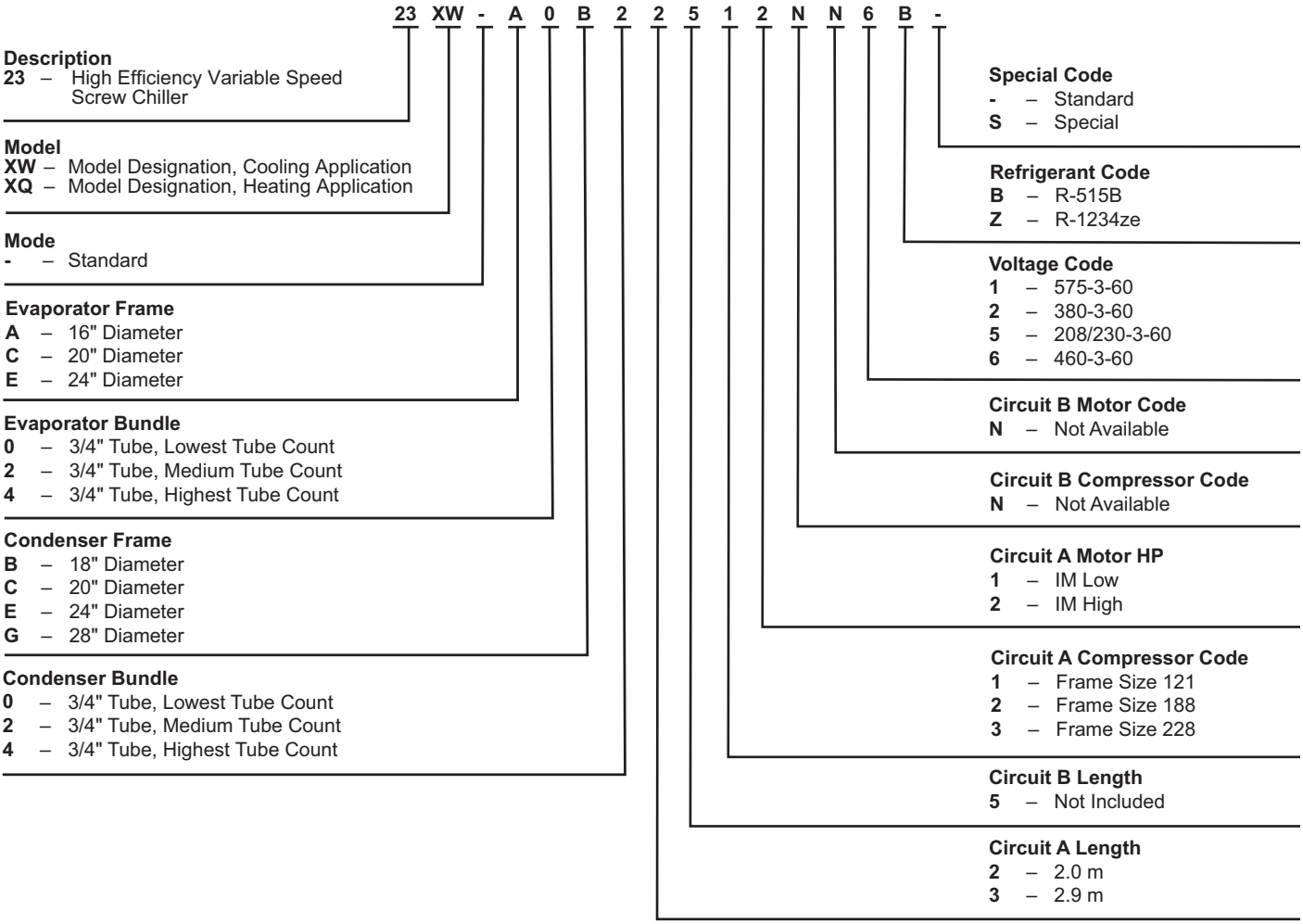
Heat Mode Controls

The AquaForce 23XW/XQ can be configured to operate in either cooling or heating mode. The unit controls compressor capacity to maintain the selected leaving chilled-water or hot-water temperature setpoint. The operating mode can be selected through the unit controls, building management system, or an external heat/cool input.

Low Source Protection

Low source controls on the AquaForce 23XW/XQ provide evaporator suction protection to reduce nuisance trips when operating in heating applications. This capability allows the unit to operate reliably when source-water temperature or available source load is low.

Model number nomenclature



Quality Assurance

ISO 9001:2015-certified processes

Water-cooled chillers within the scope of the AHRI (Air-Conditioning, Heating, and Refrigeration Institute) Water-Cooled Chiller certification program are certified in accordance with the AHRI Water-Cooled Water-Chilling and Heat Pump Water-Heating Packages Certification Program, which is based on AHRI Standard 550/590 (I-P) and AHRI Standard 551/591 (SI). Certified units may be found in the AHRI Directory at www.ahridirectory.org.

Physical data

23XW/XQ chiller weight

The weight of a 23XW/XQ chiller is best obtained by running the chiller selection software. The 23XW/XQ chiller has an extensive number of possible combinations of evaporators (including tubing type and length), condensers (including tubing type and length), waterbox types (taking into account heat exchanger passes), compressors, motors, and system accessories. The 23XW/XQ selection software will determine the rigging weight, operating weight, corner weight, and spring deflection (if applicable) of any configured unit. Due to rigging and installation considerations, there are times when it becomes necessary to determine the contribution of individual components that comprise the chiller. For these situations, a detailed component breakdown is provided in the 23XW/XQ Installation Instructions.

Options and accessories

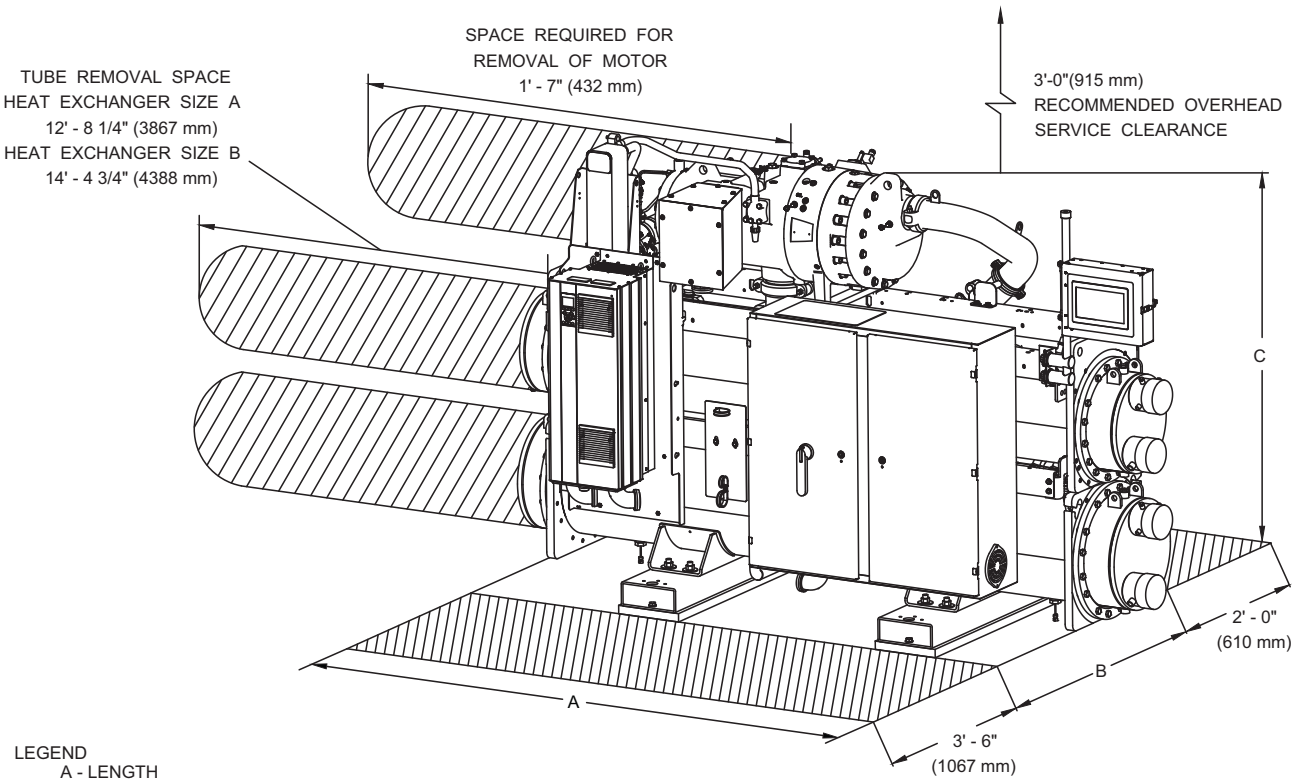
ITEM	OPTION[a]	ACCESSORY[b]
Freestanding 3% Line Reactor		X
Freestanding Harmonic Filter		X
.028 or .035 in. (0.711 or 0.889 mm) Internally/Externally Enhanced Copper Tubing — Evaporator/Condenser	X	
Flanged Evaporator and/or Condenser Waterbox Nozzles[c]	X	
Hinged Waterboxes[d]	X	
Marine Waterboxes, 150 psig (1034 kPa)[e]	X	
Marine Waterboxes, 300 psig (2068 kPa)[e]	X	
Nozzle-in Head Waterbox, 300 psig (2068 kPa)	X	
One, 2, or 3 Pass Evaporator or Condenser Waterside Construction	X	
100K AIC (Amp Interrupt Capacity) High Interrupt Circuit Breaker (Not Available on 575-v Std Tier Drive)	X	
Analog Voltmeter and Ammeter with 3 Phase Selector Switch (575-v Std Tier VFD Only)	X	
Digital Meter Kit (Std Tier Only)	X	
LonWorks[f] Carrier Translator		X
Sensor Package		X
Refrigerant Isolation Valves	X	
Shipped Factory Charged with Refrigerant	X	
Soleplate Package		X
Spring Isolator Kit		X
Customer Factory Performance Testing	X	
Export Crating	X	
Extended Warranty (North American Operations [NAO] only)	X	
Service Contract	X	
Low Noise	X	
Ultra Low Noise	X	
10 in. Swivel Mount HMI Panel	X	
Thermal Compressor Insulation[g]	X	

NOTE(S):

a. Factory installed.
b. Field installed.
c. Standard waterbox nozzles are Victaulic type. Flanged nozzles are available as an option with either nozzle-in-head type waterboxes or marine waterboxes.
d. Not available with all frame sizes and pass arrangements.
e. Optional marine waterboxes available for 23XW/XQ heat exchangers. Standard waterboxes for 23XW/XQ are nozzle-in-head type, 150 psig (1034 kPa).
f. Third party trademarks and logos are the property of their respective owners.
g. This is standard on 23XQ heat exchangers and an option for 23XW heat exchangers.

Dimensions

23XW/XQ Heat Exchanger



LEGEND
- A - LENGTH
- B - WIDTH
- C - HEIGHT

SERVICE AREA

NOTES:
1. Dished head (NIH) waterbox shown.
2. Service areas are minimum space required.
3. Allow 48" [1219mm] on either side of the chiller.
4. Provide free space above the tube pull area equal to the height of the chiller plus 63" [1600 mm]. The overhead rigging space will allow the tube pull area to be utilized for service area.
5. For actual unit dimensions, contact your Carrier sales professional for certified drawings.

Dimensions (cont)

23XW/XQ Dimensions (Nozzle-In-Head Waterbox)

EVAPORATOR LENGTH			CONDENSER LENGTH		
HX-FRAMES	1-PASS	2-PASS	HX-FRAMES	1-PASS	2-PASS
	in.	in.		in.	in.
A	121.32	120.34	B	121.32	115.81
C	142.01	136.50	C	122.32	116.81
E	142.01	136.50	E	142.01	136.50
			G	142.01	136.50

NOTES:
1. Assumes both evaporator and condenser nozzles on same end of chiller; nozzle-in-head waterboxes, 150 psi rated.
2. Service access should be provided per American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 15, latest edition, National Fire Protection Association (NFPA) 70, local safety code, and Carrier drawings.
3. Overhead clearance for service rigging compressor should be at minimum 5 feet (1524 mm) with floor space identified adjacent to unit as per service clearance illustration to allow for compressor service.
4. Dimensions are approximate. Certified drawings available upon request.
5. Waterboxes typically add to the width of the machine. See certified drawings for details.
6. 'A' length dimensions shown are for standard 150 psig (1034 kPa) design and flanged connections. See certified drawings.
7. 23XW/XQ unit heights can vary depending on the configuration. Check 23XW/XQ certified drawings for height information.
8. Table contains heat exchanger dimensions. For arrangements where the compressor motor housing extends past the waterbox, consult the 23XW/XQ certified drawings.
9. Consult factory for configurations not listed in the above table.

23XW/XQ Nozzle-In-Head / Marine Waterbox Nozzle Size

NOZZLE SIZE (in.) (Nominal Pipe Size)							
FRAME SIZE	Evaporator			FRAME SIZE	Condenser		
	1-Pass	2-Pass	3-Pass		1-Pass	2-Pass	3-Pass
A	6	5	5	B	6	5	5
C	8	6	6	C	8	6	5
E	8	6	6	E	8	8	8
				G	8	8	8

23XW/XQ Dimensions (Marine Waterbox, 150 psig)

EVAPORATOR LENGTH			CONDENSER LENGTH		
HX-FRAMES	1-PASS	2-PASS	HX-FRAMES	1-PASS	2-PASS
	in.	mm		in.	in.
A	139.35	124.82	B	139.58	124.94
C	159.52	145.25	C	139.83	125.57
E	160.01	145.50	E	160.01	145.50
			G	160.5	145.74

NOTES:
1. Assumes both evaporator and condenser nozzles on same end of chiller; marine waterboxes, 150 psi rated.
2. Service access should be provided per American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 15, latest edition, National Fire Protection Association (NFPA) 70, local safety code, and Carrier drawings.
3. Overhead clearance for service rigging compressor should be at minimum 5 feet (1524 mm) with floor space identified adjacent to unit as per service clearance illustration to allow for compressor service.
4. Dimensions are approximate. Certified drawings available upon request.
5. Marine waterboxes typically add to the width of the machine. See certified drawings for details.
6. 'A' length dimensions shown are for standard 150 psig (1034 kPa) design and flanged connections. See certified drawings.
7. 23XW/XQ unit heights can vary depending on the configuration. Check 23XW/XQ certified drawings for height information.
8. Table contains heat exchanger dimensions. For arrangements where the compressor motor housing extends past the waterbox, consult the 23XW/XQ certified drawings.
9. Consult factory for configurations not listed in the above table.

Dimensions (cont)

23XW/XQ Evaporator and Condenser Dimensions (Nozzle-in-Head Waterbox)[a,b,c,d,e,f]

HEAT EXCHANGER FRAME	EVAPORATOR LENGTH (MARINE WATERBOX)[g]		CONDENSER LENGTH (MARINE WATERBOX)	
	1-PASS	2-PASS	1-PASS	2-PASS
	in.	in.	in.	in.
A	121.32	120.34	121.32	115.81
C	142.01	136.50	122.32	116.81
E	142.01	136.50	142.01	136.50
G	—	—	142.01	136.50

NOTE(S):

a. Service access should be provided per American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 15, latest edition, National Fire Protection Association (NFPA) 70, and local safety code.
b. Allow at least 3 ft (915 mm) overhead clearance for service rigging for compressor.
c. Certified drawings available upon request.
d. Marine waterboxes may add 6 in. (152 mm) to the width of the machine. See certified drawings for details.
e. 'A' length dimensions shown are for standard 150 psig (1034 kPa) design and Victaulic connections. The 300 psig (2068 kPa) design and/or flanges will add length. See certified drawings.
f. Dished head waterbox covers are available only for 2-pass design.
g. 1 or 3 pass length applies if either (or both) evaporator or condenser is a 1 or 3 pass design. The 2-pass length assumes both evaporator and condenser nozzles on same end of chiller.

23XW/XQ Evaporator and Condenser Dimensions (Marine Waterbox)[a,b,c,d,e]

HEAT EXCHANGER FRAME	EVAPORATOR LENGTH (MARINE WATERBOX)[f]		CONDENSER LENGTH (MARINE WATERBOX)	
	1-PASS	2-PASS	1-PASS	2-PASS
	in,	in.	in.	in.
A	139.35	124.82	139.58	124.94
C	159.52	145.25	139.83	125.57
E	160.01	145.50	160.01	145.50
G	—		160.50	145.74

NOTE(S):

a. Service access should be provided per American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 15, latest edition, National Fire Protection Association (NFPA) 70, and local safety code.
b. Allow at least 3 ft (915 mm) overhead clearance for service rigging for the compressor.
c. Certified drawings available upon request.
d. Marine waterboxes may add 6 in. (152 mm) to the width of the machine. See certified drawings for details.
e. 'A' length dimensions shown are for standard 150 psig (1034 kPa) design and Victaulic connections. The 300 psig (2068 kPa) design and/or flanges will add length. See certified drawings.
f. 1 or 3 pass length applies if either (or both) evaporator or condenser is a 1 or 3 pass design. The 2-pass length assumes both evaporator and condenser nozzles on same end of chiller.

Nozzle Size

FRAME SIZE	NOZZLE SIZE (in.) (Nominal Pipe Size)					
	Evaporator			Condenser		
	1-Pass	2-Pass	3-Pass	1-Pass	2-Pass	3-Pass
A	6	5	5	—	—	—
B	—	—	—	6	5	5
C	8	6	6	8	6	5
E	8	6	6	8	8	8
G	—	—	—	8	8	8

LEGEND

NIH — Nozzle-in-Head

Electrical data

VFD Frame Sizes

DRIVE CODE	DANFOSS FRM	OUTPUT kW	INPUT A
1	D1h	110	290
2	D1h	132	240
3	D1h	160	302
4	D2h	200	361
5	D2h	250	443
6	D2h	315	535

Controls

Microprocessor controls

The microprocessor control system matches the capacity of the chiller to the cooling or heating load while providing state-of-the-art chiller protection. The microprocessor-based control center protects the chiller by monitoring the digital and analog inputs and executing capacity overrides or safety shutdowns as necessary. The system controls cooling load within the set point (plus or minus the dead band) by sensing the water or brine temperature, regulating system EXV, and regulating VFD (variable frequency drive) speed.

Control system

The control system on each 23XW/XQ chiller is factory mounted, wired, and tested to ensure machine protection and efficient capacity control. In addition, the program logic ensures proper starting, stopping, and recycling of the chiller and provides a communication link to the Carrier Comfort Network® (CCN) system. The PIC6 control system consists of consist of two CIOBs. All boards communicate via an internal LEN bus. The main control board is supplied from a 24VAC supply reference to earth ground. In the event of a power supply interrupt, the unit can restart automatically without the need for an external command. However, any faults active when the supply is interrupted are saved, and may in certain cases prevent a circuit or unit from restarting. Always separate communication cables from other cables and always run wiring as directly as possible.

Features

Control system

- Component test and diagnostic check
- Programmable recycle allows chiller to recycle at optimum loads for decreased operating costs
- Menu-driven keypad interface for status display, set point control, and system configuration
- CCN-system compatible
- Primary and secondary status messages
- Individual start/stop schedules for local and CCN operation modes
- Recall of up to 25 alarm messages and 25 alert messages with diagnostic help
- Optional soft stop unloading decreases compressor speed to unload the motor to the configured amperage level prior to stopping
- Languages pre-programmed at factory for English, Chinese, and Portuguese
- ILT (International Language Translator) available for conversion of extended ASCII characters

Safety cutouts

- Motor high temperature[1,2]
- Refrigerant (condenser) high pressure[1,2]
- Refrigerant (evaporator) low temperature[1,2]
- Lube oil low pressure[1]
- Compressor (refrigerant) high discharge temperature[1]
- Under voltage[3]
- Over voltage[3]
- Evaporator and condenser liquid flow
- Motor overload[2]
- Motor acceleration time
- Intermittent power loss[3]
- Motor stall protection
- Low level ground fault
- Evaporator and condenser freeze prevention[1]
- Low oil temperature
- Motor current imbalance
- Motor rotation reversal
- Excessive motor amps
- Motor starts limit
- VFD speed out of range
- High VFD inverter temperature[1,2]
- DC bus voltage (Low/High)

Capacity control

- Leaving chilled liquid control
- Entering chilled liquid control
- Soft loading control by temperature or load ramping
- Hot gas bypass valve
- Power (demand) limiter
- Automatic chilled liquid reset (3 methods)
- Manual speed control

Interlocks

- Manual/automatic remote start
- Starting/stopping sequence
  Pre-lube/post-lube
  Pre-flow/post-flow
- Compressor run interlock
- Pre-start check of safeties and alerts
- Low chilled liquid (load) recycle
- Monitor/number compressor starts and run hours
- Manual reset of safeties

Indications

- Chiller operating status message
- Power-on
- Pre-start diagnostic check
- Compressor motor amps
- Alert (pre-alarm)[4]
- Alarm
- Contact for remote alarm
- Safety shutdown messages
- Elapsed time (hours of operation)
- Chiller input kW
- Demand kW

Drive control parameters

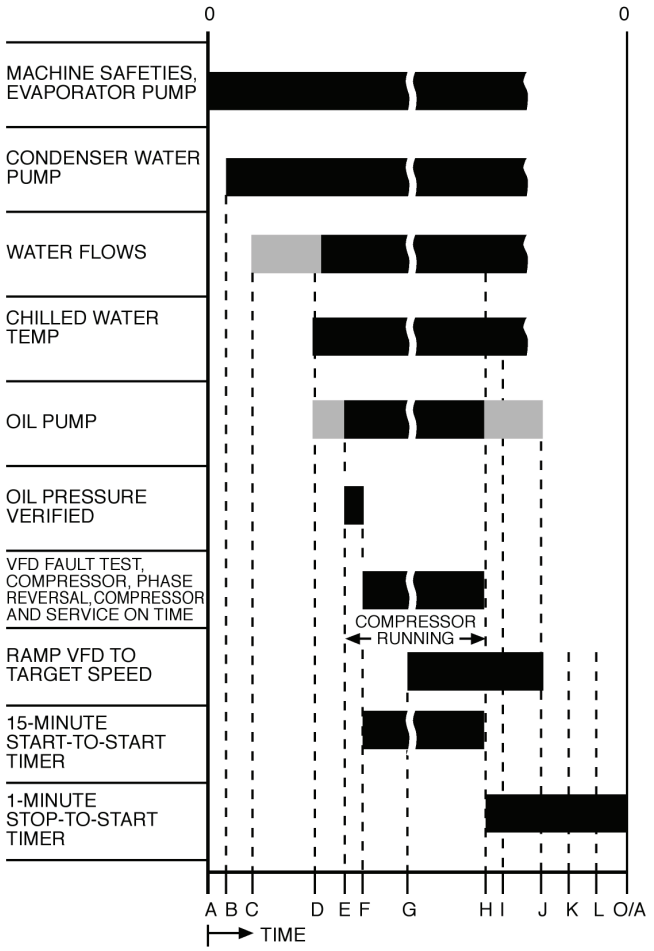
- Compressor 100% speed (Hz)

1. Can be configured by the user to provide alert indication at user-defined limit.
2. Override protection: Causes compressor to first unload and then, if necessary, shut down.
3. Will not require manual reset or cause an alarm if auto-restart after power failure is enabled.
4. By display code only.

Controls (cont)

- Motor rated load kW
- Motor rated load amps
- Motor nameplate amps
- Motor nameplate RPM
- Motor nameplate kW
- Inverter PWM (pulse width modulation) frequency

CONTROL SEQUENCE



0 — Phase reversal monitored
A — START INITIATED: Pre-start checks are made; evaporator pump started
B — Condenser liquid pump started (5 seconds after A)
C — Liquid flows verified (30 sec to 5 minutes maximum after B)
D — Chilled liquid temperature checked against control point; oil pump on.
E — Oil pressure verified (oil pressure verified 45-300 sec after D).
F — VFD starts; phase reversal conditions monitored; compressor ontime and service ontime start; 15-minute inhibit timer starts (VFD fault tests for 15 sec after F)
G — Verify average current >5% within 15 sec after VFD start, ramp to VFD target speed.
H — Compressor reaches target speed, chiller set to running status
I — Shutdown initiated: Target VFD speed to 0% (or J occurs)
J — Ramp down until percent line current ≤ soft stop amps threshold (0-60 sec after I)
K — Oil pump relay off (1-20 sec after J)
L — Evaporator pump de-energized (60 sec after K); condenser pump may continue to operate if condenser pressure is high; evaporator pump may continue if in RECYCLE mode
O/A — Restart permitted (both inhibit timers expired) (minimum of 15 minutes after F; minimum of 3 minutes after L)

Control sequence

To start

Local start-up (manual start-up) is initiated by pressing the LOCAL or CCN menu softkey, which is indicated on the default international chiller visual control (PIC6) screen. Time schedule 01 or 03, respectively, must be in the Occupied mode and the internal 15-minute start-to-start and the 1-minute stop-to-start inhibit timers must have expired. All pre-start safeties are checked to verify that all prestart alerts and safeties are within limits (if one is not, an indication of the fault displays and the start will be delayed or is aborted). The signal is sent to start the evaporator liquid pump. Five seconds later, the condenser liquid pump is energized. If satisfied, it checks the chilled liquid temperature against the control point. If the temperature is less than or equal to the chilled liquid control point, the condenser liquid pump is de-energized and the chiller goes into a recycle mode.

If the chilled liquid temperature is high enough, the start-up sequence continues. The oil pump is started and waits a minimum of 45 seconds to verify oil flow. Once oil flow is verified, the VFD is energized. The control will monitor for a phase reversal condition. At this time, the following occurs:

- The “start-to-stop” timer is activated.
- The “compressor on-time” and “service on-time” timers are activated.
- The “starts in 12-hour counter” advances by one.
- The “total compressor starts counter” advances by one.

Once started

If the VFD average current is >5% within 15 seconds after VFD start, the machine enters run mode and speed will be ramped up to meet VFD target speed. Once the target speed is met, the control enters the capacity control mode.

Controls (cont)

Shutdown sequence

The chiller shutdown is initiated if any of the following occur:

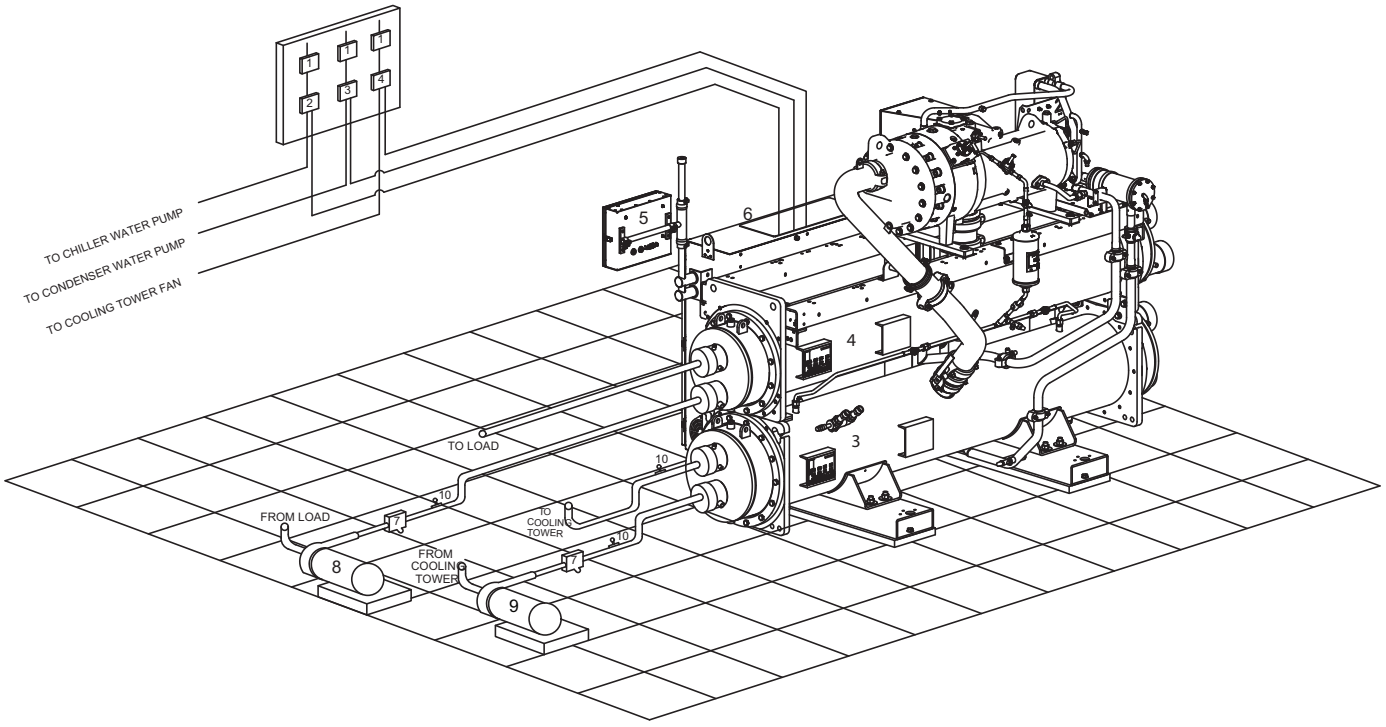
- The Stop button is pressed for at least one second (the alarm light blinks once to confirm the stop command).
- A recycle shutdown is initiated.
- The time schedule has gone into unoccupied mode.
- The chiller protective limit has been reached and the chiller is in alarm.
- The start/stop status is overridden to stop from the PIC6, CCN system, or building management system.

Once the controls shutdown sequence is initiated, the compressor is stopped and the VFD target speed is set to 0. If optional soft stop unloading is activated when the Stop button is pressed or the remote contacts open, motor speed decreases to a configured amperage level, and the compressor is stopped. The display indicates "Shutdown in Progress" while the motor speed decreases. Compressor ontime and service ontime timers stop once the current in all phases is <5%, indicating a VFD Stop Complete. The oil pump and evaporator liquid pump are then deenergized. The condenser liquid pump shuts down when the refrigerant temperature or entering condenser liquid temperature is below pre-established limits. The 3-minute start-to-stop timer starts.

Restart

Restart is permitted after both inhibit timers have expired. If shutdown was due to a safety shutdown, the reset button must be depressed before restarting the chiller.

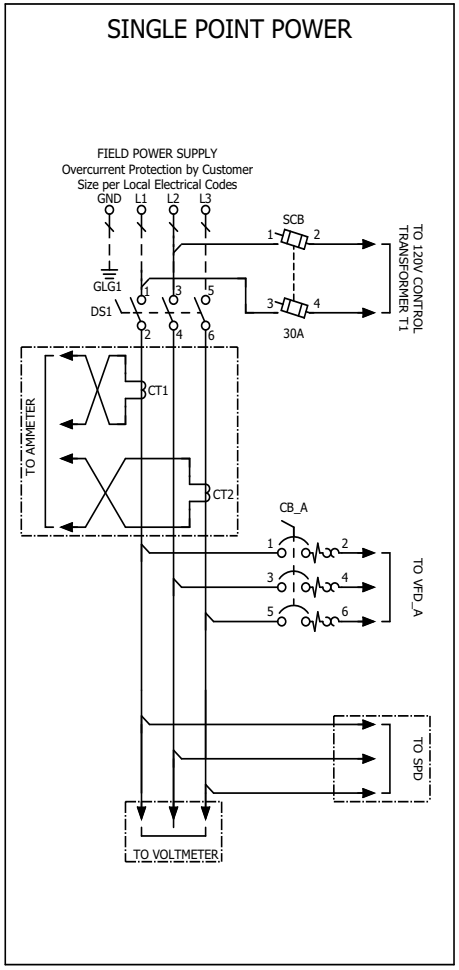
23XW/XQ Chiller
(Unit with Unit-Mounted VFD)

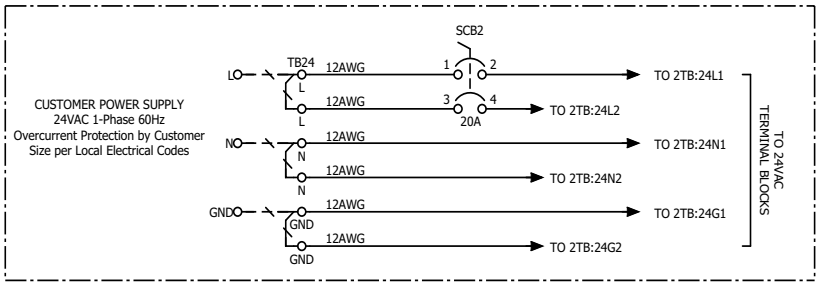


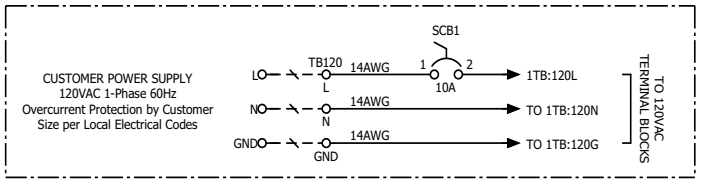
LEGEND
1 — Disconnect
2 — Chilled Water Pump Starter
3 — Condenser Water Pump Starter
4 — Cooling Tower Fan Starter (Low Fan, High Fan)
5 — HMI
6 — Power Panel
7 — Strainers
8 — Chilled Water Pump
9 — Condenser Water Pump
10 — Pressure Gages
11 — Local Disconnect (hidden - in power panel)
Piping
Control Wiring
Power Wiring

NOTES:
1. Wiring and piping shown are for general point-of-connection only and are not intended to show details for a specific installation. Certified field wiring and dimensional diagrams are available on request.
2. All wiring must comply with applicable codes.
3. Wiring not shown for optional devices such as:
   (a) Remote Start/Stop
   (b) Remote Alarms
   (c) Optional Safety Device
   (d) 4 to 20 mA Resets
   (e) Optional Remote Sensors
4. IMPORTANT: Carrier suggests that a structural engineer be consulted if transmission of vibrations from mechanical equipment is of concern.
5. Isolation valves are recommended on the evaporator and condenser water piping to each chiller for service.
6. Operating environment — Chiller should be installed in an indoor environment where the ambient temperature is 40 to 104°F (4 to 40°C) with a relative humidity (non-condensing) of 95% or less. To ensure that electrical components operate properly, do not locate the chiller in an area exposed to dust, dirt, corrosive fumes, or excessive heat and humidity.
7. Disconnection must be incorporated in the fixed wiring in accordance with the local country- specific requirements or NFPA (National Fire Protection Association).
8. Tophat is shipped loose and field assembled.
9. Strainers are typically located on the suction side of the water pumps. It is acceptable to install strainers on either side of the pump.

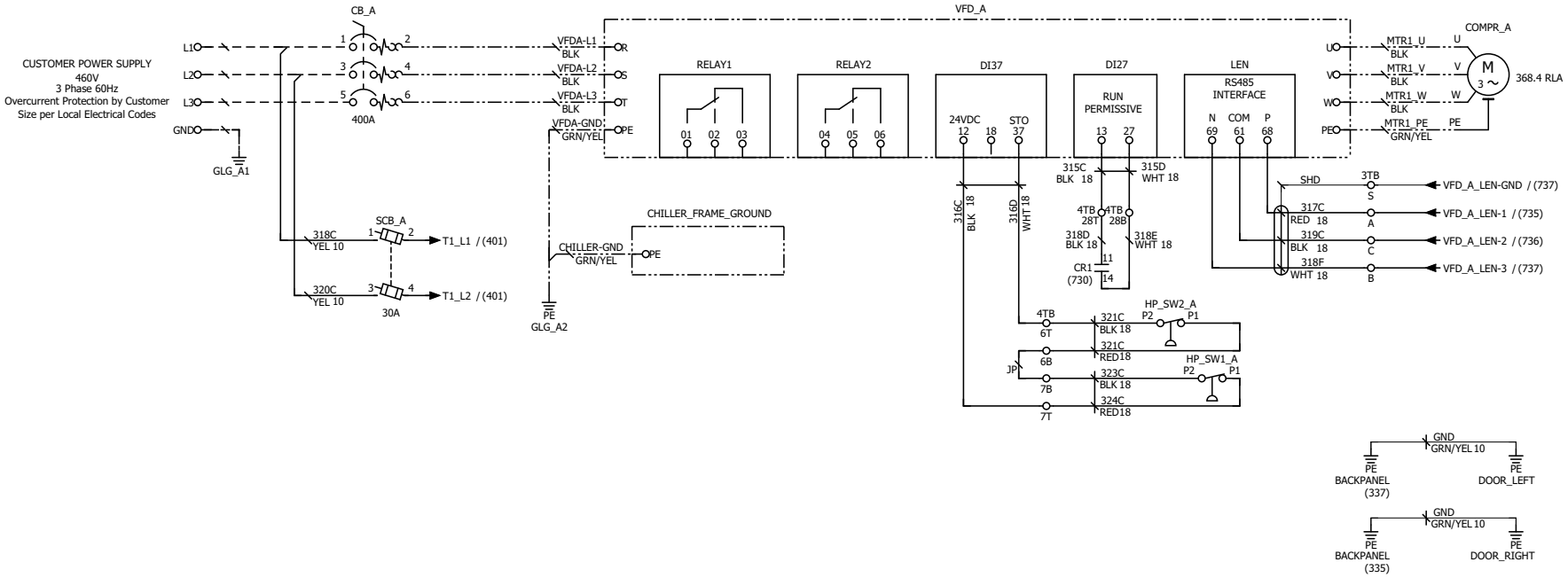
23XW/XQ Incoming Power Options



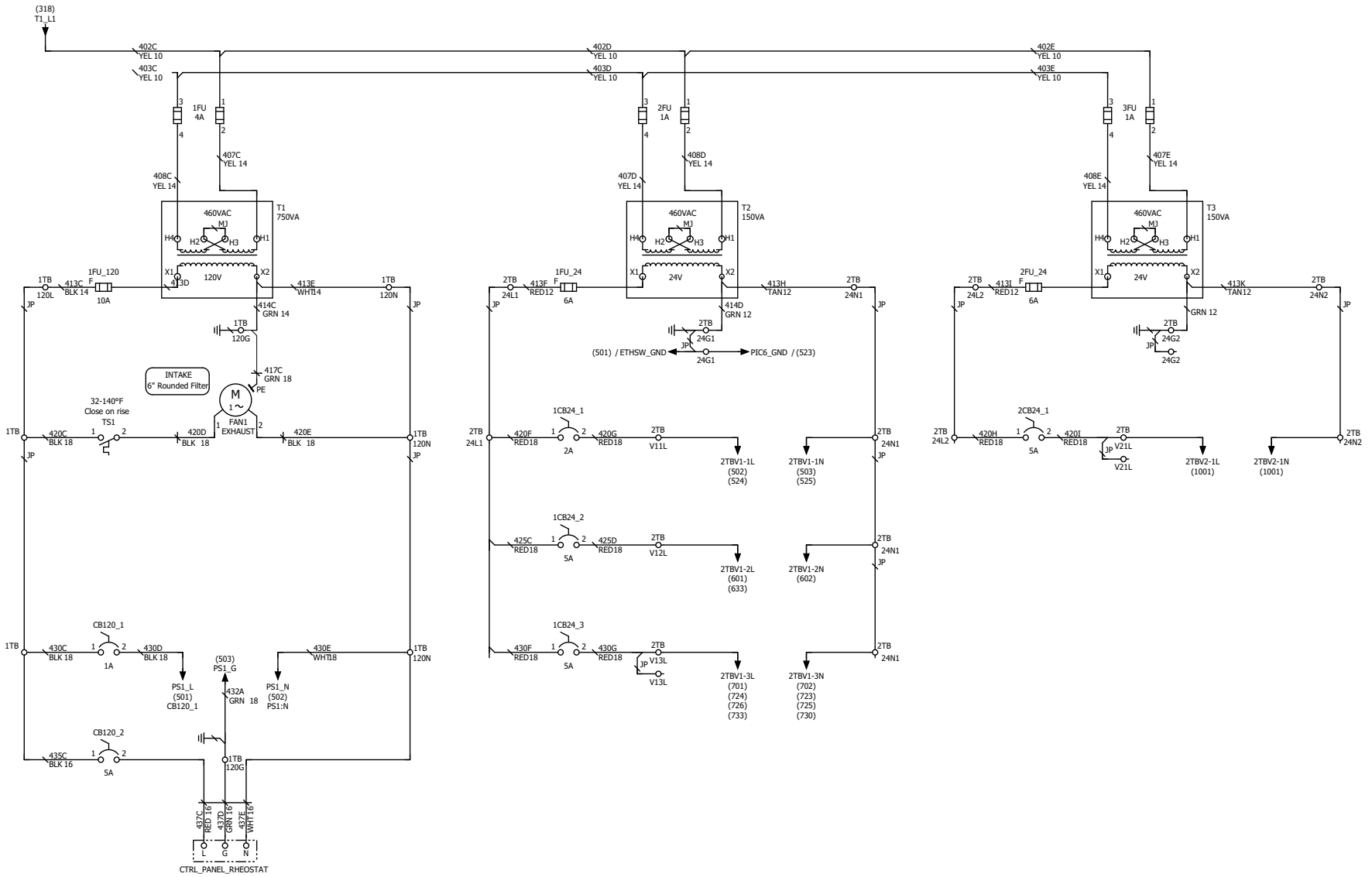




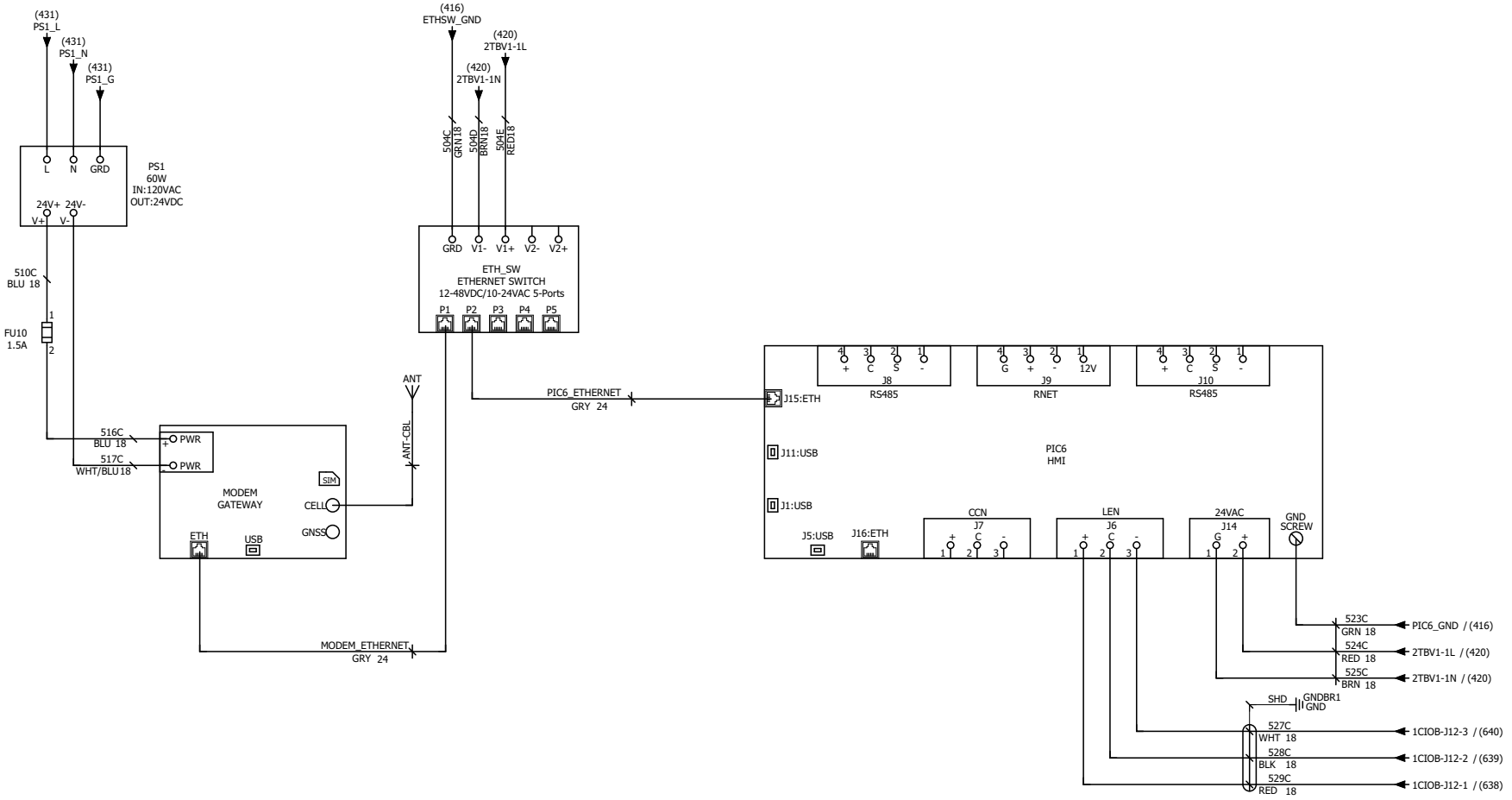
23XW/XQ Incoming Power Supply



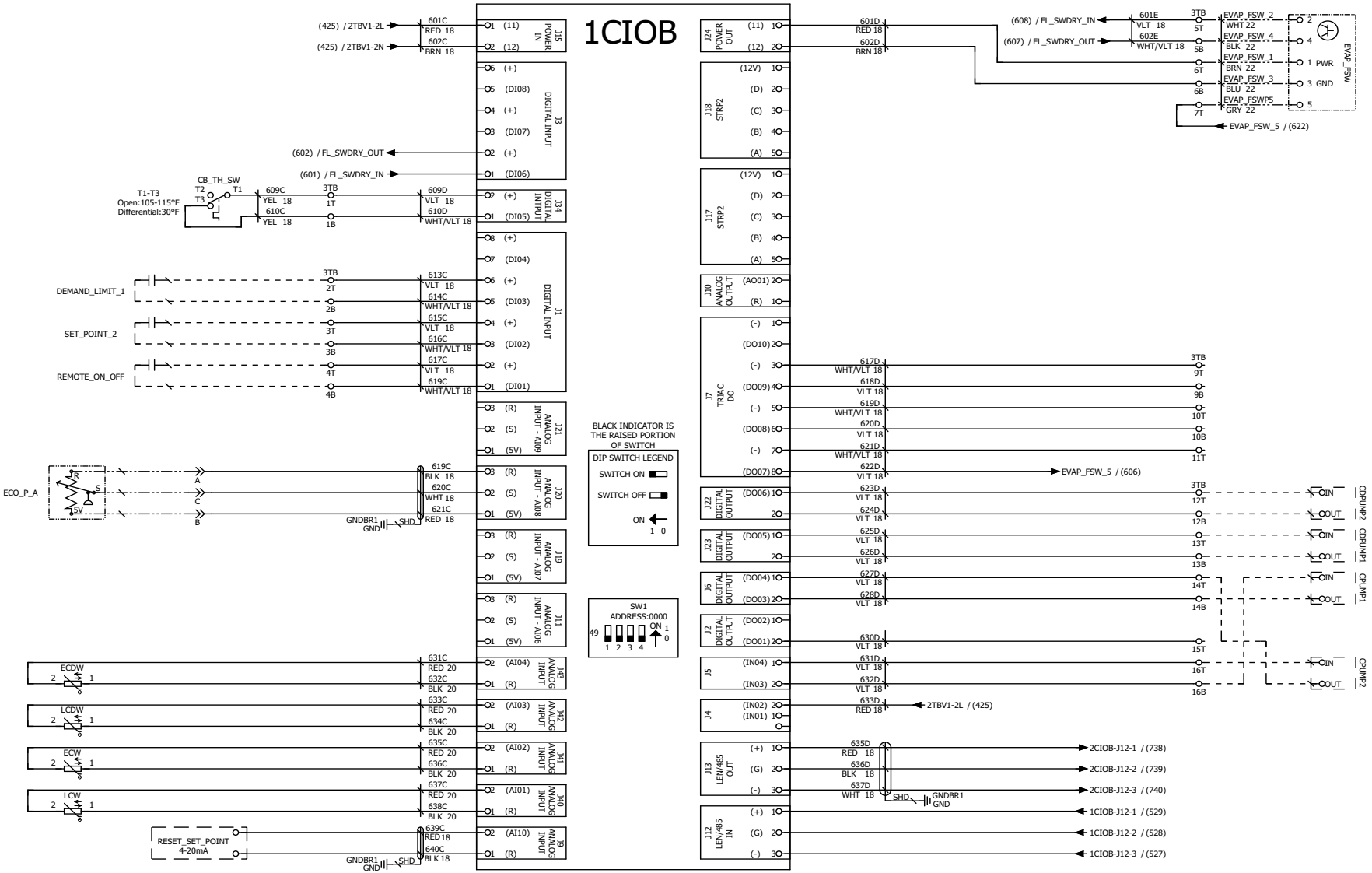
23XW/XQ Control Power Supply



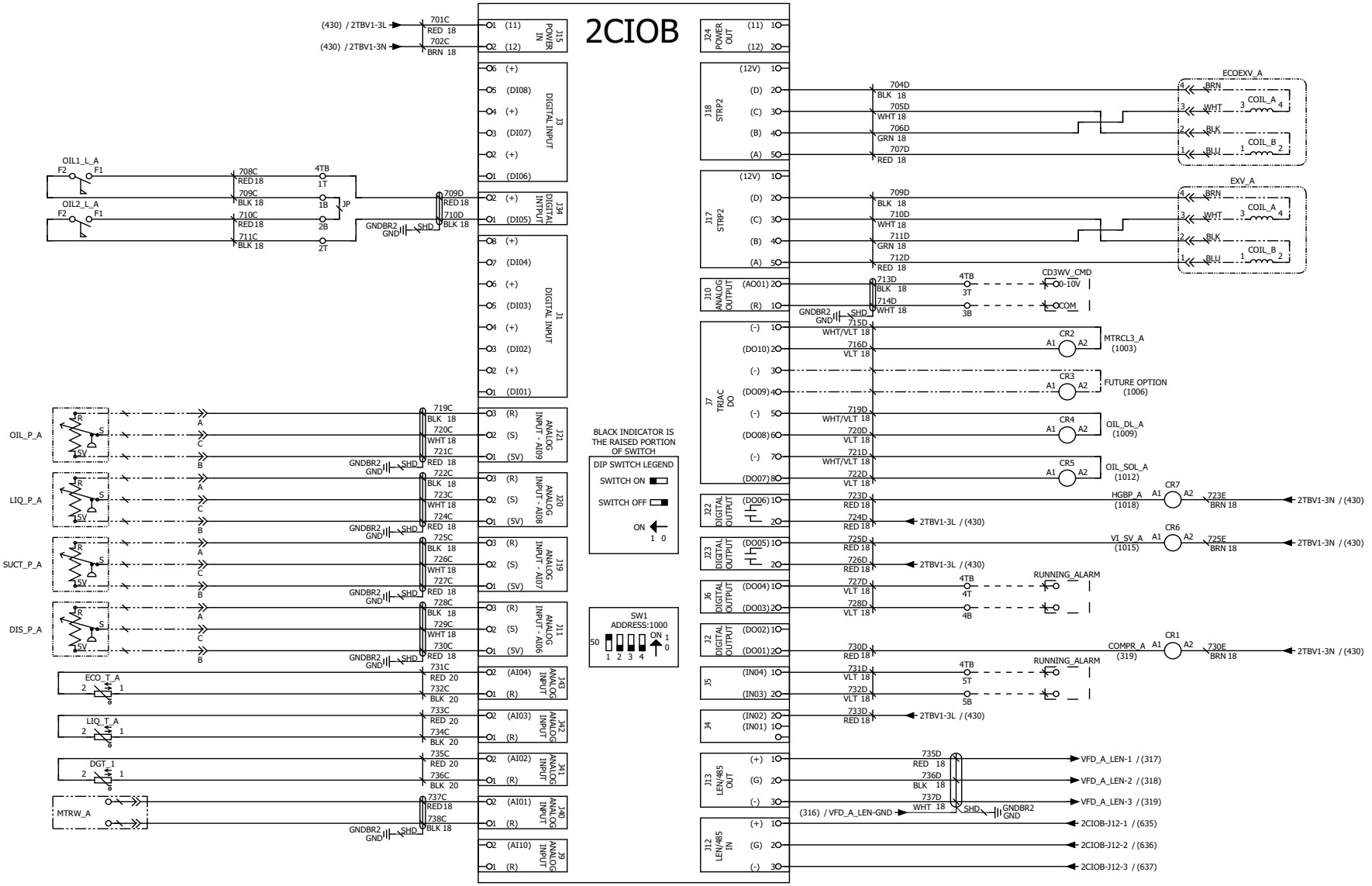
23XW/XQ PIC6 Controls



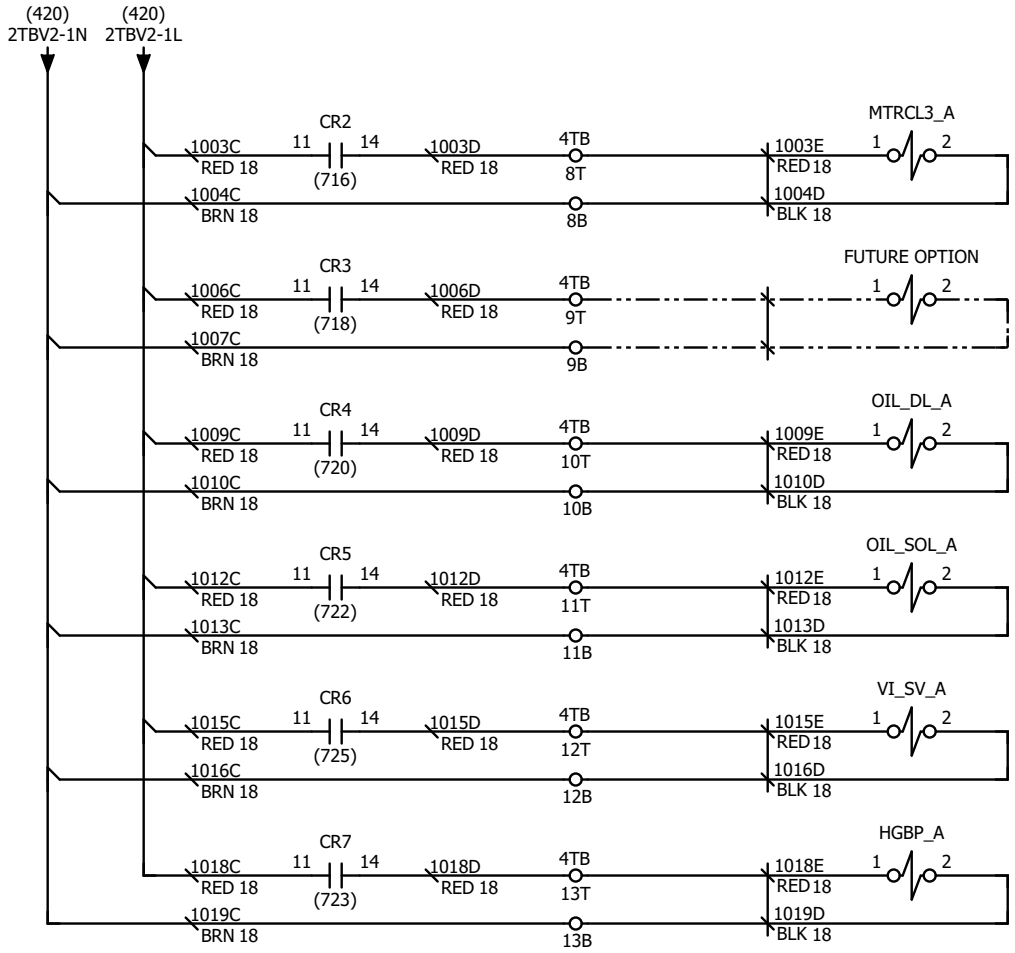
23XW/XQ 1CIOB Controls



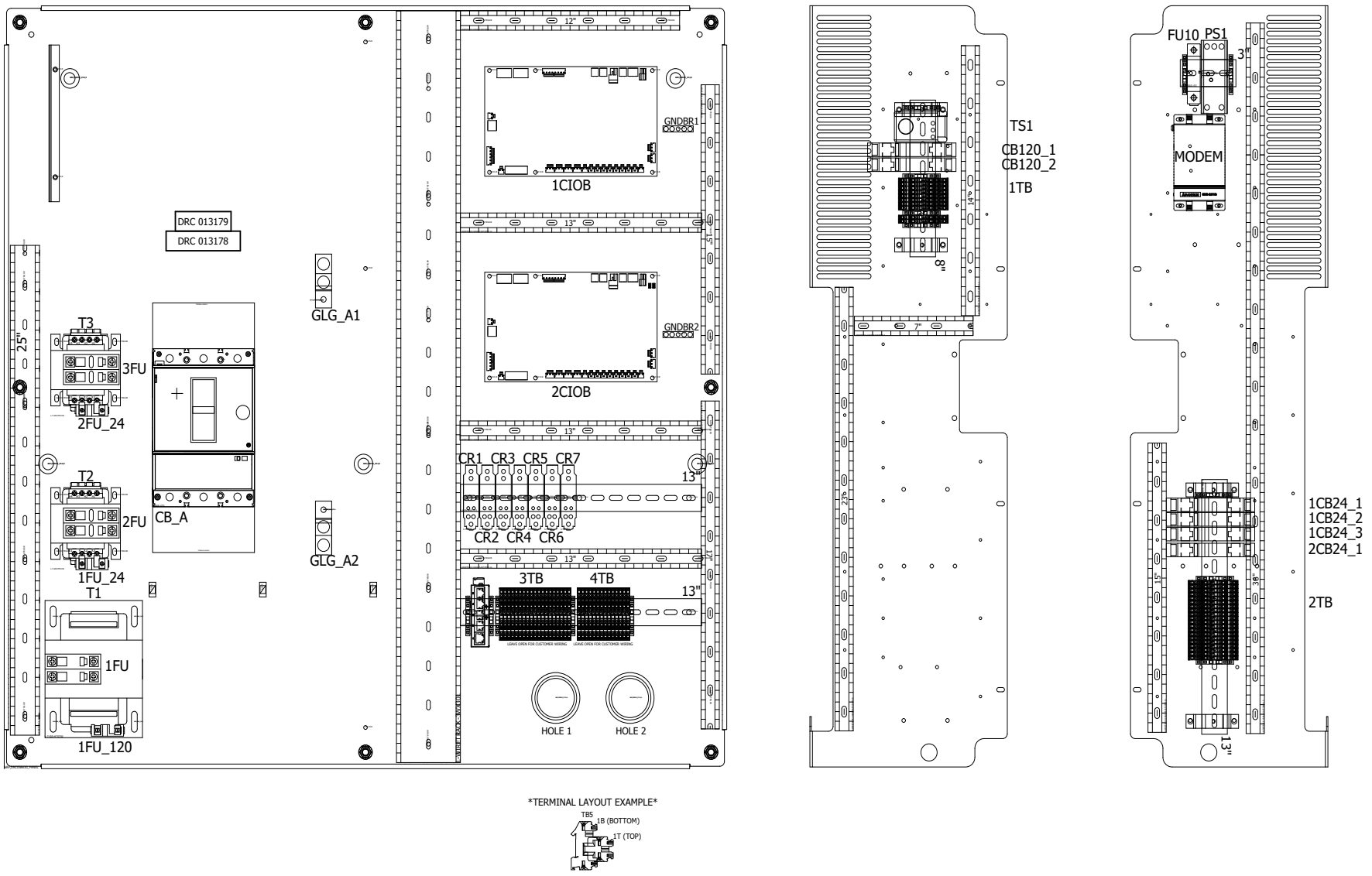
23XW/XQ 2CIOB Controls



23XW/XQ Solenoid Valves Controls

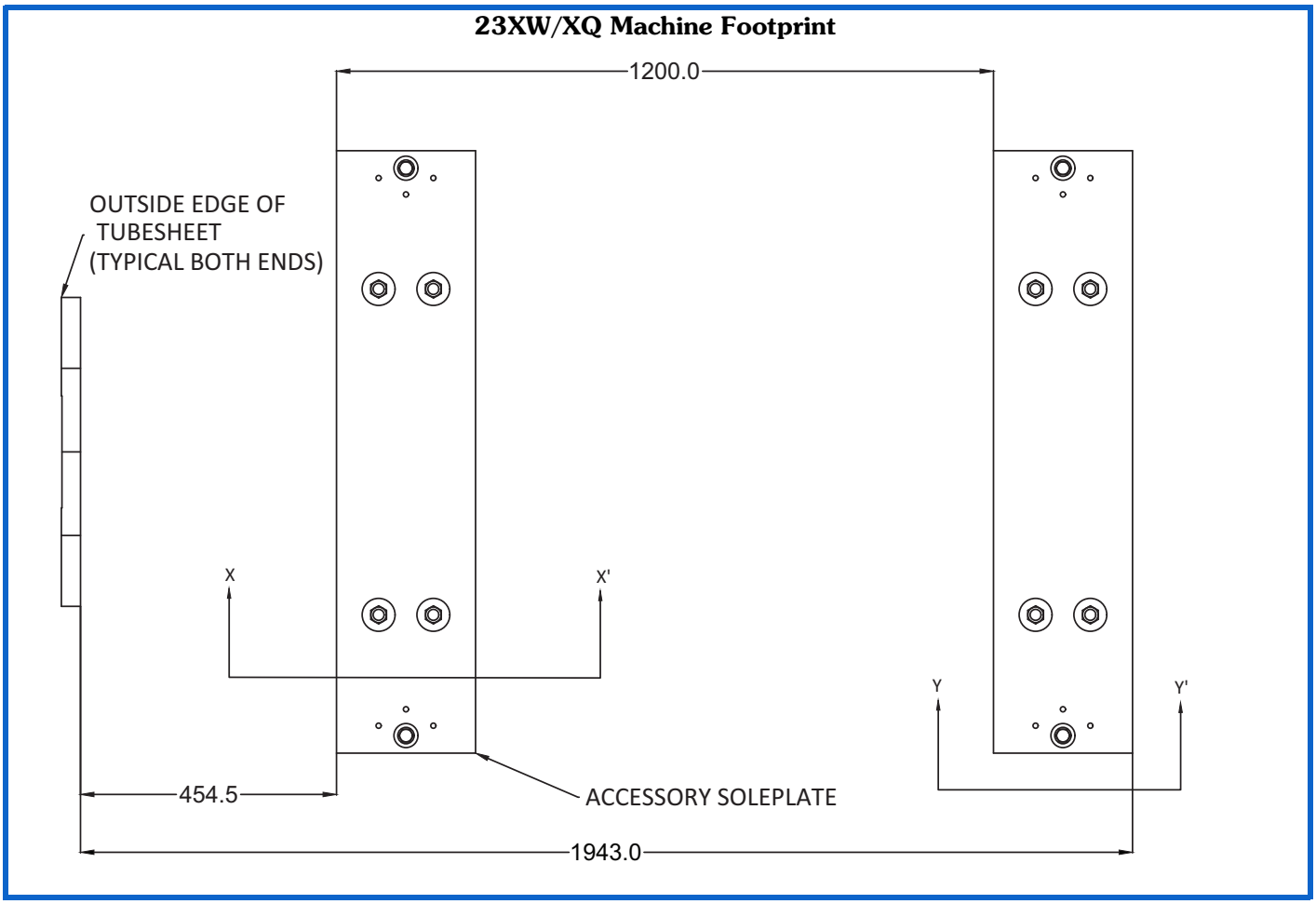


23XW/XQ Control Panel Layout



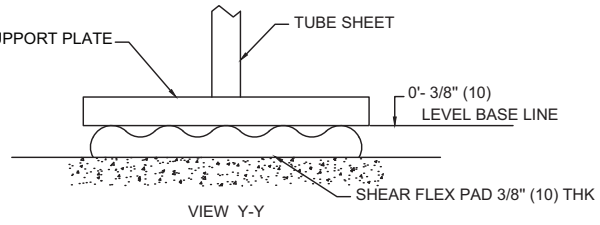
TERMINAL LAYOUT EXAMPLE

Control wiring schematic (cont)



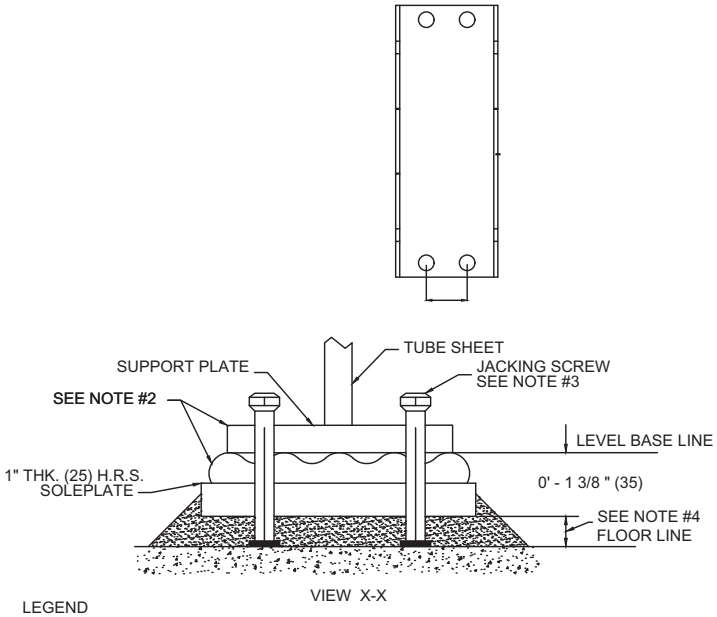
Control wiring schematic (cont)

23XW/XQ Isolation with Accessory Soleplate Packages



VIEW Y-Y

NOTES:
1. Dimensions in ( ) are in millimeters.
2. Isolation package includes 4 shear flex pads.



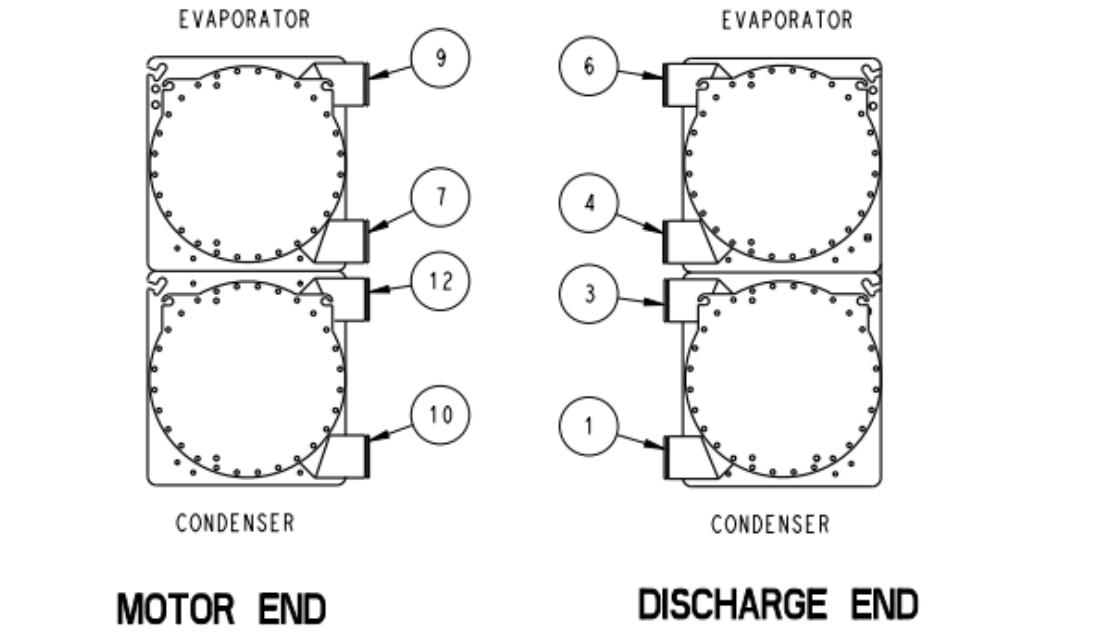
VIEW X-X

LEGEND
HRS — Hot Rolled Steel

NOTES:
1. Dimensions in ( ) are in millimeters.
2. Accessory (Carrier supplied, field installed) soleplate package includes 4 soleplates, 16 jacking screws and leveling pads.
3. Jacking screws to be removed after grout has set.
4. Thickness of grout will vary, depending on the amount necessary to level chiller. Use only pre-mixed non-shrinking grout, Ceilcote 748 OR Chemrex Embeco 636 Plus Grout 0' 1-1/2" (38.1) to 0' 2-1/4" (57) thick.

Control wiring schematic (cont)

23XW/XQ Nozzle Arrangements
Nozzle-in-Head Waterboxes



PASS	EVAPORATOR WATERBOXES		
	In	Out	Arrangement Code
1	9	6	A
	6	9	B
2	7	9	C
	4	6	D
3	7	6	E
	4	9	F

PASS	CONDENSER WATERBOXES		
	In	Out	Arrangement Code
1	12	3	P
	3	12	Q
2	10	12	R
	1	3	S
3	10	3	T
	1	12	U

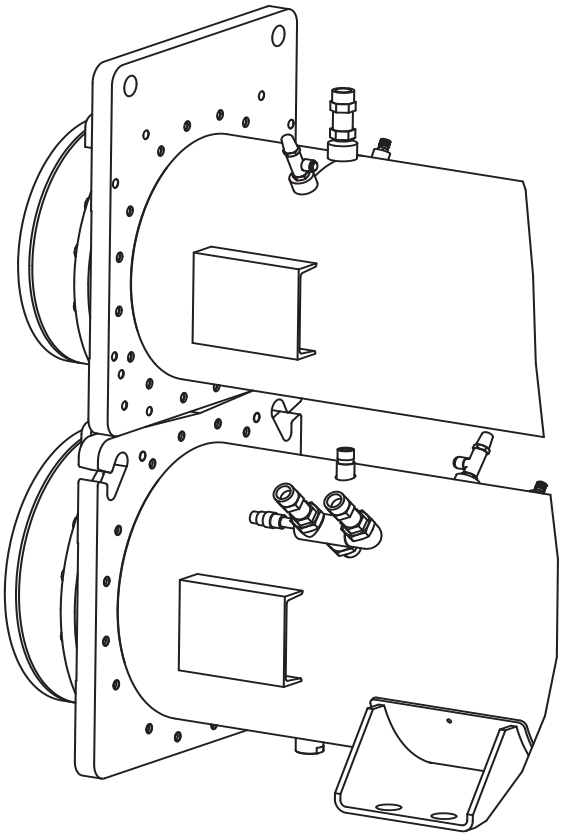
Relief Valve Locations

LOCATION	FRAME SIZE	RELIEF VALVE OUTLET SIZE	QUANTITY WITHOUT ISOLATION VALVES	QUANTITY WITH ISOLATION VALVES
Evaporator	1-3	1 in. NPT Female Connector	2	1
Condenser	1-3	1 in. NPT Female Connector	2	2

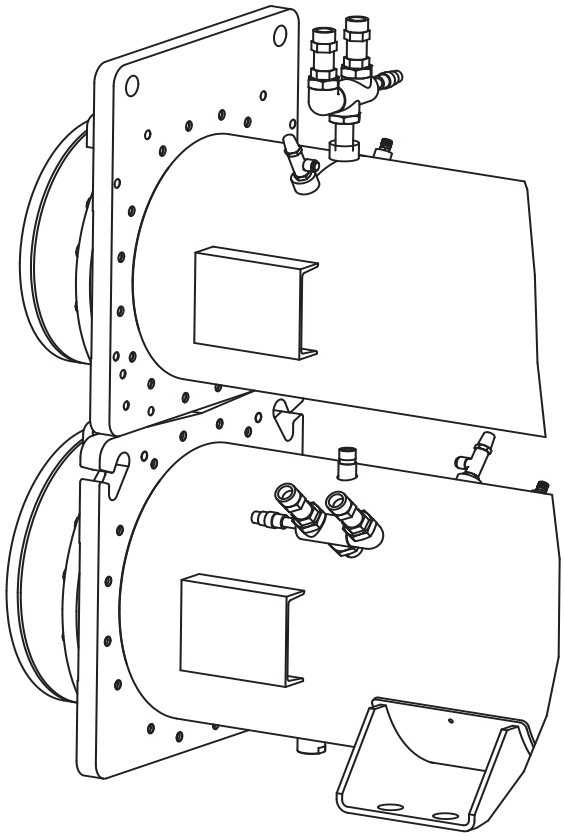
NOTE: All valves relieve at 220 psig (1517 kPa).

Control wiring schematic (cont)

Relief Valve Arrangements



WITH OPTIONAL ISOLATION



WITHOUT OPTIONAL ISOLATION

Vent and drain connections

Nozzle-in-head waterboxes have vent and drain connections on covers. Marine waterboxes have vent and drain connections on waterbox shells.

Provide high points of the chiller piping system with vents and the low points with drains. If shutoff valves are provided in the main liquid pipes near the unit, a minimal amount of system liquid is lost when the heat exchangers are drained. This reduces the time required for drainage and saves on the cost of re-treating the system liquid.

It is recommended that pressure gauges be provided at points of entering and leaving liquid to measure pressure drop through the heat exchanger. Gauges may be installed as shown in Pressure Gauge Location table. Pressure gauges installed at the vent and drain connections do not include nozzle pressure losses.

Use a reliable differential pressure gauge to measure pressure differential when determining liquid flow. Regular guages of the required pressure range do not have the accuracy to provide accurate measurement of flow conditions.

Pressure Gauge Location

NUMBER OF PASSES	GAUGE LOCATION (Evaporator or Condenser)
1 or 3	One gauge in each waterbox
2	Two gauges in waterbox with nozzles

ASME stamping

All 23XW/XQ heat exchangers are constructed in accordance with ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) 15 Safety Code for Mechanical Refrigeration (latest edition). This code, in turn, requires conformance with ASME (American Society of Mechanical Engineers) Code for Unfired Pressure Vessels wherever applicable.

Each vessel is constructed and certified in accordance with

Relief valve discharge pipe sizing

See page 26 for number of relief valves.

Relief valve discharge piping size should be calculated per the current version of the ASHRAE 15, latest edition, code using the tabulated C factors for each vessel shown in the table below.

23XW/XQ Relief Valve Discharge Pipe Sizing

EVAP/COND	VESSEL REQUIRED C FACTOR	RELIEF VALVE RATED C FACTOR	FIELD CONN SIZE (NPT)
Frame	(lb air/min)	(lb air/min)	in.
A	17.4	52.7	1-3/4
B	19.6	52.7	1-3/4
C	21.7	52.7	1-3/4

23XW/XQ Relief Valve Discharge Pipe Sizing

C	26.3	52.7	1-3/4
D	28.9	52.7	1-3/4
E	31.5	52.7	1-3/4
F	34.1	52.7	1-3/4
G	36.8	52.7	1-3/4

Carrier further recommends that an oxygen sensor be installed to protect personnel. Sensor should be able to sense the depletion or displacement of oxygen in the machine room below 19.5% volume oxygen per ASHRAE 15, latest edition.

Design pressures

Design and test pressures for heat exchangers are listed below.

Design and Test Pressures (23XW/XQ)

PRESSURES	SHELL SIDE (Refrigerant)		STANDARD TUBE SIDE (Liquid)		OPTIONAL TUBE SIDE (Liquid)	
	psig	kPa	psig	kPa	psig	kPa
Leak Test at Design Pressure[a]	220	1517	150	1034	300	2068
Hydrostatic	—	—	195	1344	390	2689
Proof Test[a]	242	1669	—	—	—	—

NOTE(S):

a. Nitrogen/Helium

Heat Exchanger Material Specifications

ITEM	MATERIAL	SPECIFICATION
Shell	HR Steel	ASME SA516 GR.70, SA106 GR. B, or SA53 E/B
Tube Sheet	HR Steel	ASME SA516 GR.70
Condenser/Evaporator Waterbox Cover		
Frames A & B 2-Pass Victaulic NIH	Cast Iron	ASTM A-536[a]
All Others	HR Steel	ASME SA516 GR .70, SA-36, SA-285 GRC, or Q345R
Condenser/Evaporator Waterbox Shell	HR Steel	ASME SA675 GR .60, SA-516 GR .70 or SA-181 CL70, SA-36, SA675GR70, SAE AME 7496, or ASTM A139 GRB
Tubes	Finned Copper	ASME SB359 or SB75
Discharge/Suction		
Pipe	Steel	ASME SA106 GRB or SA53 E/B
Flanges	Steel	ASME SA105

NOTE(S):

a. Cannot weld to A-536.

LEGEND

ASME — American Society of Mechanical Engineers
HR — Hot Rolled
NIH — Nozzle-in-Head

Insulation

23XW/XQ Minimum Field-Installed Insulation Requirements

COMPONENT	SIZE	INSULATION
		ft²
Evaporator	A	43
	C	62
	E	74
Condenser	B	45
	C	53
	E	71
	G	84
Compressor	Frame-1	32.96
	Frame-2	40.59
	Frame-3	46.60
Evaporator	Module-1	3.16
	Module-2	3.23
	Module-3	5.62

Factory insulation

Thermal insulation is factory provided to the following areas:

- Evaporator
- Condenser (standard on 23XQ, option on 23XW
- Compressor
- Economizer
- Refrigerant piping

Factory insulation is not available for the waterboxes.

Thermal insulation consists of 3 layers composed of 1/2 in. (13 mm) closed cell, 1/2 in. (13 mm) open cell, and 3/16 in. (5 mm) vinyl for a total of 1-3/16 in. (31 mm) minimum. The 1/2 in. (13 mm) closed cell foam has a thermal conductivity K value of 0.28 (BTU in.)/(hr sq ft °F) [0.0404 W/(m °C)] and conforms with Underwriters Laboratories (UL) Standard 94, Classification 94 HF-1. Both the 1/2-in. (13 mm) foam and the 3/16 in. (5 mm) vinyl layer will pass flammability test method MVSS 302.

Field insulation

The factory insulation provides excellent protection against condensation under most operating conditions. If temperatures in the equipment area exceed the maximum design conditions, extra insulation is recommended.

If the machine is to be field insulated, obtain the approximate areas from the 23XW/XQ Minimum Field-Installed Insulation Requirements table.

Insulation of waterbox is made only in the field and this area is not included in 23XW/XQ Minimum Field-Installed Insulation Requirements table. When insulating the covers, allow for service access and removal of covers. To estimate water-box cover areas, refer to certified drawings.

High humidity jobsite locations may require field-supplied and field-installed insulation on the float chamber, suction housing, and the lower half of the condenser.

Minimum fluid loop volume

For 23XW/XQ units with Q or R compressors, minimum fluid volume must be in excess of 1.5 gal per ton (1.6 L per kW) for comfort cooling applications and apply 3 to 5 gal per ton (3.2 to 5.4 L per kW) fluid loop volume for process applications.

For 23XW/XQ units with P compressors, minimum fluid volume must be in excess of 3.0 gal per ton (3.2 L per kW) for comfort cooling applications and apply 6 to 10 gal per ton (6.5 to 10.7 L per kW) fluid loop volume for process applications.

Variable Speed Screw Chiller with Greenspeed® Intelligence

HVAC Guide Specifications

Size Range: **75 to 200 Tons (264 to 703 kW) (Cooling) and 960 to 2900 MBH (Heating) Nominal**

Carrier Model Number: 23XW/XQ

Part 1 — General

1.01 SYSTEM DESCRIPTION

A. Microprocessor-controlled liquid chiller shall use a semi-hermetic screw compressor using refrigerant Ultra Low GWP R-1234ze(E) or low GWP R-515B.

B. If a manufacturer proposes a liquid chiller using R-514A refrigerant, which has a planned phase-out date, then the manufacturer shall include in the chiller price:

1. A vapor activated alarm system consisting of all alarms, sensors, safeties, and ventilation equipment as required by ANSI/ASHRAE (American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers) Standard 15 Safety Code for Mechanical Refrigeration (latest edition) with the quotation. System shall be capable of responding to R-514A levels of 10 ppm Allowable Exposure Limit (AEL).
2. A free-standing refrigerant storage tank and pumpout unit shall be provided. The storage vessels shall be designed per ASME (American Society of Mechanical Engineers) Section VIII Division 1 code with 300 psig (2068 kPa) design pressure. Double relief valves per ANSI/ASHRAE 15, latest edition, shall be provided. The tank shall include a liquid level gauge and pressure gauge. The pumpout unit shall use a semi-hermetic reciprocating compressor with water-cooled condenser. Condenser water piping, 3-phase motor power, and 115-volt control power shall be installed at the jobsite by the installing contractor.
3. Zero emission purge unit capable of operating even when the chiller is not operating.
4. Back-up relief valve to rupture disk.
5. Factory-installed chiller pressurizing system to prevent leakage of noncondensables into the chiller during shutdown periods.
6. Plant room ventilation.
7. Removal and disposal of refrigerant at the end of the phase-out period.
8. Chillers utilizing a purge unit shall include in the machine price the costs to perform the following regular maintenance procedures:
   a. Weekly: Check refrigerant charge.
   b. Quarterly: Charge purge unit dehydrator at least quarterly, more often if necessary. Clean foul gas strainer. Perform chemical analysis of oil.
   c. Annually: Clean and inspect all valves. Drain and flush purge shell. Clean orifices.

1.02 QUALITY ASSURANCE

A. Chiller performance shall be rated in accordance with AHRI (Air-Conditioning, Heating and Refrigeration Institute) Standard 550/590, latest edition.

B. Equipment and installation shall be in compliance with ANSI/ASHRAE 15 (latest edition).

C. Evaporator and condenser refrigerant side shall include ASME 'U' stamp and nameplate certifying compliance with ASME Section VIII, Division 1 code for unfired pressure vessels.

D. A manufacturer's data report is required to verify pressure vessel construction adherence to ASME vessel construction requirements. Form U-1 as required per ASME code rules is to be furnished to the owner. The U-1 Form must be signed by a qualified inspector, holding a National Board Commission, certifying that construction conforms to the latest ASME Code Section VIII, Div. 1 for pressure vessels. The ASME symbol "U" must also be stamped on the heat exchanger. Vessels specifically exempted from the scope of the code must come with material, test, and construction methods certification and detailed documents similar to ASME U-1; further, these must be signed by an officer of the company.

E. Chiller shall be designed and constructed to meet UL and UL of Canada requirements and have labels appropriately affixed.

F. The management system governing the manufacture of this product is ISO (International Organization for Standardization) 9001:2015 certified.

G. Each compressor assembly shall undergo a mechanical run-in test to verify vibration levels, oil pressures, and temperatures are within acceptable limits. Each compressor assembly shall be proof tested at a minimum 204 psig (1407 kPa) and leak tested at 185 psig (1276 kPa) with a tracer gas mixture.

H. Entire chiller assembly shall be proof tested at 204 psig (1407 kPa) and leak tested at 220 psig (1517 kPa) with a tracer gas mixture on the refrigerant side. The leak test shall not allow any leaks greater than 0.5 oz (14.78 mL) per year of refrigerant. The water side of each heat exchanger shall be hydrostatically tested at 1.3 times rated working pressure.

I. Prior to shipment, the chiller automated controls test shall be executed to check for proper wiring and ensure correct controls operation.

J. Chillers shall have factory-mounted, factory-wired and factory-tested unit-mounted variable frequency drive (VFD). Proper VFD operation shall be confirmed prior to shipment.

1.03 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled in accordance with manufacturer's instructions.

B. Unit shall be shipped with all refrigerant piping and control wiring factory installed.

C. Unit shall be shipped charged with oil and full charge of refrigerant Ultra Low GWP R-1234ze(E) or low GWP R-515B or a nitrogen holding charge as specified on the equipment schedule.

D. Unit shall be shipped with firmly attached labels that indicate name of manufacturer, chiller model number, chiller serial number, and refrigerant used.

E. If the unit is to be exported, the manufacturer shall provide sufficient protection against sea water corrosion, making the unit suitable for shipment in a standard open top ocean shipping container.

F. Chiller and starter shall be stored indoors, protected from construction dirt and moisture. Chiller shall be inspected under shipping tarps, bags, or crates to be sure water has not collected during transit. Protective shipping covers shall be kept in place until machine is ready for installation. The inside of the protective cover shall meet the following criteria:

1. Temperature is between 40°F (4.4°C) and 120° F (48.9°C).
2. Relative humidity is between 10% and 80% non-condensing.

1.04 WARRANTY

Warranty shall include parts and labor for one year after start-up or 18 months from shipment, whichever occurs first. A refrigerant warranty shall be provided for a period of 5 years (North America only).

Part 2 — Products

2.01 EQUIPMENT

A. General:

Factory-assembled, single piece, liquid chiller shall consist of compressor, motor, VFD, lubrication system, evaporator, condenser, initial oil and refrigerant operating charges, microprocessor control system, and documentation required prior to start-up.

B. Compressor:

1. One variable speed screw compressor of the high performance type.
2. Compressor and motor shall be hermetically sealed into a common assembly and arranged for easy field servicing.
3. The compressor motor shall be accessible for servicing without removing the compressor base from the chiller. Connections to the compressor casing shall use O-rings and gaskets to reduce the occurrence of refrigerant leakage. Connections to the compressor shall be flanged or bolted for easy disassembly.
4. Compressor bearings must have individual design life of 50 years or greater when operating at AHRI conditions.
5. Compressor shall provide capacity modulation from 100% to 25% capacity without the use of hot gas bypass or mechanical unloaders.
6. Compressor shall be provided with a factory-installed positive pressure lubrication system to deliver oil under pressure to bearings and rotors at all operating conditions. Lubrication system shall include:
   a. Oil pump with factory-installed motor contactor with overload protection.
   b. Oil pressure sensor with differential readout at main control center.
   c. Oil pressure regulator.
   d. Oil filter with isolation valves to allow filter change without removal of refrigerant charge.
   e. Oil sump heater [115 v, 50 or 60 Hz] controlled from unit microprocessor.
   f. Oil reservoir temperature sensor with main control center digital readout.
   g. All wiring to oil pump, oil heater, and controls shall be pre-wired in the factory and power shall be applied to check proper operation prior to shipment.
7. Compressor shall be fully field serviceable. Compressors that must be removed and returned to the factory for service shall be unacceptable.
8. Acoustical attenuation shall be provided as required, to achieve a maximum (full load) sound level, measured per AHRI Standard 575 (latest edition).

C. Motor:

1. Compressor motor shall be of the semi-hermetic, liquid-refrigerant-cooled, squirrel-cage, induction-type suitable for voltage shown on the equipment schedule.
2. If an open (air-cooled) motor is provided, a compressor shaft seal leakage containment system shall be provided:
   a. An oil reservoir shall collect oil and refrigerant that leaks past the seal.
   b. A float device shall be provided to open when the reservoir is full, directing the refrigerant/oil mixture back into the compressor housing.
   c. A refrigerant sensor shall be located next to the open drive seal to detect leaks.
3. Motors shall be suitable for operation in a refrigerant atmosphere and shall be cooled by atomized refrigerant in contact with the motor windings.

4. Motor stator shall be arranged for service or removal with only minor compressor disassembly and without removing main refrigerant piping connections.
5. Full load operation of the motor shall not exceed nameplate rating.
6. One motor winding temperature sensor (and one spare) shall be provided.
7. Should mechanical contractor choose to provide a chiller with an air-cooled motor instead of the specified semi-hermetic motor, the contractor shall install additional cooling equipment to dissipate the motor heat.

   The following formula applies:

   Btuh = (FLkW motor) (0.05) (3413)

   Btuh = (FLkW motor) (171)

   CFM = Btuh/1.08 x 20 F (additional air flow)

   and, alternately

   Tons = Btuh/12,000

   The additional piping, valves, air-handling equipment, insulation, wiring, switchgear changes, ductwork, and coordination with other trades shall be the responsibility of the mechanical contractor. Shop drawings reflecting any changes to the design shall be included in the submittal and incorporated into the final as-built drawings for the project.
8. Also, if an open motor is provided, a mechanical room thermostat shall be provided and set at 104°F (40°C). If this temperature is exceeded, the chillers shall shut down and an alarm signal shall be generated to the central Energy Management System (EMS) display module, prompting the service personnel to diagnose and repair the cause of the overtemperature condition. The mechanical contractor shall be responsible for all changes to the design, including coordination with temperature control, electrical and other trades. In addition, the electrical power consumption of any auxiliary ventilation and/or mechanical cooling required to maintain the mechanical room conditions stated above shall be considered in the determination of conformance to the scheduled chiller energy efficiency requirement.

D. Evaporator and Condenser:

1. Evaporator and condenser shall be of shell and tube type construction, each in separate shells. Units shall be fabricated with high-performance tubing, steel shell and tube sheets with waterboxes. Waterboxes shall be nozzle-in-head type with stub out nozzles having Victaulic grooves to allow for use of Victaulic couplings.
2. Tubing shall be copper, high-efficiency type, with integral internal and external enhancement unless otherwise noted. Tubes shall be nominal 3/4-in. outside diameter (OD) with nominal wall thickness of 0.025 in. measured at the root of the fin unless otherwise noted. Tubes shall be rolled into tube sheets and shall be individually replaceable. Tube sheet holes shall be double grooved for joint structural integrity. Intermediate support sheet spacing shall not exceed 36 in. (914 mm).
3. Waterboxes and nozzle connections shall be designed for 150 psig (1034 kPa) minimum working pressure unless otherwise noted. Nozzles should have grooves to allow use of Victaulic couplings.
4. The tube sheets of the evaporator and condenser shall be bolted together to allow for field disassembly and reassembly.
5. The vessel shall display an ASME nameplate that shows the pressure and temperature data and the 'U' stamp for ASME Section VIII, Division 1. A re-seating pressure relief valve(s) shall be installed on each heat exchanger. If a non-reseating type is used, a backup reseating type shall be installed in series.
6. Waterboxes shall have vents, drains, and covers to permit tube cleaning within the space shown on the drawings. A thermistor-type temperature sensor with quick connects shall be factory installed in each water nozzle.
7. Evaporator shall be designed to prevent liquid refrigerant from entering the compressor. Devices that introduce pressure losses (such as mist eliminators) shall not be acceptable because they are subject to structural failures that can result in extensive compressor damage.
8. Tubes shall be individually replaceable from either end of the heat exchanger without affecting the strength and durability of the tube sheet and without causing leakage in adjacent tubes.
9. The subcooler, located in the bottom of the condenser, shall increase the refrigeration effect by cooling the condensed liquid refrigerant to a lower temperature, thereby reducing compressor power consumption.

E. Refrigerant Flow Control:

The variable flow control system regulates refrigerant flow according to load conditions, providing a liquid seal at all operating conditions, eliminating unintentional hot gas bypass.

F. Automatic Hot Gas Bypass:

Hot gas bypass valve and piping shall be factory-furnished to permit chiller operation for extended periods of time.

G. Controls, Safeties, and Diagnostics:

1. Controls:

a. The chiller shall be provided with a factory-installed and factory-wired microprocessor control center. The microprocessor can be configured for either English or SI units.

b. All chiller and starter monitoring shall be displayed at the chiller control panel.

c. The controls shall make use of non-volatile memory.

d. The chiller control system shall have the ability to interface and communicate directly to the building control system.

e. The default standard display screen shall simultaneously indicate the following minimum information:

1) date and time of day
2) 24-character primary system status message
3) 24-character secondary status message
4) chiller operating hours
5) entering chilled water temperature
6) leaving chilled water temperature
7) evaporator refrigerant temperature
8) entering condenser water temperature
9) leaving condenser water temperature
10) condenser refrigerant temperature
11) oil supply pressure
12) oil sump temperature
13) percent motor rated load amps (RLA)

f. In addition to the default screen, status screens shall be accessible to view the status of every point monitored by the control center including:

1) evaporator pressure
2) condenser pressure
3) bearing oil supply temperature
4) compressor discharge temperature
5) motor winding temperature
6) number of compressor starts
7) control point settings
8) discrete output status of various devices
9) compressor motor starter status
10) optional spare input channels
11) current and voltage for each phase
12) frequency

g. Schedule Function:

The chiller controls shall be configurable for manual or automatic start-up and shutdown. In automatic operation mode, the controls shall be capable of automatically starting and stopping the chiller according to a stored user programmable occupancy schedule. The controls shall include built-in provisions for accepting:

1) A minimum of two 365-day occupancy schedules.
2) Minimum of 8 separate occupied/unoccupied periods per day.
3) Daylight savings start/end.
4) Minimum of 18 user-defined holidays.
5) Means of configuring an occupancy timed override.
6) Chiller start-up and shutdown via remote contact closure.

h. Service Function:

The controls shall provide a password protected service function which allows authorized individuals to view an alarm history file which shall contain the last 25 alarm/alert messages with time and date stamp. These messages shall be displayed in text form, not codes.

i. Network Window Function:

Each chiller control panel shall be capable of viewing multiple point values and statuses from other like controllers connected on a common network, including controller maintenance data. The operator shall be able to alter the remote controller's set points or time schedule and to force point values or statuses for those points that are operator forcible. The control panel shall also have access to the alarm history file of all like controllers connected on the network.

j. Pump Control:

Upon request to start the compressor, the control system shall start the chilled water pump, condenser water pumps and verify that flows have been established.

k. Ramp Loading:

A user-configurable ramp loading rate, effective during the chilled water temperature pulldown period, shall control the rate of guide vane opening to prevent a rapid increase in compressor power consumption. The controls shall allow configuration of the ramp loading rate in either degrees/minute of chilled water temperature pulldown or percent motor amps/minute. During the ramp loading period, a message shall be

displayed informing the operator that the chiller is operating in ramp loading mode.

l. Chilled Water Reset:

The control center shall allow reset of the chilled water temperature set point based on any one of the following criteria:

1) Chilled water reset based on an external 4 to 20 mA signal.
2) Chilled water reset based on a remote temperature sensor (such as outdoor air).
3) Chilled water reset based on water temperature rise across the evaporator.

m. Demand Limit:

The control center shall limit amp draw of the compressor to the rated load amps or to a lower value based on one of the following criteria:

1) Demand limit based on a user input ranging from 40% to 100% of compressor rated load amps.
2) Demand limit based on external 4 to 20 mA signal.

n. Controlled Compressor Shutdown:

The controls shall be capable of being configured to soft stop the compressor. When the stop button is pressed or remote contacts open with this feature active, the guide vanes shall close to a configured amperage level and the machine shall then shut down. The display shall indicate "shutdown in progress."

o. BACnet™[1] Communication:

Allows integration with i-Vu® Open control system or a BACnet building automation system.

2. Safeties:

a. Unit shall automatically shut down when any of the following conditions occur (each of these protective limits shall require manual reset and cause an alarm message to be displayed on the control panel screen, informing the operator of the shutdown cause):

1) Motor overcurrent
2) Over voltage[2]
3) Under voltage[2]
4) Single cycle dropout[2]
5) Low oil sump temperature
6) Low evaporator refrigerant temperature
7) High condenser pressure
8) High motor temperature
9) High compressor discharge temperature
10) Low oil pressure
11) Prolonged stall
12) Loss of evaporator water flow
13) Loss of condenser water flow
14) Variable frequency drive fault
15) High variable frequency drive temperature

b. The control system shall detect conditions that approach protective limits and take self-corrective action prior to an alarm occurring. The system shall automatically reduce chiller capacity when any of the following parameters are outside their normal operating range:

1) High condenser pressure
2) High motor temperature
3) Low evaporator refrigerant temperature
4) High motor amps
5) High VFD inverter temperature

c. During the capacity override period, a pre-alarm (alert) message shall be displayed, informing the operator which condition is causing the capacity override. Once the condition is again within acceptable limits, the override condition shall be terminated and the chiller shall revert to normal chilled water control. If during either condition the protective limit is reached, the chiller shall shut down and a message shall be displayed informing the operator which condition caused the shutdown and alarm.

d. Internal built-in safeties shall protect the chiller from loss of water flow. Differential pressure switches shall not be allowed to be the only form of freeze protection.

3. Diagnostics and Service:

a. A self-diagnostic controls test shall be an integral part of the control system to allow quick identification of malfunctioning components.

b. Once the controls test has been initiated, all pressure and temperature sensors shall be checked to ensure they are within normal operating range. A pump test shall automatically energize the chilled water pump, condenser water pump, and oil pump. The control system shall confirm that water flow and oil pressure have been established and require operator confirmation before proceeding to the next test.

c. In addition to the automated controls test, the controls shall provide a manual test, which permits selection and testing of individual control components and inputs. A thermistor test and transducer test shall display on the PIC6 screen the actual reading of each transducer and each thermistor

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2. Shall not require manual reset or cause an alarm if auto-restart after power failure is enabled.

installed on the chiller. All out-of-range sensors shall be identified. Pressure transducers shall be serviceable without the need for refrigerant charge removal or isolation.

4. Multiple Chiller Control:

   The chiller controls shall be supplied as standard with a 2-chiller lead/lag and a third chiller standby system. The control system shall automatically start and stop a lag or second chiller on a 2-chiller system. If one of the 2 chillers on line goes into a fault mode, the third standby chiller shall be automatically started. The 2-chiller lead/lag system shall allow manual rotation of the lead chiller and a staggered restart of the chillers after a power failure. The lead/lag system shall include load balancing if configured to do so.

H. Electrical Requirements:

1. Electrical contractor shall supply and install main electrical power line, disconnect switches, circuit breakers, and electrical protection devices per local code requirements and as indicated necessary by the chiller manufacturer.
2. Electrical contractor shall wire the chilled water pump and flow, condenser water pump and flow, and tower fan control circuit to the chiller control circuit.
3. Electrical contractor shall supply and install electrical wiring and devices required to interface the chiller controls with the building control system if applicable.
4. Electrical power shall be supplied to the unit at the voltage, phase, and frequency listed in the equipment schedule.

I. Piping Requirements — Instrumentation and Safeties:

1. Mechanical contractor shall supply and install pressure gauges in readily accessible locations in piping adjacent to the chiller such that they can be easily read from a standing position on the floor. Scale range shall be such that design values shall be indicated at approximately mid-scale.
2. Gauges shall be installed in the entering and leaving water lines of the evaporator and condenser.

J. Vibration Isolation:

Chiller manufacturer shall furnish neoprene isolator pads for mounting equipment on a level concrete surface.

K. Start-Up:

1. The chiller manufacturer shall provide a factory-trained representative, employed by the chiller manufacturer, to perform the start-up procedures as outlined in the Start-Up, Operation and Maintenance manual provided by the chiller manufacturer.
2. Manufacturer shall supply the following literature:
   a. Start-up, operation and maintenance instructions.
   b. Installation instructions.
   c. Field wiring diagrams.
   d. One complete set of certified drawings.

L. Special Features:

1. Soleplate Package:

   Unit manufacturer shall furnish a soleplate package consisting of soleplates, jacking screws, leveling pads, and neoprene pads.

2. Spring Isolators:

   Spring isolators shall be field furnished and selected for the desired degree of isolation.

3. Spare Sensors with Leads:

   Unit manufacturer shall furnish additional temperature sensors and leads.

4. Building Control System Interface (LON):

   The chiller control system shall have the ability to interface and communicate directly to the building control using a LON-based system. The LonWorks®[1] Carrier Translator shall output data in standard LON profiles.

5. Refrigerant Charge:

   The chiller shall ship from the factory fully charged with R-151B or R-1234ze(E) refrigerant and oil.

6. Thermal Insulation:

   Unit manufacturer shall insulate the evaporator shell, economizer, suction elbow, motor shell, and motor cooling lines. Insulation shall be 1 in. (25.4 mm) thick with a thermal conductivity not exceeding

   $$0.28 \frac{(\text{Btu} \cdot \text{in.})}{\text{hr. Ft}^2\ \text{F}} \left(0.0404 \frac{\text{W}}{\text{m C}} \right)$$

   and shall conform to UL standard 94, classification 94 HF-1.

7. Evaporator and Condenser Tubes:

   Contact your local Carrier Representative for other tube offerings.

8. Evaporator and Condenser Passes:

   Unit manufacturer shall provide the evaporator and/or condenser with 1, 2 or 3-pass configuration on the water side.

9. Nozzle-In-Head, 300 psig (2068 kPa):

   Unit manufacturer shall furnish nozzle-in-head style waterboxes on the evaporator and/or condenser rated at 300 psig (2068 kPa).

10. Marine Waterboxes, 150 psig (1034 kPa):

    Unit manufacturer shall furnish marine style waterboxes on evaporator and/or condenser rated at 150 psig (1034 kPa).

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Guide specifications (cont)

11. Marine Waterboxes, 300 psig (2068 kPa):

    Unit manufacturer shall furnish marine style waterboxes on evaporator and/or condenser rated at 300 psig (2068 kPa).

12. Flanged Water Nozzles:

    Unit manufacturer shall furnish standard flanged piping connections on the evaporator and/or condenser.

13. Hinges:

    Unit manufacturer shall furnish hinges on waterboxes to facilitate tube cleaning.

14. Optional Compressor Discharge Isolation Valve and Liquid Line Ball Valve:

    These items shall be factory installed to allow isolation of the refrigerant charge in the condenser for servicing the compressor.

15. Unit-Mounted Variable Frequency Drive (VFD):

    a. Design:

        1) VFD shall be air cooled, microprocessor-based, pulse width modulated design. Water-cooled designs are not acceptable.
        2) Output power devices shall be insulated gate bipolar transistors (IGBTs).
        3) Converter section with full-wave fixed diode bridge rectifier shall convert incoming fixed voltage/frequency to fixed DC voltage.
        4) DC link shall filter and smooth the converted DC voltage.
        5) Transistorized inverter and control regulator shall convert fixed DC voltage to a sinusoidal PWM waveform.
        6) Integrated controls shall coordinate the motor speed to optimize chiller performance over a wide variety of operating conditions.

    b. Enclosure:

        1) Pre-painted, unit-mounted NEMA 1 cabinet shall include hinged, lockable doors and removable lifting lugs.
        2) VFD shall have a short circuit current rating of at least 65,000 amps (100,000 amps is optional).
        3) Provisions to padlock main disconnect handle in the "Off" positions shall be provided. Mechanical interlock to prevent opening cabinet door with disconnect in the "On" position or moving disconnect to the "ON" position while the door is open shall be provided.
        4) Provisions shall be made for top entry of incoming line power cables.

    c. Heat Sink:

        1) The heat sink shall be refrigerant cooled. Heat sink and mating flanges shall be suitable for ASME design working pressure of 220 psig (1517 kPa).
        2) Refrigerant cooling shall be metered by integrated standard controls to maintain heat sink temperature within acceptable limits for ambient temperature.

    d. VFD Rating:

        1) Drive shall be suitable for nameplate voltage ±10%.
        2) Drive shall be suitable for continuous operation at 100% of nameplate amps and 150% of nameplate amps for 3 seconds.
        3) Drive shall comply with applicable UL, CE, and NEMA standards.
        4) Drive shall be suitable for operation in ambient temperatures between 40 and 104 F (4.4 and 40 C), 95% humidity (non-condensing) for altitudes up to 3300 ft (1006 m) above sea level. Specific drive performance at jobsite ambient temperature and elevation shall be provided by the manufacturer in the bid.

    e. User Interface:

    Displays shall provide interface for programming and display of VFD and chiller parameters. Viewable parameters include:

        1) Operating, configuration and fault messages
        2) Frequency in Hz
        3) Load side voltage and current (at the VFD)
        4) kW (on the VFD interface)

    f. VFD Performance:

        1) VFD full load efficiency shall meet or exceed 97% at 100% VFD Rated Ampacity.
        2) Base motor frequency shall be either 50 or 60 Hz.

    g. VFD Electrical Service (single point power):

        1) VFD shall have input circuit breaker with minimum 65,000 amp interrupt capacity.
        2) VFD shall have standard 15 amp branch oil pump circuit breaker to provide power for chiller oil pump.
        3) VFD shall have standard 4 KVA control power transformer with circuit breaker to provide power for oil heater, VFD controls, and chiller controls.
        4) The branch oil pump circuit breaker and control power transformer shall be factory wired.
        5) Input power shall be 380/480 vac, ±10 percent, 3 phase, 50/60 Hz, ±3 Hz.

h. Discrete Outputs:

115-v discrete contact outputs shall be provided for:

1) Chilled water pump
2) Condenser water pump
3) Alarm status.

i. Protection (the following shall be supplied):

1) Under-voltage
2) Over voltage
3) Phase loss
4) Phase unbalance protection
5) Programmable auto re-start after loss of power
6) Motor overload protection (NEMA Class 10)
7) Motor over temperature protection

j. VFD Testing:

The VFD shall be factory mounted, wired, and tested on the chiller prior to shipment.

16. Unit-Mounted Variable Frequency Drive (VFD) without Built-In Harmonic Filter (available for low voltage only, 19MV3 only):

a. Design:

1) VFD shall be air cooled, microprocessor based, pulse width modulated (PWM) design. Water cooled designs are not acceptable.
2) Output power devices shall be insulated gate bipolar transistors (IGBTs).
3) Converter section with full-wave fixed diode bridge rectifier shall convert incoming fixed voltage/frequency to fixed DC voltage.
4) DC link shall filter and smooth the converted DC voltage.
5) Transistorized inverter and control regulator shall convert fixed DC voltage to a sinusoidal PWM waveform.
6) Integrated controls shall coordinate motor speed and guide vane position to optimize chiller performance over a wide variety of operating conditions.
7) Surge prevention and surge protection algorithms shall take action to prevent surge and move chiller operation away from surge.

b. Enclosure:

1) Pre-painted, unit-mounted cabinet protected against limited ingress of dust and water splashing shall include hinged doors and removable lifting lugs.
2) Electrical system shall have a short circuit interrupt and withstand rating of at least 65kA (option for 100kA).
3) Provisions to padlock main disconnect handle in the “Off” position shall be provided. Mechanical interlock to prevent opening cabinet door with disconnect in the “On” position or moving disconnect to the “ON” position while the door is open shall be provided.
4) Provisions shall be made for top entry of incoming line power cables.

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