MSS-X

Chiller Submittal

[redacted]
Reviewed - OK to proceed
[redacted]
PRESIDENT
8/27/2019

Job Name: [redacted] Chemical Plant

Job Number: QMJANDRT08072019-1

Model Number:(4) MSS050XCHGEAA--DBMBM-AAQ-CB-B

Date: 08/27/2019 TC

Total Access
Don Eddie 10/3/2019.

MULTISTACK

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ER

MULTISTACK

Job Name	Sofix Chemical Plant	Job Number	
Location	Tennessee	Quote Number	QMJANDRT08072019-1
Engineer		Representative	Steve Bandy
Contractor		Rep Office	Chattanooga

Mechanical Modules: (4) MSS050XCHGEAA--DBMBM-AAQ-CB-B
Accessory Modules:

SUMMARY PERFORMANCE DATA

							EVAPORATOR			CONDENSER			
Load	Capacity (Tons)	kW	THR MBtu/h	kW/ton	EER	COP	Flow Rate (GPM)	Leaving °F	ΔP (ft)	Flow Rate (GPM)	Entering °F	Leaving °F	ΔP (ft)
100%	86.16	131.9	1.484	1.531	7.837	2.300	248.2	5.000	5.795	322.7	85.00	94.30	6.284
75%	64.62	82.79	1.058	1.281	9.366	2.740	248.2	5.000	5.795	322.7	75.00	81.56	6.284
50%	43.08	47.76	0.6800	1.108	10.83	3.170	248.2	5.000	5.795	322.7	65.00	69.21	6.284
25%	21.54	25.43	0.3453	1.181	10.16	2.980	248.2	5.000	5.795	322.7	65.00	67.14	6.284

The 25, 50 % points have incorporated a cycling penalty per AHRI 550/590.

Cooling COP	Heating COP	Heating and Cooling COP
2.300	N/A	N/A

		kW/Ton	EER	COP
With Tower Relief (per AHRI 550/590)	NPLV.IP	1.188	10.10	2.964

EVAPORATOR DESIGN DATA	(Based on 50% PG)
Entering Temperature	15.00
Leaving Temperature	5.000
Design Flow (GPM)	248.2
Pressure Drop (Full Load)	2.509 PSI / 5.795 ft H2O
Chiller Minimum Flow	248.2
Minimum GPM for sizing system bypass	248.2
Heat Exchanger Type	Brazed Plate
Fouling Factor	.000100
Header Size	6"
Header Connection Type	Grooved Coupling

CONDENSER DESIGN DATA	(Based on Water)
Entering Temperature	85.00
Leaving Temperature	94.30
Design Flow (GPM)	322.7
Pressure Drop (Full Load)	2.720 PSI / 6.284 ft H2O
Chiller Minimum Flow	322.7
Minimum GPM for sizing system bypass	322.7
Heat Exchanger Type	Brazed Plate
Fouling Factor	.000250
Header Size	6"
Header Connection Type	Grooved Coupling

PHYSICAL DATA	Section 1	Section 2
Length (in.)	128	
Width (in.)	56	
Height (in.)	67	
Estimated Dry weight (lbs)	7800	
Estimated Operating weight (lbs)	8400	
Refrigerant Type	R-410A	
Refrigerant Charge (lbs per circuit)	18	

ELECTRICAL DATA (Direct Connect-Per Module)	MCA	MOP		
(4) MSS050X	68	100		
Voltage	460/60/3			

Dimensions are estimated and do not include J-Boxes

CHILLER DATA	
Compressor Description	Scroll
Options	With Tower Relief (per AHRI 550/590)
Compressor RLA (Amps)	30

*Parallel feeds not required (Assumes no larger than 300 MCM/kcmil wire)

MOUNTING/LIFTING FRAME	
Materials	Option Not Selected
I-Beam Size	Option Not Selected
Bolt together frame - # of pieces	Option Not Selected
End Type	Option Not Selected

Software Version #: 1.0.4435.29800

Performance Run Date: 8/15/2019 11:29:29 AM

Outside the scope of AHRI Standard 550/590 (I-P).

MEMBER AHRI AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE

Product Overview:

Model Description	Compressor Description
(4) MSS050XCHGEAA--DBMBM-AAQ-CB-B	Scroll

Services & Special Features:

- Chiller Waterside Maximum Working Pressure is 150 PSIG
- Heat exchanger maximum working pressure (refrigerant 650 PSI, waterside 361 PSI)
- Lead compressor sequencing (24hrs)
- Automatic internal rescheduling if fault occurs
- Multiple, independent refrigeration systems
- Automatic logging of any fault condition
- Electronic chilled water control
- Quick interconnect modular design
- Filters in evaporator and condenser supply headers
- Stainless steel evaporator and condenser inlet header
- R-410A Refrigerant
- Modules fit through single width doors and into passenger elevators
- 5kA SCCR
- Electrical Connection Type - Direct Connect
- Warranty: Compressor (5 Year)
- Warranty: All Parts (1 Year)
- Low Temp (SLT) Application (CCH, 1.5" Ins. & Comp. Ins.)
- Power Phase Monitor (for Direct Connect per module)
- Total Access Design (C-Steel Valves)
- Multiflush™ (Debris Removal System) - Cond
- ¾" Insulation (Evaporator)
- Interoperability Web Portal for Mechanicals (BACnet Ethernet)

Excluded By Multistack:

- Acoustical Panels - indoor rated
- Interconnecting piping between sections if two sections exist.
- Multistack recommends a 2-3 minute minimum loop time. Contact Multistack if you have questions regarding system loop time design

MULTISTACK®
Originators. Innovators. Never the Imitators.

MultiFlush™

Time and Money Saving Advantages:

- **Increase system reliability and chiller up-time**
- **Interface with an Energy Management System for timed blow-down of MultiFlush™**
- **Reduce maintenance costs**
- **Increase chiller operating efficiency which reduces energy costs**

Problem

Excessive debris in the water system can cause clogging of the MULTISTACK chiller's in-line strainers requiring frequent system shut down for cleaning.

Solution

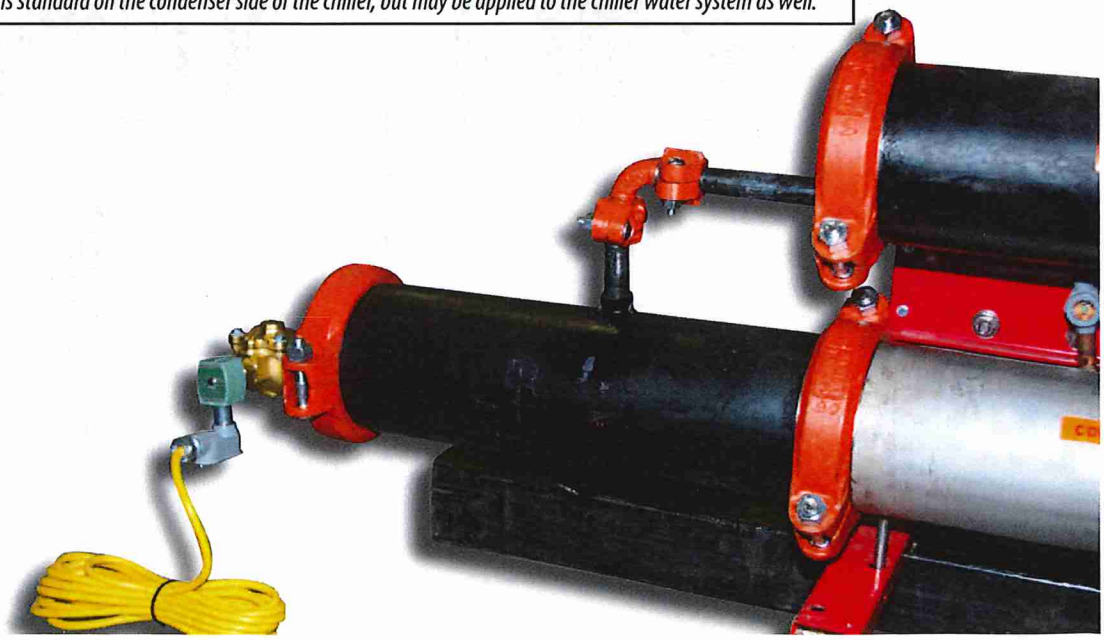
MULTISTACK developed MultiFlush™ to provide a trap for foreign material circulating in the chiller water system. The flow of water from the supply header to the return header moves water impurities down the line where they settle in the collector tank extension. The collected sediment is then removed by opening the drain valve for 1 ½ to 3 minutes during system pump operation.

Automated Drain Valve

A solenoid control valve can be operated by a programmed timer to open and close periodically. The amount of water discharged is small in comparison to the total water in the cooling circuit, and actually contributes to the cooling tower blow-down requirements.

Multistack's MultiFlush™ does the job of a centrifugal separator at a fraction of the cost.			
	Hardware Cost	**Installation Cost**	**Performance**
MULTISTACK MultiFlush™	Included*	Approximately 1 hour (No piping modification required.)	Works with all types of debris

**The MultiFlush™ system is standard on the condenser side of the chiller, but may be applied to the chiller water system as well.*



MULTISTACK
ORIGINATORS. INNOVATORS. NEVER THE IMITAT
1065 MAPLE AVENUE SPARTA, WI 54656

DRAWN BY: RS | DATE: 8/27/19

SOFIX CHEMICAL PLAN

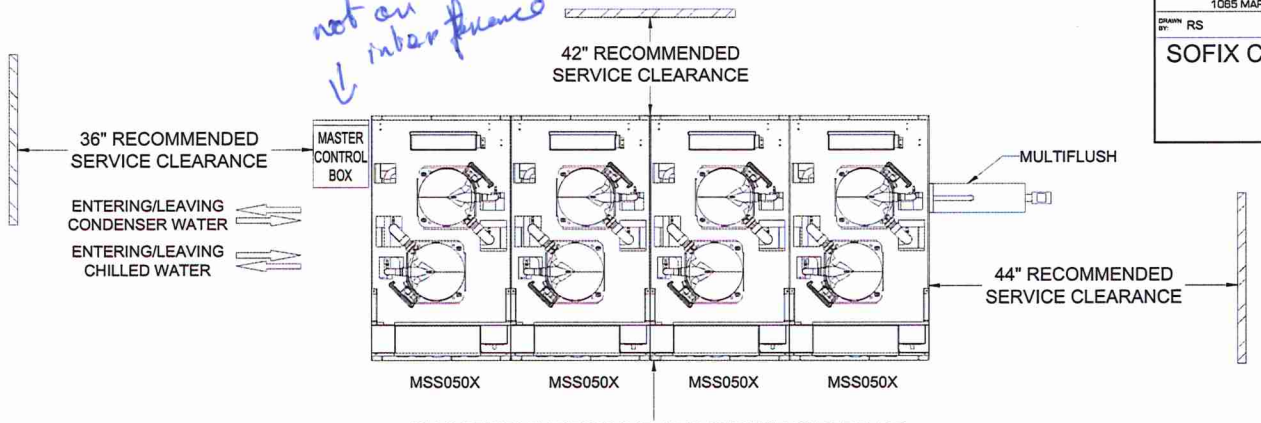
(4) MSS050X

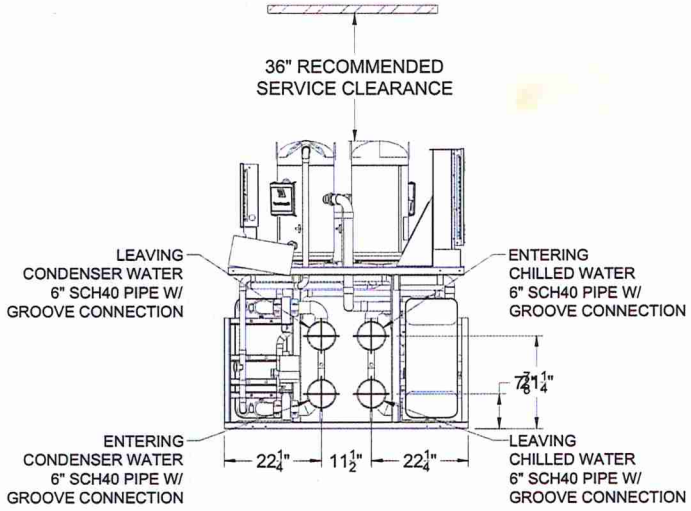
ESTIMATED WEIGHTS

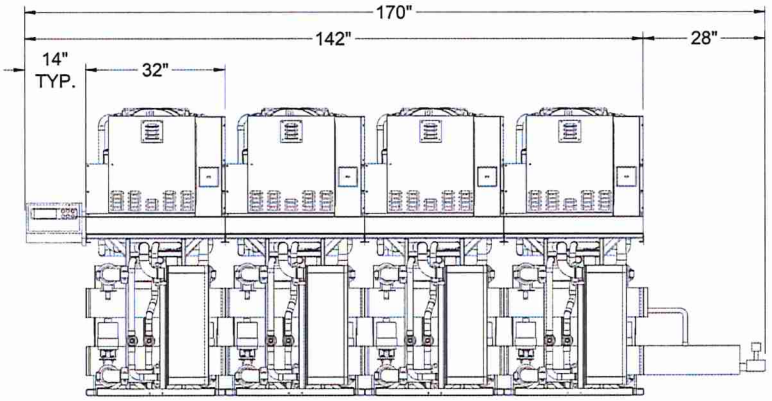
WET - 9,265 LBS

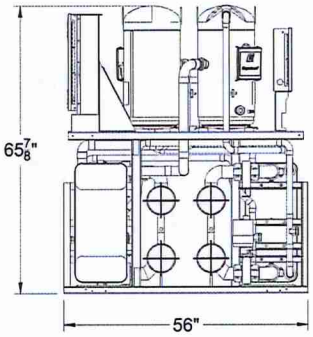
DRY - 8,635 LBS

not an interference









IF CHILLER IS GOING TO BE INSTALLED IN A PIT, CONTACT FACTORY.
LAYOUT DRAWINGS ARE FOR REFERENCE ONLY, DIMENSIONAL DATA IS SUBJECT TO CHANGE UPON FINAL DESIGN

PPM

MotorSaver® THREE-PHASE ELECTRIC MOTOR PROTECTOR

INSTALLATION INSTRUCTIONS FOR SYMCOM'S MOTORSAVER®

MODEL 460

DANGER!

HAZARDOUS VOLTAGES MAY BE PRESENT DURING INSTALLATION.
Electrical shock can cause death or serious injury.
Installation should be done by qualified personnel following all national, state and local electrical codes.

BE SURE POWER IS DISCONNECTED PRIOR TO INSALLATION!
FOLLOW NATIONAL, STATE, AND LOCAL CODES!
READ THESE INSTRUCTIONS ENTIRELY BEFORE INSTALLATION!

! WARNING !

UNEXPECTED OUTPUT ACTUATION CAN OCCUR.
Use hard-wired safety interlocks where personnel and/or equipment hazards exist.
Failure to follow this instruction can result in death, injury or equipment damage.

The Model 460 MotorSaver® is an auto ranging voltage monitor designed to protect three-phase motors regardless of size. The MotorSaver® is used on 190-480 VAC, 50 to 60 Hz motors to protect from damage caused by single phasing, low voltage, high voltage, phase reversal, and voltage unbalance.

CONNECTIONS

1. Mount the MotorSaver® in a convenient location in or near the motor control panel. If the location is wet or dusty, the MotorSaver® should be mounted in a NEMA 4 or 12 enclosure. The MotorSaver® can be mounted to a back panel using two #6 or #8 x 5/8 screws or can be snapped onto a DIN rail.
2. Connect L1, L2 and L3 on the MotorSaver's terminal strip to the LINE SIDE of the motor starter. (See Figure No. 1).
3. Connect the output relay to the circuitry to be controlled. For motor control, connect the normally open contact in series with the magnetic coil of the motor starter as shown in Figure No. 1. For alarm operation, connect the normally closed contact in series with the control circuit as shown in Figure No. 2.

II-460-B

www.SymCom.com
...your electronic control & protection specialists

222 Disk Drive, Rapid City, SD 57701
(800) 843-8848 www.symcom.com

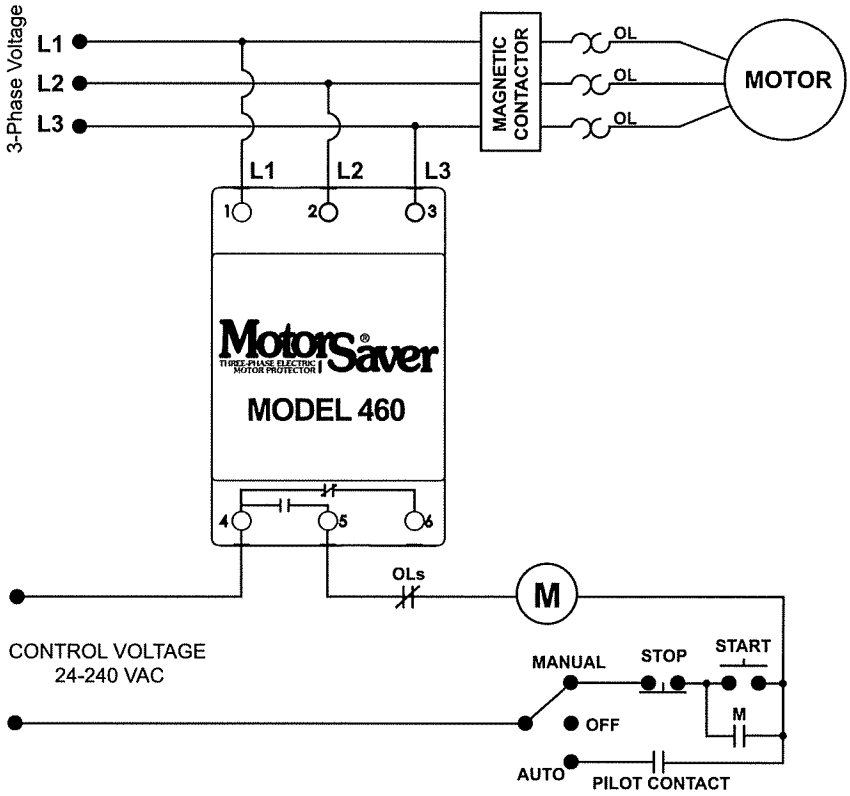


FIGURE NO. 1: CONTROL WIRING DIAGRAM

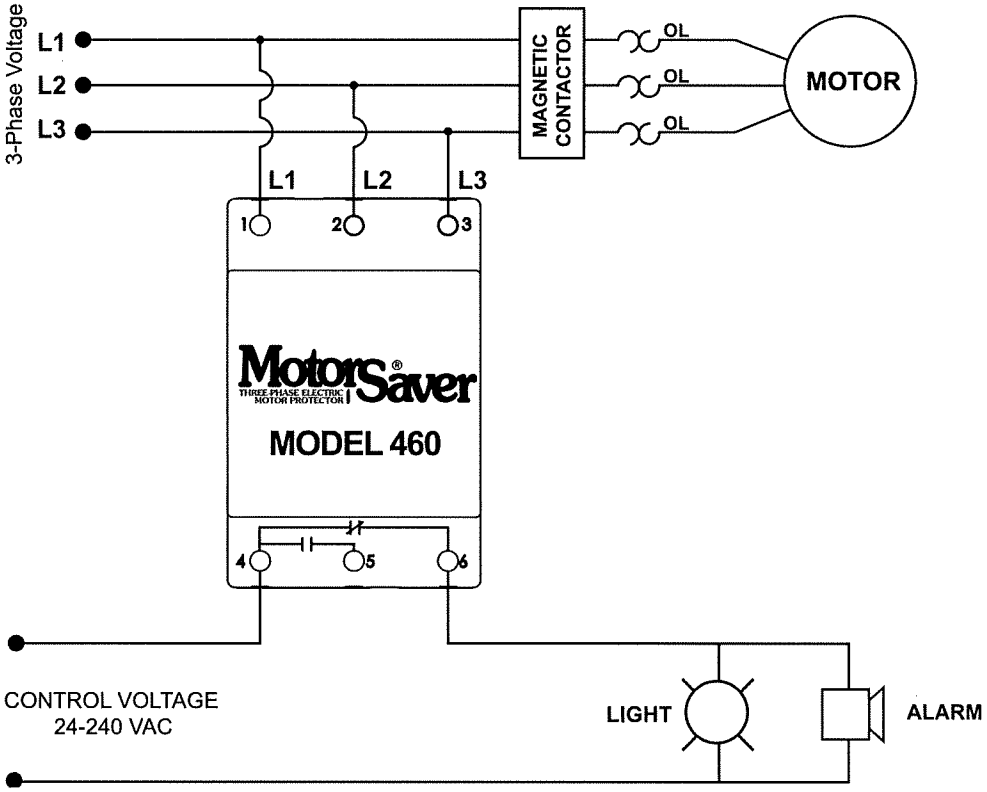
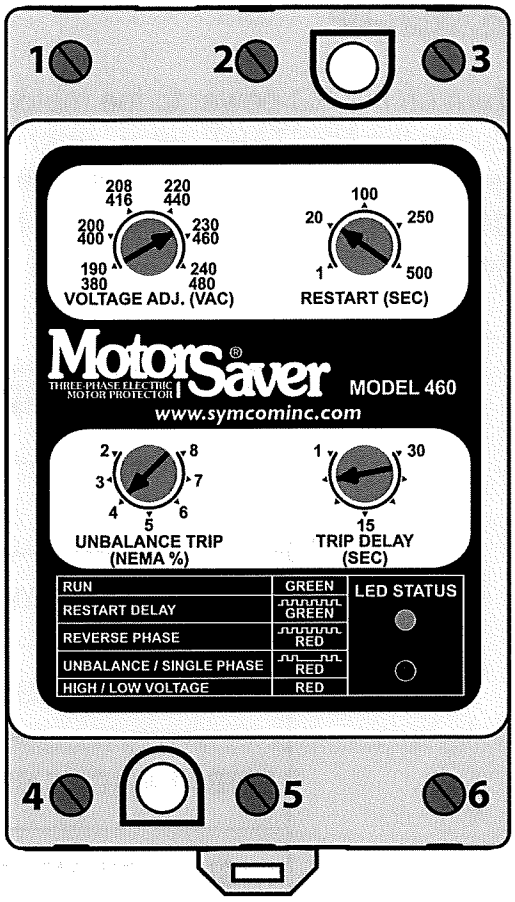


FIGURE NO. 2: ALARM WIRING DIAGRAM

SETTINGS



1. Line voltage adjustment: Rotate the **"VOLTAGE ADJ. (VAC)"** to the nominal three-phase line voltage feeding the motor to be protected.
2. Restart delay adjustment: Rotate the **"RESTART (SEC)"** adjustment to the desired position. The restart delay is the time between MotorSaver® seeing acceptable voltage and the MotorSaver® closing its output contacts. For compressor applications, the restart delay should be set for the approximate time it takes for the head pressure to bleed off of the compressor. For other applications, the restart delay is typically set between 2 and 10 seconds.
3. Trip delay adjustment: Rotate the **"TRIP DELAY (SEC)"** adjustment to the desired setting. This adjustment does not affect the trip delay on phasing faults. Typically, the trip delay adjustment is set between 1 and 5 seconds. In areas where voltage fluctuations are frequent, the trip delay adjustment may be set greater than 10 seconds.
4. Voltage unbalance adjustment: Rotate the **"UNBALANCE TRIP (NEMA%)"** adjustment to the desired unbalance trip level. The NEMA MG1 standard does not recommend operating a motor above 1% voltage unbalance without derating the motor. The NEMA MG1 standard also recommends against operating a motor above a 5% voltage unbalance under any circumstances. SymCom recommends consulting the motor manufacturer for specific tolerances.

$$\text{Percent Unbalance} = \frac{\text{Maximum Deviation from the Average}}{\text{Average}} \times 100$$

Example: The measured line-to-line voltages are 203, 210, and 212.

$$\text{Average} = \frac{203 + 210 + 212}{3} = 208.3$$

The maximum deviation from the average is the largest difference between the average voltage (208.3) and any one voltage reading.

208.3 - 203 = 5.3 210 - 208.3 = 1.7 212 - 208.3 = 3.7

The maximum deviation from the average is 5.3.

$$\frac{5.3}{208.3} \times 100 = 2.5\% \text{ Unbalance}$$

POWER-UP

Turn on the 3∅ power to the motor. The MotorSaver's green RUN light will blink during the RESTART delay. After the RESTART delay, the MotorSaver® will energize its output contacts and the green RUN light will illuminate. If the contacts do not energize and the RUN light does not illuminate, see the TROUBLESHOOTING section.

DIAGNOSTIC INDICATOR LIGHTS	
RUN	GREEN
RESTART DELAY	 GREEN
REVERSE PHASE	 RED
UNBALANCE / SINGLE PHASE	 RED
HIGH / LOW VOLTAGE	RED

CONGRATULATIONS!!
YOU HAVE JUST INSTALLED THE FINEST MOTOR PROTECTION AVAILABLE!!

TROUBLESHOOTING

SYMPTOM	LIGHT PATTERN	SOLUTION
No lights are on. The unit seems completely dead.	N / A	Measure the three line-to-line voltages. If any of the voltages are below 150 VAC, the MotorSaver® does not have enough power to operate its internal electronics. This may occur on a single-phased system. If the voltages are correct, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Red light is blinking (on initial power up).	 RED	Turn off the three-phase power. Swap any two leads powering the MotorSaver® (L1, L2, or L3). There is a 50-50 chance of connecting L1, L2, and L3 correctly the first time. Re-apply the three-phase power.
Red light is blinking (after the motor has been previously running).	 RED	The incoming lines have been reverse phased. The MotorSaver® is preventing the motor from running backwards. Correct the phase sequence.
Red light is blinking in this pattern.	 RED	The voltage is unbalanced or single-phased. Measure the incoming line voltages and calculate the % unbalance. If the voltage unbalance does not exceed the % unbalance reset value, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Red light is on steady.	RED	The voltage is out of tolerance. Measure the three line-to-line voltages. Calculate the average of the three voltages. If the average is 7% above or below the nominal voltage as selected by the LINE VOLTAGE ADJUST, the MotorSaver® is functioning properly. If the voltage is within ±7% of the selected line voltage, call SymCom at 1-800-843-8848 or 1-605-348-5580.
Green light blinks and motor is not running.	 GREEN	The MotorSaver® is in restart delay.
Green light is on steady, but motor does not start.	GREEN	The MotorSaver® is in run mode. Ensure other control devices are allowing the motor to start. Check control circuit for loose wires or malfunctioning switches.

Any questions or comments call SymCom at 1-800-843-8848 or 1-605-348-5580

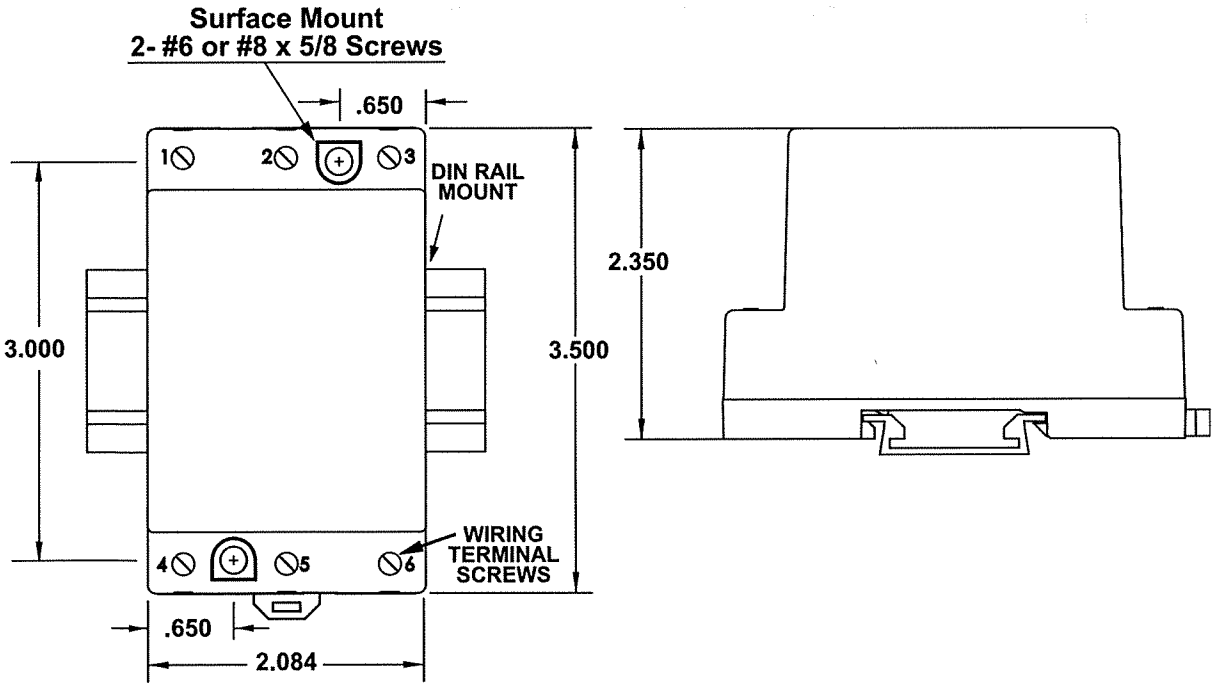
SPECIFICATIONS

3 - Phase Line Voltage	190 - 480 VAC
Frequency	50* - 60 Hz
Low Voltage (% of setpoint)	
Trip	90% ± 1%
Reset	93% ± 1%
High Voltage (% of setpoint)	
Trip	110% ±1%
Reset	107% ±1%
Voltage Unbalance (NEMA)	
Trip	2 - 8% Adjustable
Reset	Trip Setting minus 1% (5 - 8%)
	Trip Setting minus 0.5% (2 - 4%)
Trip Delay Time	
Low, High, and Unbalanced Voltage	1 - 30 Seconds Adjustable
Single-phasing faults (>25% UB)	1 Second Fixed
Restart Delay Time	
After a fault or complete power loss	1 - 500 Seconds Adjustable
Output Contact Rating - SPDT	
Pilot Duty	480 VA @ 240 VAC
General Purpose	10 A @ 240 VAC
Power Consumption	6 Watts (maximum)
Weight	14 oz
Enclosure	Polycarbonate
Terminal	
Torque	6 Inch-Pounds Max.
Wire AWG	12 - 20 AWG
Safety Marks	
UL	UL508 (File # E68520)
CE	IEC 60947-6-2
Standards Passed	
Electrostatic Discharge (ESD)	IEC 1000-4-2, Level 3, 6 kv contact, 8 kv air
Radio Frequency Immunity, Radiated	159 MHz, 10 V/m
Fast Transient Burst	IEC 1000-4-4, Level 3, 3.5 kv input power and controls

*NOTE: 50 Hz will increase all delay timers by 20%

Surge	
IEC	IEC 1000-4-5, Level 3, 4kv line-to-line; Level 4, 4kv line-to-ground
ANSI / IEEE	C62.41 Surge and Ring Wave Compliance to a level of 6kv line-to-line
Hi-potential Test	Meets UL508 (2 x rated V +1000V for 1 minute)
Environmental	
Temperature Range	Ambient Operating: -20° - 70° C (-4° - 158°F) Ambient Storage: -40° - 80° C (-40° - 176°F)
Class of Protection	IP20, NEMA 1 (Finger Safe)
Relative Humidity	10-95%, non-condensing per IEC 68-2-3

DIMENSIONS



SymCom warrants its microcontroller based products against defects in material or workmanship for a period of five (5) years* from the date of manufacture. All other products manufactured by SymCom shall be warranted against defects in material and workmanship for a period of two (2) years from the date of manufacture. For complete information on warranty, liability, terms, and conditions, please refer to the SymCom Terms and Conditions of Sale document.

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222 Disk Drive, Rapid City, SD 57701
(800) 843-8848 www.symcom.com

SUBMITTAL

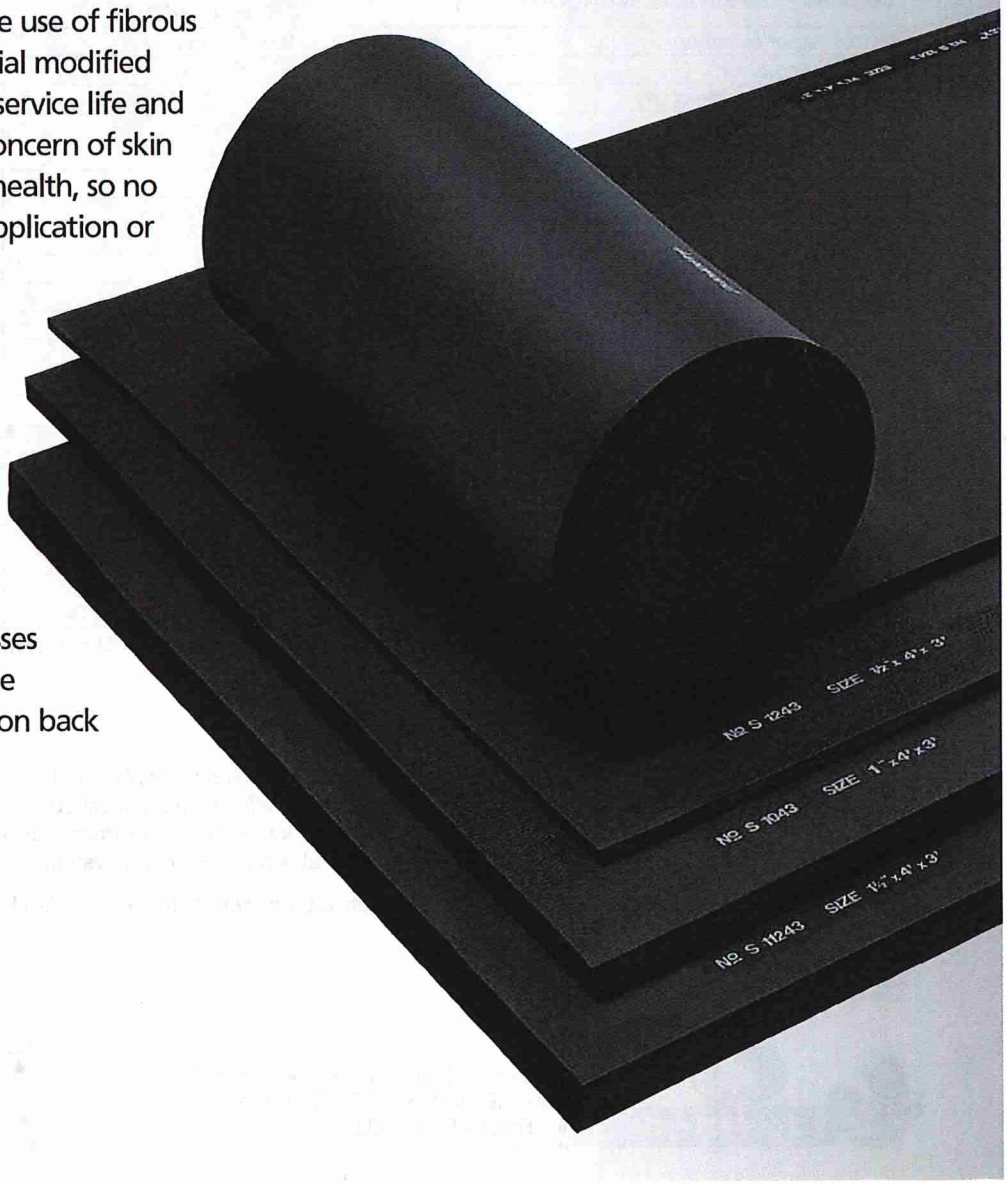
AEROCEL®

EPDM SHEET

Aerocel® EPDM Elastomeric Sheet Insulation is a flexible closed cell and lightweight elastomeric material with a smooth and durable surface, designed for insulating large pipes, tanks, vessels, air ducts, inside air handling panels and more. It is available in 3' x 4' flat sheets and rolls in thicknesses of 1/8", 1/4", 3/8", 1/2", 5/8", 3/4", 1", 1-1/4", 1-1/2" and 2".

Air Duct Systems

Besides being the ideal insulation for many kinds of piping systems and equipment, Aerocel® is also used as insulation for all kinds of HVAC ducting systems, including supply, return and intake air. Aerocel® EPDM Elastomeric Sheet is an excellent choice for insulating duct work, both internally lined and externally wrapped. Aerocel® has been favored over fibrous insulating materials mainly because of the possible dangers and health concerns with the use of fibrous materials. Aerocel®, made from special modified elastomeric material, ensures a long service life and can be safely handled without any concern of skin irritation. It is also not hazardous to health, so no special precautions are needed for application or service. Aerocel® offers superior resistance to moisture, fungus growth, vermin and rodent attack. Clean and easy to install, it offers a neat installed appearance because of its smooth surface.



Aerocel® sheet also meets the standards stated in UL 181 for mold growth/humidity, air erosion and passes ASTM G 21 Fungal Resistance. See the complete line of specifications listed on back of this page.

Key Features:

- UV Resistant
- Low Thermal Conductivity
- Easy to install
- 25/50 rated through 2" wall
- Fiber Free

Application

AEROCEL EPDM elastomeric sheet is flexible and easy to use for a wide variety of jobs including large OD pipes, tanks, vessels, air ducts and inside air handling panels. When used in duct lining applications, SMACNA duct lining practices are to be used for gluing and pinning Aerocel® to the sheet metal. An ASTM C 916 compliant duct liner adhesive** is to be used. Different adhesives will yield different performance characteristics when holding Aerocel® to sheet metal. Pins that mechanically attach or adhere to the sheet metal, and have a shank equal to the thickness of the insulation must be used. Weld-type fasteners are not to be used.

In addition to the specifications listed below, Aerocel® EPDM sheet also conforms to the following standards or holds the following approvals/acceptances: ASTM C 534 Type II, ASTM C 1534 Type I, ASTM G 21 Fungal Resistance, UL 181 Section 12 Mold Growth/Humidity, UL 181 Section 17 Air Erosion, NY City MEA #171-04-M, City of LA RR-8413, NFPA 90A & 90B, CAN/ULC-S102-07, and MIL 15280J.

Aerocel Sheet insulation meets the energy savings requirements of International Energy Conservation Code (IECC) and ASHRAE of R-4 at 1" wall thickness.

Aerocel EPDM Elastomeric Sheet Insulation has inherent Microbial Resistance based on the standard composition of this superior insulator.

Specifications

PHYSICAL PROPERTY	RESULT	TEST METHOD
Apparent Thermal Conductivity	0.245 k-Value	ASTM C 177 / C 518
Surface Burning Characteristics, Through 2" Thick	Flame Spread – 25 Max. Smoke Dev. – 50 Max.	ASTM E 84
	UL 94 5V-A, V-O	UL File E228536
	Self-Extinguishing	ASTM D 635
Service Temperature, CONTINUOUS	-297°F to +300°F -57°C to +149°C	ASTM C 411
Water Vapor Sorption	0.00% max.	ASTM C 1104
Water Absorption	0.2% max	ASTM C 209
Water Vapor Permeability	.03 perm (4.38 x 10-11)	ASTM E 96
Dimensional Stability	7% max.	ASTM C 356
Odor Emission	Pass	ASTM C 1304
Corrosiveness	Pass	ASTM C 665/C 692/DIN 1988
Fungi/Resistance	No Growth	ASTM C 1338/G 21/ UL181
Erosion Resistance	Pass	ASTM C 1071/UL181
UV Resistance	Good	ASTM G 7/ G 90
Ozone Resistance	No Cracking	ASTM D 1171
Nitrosamine Content	None Detected	U.S. FDA CPG No. 7117.11 BSEN 12868
Noise Reduction Coefficient	½" thick - .20 1" thick - .35	ASTM C 423

Thickness	3/8"	1/2"	3/4"	1"	1-1/2"	2"
R-value	1.5	2	3.1	4.1	6.1	8.2

Sound Absorption Coefficients, ASTM C423 Type "A", Mounting Practice E 795							
Frequency, Hz	125	250	500	1000	2000	4000	NRC
Type I: 1/2 in. (13 mm)	0.03	0.06	0.08	0.27	0.47	0.23	0.20
1 in. (25 mm)	0.15	0.10	0.31	0.57	0.36	0.40	0.35

** Acceptable Adhesives for Duct Lining – MEI 22-24 Eco-Spray N.F. Adhesive and Foster® 85-65™ STIC-FAS™ ADHESIVE

Aerocel can work efficiently as an insulation and sound dampening material internally and externally.

Air Duct Systems

Aerocel® sheet makes an ideal choice for HVAC duct systems because it is a low density, light weight product that also serves as an efficient acoustical absorber and an excellent thermal insulator. With low moisture absorption and low water vapor transmission, Aerocel can be used both as an internal and external insulation for all kinds of ducting systems.

To suit different decorative purposes, Aerocel® can also be coated with Aerocoat, acrylic latex emulsion paint.

AEROFLEX

282 Industrial Park Road • Sweetwater, TN 37874
1-866-AEROCEL • 1-877-337-7675 fax
Toll Free: (866) AEROCEL

III MULTISTACK®

PRELIMINARY INTERCONNECT WIRING DIAGRAM MSS-X WATER COOLED

III MULTISTACK®
1065 MAPLE AVE.
SPARTA, WI
PHONE #: (608) 366-2400
FAX #: (608) 366-2450
E-MAIL: INFO@MULTISTACK.COM
WEB SITE: WWW.MULTISTACK.COM

A	B	C	D
ADDED NOTE ABOUT CB3.	REVISED FPM AND CB3	ADDED CRANKCASE HEATER OPTION	CHANGED CONTROLLER
10/16/14 MLG	4/13/17 ESF	5/16/17 ESF	4/16/18 ESF

C.pCO WITH EVD TWIN EXPANSION VALVE CONTROL	MULTISTACK Sparta, Wisconsin 54656	B 1000-8432 D
JOB NAME:	ALL DIMENSIONS IN INCHES / DO NOT SCALE DRAWINGS	INTERCONNECT DIAGRAM WATER COOLED, FLUID COOLER, DHRC, AND VMEII WITH COMPRESSOR MOTOR PROTECTOR
	2-10VDC MOTORIZED BUTTERFLY VALVE EVAPORATOR SIDE (BELIMO GRB24-MFT) 2-10VDC MOTORIZED BUTTERFLY VALVE CONDENSER SIDE (BELIMO GRB24-MFT)	
DRAWN BY: MLG DATE: 9/24/14	CHECKED BY: DATE:	ENGR: APPR: DATE: SCALE: NONE

LEGEND

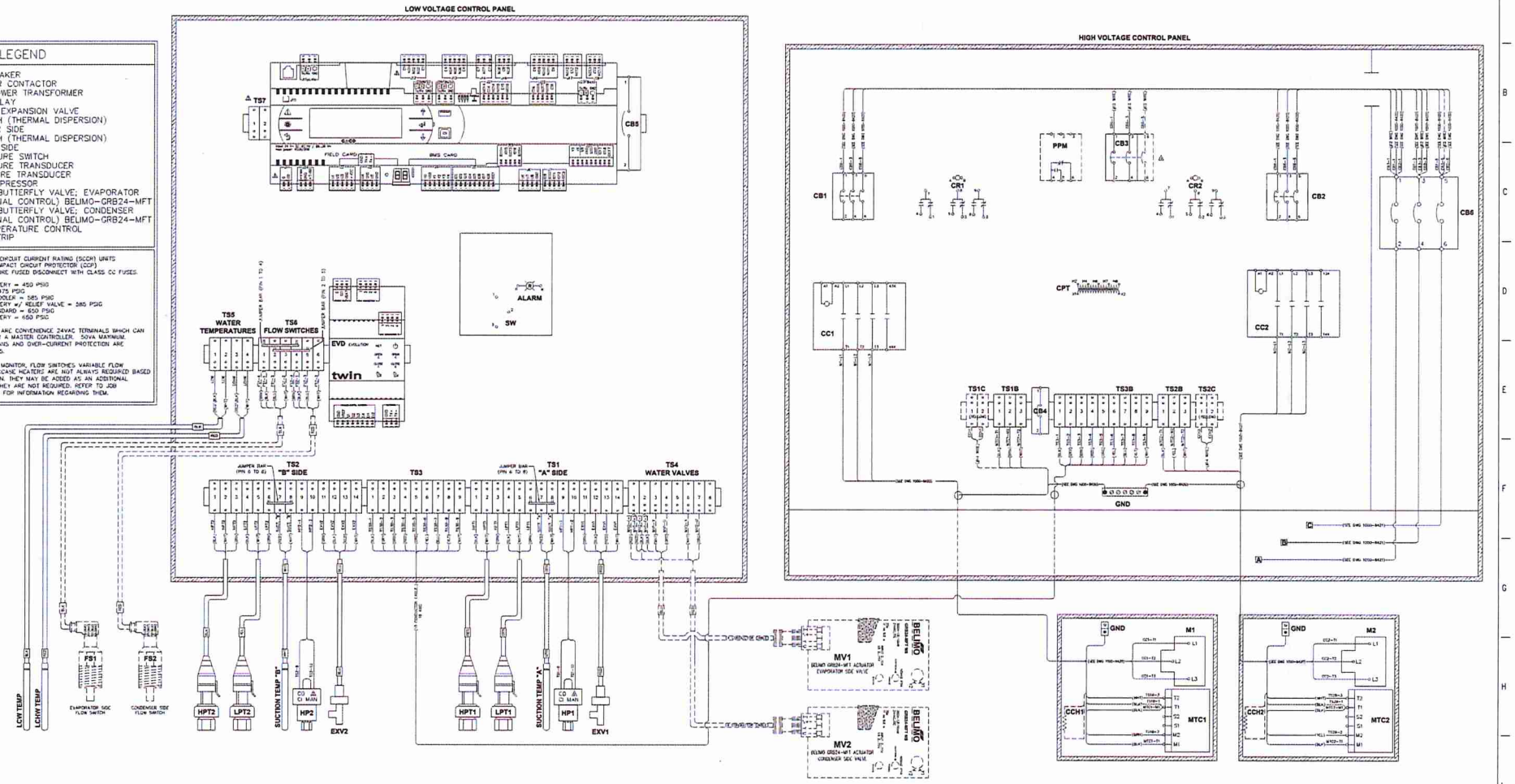
- CB CIRCUIT BREAKER
- C COMPRESSOR CONTACTOR
- CPT CONTROL POWER TRANSFORMER
- CR CONTROL RELAY
- EXV ELECTRONIC EXPANSION VALVE
- FS1 FLOW SWITCH (THERMAL DISPERSION) EVAPORATOR SIDE
- FS2 FLOW SWITCH (THERMAL DISPERSION) CONDENSER SIDE
- HP HIGH PRESSURE SWITCH
- HPT HIGH PRESSURE TRANSDUCER
- LPT LOW PRESSURE TRANSDUCER
- MTC MOTOR, COMPRESSOR
- MV MOTORIZED BUTTERFLY VALVE; EVAPORATOR (PROPORTIONAL CONTROL) BELIMO-GRB24-MFT
- MV MOTORIZED BUTTERFLY VALVE; CONDENSER (PROPORTIONAL CONTROL) BELIMO-GRB24-MFT
- TS MOTOR TEMPERATURE CONTROL TERMINAL STRIP

⚠ ON HIGHER SHORT CIRCUIT CURRENT RATING (SCCR) UNITS CB3 WILL BE A COMPACT CIRCUIT PROTECTOR (CCP) WHICH IS A MINIATURE FUSED DISCONNECT WITH CLASS CC FUSES.

⚠ R134A HEAT RECOVERY = 450 PSIG
WATER COOLED = 475 PSIG
LOW TEMP FLUID COOLER = 585 PSIG
R410A HEAT RECOVERY w/ RELIEF VALVE = 585 PSIG
FLUID COOLER STANDARD = 650 PSIG
R410A HEAT RECOVERY = 650 PSIG

⚠ TS7-1 AND TS7-2 ARE CONVENIENCE 24VAC TERMINALS WHICH CAN BE USED TO POWER A MASTER CONTROLLER. 50VA MAXIMUM. DISCONNECTING MEANS AND OVER-CURRENT PROTECTION ARE FROM CB4, NOT CB5.

THC POWER PHASE MONITOR, FLOW SWITCHES VARIABLE FLOW VALVES AND CRANKCASE HEATERS ARE NOT ALWAYS REQUIRED BASED ON THE APPLICATION. THEY MAY BE ADDED AS AN ADDITIONAL FEATURE EVEN IF THEY ARE NOT REQUIRED. REFER TO JOB SPECIFIC SELECTION FOR INFORMATION REGARDING THEM.



A	B 1001-0187	A

WIRING DIAGRAM
MASTER CONTROL
WATER COOLED/HEAT RECOVERY APPLICATION
C.pCO

SCALE: NONE

MULTISTACK
Sparta, Wisconsin 54656

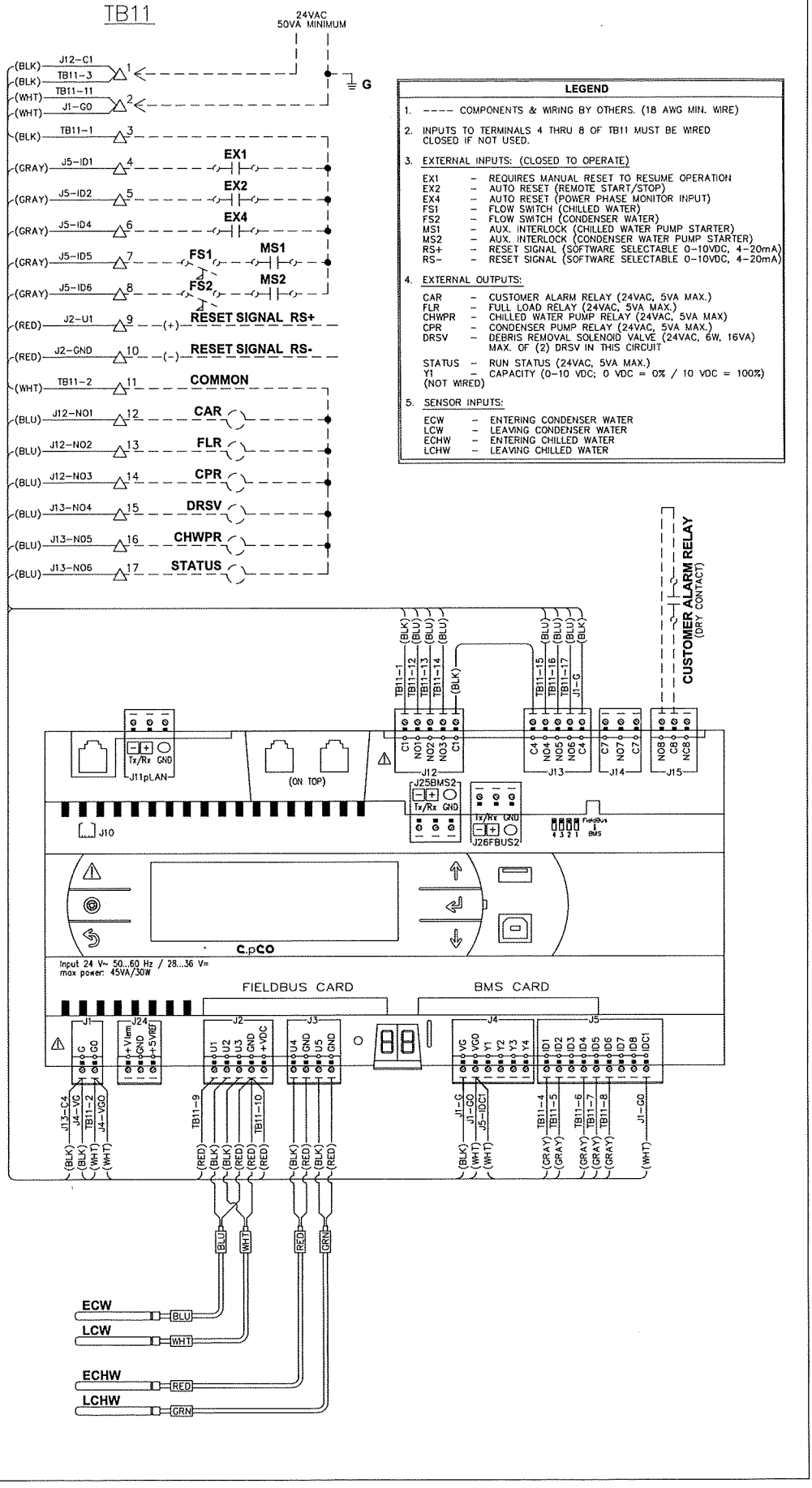
ALL DIMENSIONS IN INCHES / DO NOT SCALE DRAWINGS

ENGR:
APPR:
DATE:

CHECKED BY:
DATE:

JOB NAME:

DRAWN BY: ESF
DATE: 2/14/18



A	ADDED CAPACITY ON Y1 OUPUT

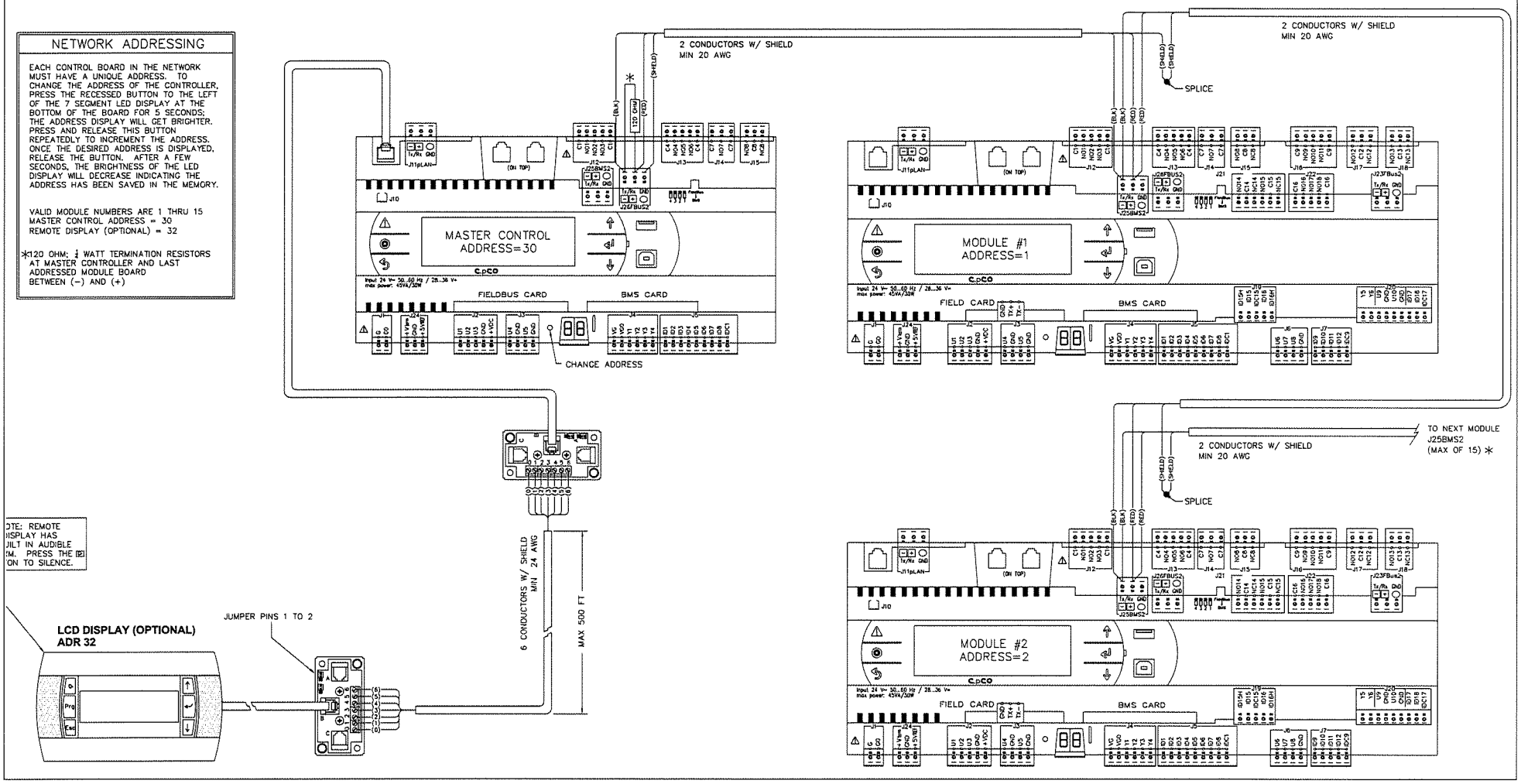
5/22/19 ESF	MULTISTACK Sparta, Wisconsin 54656 ALL DIMENSIONS IN INCHES / DO NOT SCALE DRAWINGS	B	1001-0188 A
JOB NAME:		COMMUNICATIONS INTERCONNECT DIAGRAM C.pCO	
DRAWN BY: ESF DATE: 2/14/18	CHECKED BY: DATE:	ENGR: APPR: DATE:	SCALE: NONE

NETWORK ADDRESSING

EACH CONTROL BOARD IN THE NETWORK MUST HAVE A UNIQUE ADDRESS. TO CHANGE THE ADDRESS OF THE CONTROLLER, PRESS THE RECESSED BUTTON TO THE LEFT OF THE 7 SEGMENT LED DISPLAY AT THE BOTTOM OF THE BOARD FOR 5 SECONDS; THE ADDRESS DISPLAY WILL GET BRIGHTER. PRESS AND RELEASE THIS BUTTON REPEATEDLY TO INCREMENT THE ADDRESS. ONCE THE DESIRED ADDRESS IS DISPLAYED, RELEASE THE BUTTON. AFTER A FEW SECONDS, THE BRIGHTNESS OF THE LED DISPLAY WILL DECREASE INDICATING THE ADDRESS HAS BEEN SAVED IN THE MEMORY.

VALID MODULE NUMBERS ARE 1 THRU 15
MASTER CONTROL ADDRESS = 30
REMOTE DISPLAY (OPTIONAL) = 32

*120 OHM; ¼ WATT TERMINATION RESISTORS AT MASTER CONTROLLER AND LAST ADDRESSED MODULE BOARD BETWEEN (-) AND (+)



OTE: REMOTE ISPLAY HAS JILT IN AUDIBLE M. PRESS THE ON TO SILENCE.

System Wire & Fuse Sizing Specifications

(Applicable codes may require different wire sizing)

-Fuse Sizing: Maximum Fuse (MF), Type RK5 Fuse

MF= (2.25 x RLA1*) + RLA2 + RLA3

Where the MF does not equal a standard size fuse, the next larger size should be used.

NOTES:

A.*RLA1 = RLA of the largest compressor in the system. RLA2 & RLA3 = RLA of the other compressors in the system.

B. The total system Minimum Circuit Ampacity (aMCA) shall not exceed 500A.

C. Wire sizing is based on the Nat. Electr. Code (NEC) rating for 75°C copper wire, with 3 wires per conduit.

D. Wiring Distance from branch circuit shall not exceed 100ft.

-Wiring Sizing: Minimum Circuit Ampacity

(MCA) MCA = (1.25 x RLA1*) + RLA2 + RLA3

MCA	3 CONDUCTORS 1 CONDUIT	6 CONDUCTORS 2 CONDUIT
50	8	—
65	6	—
85	4	—
100	3	—
115	2	—
130	1	—
150	1/0	—
175	2/0	—
200	3/0	—
230	4/0	—
255	250 MCM	—
285	300 MCM	1/0
300	—	2/0
350	—	3/0
400	—	4/0
460	—	4/0
500	—	250 MCM

SECTION 23 64 23
MULTISTACK WATER COOLED WATER CHILLER
MODEL (MSS-050X)
GUIDE SPECIFICATION

PART 1 GENERAL

1.01 SUMMARY

Section includes design, performance criteria, refrigerants, controls, and installation requirements for Multistack water cooled centrifugal chillers.

1.02 REFERENCES

Comply with the following codes and standards: (as adopted by each individual State)

ARI 550/590
ANSI/ASHRAE 15
ASME Section VIII
NEC
ETL
CSA
OSHA

1.03 SUBMITTALS

Submittals shall include the following:

A. Chiller dimensional drawings with elevation overview. Drawings to include required service clearances, location of all field installed piping and electrical connections.
B. A summary of all auxiliary utility requirements for normal system operation required. Auxiliary utility requirements include: electrical, water, and air. Summary of auxiliary equipment shall include quantity and quality of each specific auxiliary utility required.
C. Chiller Control documentation to include: Chiller control hardware layout, wiring diagrams depicting factory installed wiring, field installed wiring with points of connection, and points of connection for BAS control/interface points.
D. Sequence of operation depicting overview of control logic used.
E. Installation and Operating Manuals.
F. Manufacturer certified performance data at full load in addition to either IPLV or NPLV.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the codes and standards as defined in Section 1.02 titled REFERENCES
B. Chiller is required to be run tested at manufacturer's facility to job specific requirements, prior to shipment. Report available upon request.

1.05 DELIVERY and HANDLING

A. Chiller(s) shall be delivered to the job site completely assembled and charged with complete refrigerant charge.
B. Installing contractor to comply with the manufacturer's instructions for transporting, rigging, a assembly of chiller.

1.06 WARRANTY and START-UP

A. Manufacturer shall provide the following warranty coverage for the entire chiller for the time period defined below. All parts shall be warranted against defects in material and workmanship.
B. The warranty period shall commence either on the equipment start-up date or six months after shipment, whichever is earlier.
C. Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. After start-up a Manufacturer's Representative shall provide a minimum of 8-hours of operator training to the owner's designated representative(s).

1.07 MAINTENANCE

A. Maintenance of the chiller shall be the sole responsibility of the owner.

PART 2 PRODUCTS

2.01 OPERATING CONDITIONS

A. Provide water-cooled liquid chiller with the capacity as scheduled on drawings at job site elevation listed in Section 15050.

B. Chiller shall be designed to operate using **R-410a** Refrigerant.

C. Chiller shall be designed for parallel evaporator water flow.

D. The liquid to be chilled will be water containing corrosion inhibitors.

E. Chiller shall be designed to operate using **460** 3 phase, **60 Hz** electrical power supply.

2.02 WATER-COOLED PACKAGED CHILLER

A. Approved manufacturer is MULTISTACK.

B. System Description: Chiller shall incorporate Scroll-type compressors and can consist of multiple **(50)**-ton modules. Each refrigerant circuit shall consist of an individual compressor, common dual circuited condenser, dual circuited evaporator, thermal expansion valve, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical stand-point. The multi-circuit chiller must be able to produce chilled water even in the event of a failure of one or more refrigerant circuits. Circuits shall not contain more than **(18)** lb. of **R-410a** refrigerant.

C. General

1. Chiller Modules shall be ETL listed in accordance with UL Standard 1995, CSA certified per Standard C22.2#236.

2. Chiller modules shall be AHRI certified.

3. Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment on an AHRI certified or 3rd party verified test stand.

4. Compressors, heat exchangers, piping and controls shall be mounted on a heavy gauge, powder coated steel frame. Electrical controls, contactors, and relays for each module shall be mounted within that module.

D. Chilled and Condenser Water Mains: Each module shall include supply and return mains for both chilled and condenser water. Cut grooved end connections are provided for interconnection to **(six)**-inch **(6.625")** standard outside diameter piping with grooved type couplings. Rolled grooved shall be unacceptable. Chilled water mains shall be insulated with ¾" closed cell insulation. Water Mains shall be installed such that they are beneath any power or control wiring so as to insure for safe operation in the event of condensation or minor piping leaks.

E. Evaporators and condensers: Each evaporator and condenser shall be brazed plate heat exchangers constructed of 316 stainless steel; designed, tested, and stamped in accordance with UL 1995 code for 650 psig refrigerant side working pressure and 360 psig water side working pressure. Both the condenser and evaporator heat exchanger shall be mounted below the compressor, to eliminate the effect of migration of refrigerant to the cold evaporator with consequent liquid slugging on start-up.

F. Compressor: Each module shall contain two hermetic scroll compressors independently circuited and mounted to the module with rubber-in-shear isolators. Each system also includes high discharge pressure and low suction pressure manual reset safety cut-outs.

G. Central Control System.

1. Scheduling of the various compressors shall be performed by a microprocessor based control system (Master Controller). A new lead compressor is selected every 24 hours to assure even distribution of compressor run time.

2. The Master Controller shall monitor and report the following on each refrigeration system:
   a. Discharge Pressure Fault
   b. Suction Pressure Fault
   c. Compressor Winding Temperature
   d. Suction Temperature
   e. Evaporator Leaving Chilled Water Temp.

3. The Master Controller shall be powered by the chillers single point power connection and shall monitor and report the following system parameters:
   a. Chilled Water Entering and Leaving Temperature
   b. Condenser Water Entering and Leaving Temperature
   c. Chilled Water and Condenser Water Flow

4. An out of tolerance indication from these controls or sensors shall cause a "fault" indication at the Master Controller and shutdown of that compressor with the transfer of load requirements to the next available compressor. In the case of a System Fault the entire chiller will be shut down. When a fault occurs, the Master Controller shall record conditions at the time of the fault and store the data for recall.

   This information shall be capable of being recalled through the keypad of the Master Controller and displayed on the Master Controller's 2 line by 40 character back-lit LCD. A history of faults shall be maintained including date and time of day of each fault (up to the last 20 occurrences).

5. Individual monitoring of leaving chilled water temperatures from each refrigeration system shall be programmed to protect against freeze-up.

6. The control system shall monitor entering and leaving chilled water temperatures to determine system load and select the number of compressor circuits required to operate. Response times and set points shall be adjustable. The system shall provide for variable time between compressor sequencing and temperature sensing, so as to fine tune the chiller to different existing building conditions.

7. **INTEROPERABILITY WEB PORTAL**
The Chiller shall be capable of interfacing to a building automation system. Interface shall be accomplished using an Interoperability Web Portal and shall be capable of communication over **BACNet, Ethernet.**

H. Chiller shall have a single point power connection and external inputs and outputs to be compatible with the building management system. Inputs/Outputs include:

1. Remote Start/Stop
2. Customer Alarm Relay
3. Customer Chilled/Load Limit Reset Signal
4. ECW to Mechanical Cooling Module
5. LCW from Mechanical Cooling Module
6. ECHW to Mechanical Cooling Module
7. LCHW from Mechanical Cooling Module
8. Power Phase Monitor
9. Chilled Water Flow Switch Input
10. Condenser Water Flow Switch Input
11. Full Load Indicator Relay
12. Condenser Pump Relay
13. DDRS Condenser Multiflush Relay
14. Chilled Water Pump Relay

I. Each inlet water header shall incorporate a built in 30-mesh (maximum) in-line strainer system to prevent heat exchanger fouling and accommodate 100% flow filtration with a minimum surface area of 475 sq inches per module. Condenser-side strainer system shall incorporate an automatic debris blow-down system for self-cleaning of the strainer system that is controlled and powered by the chiller.

J. **DIRECT CONNECT:** Chiller shall be equipped with **DIRECT CONNECT POWER** at a **5,000 amp SCCR.**

L. **Total Access Design.**
Isolation valves shall be installed between the heat exchangers and water supply mains for heat exchanger isolation and removal without the requirement to remove a module or shut down the entire chiller allowing for total access to all serviceable components.

2.03 SAFETIES, CONTROLS AND OPERATION

A. Chiller safety controls system shall be provided with the unit (minimum) as follows:

1. Low evaporator refrigerant pressure
2. Loss of flow through the evaporator
3. Loss of flow through the condenser
4. High condenser refrigerant pressure
5. High compressor motor temperature
6. Low suction gas temperature
7. Low leaving evaporator water temperature

B. Failure of chiller to start or chiller shutdown due to any of the above safety cutouts shall be annunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English. Alphanumeric codes shall be unacceptable.

C. The chiller shall be furnished with a Master Controller as an integral portion of the chiller control circuitry to provide the following functions:

1. Provide automatic chiller shutdown during periods when the load level decreases below the normal operating requirements of the chiller. Upon an increase in load, the chiller shall automatically restart.

2. Provisions for connection to automatically enable the chiller from a remote energy management system.
3. The control panel shall provide alphanumeric display showing all system parameters in the English language with numeric data in English units.

4. Each module shall contain a slave controller that will allow any module to run in the event of a master controller failure or loss of communication with the master controller via an on/off/manual toggle switch.

D. Normal Chiller Operation

1. When chiller is enabled, the factory supplied Master Controller stages the chiller capacity from minimum to maximum as required by building load.

2. The Chiller control system shall respond to Entering Water Temperature (constant primary flow) or to Leaving Water Temperature (variable primary flow) and will have an integral reset based on entering water temperature to provide for efficient operation at part-load conditions.

E. Power Phase Monitor **(PPM)**

1. Provide a Power Phase Monitor on the incoming power supply to the chiller. This device shall prevent the chiller from operating during periods when the incoming power is unsuitable for proper operation.

2. The Power Phase Monitor shall provide protection against the following conditions:

   a. Low Voltage (Brown-Out)
   b. Phase Rotation
   c. Loss of Phase
   d. Phase Imbalance

PART 3 INSTALLATION

3.01 PIPING SYSTEM FLUSHING PROCEDURE

A. Prior to connecting the chiller to the condenser and chilled water loop, the piping loops shall be flushed with a detergent and hot water (110-130° F) mixture to remove previously accumulated dirt and other organics. In old piping systems with heavy encrustation of inorganic materials consult a water treatment specialist for proper passivation and/or removal of these contaminants.

B. During the flushing, a 30 mesh (max.) Y-strainers (or acceptable Equivalent) shall be in place in the system piping and examined periodically as necessary to remove collected residue. The use of on board chiller strainers shall not be acceptable. The flushing process shall take no less than 6 hours or until the strainers when examined after each flushing are clean. Old systems with heavy encrustation shall be flushed for a minimum of 24 hours and may take as long as 48 hours before the filters run clean.

Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturer's instructions. After flushing with the detergent and/or dilute acid concentrations the system loop shall be purged with clean water for at least one hour to ensure that all residual cleaning chemicals have been flushed out.

C. Prior to supplying water to the chiller the Water Treatment Specification shall be consulted for requirements regarding the water quality during chiller operation. The appropriate chiller manufacturer's service literature shall be available to the operator and/or service contractor and consulted for guidelines concerning preventative maintenance and off-season shutdown procedures.

3.02 WATER TREATMENT REQUIREMENTS

A. Supply water for both the chilled water and condenser water circuits shall be analyzed and treated by a professional water treatment specialist who is familiar with the operating conditions and materials of construction specified for the chiller's heat exchangers, headers and associated piping. Cycles of concentration shall be controlled such that recirculated water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers is maintained within the following parameters:

1. pH	Greater than 7 and less than 9
2. Total Dissolved Solids (TDS)	Less than 1000 ppm
3. Hardness as $CaCO_3$	30 to 500 ppm
4. Alkalinity as Ca CO_3	30 to 500 ppm
5. Chlorides	Less than 200 ppm
6. Sulfates	Less than 200 ppm

3.03 WARRANTY and START-UP

A. Manufacturer's Warranty: Manufacturer shall provide full parts-only warranty coverage for entire chiller for a period of one year. All parts shall be warranted against defects in material and workmanship. Similar parts-only coverage shall be provided for the chillers compressors for a period of five years. The warranty period shall commence either on the equipment start-up date or six months after shipment, whichever is earlier.

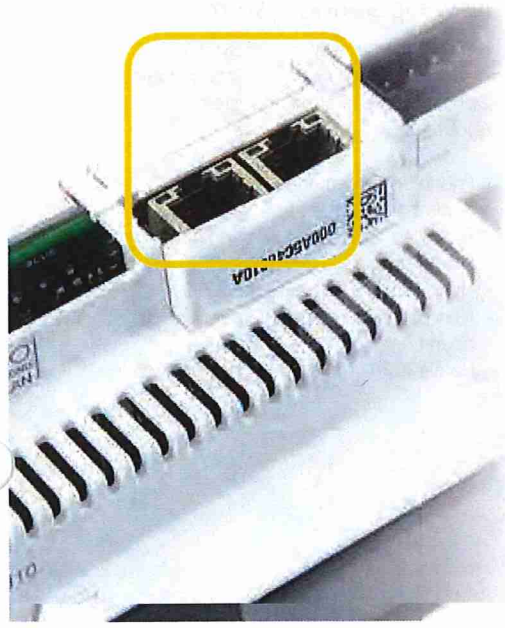
B. Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. Factory Authorized Service Engineer shall also be responsible for assembly of the chillers cabinetry package and electrical bus bar system. After start-up a Manufacturer's Representative shall provide a minimum of 8-hours of operator training to the owner's designated representative(s).

Controller Information

c.pco

The new family of connected programmable controller

The c.pCO controller family represents the evolution of pCO5+ towards unprecedented networking capabilities.
Thanks to a Multitasking Operating System and the adoption of standard protocols, local and remote connectivity are the key innovation of the new c.pCO system.



Integrated Ethernet Interfaces

Two built-in 10/100 MB/s switched ports
Build networks without external switches
Wide range of integrated services

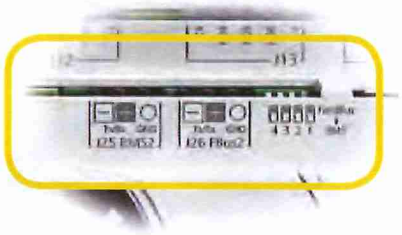
- Web Server with dynamic content
- FTP Server for upgrades and file upload
- Modbus/TCP Master and Slave
- BACNet/IP B-BC profile
- On-target debugging
- tERA cloud connections

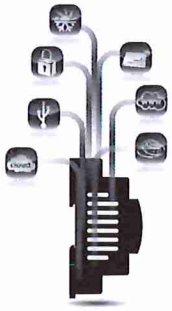
Integrated USB interface

Two built-in USB 2.0 standard ports
USB Host for storage devices
USB Devices for PC connection

- Upload application and OS upgrade packages
- Upload Web pages and generic user documents
- Download data logger CSV files
- Download user documents
- Application Cloning with encryption and digital signature
- On-target debugging

- 5 different sizes to better fit all applications
- ranging from 16 to 55 I/O points
- new controller size: c.pCO mini
- great I/O flexibility with Carel ASIC solution
- integrated BMS, Fieldbus, USB interfaces
- builtin Ethernet ports with Web server, FTP and tERA connection
- open protocols: Modbus®, BACnet™ , HTTP, FTP
- integrated energy saving with Valve Driver and Ultracap





BMS & Field Bus connectivity

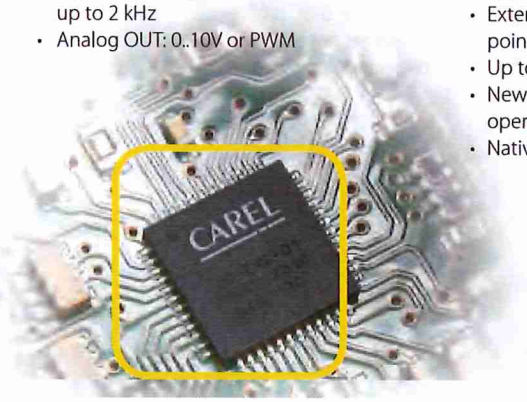
Two built-in RS485 interfaces
Expandable with two additional optional cards.
Multitasking independent protocol engines

- RS485 high speed interfaces up to 115200 bps
- Modbus® RTU Master and Slave protocols
- CAREL optimised Master and Slave protocols
- BACNet™ MSTP B-BC profile
- Custom protocol (Function blocks for Direct RS485 access)

Flexible I/O

Up to 10 Universal I/O channels
CAREL ASIC proprietary silicon technology

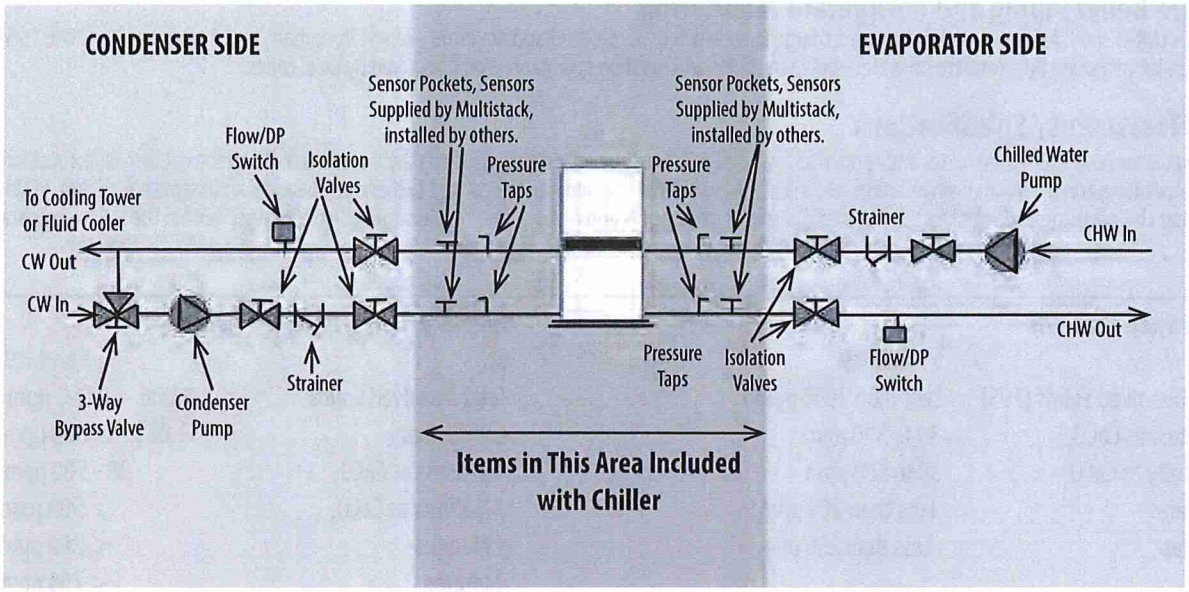
- Analog IN: NTC, PTC, PT100, PT500, PT1000, 0..1V, 0..5V, 0..10V, 0..20mA, 4..20mA
- Digital IN: Voltage free and fast counter up to 2 kHz
- Analog OUT: 0..10V or PWM



New Operating system

New Multitasking Operating System
New Virtual Machine for application logic
Optimal usage of onboard system resources.

- Priority management to guarantee application loop speed
- Extended datatypes: 32bit and floating point numbers
- Up to 5x speed increase on pCO5+
- New protocol engines for independent operation
- Native TCP/IP multitasking protocol stack



Recommended Piping

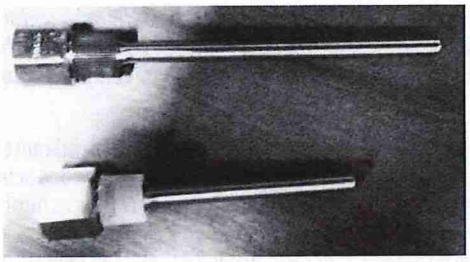
All piping must be properly and adequately supported at coupling connections and suitable intervals along the piping runs. Hanger design must provide for the weight of fluids in the piping system when the chiller is in operation.

Multistack modules are equipped with brazed plate heat exchangers made of 316 stainless steel. Multistack recommends use of a 30-mesh system strainer, Y-type basket or equal, in each condenser and evaporator inlet header.

It is the installing contractor's responsibility to make sure the water systems have been flushed and the strainers are clean and clear of debris before starting the chiller. Do not flush piping so as to push debris into or through the through the chiller heat exchangers.

Important

Be sure to install the supplied sensor wells in the system piping. The wells should be installed a few feet from the chiller in the entering and leaving chilled water and entering and leaving condenser water pipes.



Typical Sensor Wells

Flow Protection

Proof of chilled water and condenser water flow is required by the Master Controller inputs. Paddle-type or Differential Pressure (DP) switches may be used. Switches can be supplied by Multistack as an option, otherwise they are to be field supplied and installed. Chillers purchased with chilled or condenser water pump modules have a DP switch installed across the pump to verify operation. Multistack recommends a paddle-type switch be installed in the leaving chilled water piping using a differential pressure switch. Install it across the inlet and outlet water connections to the chilled and/or condenser water piping connections. PSC.

System Water Volume

A properly sized chilled water system must have enough time (at least three minutes) to properly control and respond to changes in load and to prevent short cycling of the chiller. To ensure the system water volume is adequate, a general rule of thumb is:

7-10 gallons of water per ton or Acceptable Chilled Water Volume = Chilled Water Design GPM X 3

If the system heat exchangers, piping and components cannot hold the necessary chilled water volume, a properly sized chilled water storage tank should be added.

Condenser Water Temperature Control

For installations where entering condenser water temperature could be lower than 65°F Multistack recommends installing a three-way tower bypass valve to maintain a minimum of 65°F entering condenser water temperature. This is based on a 10°F Delta-T system.

Pressure Relief Piping and Refrigerant Monitoring

Multistack chiller modules use a small refrigerant charge (typically 0.6 lbs. per ton) and are often exempt from many requirements of ASHRAE 15 Standard. Pressure relief valves are not standard on water-cooled modules and must be special ordered if required by local codes.

Water Treatment / Specifications

Supply water for both the chilled water and condenser water circuits must be analyzed and treated by a professional water treatment specialist familiar with the operating conditions and construction materials used in Multistack modular chiller heat exchangers, headers and associated piping. Water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers must be maintained within the following parameters:

Water Specifications	
ph	>7 and <9
Total Dissolved Solids (TDS)	Less than 1000 ppm
Hardness as $CaCO_3$	30 to 500 ppm
Alkalinity as $CaCO_3$	30 to 500 ppm
Chlorides	Less than 200 ppm
Sulfates	Less than 200 ppm

Specifications with 25 Percent Glycol	
ph	>7 and <9
Total Dissolved Solids	1,000 - 10,000 ppm
Conductivity	1,000 - 15,000 ppm
Hardness as $CaCO_3$	30 - 500 ppm
Alkalinity as $CaCO_3$	> 500 ppm
Chlorides	< 200 ppm
Sulfates	< 200 ppm

Pipe System Flushing Procedure

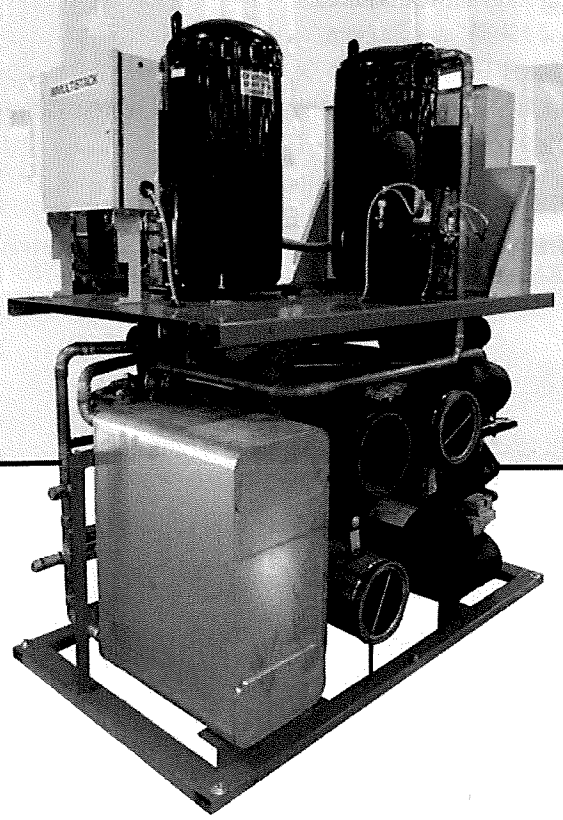
Before connecting the chiller to the condenser and chilled water loop, the piping loops must be flushed with a detergent and hot water (110-130° F) mixture to remove any dirt and organic residue. After removing residue, continue flushing with a dilute phosphoric acid, sulfamic acid or citric acid and water mixture to remove inorganic scale in the pipe. Cleaning chemicals such as Nu-Calgon "Imperial Grade" Scale Remover part number 4360-84 or equivalent suitable for both organic residue and scale removal may be substituted. Otherwise detergents and acids shall not be combined unless approved by the chemical manufacturers. Only chemicals compatible with 316 stainless steel, copper and carbon steel shall be used. (Any concentrations of hydrochloric or sulfuric acid or chloride containing chemicals shall not be allowed to come in contact with copper brazed 316 stainless steel heat exchangers).

Caution: The use of unapproved chemicals in the chilled or condenser water supplies may damage the heat exchangers. These chemicals include, but are not limited to, hydrochloric acid, sulfuric acid, muriatic acid, and household bleach. Damage caused by the use of these and other unapproved chemicals is not covered by warranty. The only approved chemicals for heat exchanger cleaning are phosphoric or sulfamic acids in concentrations of 10 percent or less by volume. For more information contact your Multistack representative.

While flushing, 30-mesh Y-strainers (or equivalent) must be in place in the system piping and examined periodically as needed to remove collected residue. The flushing process shall take no less than six hours, or until the strainers are clean after flushing. Old pipe systems with heavy encrustation shall be flushed a minimum of 24 hours and may require as much as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturers instructions. After flushing with the detergent and/or dilute acid concentrations, the system loop shall be purged with clean water for at least an hour to flush out all residual cleaning chemicals.

MULTISTACK®

Originators. Innovators. Never the Imitators.



Modular Water-Cooled Chillers

Installation, Operation, Maintenance

MS010XC, MS015XC, MS020XC, MS030XC, MS040XC, MS050XC, MS070XC, MS085XC

Standard and Total Access™ Modules

This manual provides information on the proper installation, operation and maintenance requirements for Multistack water-cooled modular chillers. Follow these instructions to help ensure that the chiller performs properly. Failure to follow these instructions can significantly affect the chiller's performance and reliability and may adversely affect the equipment warranty.

Contents

This Multistack installation and operation manual will assist in the proper installation and operation of Multistack modular chillers. Review this manual carefully.

- The information and illustrations contained in this manual are generalized. Consult with a Multistack representative to address specific installation and operating details not covered in this manual.
- Good electrical and piping practices in accordance with all National and local codes must be followed.
- This equipment must not be installed near an open flame per local codes and ASHRAE specifications.
- Personnel servicing Multistack modular chillers must have, at minimum, a Class II EPA certification.
- Questions regarding the content of this manual and Multistack products should be directed to an authorized Multistack representative or to the Multistack Service Department at: (608) 366-2400 or via e-mail to info@multistack.com

Planning Ahead

To ensure all warranties and a successful installation, a Factory Authorized Technician is required to perform start-up of the Multistack Chiller. If start-up is to be performed directly by Multistack, a minimum of two weeks notice is required. Please call the Multistack Service Department at (608) 366-2400 to schedule.

Multistack has a policy of continual improvement and reserves the right to change product design, literature and specifications without notice.

Safety Information

This manual includes warnings, cautions and notes.

DANGER conveys serious hazards for injury or death.

WARNING indicates risk of injury or death.

CAUTION warns of possible injury or damage.

NOTE calls out work practices that can result in optimal operations.

Warnings, cautions and notes include:

DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tag outs.

DANGER: Use extreme caution when working around electrical components, wiring and connections to avoid injury or death by electric shock.

DANGER: Never remove a lockout from equipment unless you placed it there. Each person shall place his/her own lock/tag when required to isolate an energy source. Do not start any adjustment, service or repair without verifying that the tag/lock out switch or control cannot be by-passed or over-ridden. Verify that the locked-out switch or control cannot be overridden. Test the equipment to be certain that the locked-out switch is de-energized and not simply malfunctioning. Press all start buttons to confirm that the equipment WILL NOT start. Confirm that the system being serviced or repaired is the system that has been locked out. Before restarting equipment, verify all tools and other items have been removed, all machine guards are in place, all electric systems are reconnected, and personnel are clear of equipment.

DANGER: During installation, testing, servicing and troubleshooting this product, it may be necessary to work with live electrical components. Only qualified licensed electricians or other properly trained persons may perform these tasks. Failure to follow all electrical safety precautions can result in death or serious injury. All HVAC equipment must be installed per the National Electric Code (NEC) and/or all applicable state/local codes.

DANGER: Incorrect handling of HVAC equipment can result in explosions, electrical shock or fire, causing property damage, injury and/or fatality.

DANGER: HVAC liquids and chemicals can be dangerous if used incorrectly or if spills or accidents occur. Handle detergents and solvents with care to avoid spills and burns.

DANGER: Danger of explosion. Refrigerant cylinders can explode causing serious injury and/or death if not handled and stored properly.

WARNING: Only qualified, licensed electricians with proper personal protection equipment should wire Multistack chillers. Injury or death my result if not properly wired due to electric shock hazard

WARNING: Danger of electrical shock. Many types of HVAC equipment have switches and regulators with electrical current on even when other parts of the equipment appear to be turned off. Main circuit breakers must be turned off before servicing equipment to avoid injury, fatality.

WARNING: Be sure to use lifting slings with lifting capacity to safely handle unit weight. Consult the unit's as-built submittal drawings for unit weight data.

WARNING: If welding on chiller water connections, use proper electrical grounding to avoid damaging the compressors or chiller controls. Never weld directly on the heat exchanger shells. Only an authorized ASME-certified repair agency may weld directly on ASME-certified shells. After welding, an "R" stamp is required.

CAUTION: Working with HVAC equipment can be hazardous due to electricity, moving parts, chemicals, combustion and other hazards. Use safe work habits including proper tools and personal protective equipment. Understand and heed all safety information, installation guidelines and operation and maintenance procedures.

CAUTION: Pressurized application of cleaning substances or refrigerants must be done with the correct procedures to ensure the safety of technicians and others, and avoid property damage.

NOTE: Use correct tools for HVAC equipment installation, maintenance and adjustment. Use the correct tools to make tight connections without stripping threads or breaking screws and bolts. Use accurate refrigerant and electrical meters to properly maintain and diagnose HVAC equipment.

Multistack Water-Cooled Modular Chillers

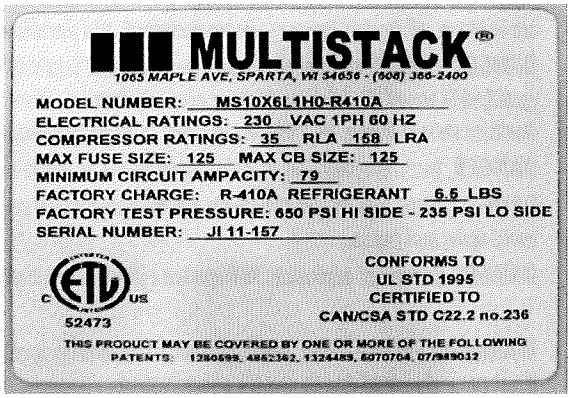
Multistack invented the modular chiller. Multistack modular chillers are available in a wide range of capacities, and with two independent scroll compressors. Modules can be mix-matched and combined to create up to 15-module arrays and 1,275 tons of cooling capacity using environmentally friendly R-410A. Multistack modular chillers can help owners qualify for USGBC LEED points and significant utility rebates. Multistack's innovative modular design makes adding more capacity as easy as purchasing and installing more modules.

Total Access™ Modular Chillers

With Total Access, heat exchangers are located on the outer edges of the chiller frame to provide easy serviceability with a small equipment room footprint. Total Access options include 10- through 85-ton modular chillers.

Unit Nameplate

The chiller nameplate is located on the front of the control panel. Use the unit model number nomenclature to identify specific features and options of an Multistack chiller module.



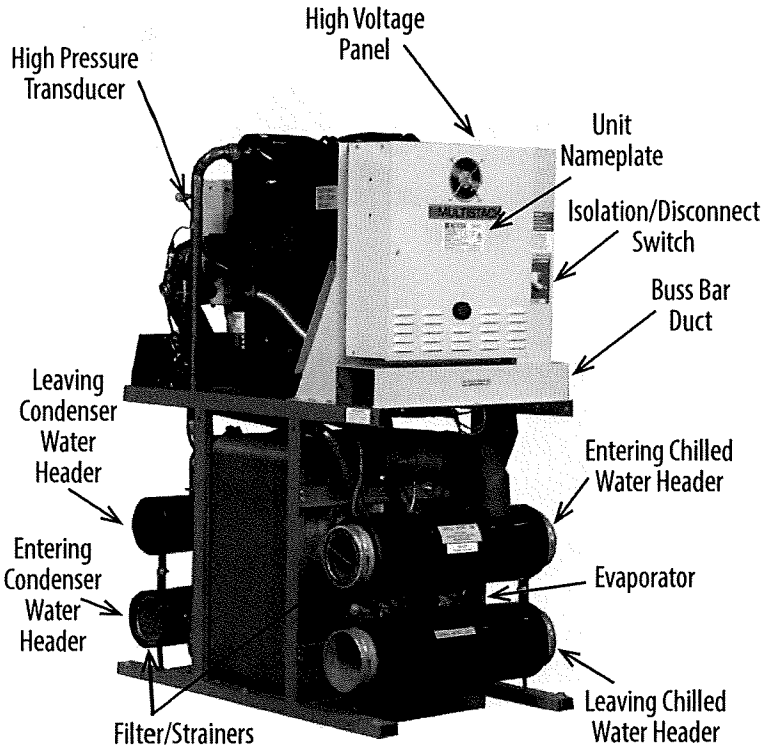
Model Number Nomenclature

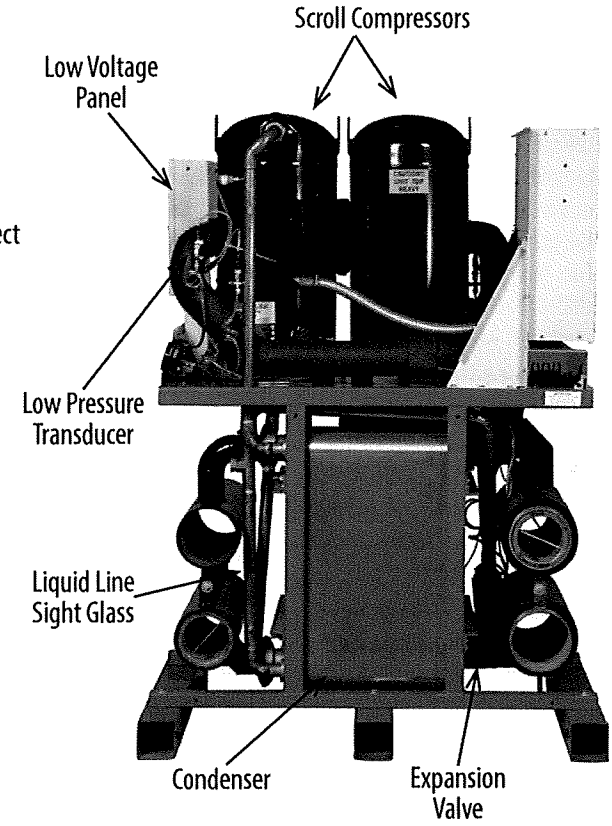
MS 050 X C or N 2 H 1 W 0 A A -410A

- -410A: Refrigerant
- A: Condenser[6]
- A: Evaporator[5]
- 0: AHRI Version - if applicable
- W: Application[4]
- 1: Module Number (1 - single, 2 - multiple)
- H: Voltage[3]
- 2: Configuration[2]
- C or N: AHRI Certified (C - certified, N - Not certified)
- X: Compressor Type[1]
- 050: Module Nominal Capacity (10 - 160 tons)
- MS: Series

[1] B: Bristol, C: Trane Cornerstone, R: Bitzer Screw, S: Trane Scroll, T: Danfoss Turbocor, Z: Copeland scroll (old elec), X: Copeland Scroll (ZP), A: Copeland Scroll (ZR)
[2] 1- Standard, 2- Total Access, 3 - Evap extended headers, 4 - Cond extended headers, 5 - Both extended headers, V - others
[3] A - 208/3/60, L - 230/3/60, H - 460/3/60, C - 575/3/60, D - 200/3/50, E - 400/3/50, F - 380/3/60, S - 220/230/1/60, V - other
[4] A - Air Cooled split, C - Single module temp controller, D - Cond unit, F - Fluid cooler (high temp),H - Heat recovery, R - Heat pump, W - Water cooled
[5] A - Brazed SS, B - Brazed SMO, C- S&T copper, D - S&T cu-Ni, V - Other
[6] A - Brazed SS, B - Brazed SMO, C- S&T copper, D - S&T cu-Ni, E - Double wall brazed, V - Other

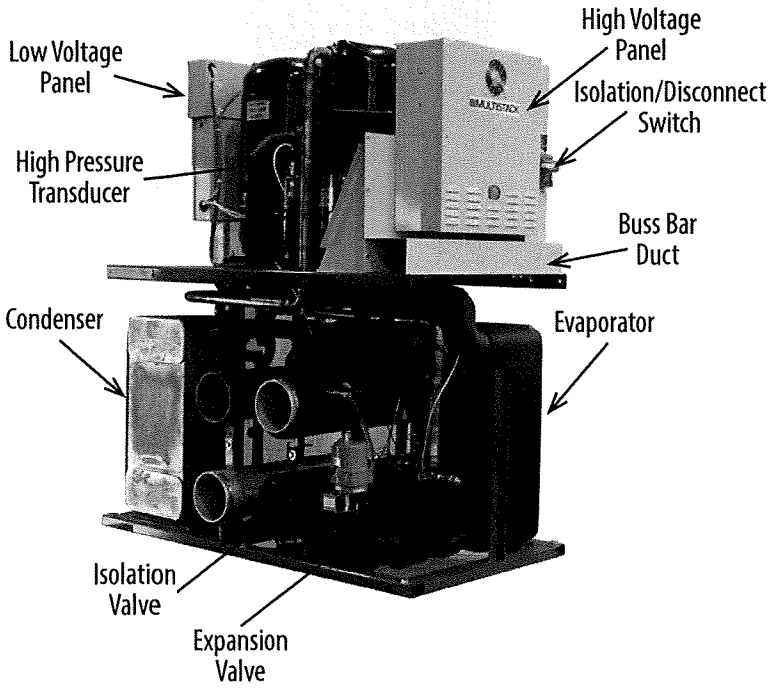
Standard Modular Chiller Arrangement

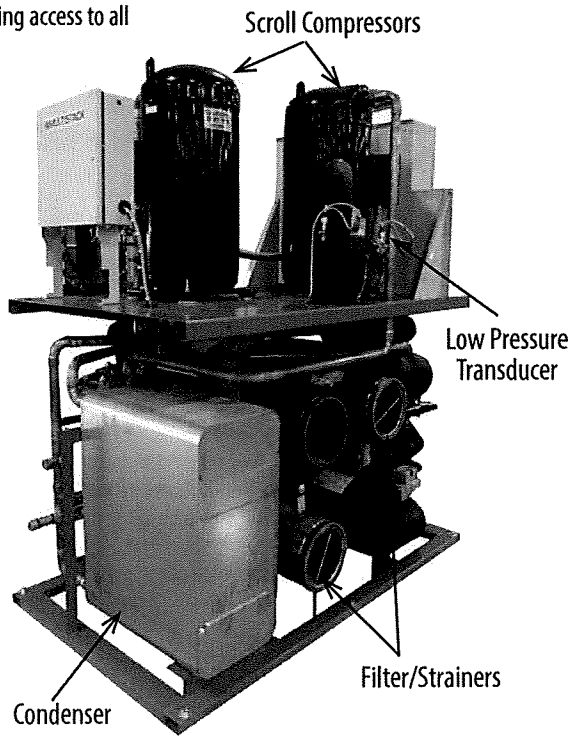




Total Access™ Modular Chiller Arrangement

Multistack's Total Access option makes maintenance and serviceability even easier by placing heat exchangers at the outside of the module frame. Manual isolation valves are factory-installed (Total Access units only) between the heat exchangers and water supply mains for heat exchanger isolation and removal without the need to remove a module or shut down the entire chiller while allowing access to all serviceable components.





Chiller Components

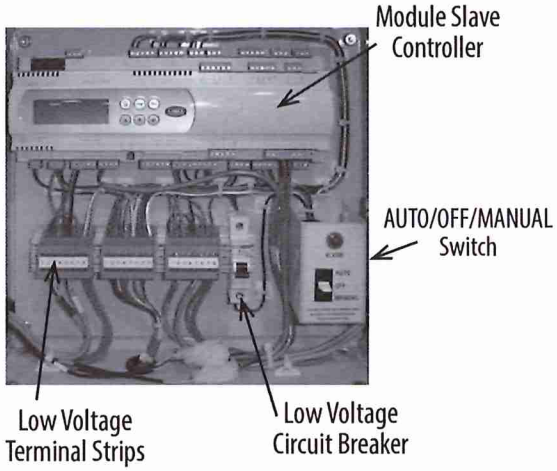
Master Control Panel

Each chiller has a master control panel that can be mounted on top of any of the module panels using provided knockouts. Sensors, cables and wiring connect through the bottom of the master control. The master control box includes built-in terminal strip inputs for flow switches, start/stop signal, alarm output, and power phase monitor. As shipped, the Master Control also contains the pLAN communication wire to be field installed by the start-up technician. Four temperature sensors and sensor wells are supplied by Multistack: entering chilled water, leaving chilled water, entering condenser water, and leaving condenser water. The sensors are to be installed in customer's piping system.

Master Controller

Module Control Boards and Low Voltage Panel

The module control boards communicate individual module temperatures and pressures to the master control. Each module has a switch labeled Auto/ Off/ Manual. Normal operation is in the Auto mode. If there is a problem with the master control, the selector switch can be changed to Manual to provide individual module leaving chilled water temperature control that was pre-set at the master control.



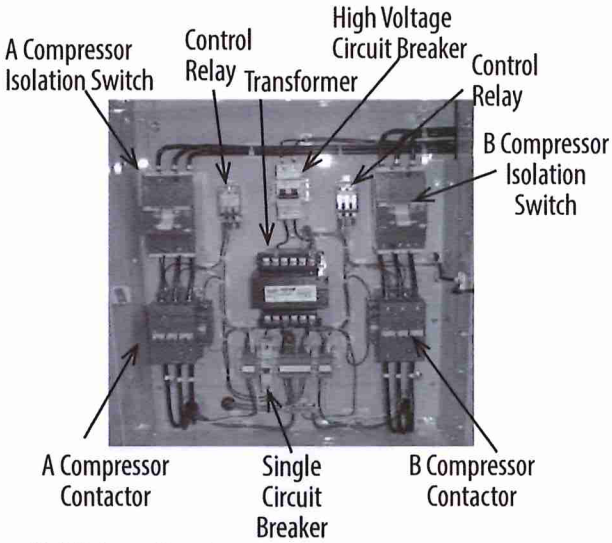
Low Voltage Panel

Module High Voltage Panel

The high voltage panel contains each compressor's contactor, circuit breaker, control relay and transformer. External to the panel is the single-module isolation switch to isolate the that module from high voltage supply power.

Compressors, Sensors, Switches

- Standard modules use two scroll compressors with separate refrigeration circuits.
- Each refrigerant circuit has a high pressure (HP) and low pressure (LP) transducer that sends pressure signals to the module slave controller board. Each compressor also includes an HP switch with a manual reset button.
- Transducers are a 0-5V ratiometric type.
- Compressors include oil level sight glasses. Oil level should be at ⅛ - ¼ full during operation.
- Each circuit has its own leaving chilled water temperature sensor and refrigerant suction temperature sensor.
- Compressor crankcase heaters are not standard on Multistack MS chiller modules.



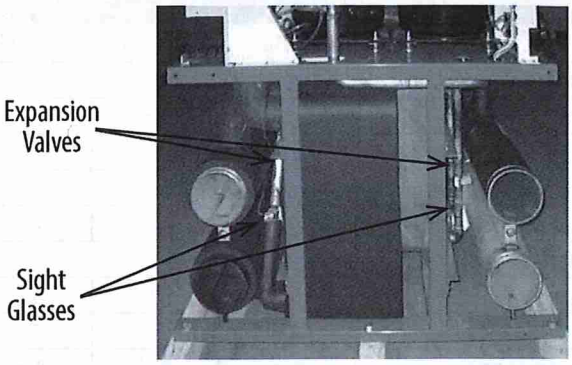
High Voltage Panel

Chilled and Condenser Water Connections

- Water connections to the chilled and condenser side are standard 6-inch grooved pipes on MS010X through 070X, and 8-inch on MS085X units.
- The upper header on the chilled water side is entering water to the module.
- The bottom header is chilled water leaving the module.
- Water entering the condenser is on the bottom.
- Water leaving the condenser is on top.
- The entering header on both the evaporator and condenser contains a 30-mesh filter strainer to prevent debris from entering the brazed plate heat exchangers. This strainer should only be used as a final filter stage.
- Proper filtration before the module should be installed for easy access to cleaning, such as a 'Y' or a basket type of strainer.

Expansion Valve, Subcooling, Liquid Line Sight Glass

- Each circuit on a module has a thermal expansion valve located between the water header pipes on the condenser side. During factory run testing the valves are adjusted to maintain 10-12 degrees superheat. Check the superheat periodically to maintain this range. Subcooling should normally be in a 10-15 degree range. No external subcooler is used.
- The liquid line sight glass shows green on the indicator bulb if no moisture is present in the refrigerant circuit. Yellow indicates potential moisture.
- Sight glasses should show full during normal operation.
- Flashing in the sight glass indicates possible under-charge of the circuit.
- Refer to the unit nameplate for refrigerant charge information.



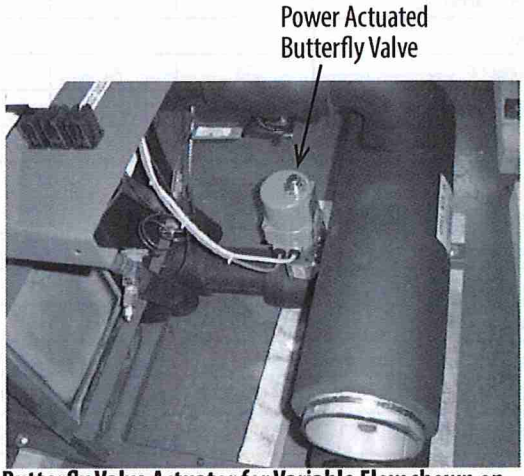
Expansion Valves and Liquid Line Sight Glasses (Standard unit.)

Variable Flow and Power Actuated Butterfly Valves

For variable flow on the chilled or condenser water side, chiller modules must be ordered with power actuated butterfly valves.

Note: The footprint of an array of standard modules will increase as the valves add length. Total Access™ module footprint will not change.

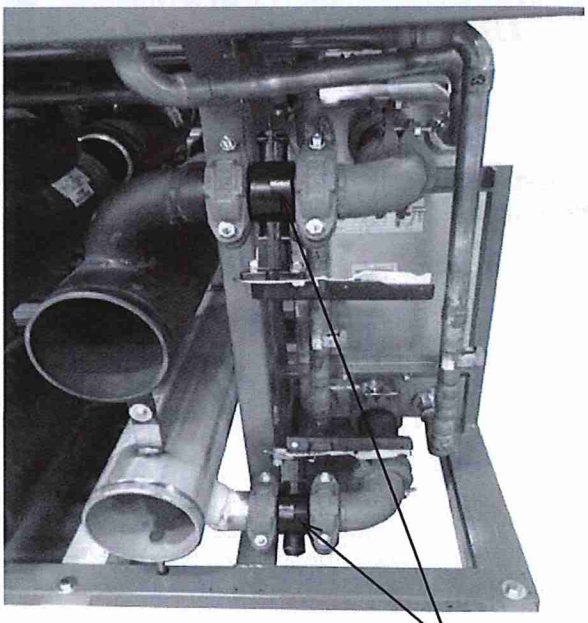
1. Multistack recommends controlling the chiller pumps to maintain pressure differential across the chiller, not the system. Control based on system pressure will provide erratic results.
2. Chiller minimum flow bypass for the system can be programmed in the master controller.



Butterfly Valve Actuator for Variable Flow shown on standard module with extended headers.

Optional Manual Isolation Valves

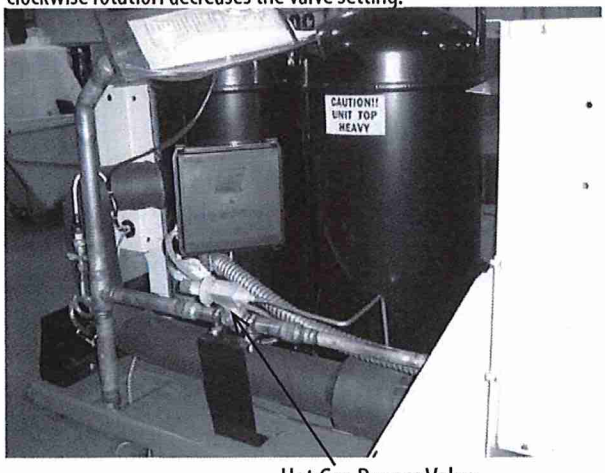
Standard modules are not supplied with isolation valves. Manual or electrically actuated valves may be ordered as an option from Multistack. Total Access modules are supplied with manual isolation valves from the factory and may be upgraded to electrically actuated valves as an option. Multistack recommends exercising the isolation valves as part of annual maintenance.



Heat Exchanger Isolation Valves on Total Access™ Modular Chiller

Optional Hot Gas Bypass

As an option, hot gas bypass valves (Sporlan HGBE-8) can be provided for each circuit. The valve is adjustable from 75 to 150 psi with a standard setting of 120 psig. A screw on the pilot valve handles the adjustment. Turning clockwise increases the valve setting; counter-clockwise rotation decreases the valve setting.



Hot Gas Bypass Valve

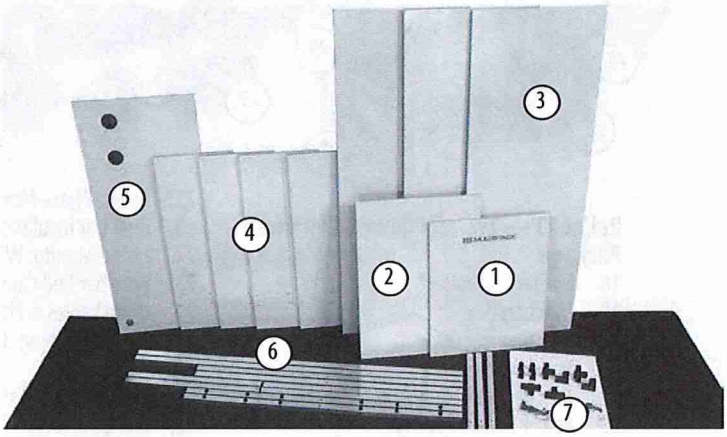
General Data Table								
	MS010X	MS015X	MS020X	MS030X	MS040X	MS050X	MS070X	MS085X
Compressor Type	Scroll							
Dry Weight (lbs. each)	89	135	135	146	280	293	390	419
Normal Capacity (tons each)	5	7.5	10	15	20	25	30	40
Compressor Quantity/Module	2	2	2	2	2	2	2	2
Oil Charge (pints per compressor)	3.5	6.9	6.9	6.9	9.5	9.5	13.3	13.3
Evaporator (Brazed Plate)	Brazed Plate							
Weight (lbs.)	50	70	70	90	180	180	220	300
Water Storage (gal.)	1.0	1.6	1.6	2.2	5.5	5.5	7.3	10.1
Circuit Configuration	Dual	Dual	Dual	Dual	Dual	Dual	Dual	Dual
Quantity	1	1	1	1	1	1	1	1
Header System (gal.)	7	7	7	7	7	7	7	14
Condenser	Brazed Plate							
Weight (lbs. each)	50	80	80	100	200	200	290	340
Water Storage (gal.)	1.1	2.2	2.2	2.9	6.6	6.6	10.1	12.3
Circuit Configuration	Dual	Dual	Dual	Dual	Dual	Dual	Dual	Dual
Quantity	1	1	1	1	1	1	1	1
Header System (gal.)	7	7	7	7	7	7	7	14
Refrigerant Type	R410A							
Charge (lbs./circuit)	6.5	6.5	6.5	10	18	20	23	28
Number of Circuits	2	2	2	2	2	2	2	2
Total Water Volume - gal./module	16.1	17.8	17.8	19.1	26.1	26.1	31.4	50.3
Operating Weight (lbs.)	1,490 (1,620)	1,500 (1,630)	1,510 (1,640)	1,610 (1,740)	1,790 (1,920)	1,970 (2,100)	2,060 (2,210)	2,350 (2,680)
Shipping Weight (lbs.)	1,330 (1,470)	1,340 (1,480)	1,350 (1,490)	1,450 (1,590)	1,630 (1,770)	1,950 (1,990)	1,890 (2,060)	2,380 (2,630)

NOTES: Figures in parentheses ( ) apply to Total Access™ configuration chillers.
Add 75 lbs. per module if equipped with enclosure panels.

Multistack has a policy of continual improvement and reserves the right to change product design, literature and specifications without notice.

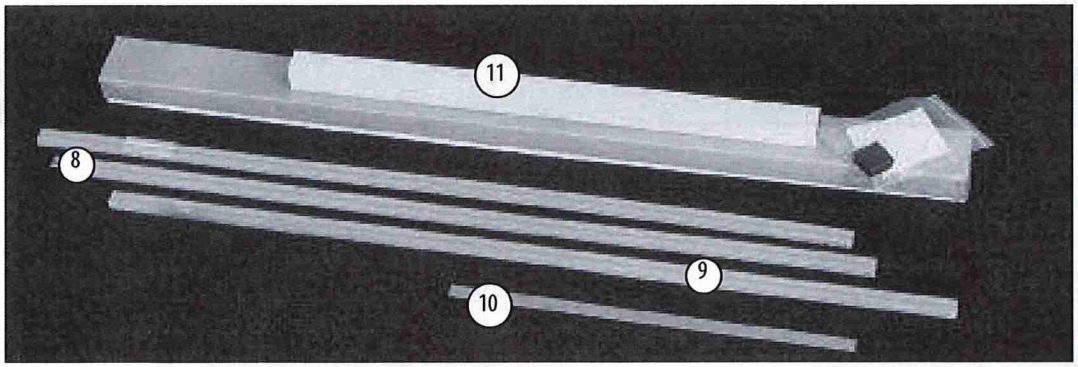
Module Shipment Package

NOTE: Before accepting delivery of the Multistack chiller, check the overall condition of the equipment for damage such as broken copper lines, oil leaks, damaged controls and/or electrical component housing, or any major component torn loose from its mounting. If the Multistack modular chiller is damaged during shipping by the transportation company or its agent, the installing contractor MUST promptly file a claim with the transportation company and advise Multistack. Any discrepancy or damage must be noted on the bill of lading.



Pallet #1 — Typical Cabinetry Package (Optional)

1. Top Front Panel
2. Bottom Front Panel
3. Rear Panel/End Panel
4. Side End Panel
5. Master Controller Top Panel
6. Frame Pieces
7. Frame Connectors, Fasteners, Clips & Magnetic Tape



Pallet #2 — Buss Connections

8. Buss bar
9. Buss bar insulation
10. Ground strap
11. Junction Box leg

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Pallet #3 — Typical Piping & Electrical Package

18. Master Controller*
19. Junction Box
20. Junction Box Cover
21. Sensors / Cables
22. Junction Box Connector (Throat)
23. Power Phase Monitor
24. Buss bar Connector
25. Power Phase Monitor Wire
26. Buss bar Insulation Overlap
27. Phase Monitor Wire
28. Buss bar End Caps
29. Drain Valves & Fittings
30. Module Joining Bolts
31. End Cap for Multiflush system (upper)
32. End Caps (evap)
33. Couplings
34. Multiflush pipe
35. Solenoid for Multiflush system
36. Pipe Stubs
37. End Cap Multiflush system (lower)
38. Filter Stops
39. Pet Cock Valves
40. Drain Valves & Fittings
41. Sensor Wells
42. 30 Mesh Filter Strainer

* May be shipped separately to sales office or job site.

** Shipped inside #19 - Junction Box

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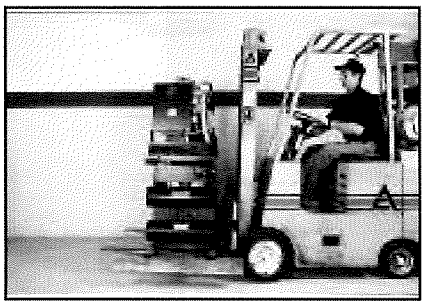
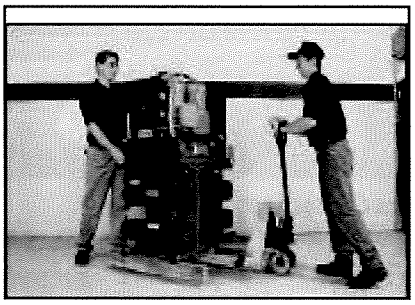
Moving Chiller Modules

Caution: Modules Are Top Heavy



Module on Fork Lift



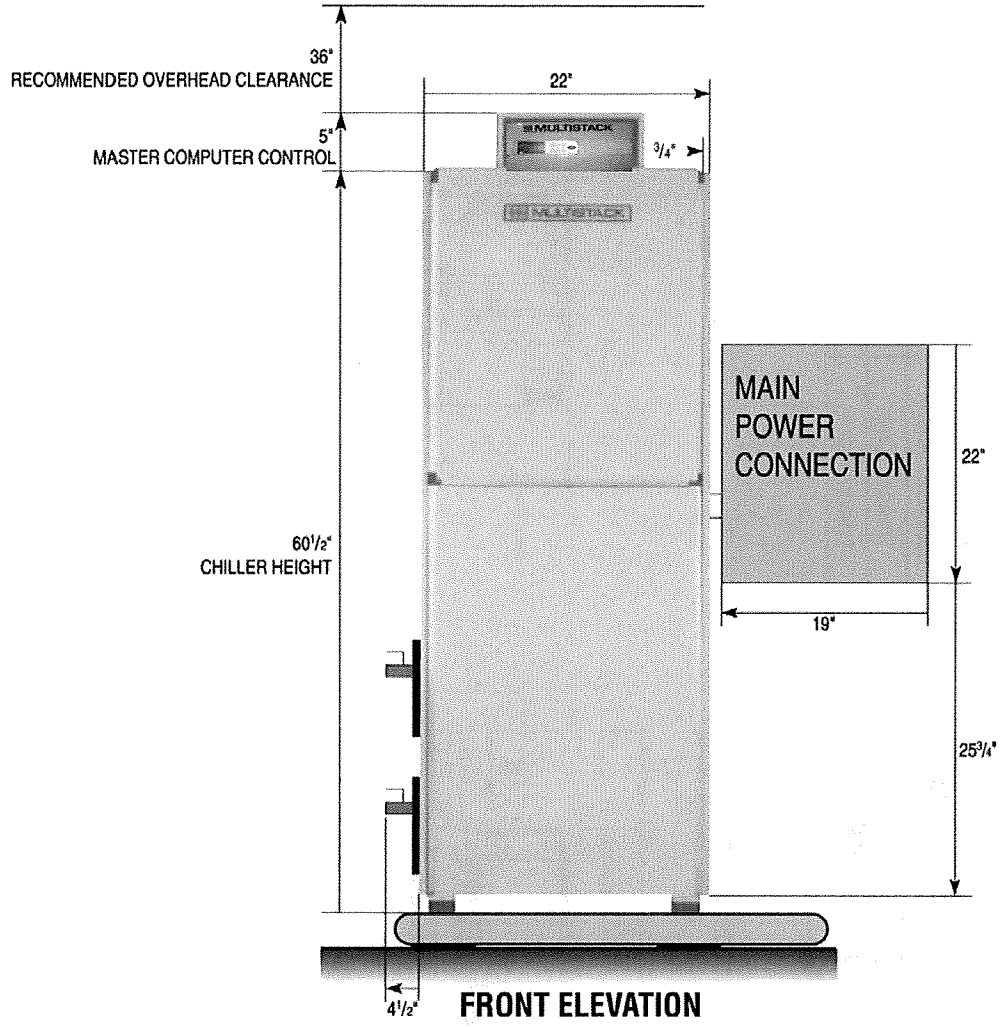
Module on Pallet Jack

Multistack chiller modules MS010 through MS085 may be moved using a fork lift truck, pallet jack or similar equipment. Optional spreader bars for lifting and factory-installed wheels are available from Multistack. Contact your Multistack representative. For unit weights see the table on Page 8 and the job-specific as-built submittal drawings.

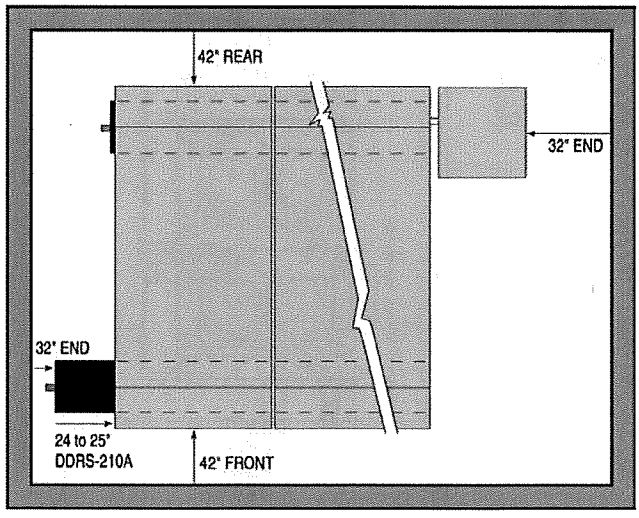
Clearances

Diagram shows typical dimensions and the recommended clearances around the modular chiller. There must be a minimum of six inches clearance over the top of the chiller, including the top of master controller if installed on top of the module.

For specific unit dimensions, refer to as-built submittal drawings.



FRONT ELEVATION



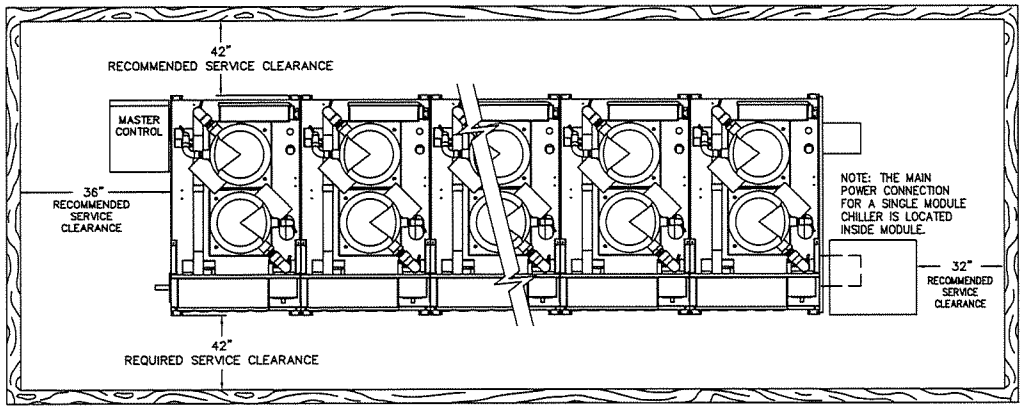
TOP VIEW

Standard Modules (Constant Flow Design)

*Standardized drawing of sample customer installation

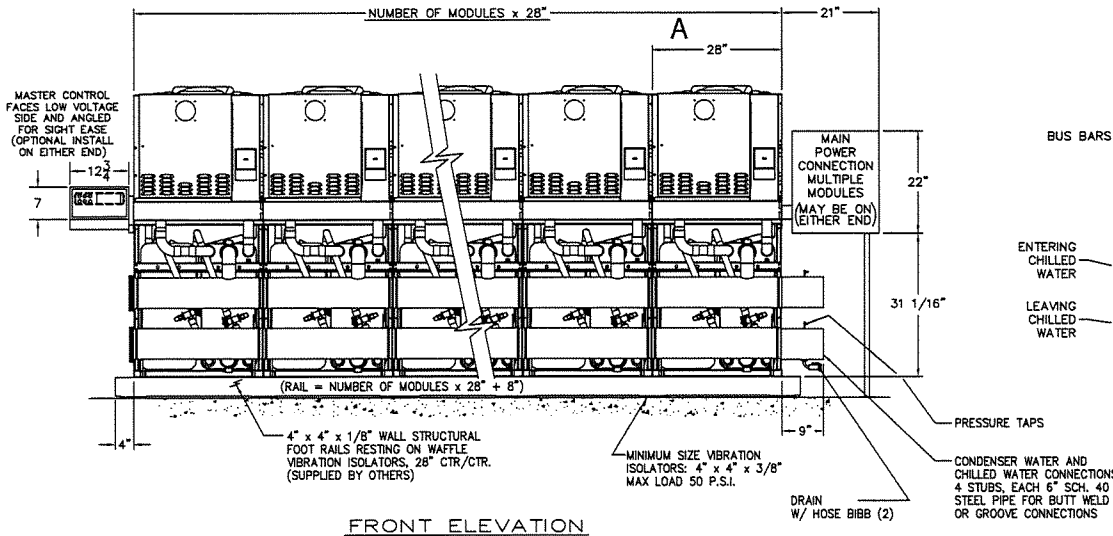
** Enclosure panels are optional

PLAN VIEW

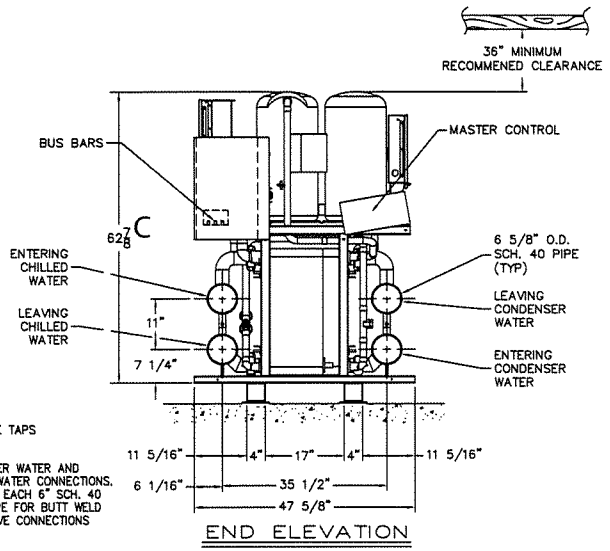


Module Dimensions (No Panels)

	Width (A)	Depth (B)	Height (C)
Standard	28"	47 5/8"	64"
Total Access (MS010--050)	32"	56"	67"
Total Access (MS070)	34"	56"	67"
Extended Headers	28"	62 1/8"	64"
Extended Headers	28"	76 5/8"	64"



FRONT ELEVATION



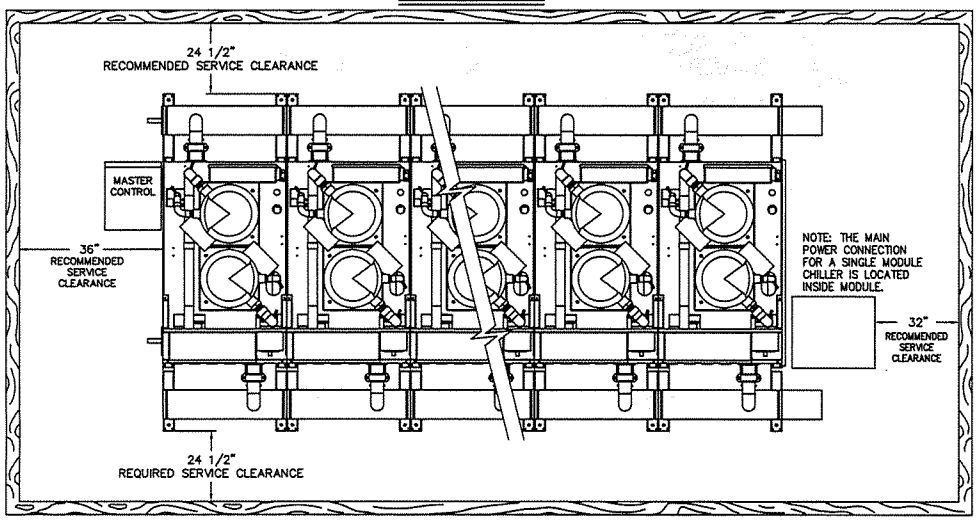
END ELEVATION

B

Variable Flow Design for Chilled and Hot Water Standard Modules with Extended Headers on Evaporators and Condensers

*Standardized drawing of sample customer installation
**Enclosure panels are optional

PLAN VIEW



Module Dimensions (No Panels)

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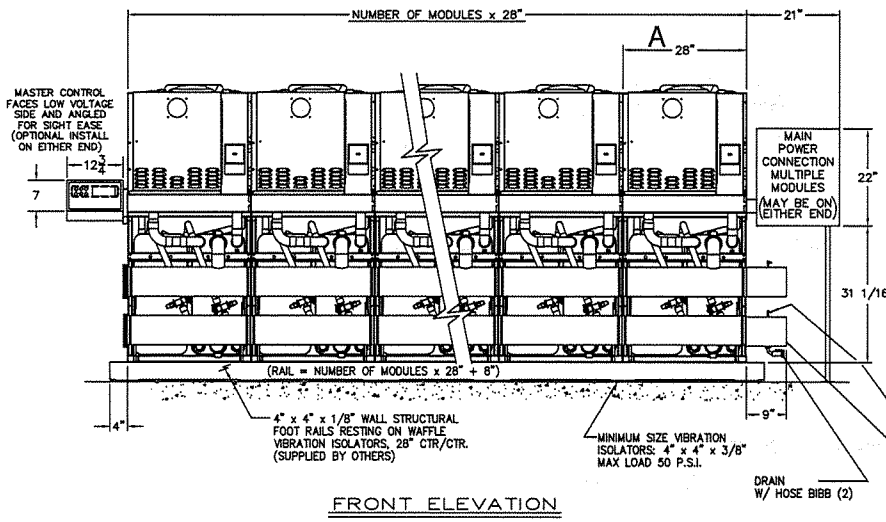
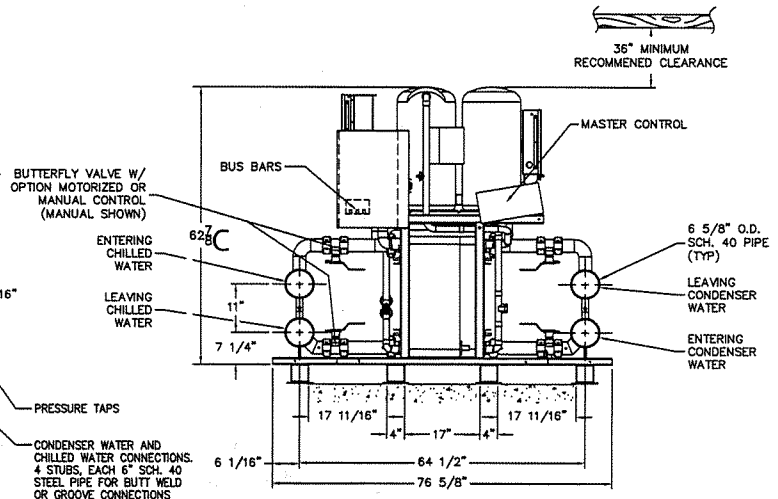


FRONT ELEVATION

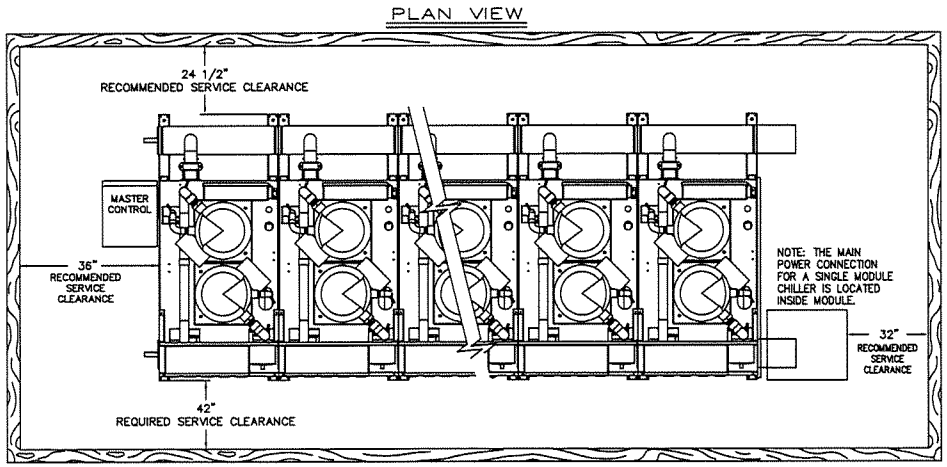


END ELEVATION

B

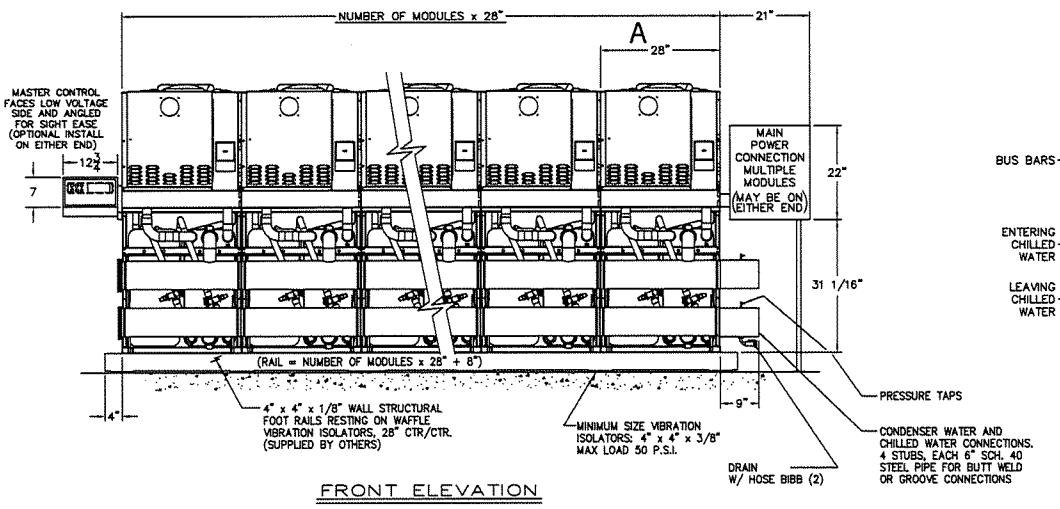
Variable Flow Design for Hot Water, Constant Flow for Chilled Water
Standard Modules with Extended Headers on Condensers

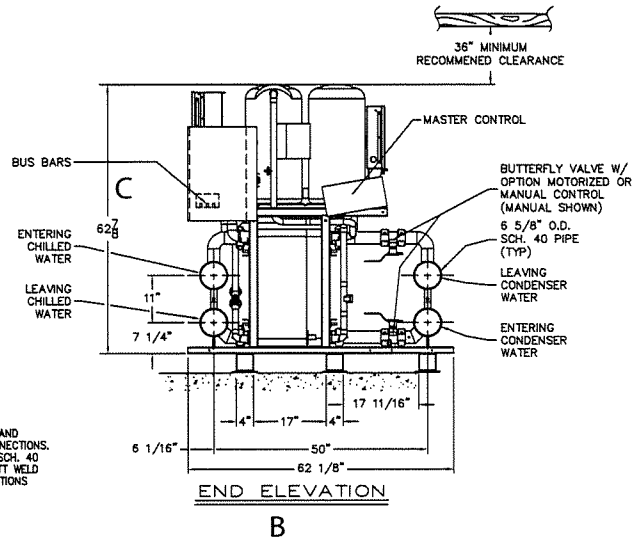
*Standardized drawing of sample customer installation
** Enclosure panels are optional



Module Dimensions (No Panels)

	Width (A)	Depth (B)	Height (C)
Standard	28"	47 5/8"	64"
Total Access (MS010–050)	32"	56"	67"
Total Access (MS070)	34"	56"	67"
Extended Headers	28"	62 1/8"	64"
Extended Headers	28"	76 5/8"	64"





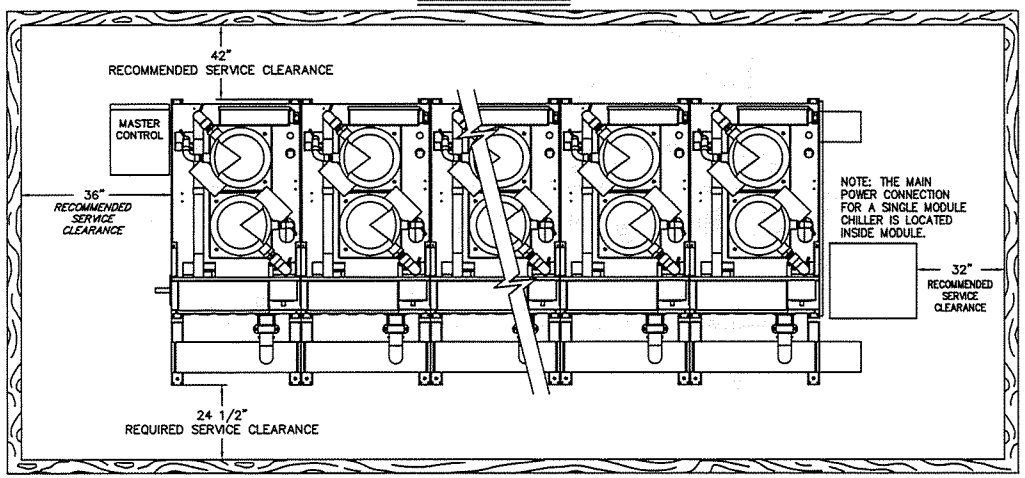
B

Variable Flow Design for Chilled Water, Constant Flow for Condenser Water
Standard Modules with Extended Headers on Evaporators

*Standardized drawing of sample customer installation

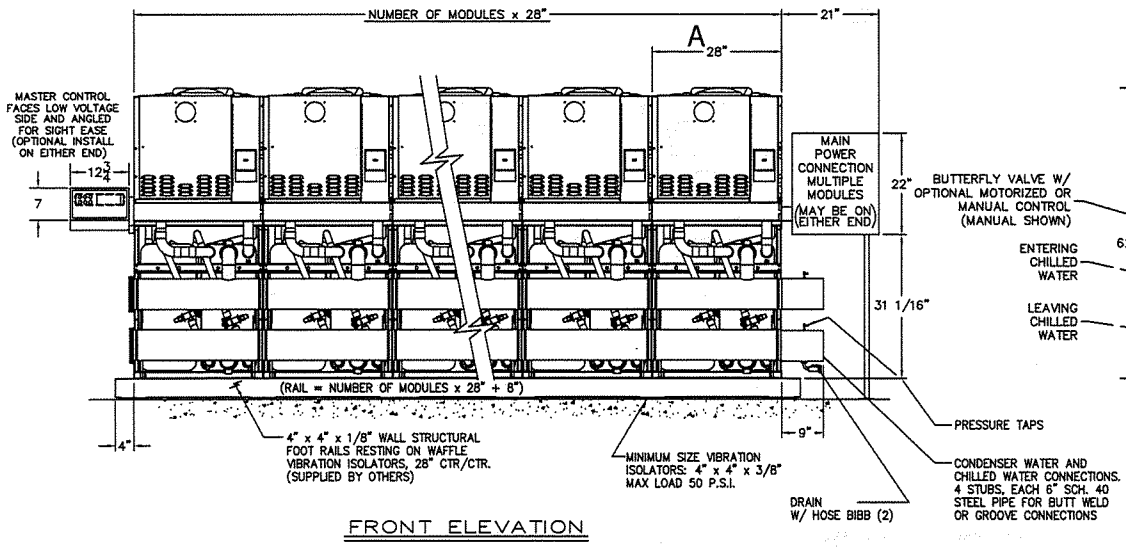
** Enclosure panels are optional

PLAN VIEW

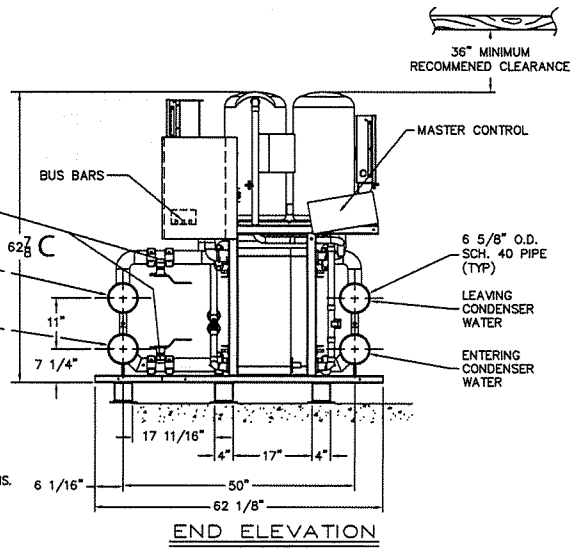


Module Dimensions (No Panels)

	Width (A)	Depth (B)	Height (C)
Standard	28"	47 5/8"	64"
Total Access (MS010--050)	32"	56"	67"
Total Access (MS070)	34"	56"	67"
Extended Headers	28"	62 1/8"	64"
Extended Headers	28"	76 5/8"	64"



FRONT ELEVATION



END ELEVATION

B

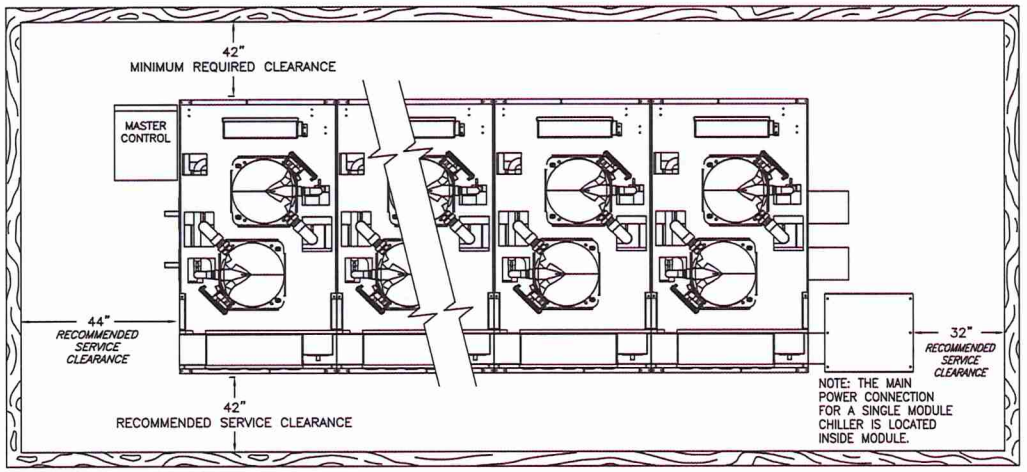
? No - Eddie 10/10/19

Total Access Modules With or Without Variable Flow

*Standardized drawing of sample customer installation

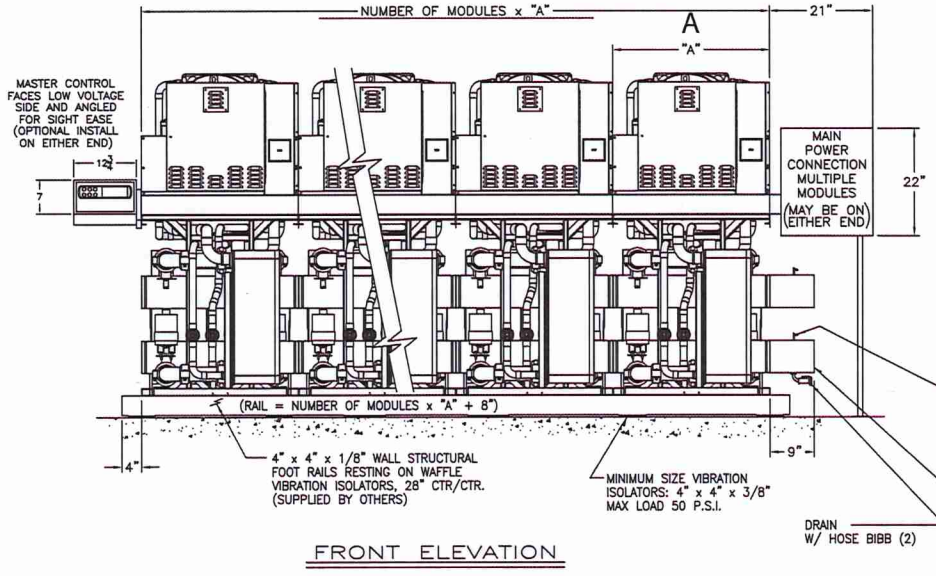
** Enclosure panels are optional

PLAN VIEW

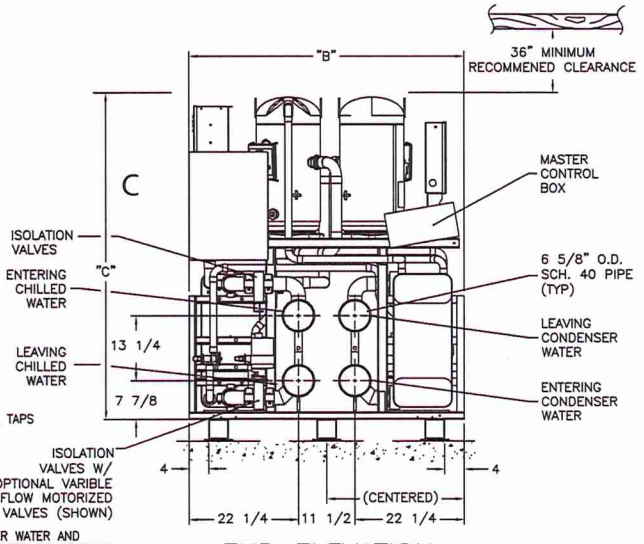


Module Dimensions (No Panels)

	Width (A)	Depth (B)	Height (C)
Standard	28″	47 5/8″	64″
Total Access (MS010–050)	32″	56″	67″
Total Access (MS070)	34″	56″	67″
Extended Headers	28″	62 1/8″	64″
Extended Headers	28″	76 5/8″	64″

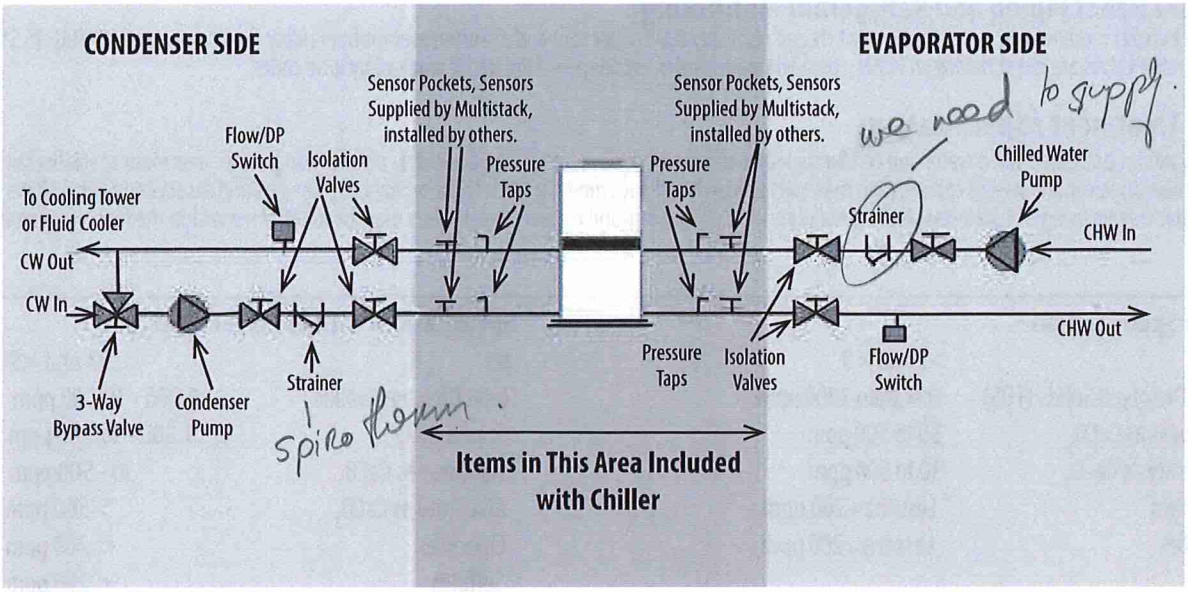


FRONT ELEVATION



END ELEVATION

B



Recommended Piping

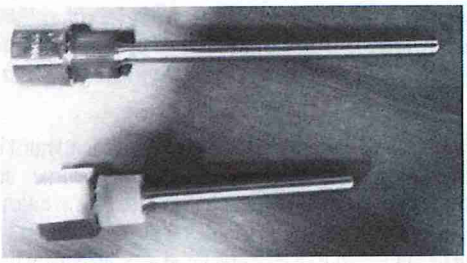
All piping must be properly and adequately supported at coupling connections and suitable intervals along the piping runs. Hanger design must provide for the weight of fluids in the piping system when the chiller is in operation.

Multistack modules are equipped with brazed plate heat exchangers made of 316 stainless steel. Multistack recommends use of a 30-mesh system strainer, Y-type basket or equal, in each condenser and evaporator inlet header.

It is the installing contractor's responsibility to make sure the water systems have been flushed and the strainers are clean and clear of debris before starting the chiller. Do not flush piping so as to push debris into or through the through the chiller heat exchangers.

Important

Be sure to install the supplied sensor wells in the system piping. The wells should be installed a few feet from the chiller in the entering and leaving chilled water and entering and leaving condenser water pipes.



Typical Sensor Wells

Flow Protection

Proof of chilled water and condenser water flow is required by the Master Controller inputs. Paddle-type or Differential Pressure (DP) switches may be used. Switches can be supplied by Multistack as an option, otherwise they are to be field supplied and installed. Chillers purchased with chilled or condenser water pump modules have a DP switch installed across the pump to verify operation. Multistack recommends a paddle-type switch be installed in the leaving chilled water piping using a differential pressure switch. Install it across the inlet and outlet water connections to the chilled and/or condenser water piping connections.

System Water Volume

A properly sized chilled water system must have enough time (at least three minutes) to properly control and respond to changes in load and to prevent short cycling of the chiller. To ensure the system water volume is adequate, a general rule of thumb is:

7-10 gallons of water per ton or Acceptable Chilled Water Volume = Chilled Water Design GPM X 3

If the system heat exchangers, piping and components cannot hold the necessary chilled water volume, a properly sized chilled water storage tank should be added.

Condenser Water Temperature Control

18.3 C

For installations where entering condenser water temperature could be lower than 65°F Multistack recommends installing a three-way tower bypass valve to maintain a minimum of 65°F entering condenser water temperature. This is based on a 10°F Delta-T system.

Pressure Relief Piping and Refrigerant Monitoring

Multistack chiller modules use a small refrigerant charge (typically 0.6 lbs. per ton) and are often exempt from many requirements of ASHRAE 15 Standard. Pressure relief valves are not standard on water-cooled modules and must be special ordered if required by local codes.

Water Treatment / Specifications

Supply water for both the chilled water and condenser water circuits must be analyzed and treated by a professional water treatment specialist familiar with the operating conditions and construction materials used in Multistack modular chiller heat exchangers, headers and associated piping. Water quality for modular chillers using 316 stainless steel brazed plate heat exchangers and carbon steel headers must be maintained within the following parameters:

Water Specifications	
ph	>7 and <9
Total Dissolved Solids (TDS)	Less than 1000 ppm
Hardness as $CaCO_3$	30 to 500 ppm
Alkalinity as $CaCO_3$	30 to 500 ppm
Chlorides	Less than 200 ppm
Sulfates	Less than 200 ppm

Specifications with 25 Percent Glycol	
ph	>7 and <9
Total Dissolved Solids	1,000 - 10,000 ppm
Conductivity	1,000 - 15,000 ppm
Hardness as $CaCO_3$	30 - 500 ppm
Alkalinity as $CaCO_3$	> 500 ppm
Chlorides	< 200 ppm
Sulfates	< 200 ppm

Pipe System Flushing Procedure

Before connecting the chiller to the condenser and chilled water loop, the piping loops must be flushed with a detergent and hot water (110-130° F) mixture to remove any dirt and organic residue. After removing residue, continue flushing with a dilute phosphoric acid, sulfamic acid or citric acid and water mixture to remove inorganic scale in the pipe. Cleaning chemicals such as Nu-Calgon "Imperial Grade" Scale Remover part number 4360-84 or equivalent suitable for both organic residue and scale removal may be substituted. Otherwise detergents and acids shall not be combined unless approved by the chemical manufacturers. Only chemicals compatible with 316 stainless steel, copper and carbon steel shall be used. (Any concentrations of hydrochloric or sulfuric acid or chloride containing chemicals shall not be allowed to come in contact with copper brazed 316 stainless steel heat exchangers).

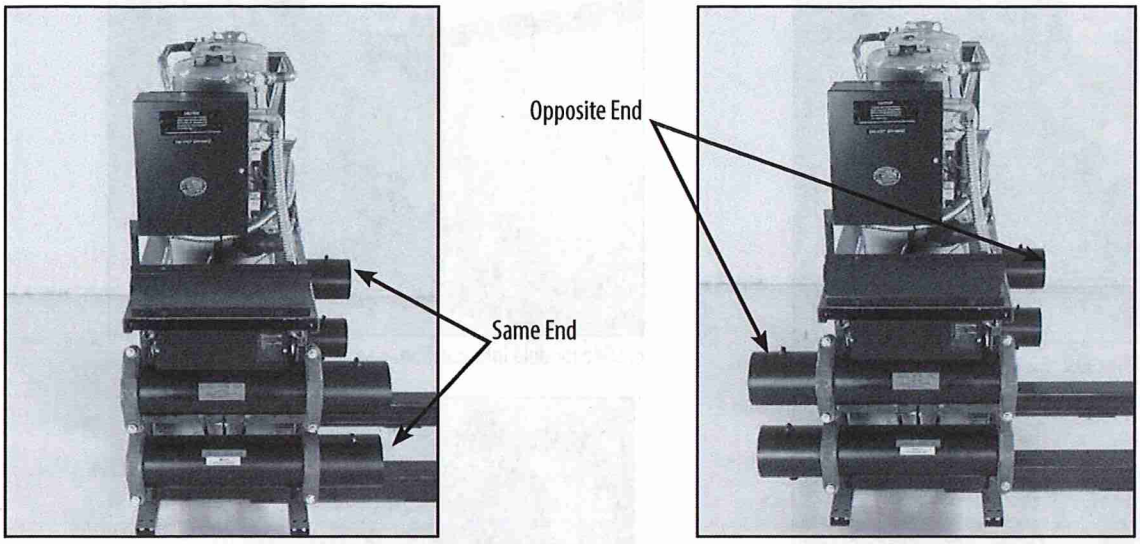
Caution: The use of unapproved chemicals in the chilled or condenser water supplies may damage the heat exchangers. These chemicals include, but are not limited to, hydrochloric acid, sulfuric acid, muriatic acid, and household bleach. Damage caused by the use of these and other unapproved chemicals is not covered by warranty. The only approved chemicals for heat exchanger cleaning are phosphoric or sulfamic acids in concentrations of 10 percent or less by volume. For more information contact your Multistack representative.

While flushing, 30-mesh Y-strainers (or equivalent) must be in place in the system piping and examined periodically as needed to remove collected residue. The flushing process shall take no less than six hours, or until the strainers are clean after flushing. Old pipe systems with heavy encrustation shall be flushed a minimum of 24 hours and may require as much as 48 hours before the filters run clean. Detergent and acid concentrations shall be used in strict accordance with the respective chemical manufacturers instructions. After flushing with the detergent and/or dilute acid concentrations, the system loop shall be purged with clean water for at least an hour to flush out all residual cleaning chemicals.

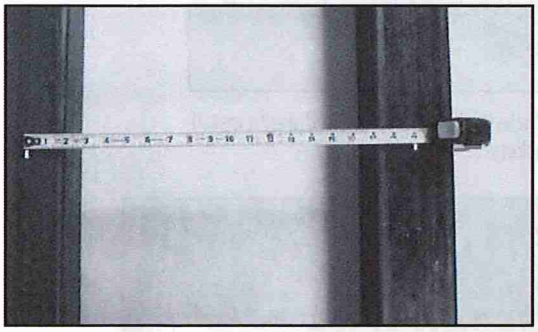
steve:
Not necessary

Module Assembly

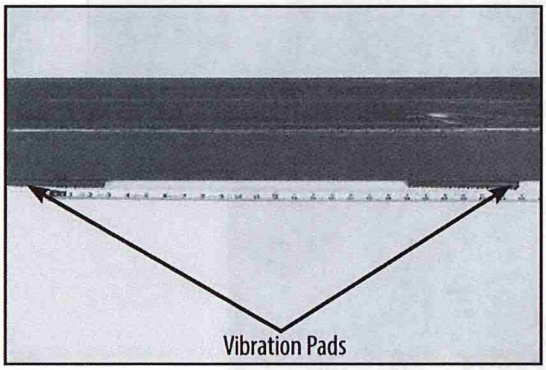
Multistack chiller modules and multiple module chiller arrays are designed to be mounted on steel rails.



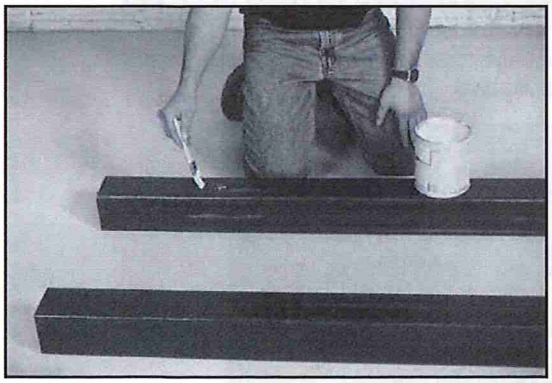
1. Determine the entering and leaving evaporator and condenser connection arrangement before setting mounting rails and modules modules in place. Connections may be at the same end or opposite ends, depending upon jobsite requirements.



2. Chiller modules are to be mounted on 4- x 4- x 4-inch steel rails or equivalent , 21 inches center-to-center.



3. Place 4- x 4- x 3/8-inch waffle type vibration pads every 22 inches under rails. 50 PSI maximum loading.



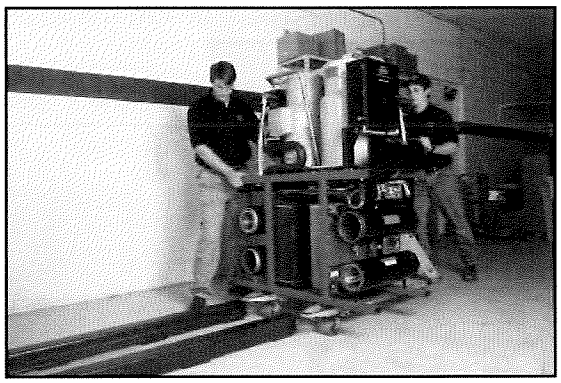
4. Lubricate rails with vegetable shortening or other non-petroleum lubricant to facilitate installation.

Note: Seismic restraint information available from Multistack.

supplied?

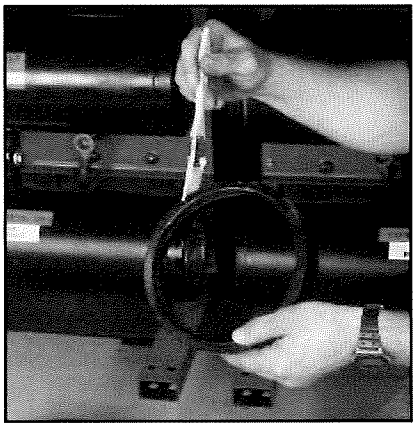
Steve will confirm, but yes since assembled

Module Assembly

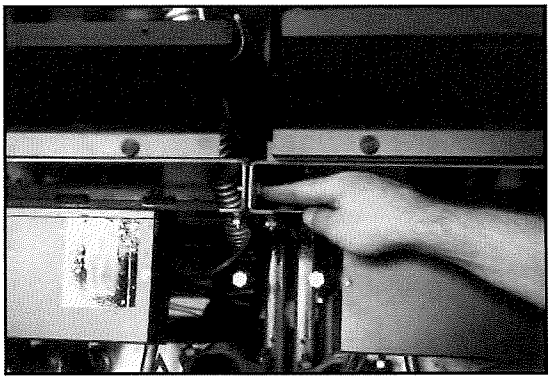


5. Place first module on the rails.

7. Place subsequent modules onto rails.

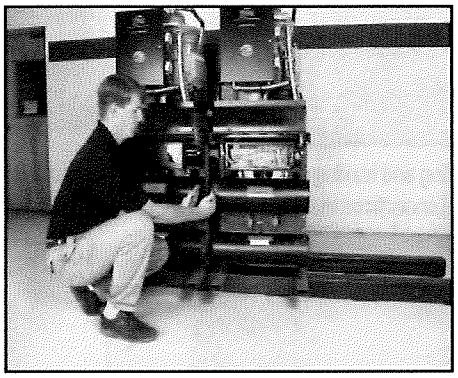


9. Lubricate gaskets with solid vegetable shortening or other non-petroleum based lubricant.

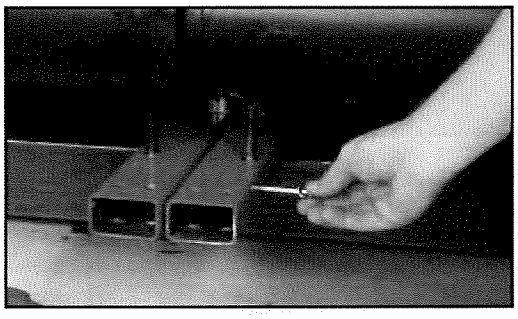


11. Install top joining bolts.

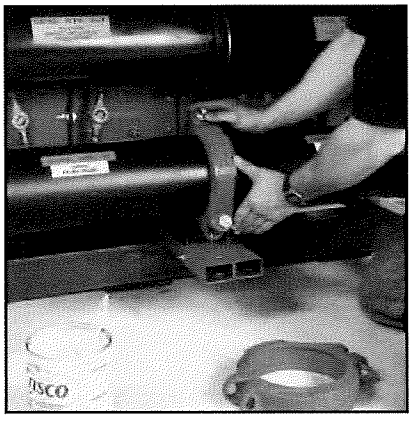
6. Slide module into position.



8. Leave sufficient space between modules to install coupling gaskets.

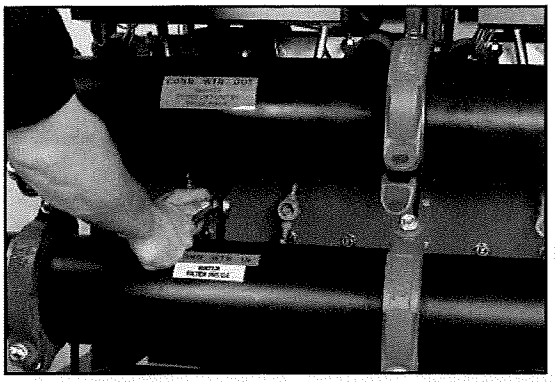


10. Slide modules together lining up footing holes. Install bottom joining bolts.

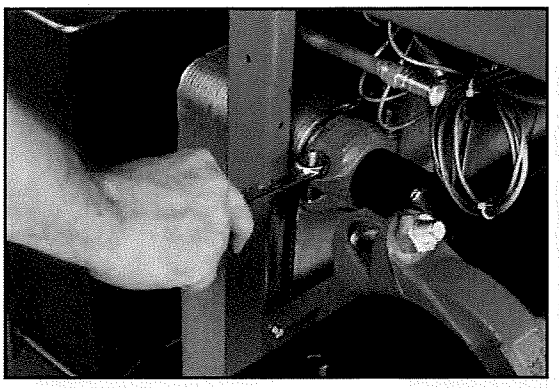


12. Starting with the lower header, install pipe couplings. Position coupling bolts at one and seven o'clock positions as shown for proper frame installation. **Note:** Assure proper strainer placement

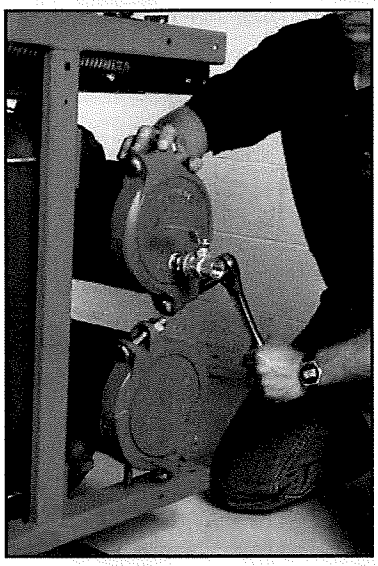
Module Assembly



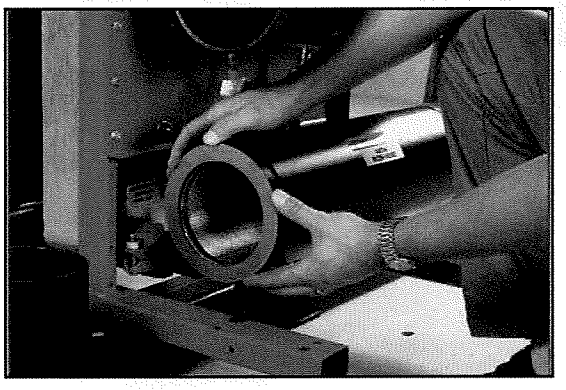
13. If adjustment is needed when tightening bolts, loosen the center header bolt.



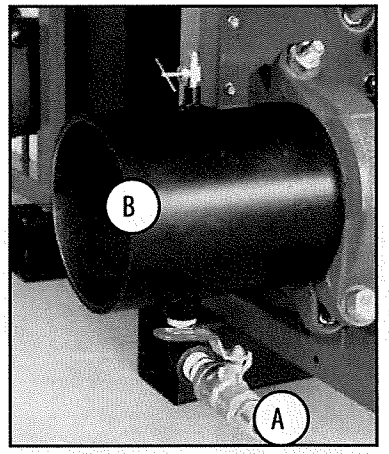
14. The grooved heat exchanger couplings may also be loosened if adjustment is required.



15. Install the header blank ends, starting at bottom, then move to the top blank that includes drain valves (evaporator shown).



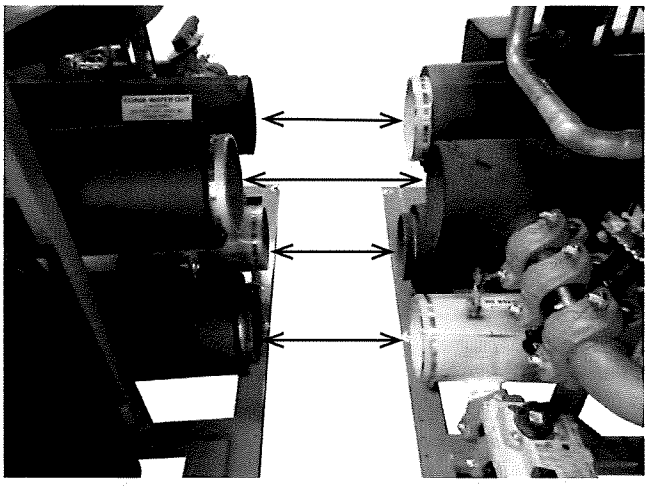
16. Install filter stop rings on module closest to piping take-off. The 9-inch long pipe stubs supplied by Multistack are to be installed at the take-off ends of the chiller.

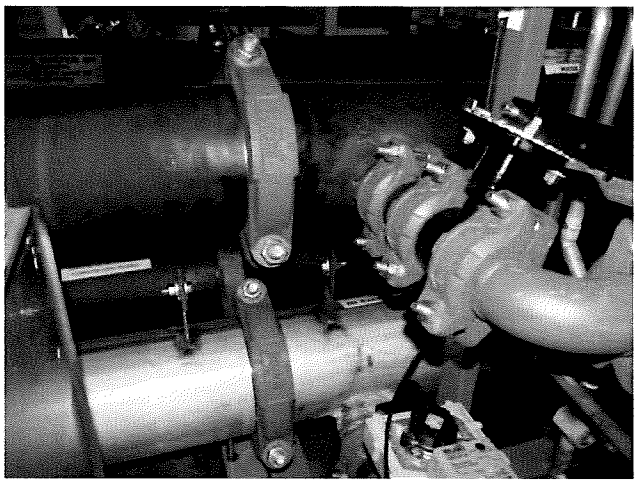


17. The 3/4-inch drain valve (A), should be located on bottom header and petcock valve (B) installed in each contractor pipe stub.

Module Assembly - Total Access™ Modules

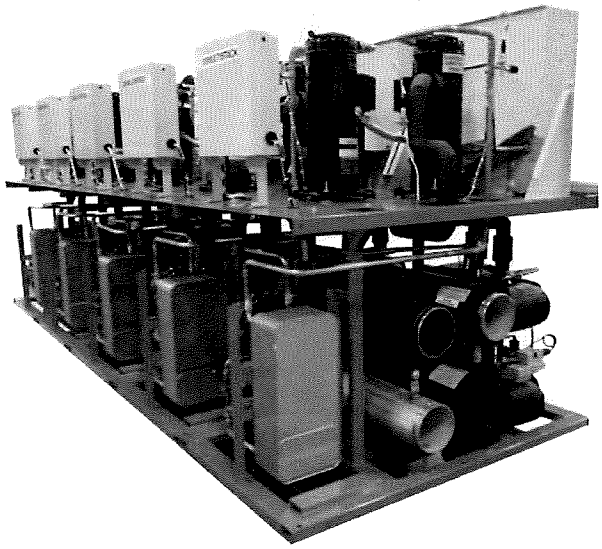
Multistack Total Access modular chillers are assembled into chiller arrays in the same manner as non-Total Access modules as shown on Pgs. 19-21.

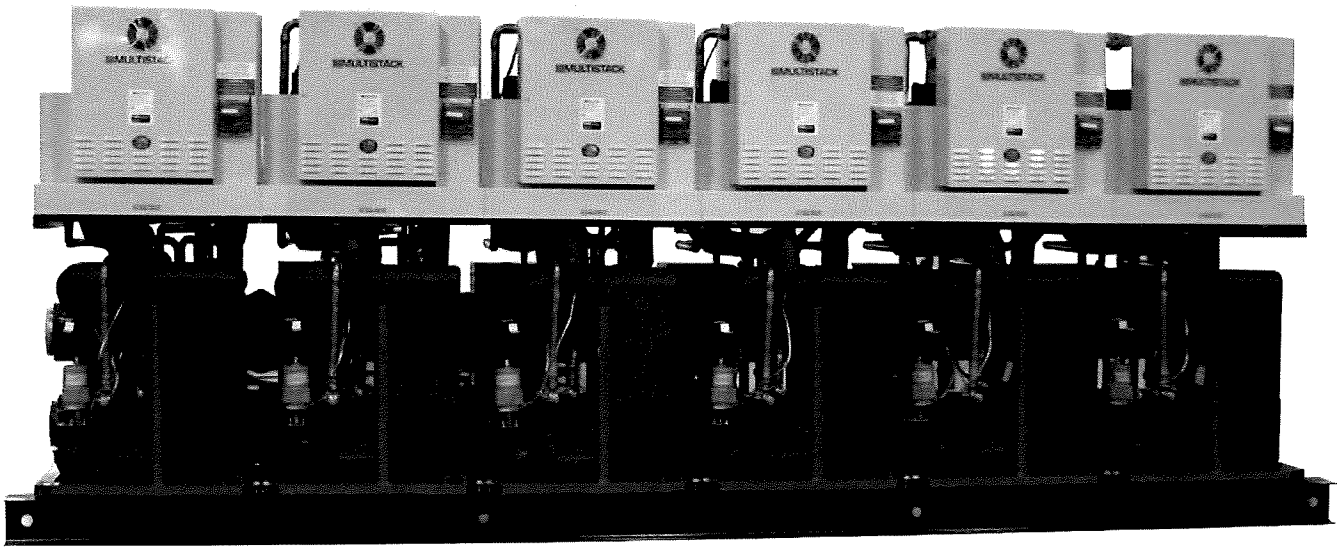




Grooved flange water connections on Total Access chiller modules joined into a chiller array.

Condenser side view of Total Access chiller modules assembled into a chiller array. .

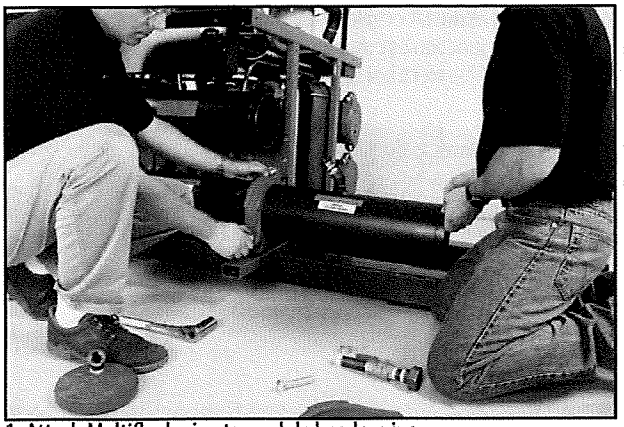




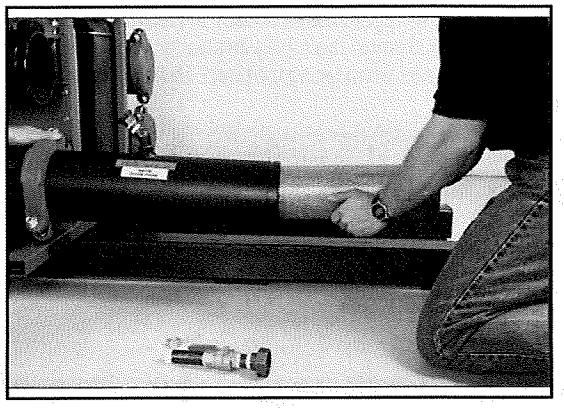
Evaporator side view of Multistack Total Access™ modules. (Optional enclosure panels not shown.)

Multiflush System Assembly

The following procedure describes installation of the Multiflush automatic debris removal system. This system is used periodically to remove dirt and debris from the from the chiller heat exchangers.

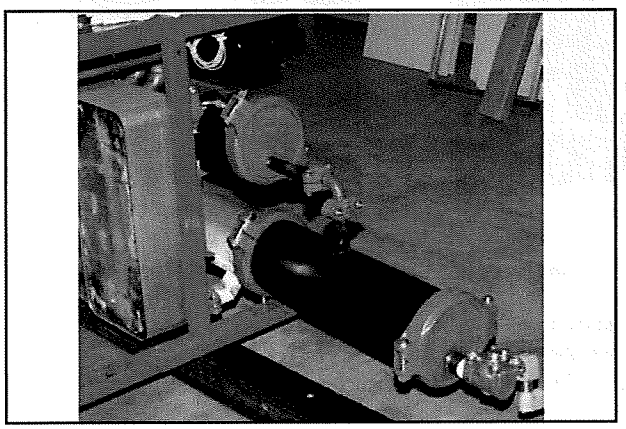


1. Attach Multiflush pipe to module header pipe.

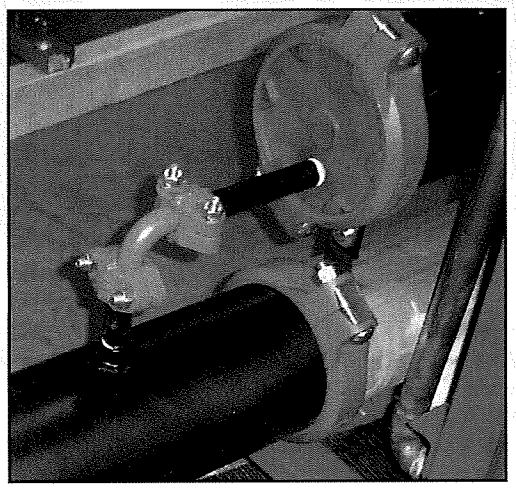


2. Insert 30-mesh filter into header.

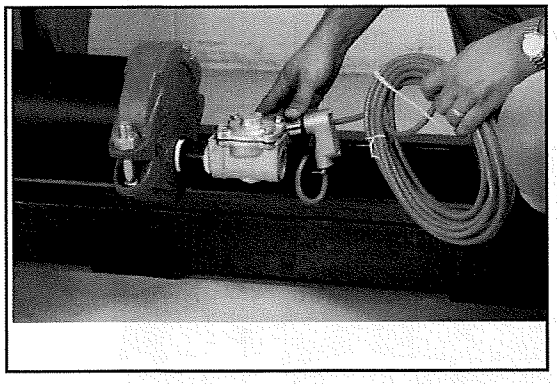
NOTE: See Pallet #3 for Multiflush components, Page 10.



3. Install large grooved pipe couplings. Leave loose - do not tighten.



4. Attach Multiflush pipe fittings using grooved couplings as shown.



5. Install manual or solenoid valve at end of Multiflush header.
6. Tighten all fittings.

Leak Testing

NOTE: Before leak testing make sure the four sensor wells have been installed.

After all piping connections are complete, make a static leak pressure test and seal any leaks. When the leak test has proved satisfactory, start the chiller system pumps and purge any air from the system. Seal any remaining leaks before proceeding.

Electrical Installation

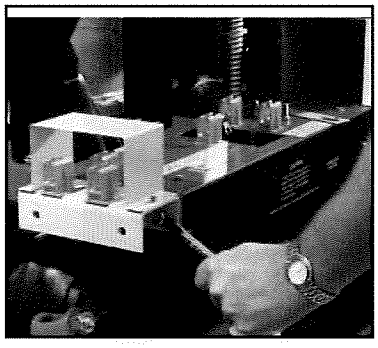
Field wiring must comply with all federal, state and local regulations. Circuit breakers, fuses, wiring and wire size must be installed per the National Electric Code (NEC). Voltage applied to Multistack chillers must be within plus/minus 10 percent of nameplate voltage. Voltage imbalance between phases may not exceed two percent. According to NEMA Standard MG-1-1998, a two percent voltage imbalance will cause a current imbalance of six to 10 times the voltage imbalance. Voltage imbalance between electrical phases must be kept to a minimum. Most Multistack chillers come with a single point of electrical connection (up to 500 amps) to simplify installation. The main electrical conduit feeding the power junction box may enter from either the top, bottom, or left side of the panel when facing the panel. Chillers requiring more than 500 amps will have multiple electrical connection points (per the 500 amp requirement).

DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tagouts.

Optional Single Module Field Connection

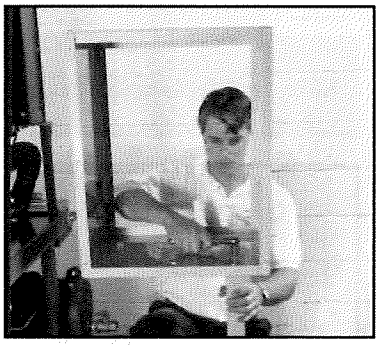
For single module installations, the power junction box can be deleted, but a power phase monitor must be installed. The main electrical feed can connect directly to the module circuit breaker.

NOTE: There is a dedicated chiller ground in this panel that must connect to a true earth ground.



Junction Box Support

Electrical Junction Box

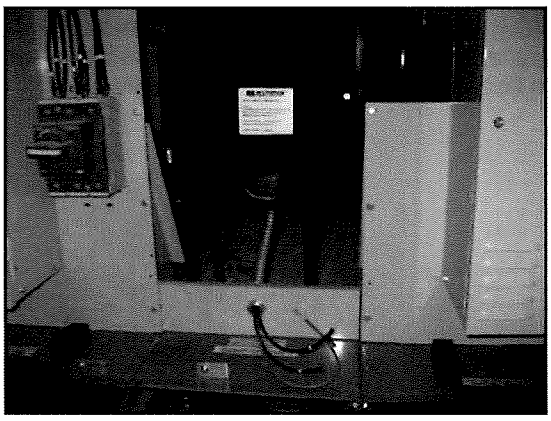


Junction Box Support Leg

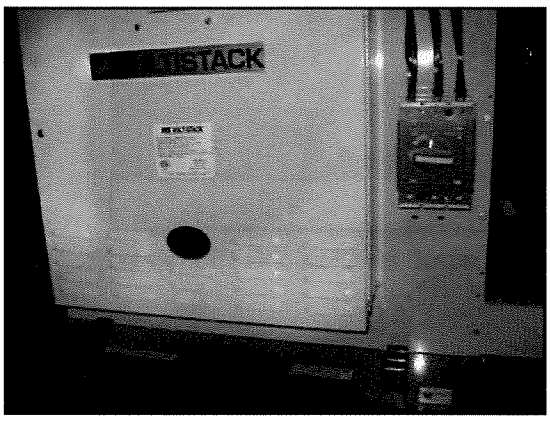
1. Attach the electrical junction box support. Line up the orange posts to ensure support is not backwards. The threaded plate slides in between frame.
2. The electrical junction box may be installed on either end of the chiller module.
3. Remove cover plate on appropriate end of the junction box, then bolt junction box to the support.
4. Cut the junction box support leg to length and fasten to the bottom of box and then to the floor, if necessary.
5. Three-phase wire and the ground wire, sized according to the nameplate rating, should be run through the junction box.

Buss bar Installation

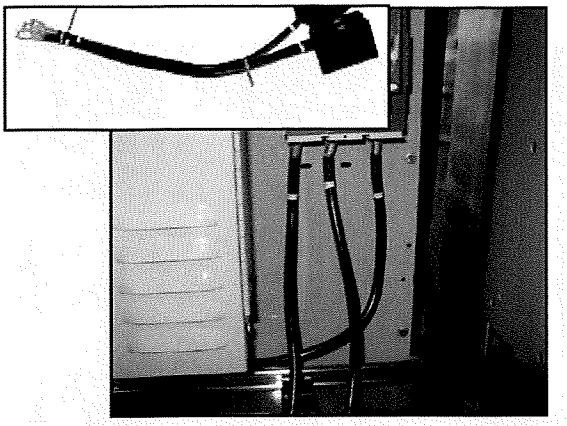
NOTE: Contact the local Multistack representative before installing the buss bar. Depending on the start-up representative's policy, the attachment of the buss bar system, and power phase monitor to the electrician's wire and lugs may be the responsibility of the electrician or the Multistack authorized start-up technician.



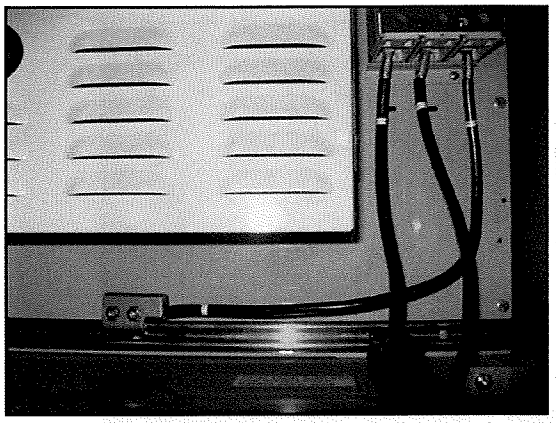
1. Remove the buss duct covers.



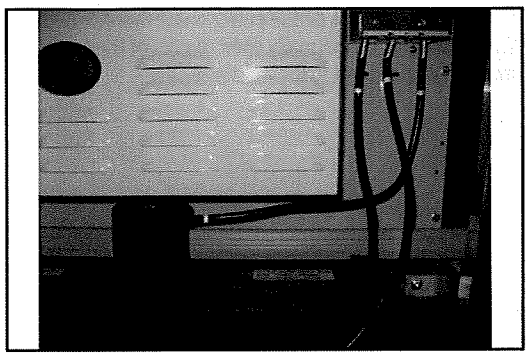
2. Remove the isolation switch cover



3. Install the three buss bar connector wires to the isolation switch at each module. The wires are shipped with each module.

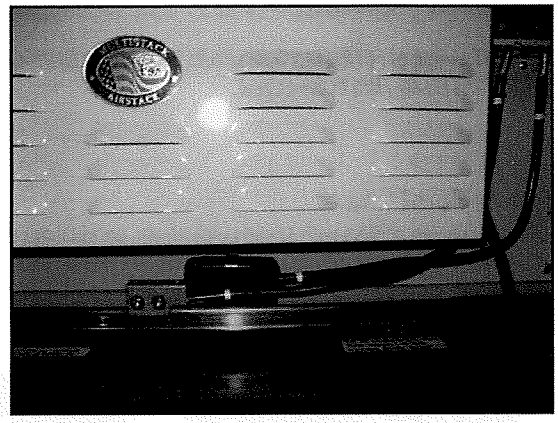


4. Remove the orange insulation and install the buss bar for Line 3 (back). Connect lug for Line 3 on each module.

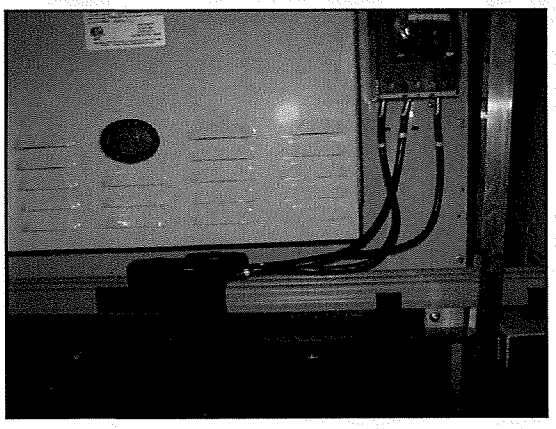


5. After connecting the Line 3 lugs for all modules, cut the orange insulation to fit between the lugs. Install the lug cover and snap the buss bar into the plastic holders.

6. Single-phase power for the modules should be taken off two lines of the buss bar. Multistack recommends using Lines 1 and 3.



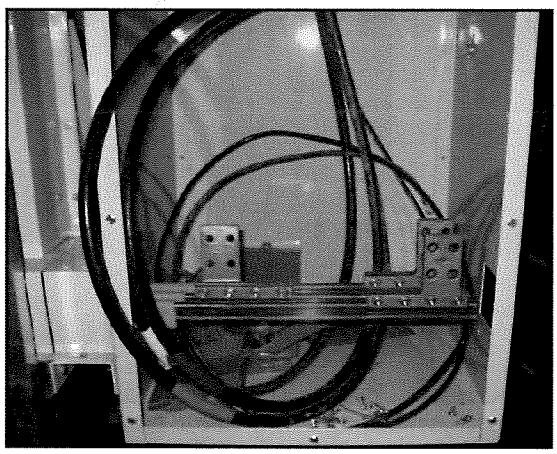
7. Follow the procedure in Step 5 to complete installation of Lines 1 and 2.



8. Follow the procedure in Step 5 to complete installation of Lines 1 and 2.

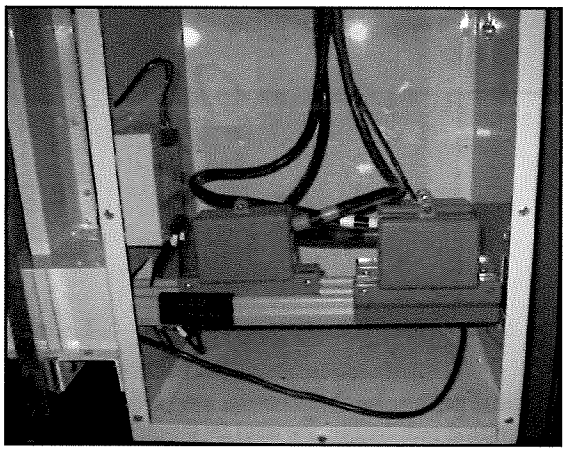
9. With all three lines installed, use the provided overlap pieces to cover any open buss bar areas.

DANGER: During installation, testing, servicing and troubleshooting this product, it may be necessary to work with live electrical components. Only qualified licensed electricians or other properly trained persons may perform these tasks. Failure to follow all electrical safety precautions can result in death or serious injury. All HVAC equipment must be installed per National Electric Code (NEC) and all applicable state/local codes.



10. The ground bar must be drilled, then attached to the module ground lug.
11. Reinstall the buss duct and isolation switch covers. Install the main power connectors as shown.

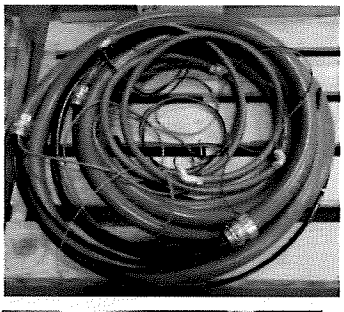
NOTE: IT IS THE ELECTRICIAN'S RESPONSIBILITY TO CONNECT MAIN POWER TO THIS CONNECTOR.

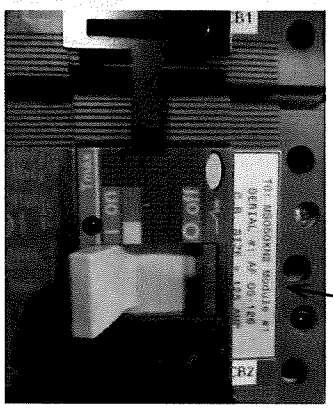


12. Install the power phase monitor as shown. When correctly installed the lettering on the power phase monitor is inverted. Wires are run to the normally open contact of the power phase monitor and connect to the master control.

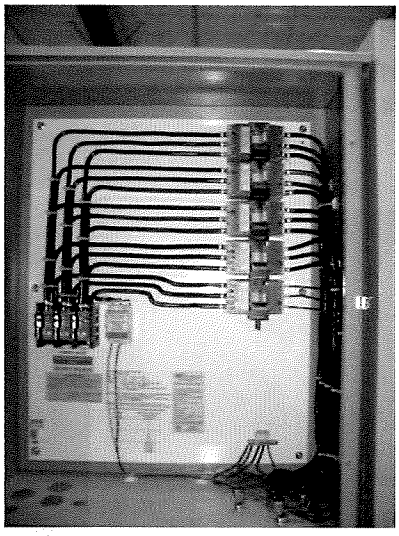
Single Point Power

On water cooled chillers with single point power, optional wire whips may be ordered and substituted for the standard buss bar. The conduit, wiring and junction box are shipped as part of the loose parts package. The wire and conduit are then connected to the junction box as the modules are installed. Each wire and circuit breaker is marked for correct connection.





Each wire and circuit breaker is marked for correct connection.

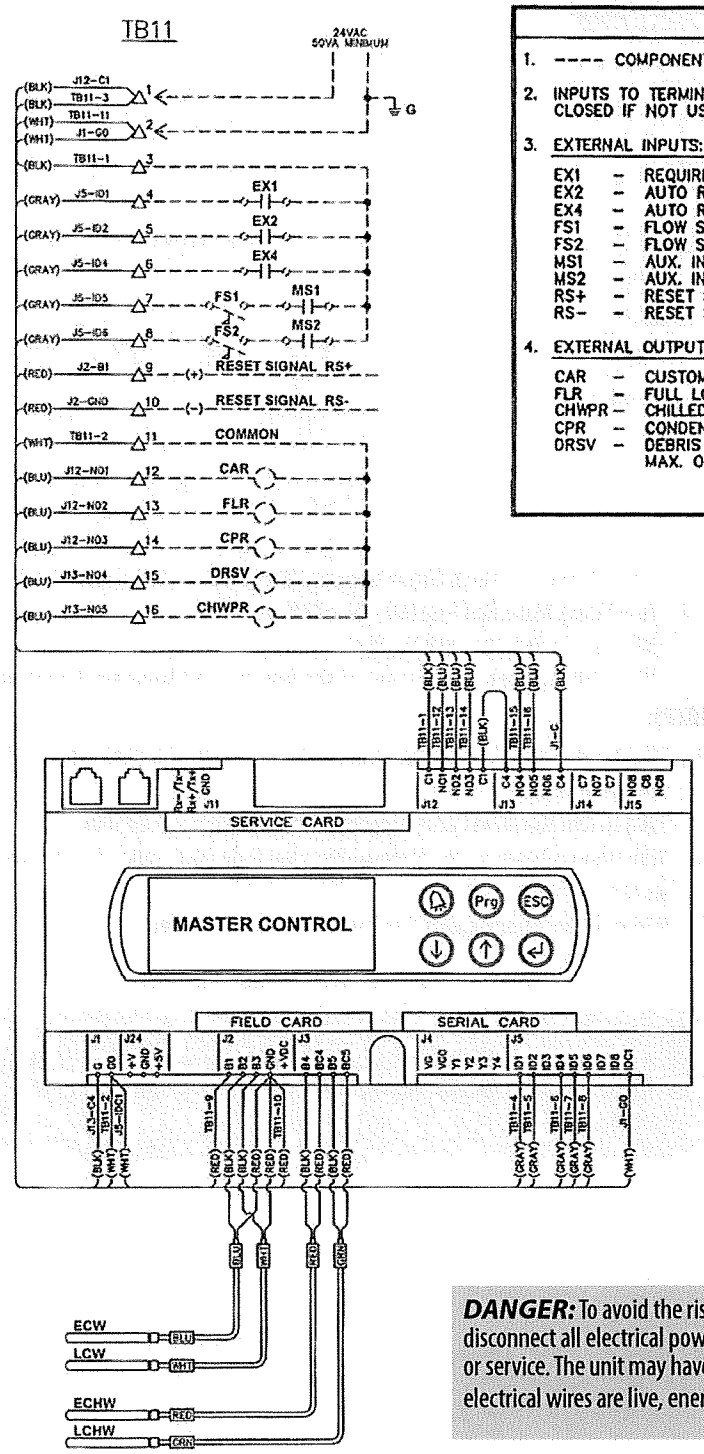


Module wiring connections to the power junction box must be completed by a qualified electrician.

NOTE: Be sure to replace all protective covers after completing wiring connections.

DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tagouts.

Typical Interconnecting Wiring. Consult the Specific, As-Built Submittal Wiring Diagrams



LEGEND

1. ---- COMPONENTS & WIRING BY OTHERS. (18 AWG MIN. WIRE)
2. INPUTS TO TERMINALS 4 THRU 8 OF TB11 MUST BE WIRED CLOSED IF NOT USED.
3. EXTERNAL INPUTS: (CLOSED TO OPERATE)

EX1	–	REQUIRES MANUAL RESET TO RESUME OPERATION
EX2	–	AUTO RESET (REMOTE START/STOP)
EX4	–	AUTO RESET (POWER PHASE MONITOR INPUT)
FS1	–	FLOW SWITCH (CHILLED WATER)
FS2	–	FLOW SWITCH (CONDENSER WATER)
MS1	–	AUX. INTERLOCK (CHILLED WATER PUMP STARTER)
MS2	–	AUX. INTERLOCK (CONDENSER WATER PUMP STARTER)
RS+	–	RESET SIGNAL (SOFTWARE SELECTABLE 0–10VDC, 4–20mA)
RS–	–	RESET SIGNAL (SOFTWARE SELECTABLE 0–10VDC, 4–20mA)

4. EXTERNAL OUTPUTS:

CAR	–	CUSTOMER ALARM RELAY (24VAC, 5VA MAX.)
FLR	–	FULL LOAD RELAY (24VAC, 5VA MAX.)
CHWPR	–	CHILLED WATER PUMP RELAY (24VAC, 5VA MAX)
CPR	–	CONDENSER PUMP RELAY (24VAC, 5VA MAX.)
DRSV	–	DEBRIS REMOVAL SOLENOID VALVE (24VAC, 6W, 16VA) MAX. OF (2) DRSV IN THIS CIRCUIT

DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tagouts.

Multistack has a policy of continual improvement and reserves the right to change product design, literature and specifications without notice.

System Wire & Fuse Sizing Specifications

Compressor Rated Load Amps (RLA) and Locked Rotor Amps (LRA) Data
Standard and Total Access™ Modules
RLA/LRA

VOLTAGE	208	230	460	575
MS010X*	13.1/136	11.8/136	5.9/66.1	4.7/55.3
MS015X	24.8/240	22.4/240	11.9/130	9.1/93.7
MS020X	28.1/240	25.4/240	13.9/140	10.7/107.6
MS030X	49.8/340	45.0/340	22.5/173	18.0/132
MS040X	54.0/538	49.0/538	23.5/229	19.5/180
MS050X	67.0/605	60.0/605	30.0/272	24.0/215
MS070X	89.0/599	80.0/599	40.0/310	32.0/239
MS085X	112.8/943	102.0/943	51.0/408	37.6/375

** MS010X units are also available for single-phase power (230/1/60) applications and have an RLA of 19.5 amps and LRA of 178 amps.*

MCA = (30 X 1.25) + (30 X 7)
= 37.5 + 210
= 247.5 → 250A

10/9/2019 - Not necessary. Each module gets own 100A supply. - See - email from Eddie.

MCA	3 CONDUCTORS 1 CONDUIT	6 CONDUCTORS 2 CONDUIT
50	8	—
65	6	—
85	4	—
100	3	—
115	2	—
130	1	—
150	1/0	—
175	2/0	—
200	3/0	—
230	4/0	—
255	250 MCM	—
285	300 MCM	1/0
300	—	1/0
350	—	2/0
400	—	3/0
460	—	4/0
500	—	250 MCM

(Applicable codes may require different wire sizing)

1. Wiring Sizing: Minimum Circuit Ampacity (MCA) MCA = (1.25 x RLA1*) + RLA2 + RLA3
2. Fuse Sizing: Maximum Fuse (MF), Type RK5 Fuse
   MF= (2.25 x RLA1*) + RLA2 + RLA3
   Where MF does not equal a standard size fuse, the next larger size fuse should be used.

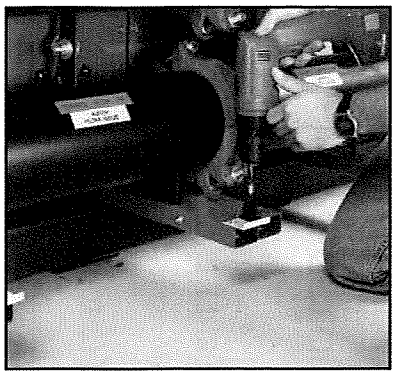
NOTES:

A. *RLA1 = RLA of the largest compressor in the system. RLA2 & RLA3 = RLA of the other compressors in the system.
B. Total system Minimum Circuit Ampacity (MCA) shall not exceed 500A.
C. Wire sizing is based on the National Electrical Code (NEC) rating for 75°C copper wire, with 3 wires per conduit.
D. Wiring distance from branch circuit shall not exceed 100 feet.

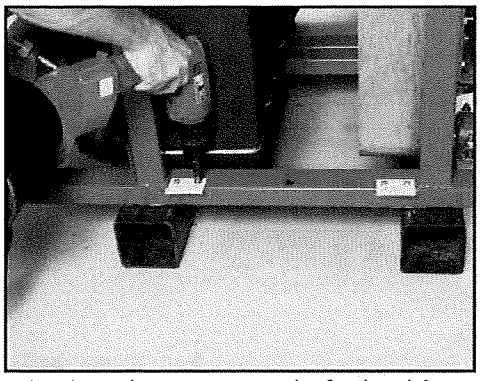
DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tagouts.

Frame & Panel Installation

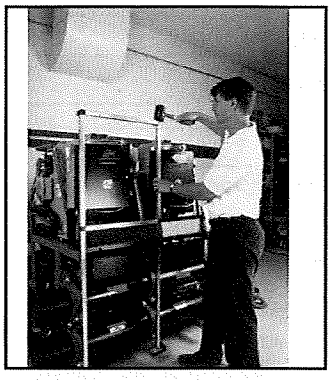
Attachment of the optional enclosure panels is the responsibility of the Multistack authorized start-up technician. Typical installation is shown.



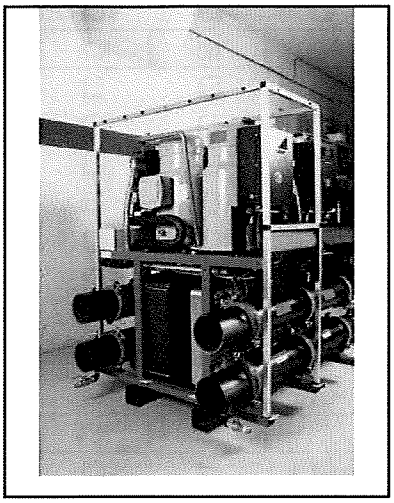
1. Install panel clips and spindle posts on the outside four corners of module frame.



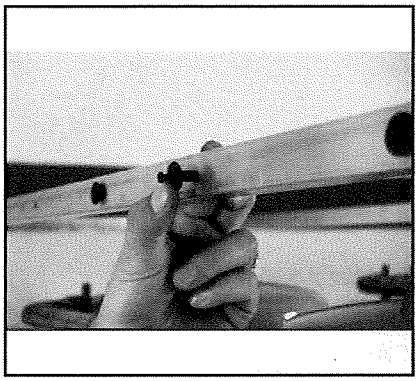
2. Attach panel supports on outside of end modules.

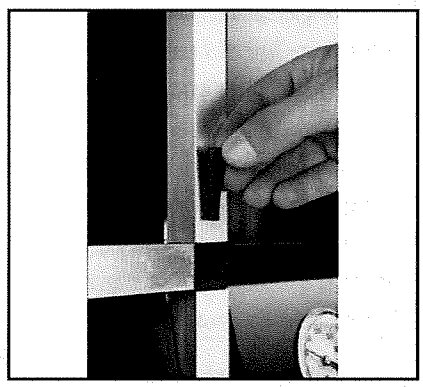


3. Attach front frame section on module (33-1⁄8 -inch pieces on bottom). Use "T" connectors in front middle. The four corner connectors go on top, front and rear.

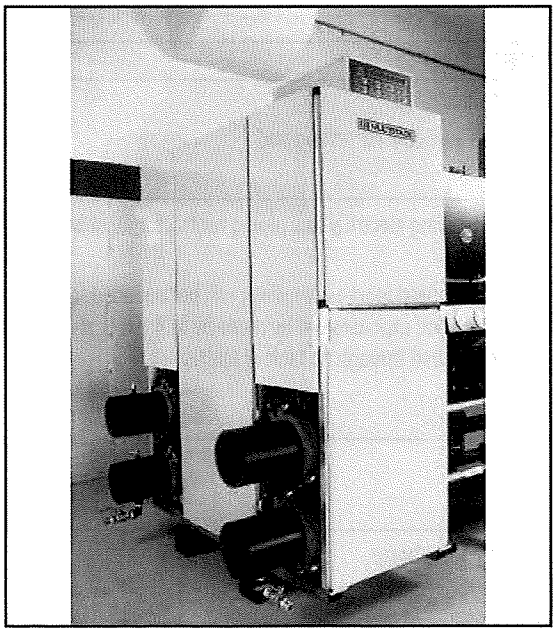


4. Install two long frames over spindle posts vertically in rear (buss bar side). Attach top frames to corner joints (use special frames with seven holes for end modules only). Attach 20-inch horizontal frames, two in front, one in rear.





5. Once the frame is assembled, attach the black fasteners and magnetic tape (or Velcro™ strips) to front of support panels.



6. With the first module frame and panels complete, install the additional enclosures.

INSTALLATION CHECKLIST & REQUEST FOR AUTHORIZED START-UP ENGINEER

CUSTOMER: _____

JOB NAME: _____

JOB LOCATION: _____

CUSTOMER ORDER NO.: _____

CHILLED WATER	Yes	No	N/A
Piping complete and connected to Multistack Units.	❑	❑	❑
Water system filled and vented.	❑	❑	❑
Pumps installed (Rotation checked).	❑	❑	❑
Recommended strainers installed.	❑	❑	❑
Controls (3-way valves & by-pass valves, etc.) operable.	❑	❑	❑
Water system operated and flow balanced to meet unit design requirements. — How do I know? pressure drop? ↳ specifically a differential pressure gage.	❑	❑	❑
Strainers checked for unusual debris.	❑	❑	❑
Flow or differential pressure switch installed.	❑	❑	❑
CONDENSER WATER	**Yes**	**No**	**N/A**
Piping complete and connected to Multistack Units.	❑	❑	❑
Cooling tower flushed, filled and vented.	❑	❑	❑
Pumps installed (Rotation checked).	❑	❑	❑
Recommended strainers installed.	❑	❑	❑
Controls (3-way valves and by-pass valves, etc.) operable.	❑	❑	❑
Cooling tower fans wired and operable.	❑	❑	❑
Condenser water system operated.	❑	❑	❑
Condenser & evaporator strainers must be checked, cleaned and free of debris.	❑	❑	❑
Flow or differential pressure switch installed.	❑	❑	❑
ELECTRICAL	**Yes**	**No**	**N/A**
Power wiring complete and in accordance with nameplate rating on Multistack unit and prepared for connection in accordance with installation manual.	❑	❑	❑
NOTE: No power is to be applied to unit prior to inspection by Multistack engineer.			
All interlock wiring complete between control panel and complies with Multistack specifications and with applicable codes.	❑	❑	❑
MISCELLANEOUS	**Yes**	**No**	**N/A**
Thermometer wells, thermometer gauges, control, etc. installed.	❑	❑	❑
A minimum system load of 50% of total building load is available for testing and adjusting controls.	❑	❑	❑

We understand that authorized representatives of the installing electrical and piping contractor must be available during the start-up period and that coordination is our responsibility.

We further understand that the services of Multistack Authorized Start-up Engineer will be furnished for a period of not more than sixteen (16) consecutive normal working hours and we agree that a charge for time and expenses will be made by Multistack if services are required for longer than sixteen (16) consecutive normal working hours or if repeat calls are required through no fault of Multistack.

Signed Title

Company Name, Company Location and Company Telephone

Job Location Telephone

START-UP DATA LOG

START-UP DATE: _____ SHIP DATE: _____

JOB NAME: _____ JOB NUMBER: _____

ADDRESS: _____

MULTISTACK REPRESENTATIVE: _____

MODEL NUMBER: _____

MODULE SERIAL NUMBERS

1. _____ 7. _____
2. _____ 8. _____
3. _____ 9. _____
4. _____ 10. _____
5. _____ 11. _____
6. _____ 12. _____

DESIGN PARAMETERS

1. ECHW _____
2. LCHW _____
3. CHW GPM _____
4. CHW P DROP _____
5. ECW _____
6. LCW _____
7. CW GPM _____
8. CW P DROP _____

WATER SIDE AND INSTALLATION CHECKLIST CIRCLE CORRECT RESPONSE

1. Chiller mounted on rails and isolators? ***YES*** ***NO***
2. Any visible damage, oil or refrigerant leaks? ***YES*** ***NO***
   If yes, detail: _____
3. All pipe work independently supported from chiller? ***YES*** ***NO***
4. System sensor wells installed: ***CHILLED:*** ***IN*** ***OUT*** ***CONDENSER:*** ***IN*** ***OUT***
5. Flow or differential switches installed: ***CHILLED:*****_____** ***CONDENSER:*****_____**
6. Operation of flow or differential switches with reduction of 50%. ***P*****_____**
8. Condenser 3-way by-pass valve? ***YES*** ***NO***
   If yes, Temperature set point: _____ ***°F***
9. System strainers installed? ***CONDENSER:*** ***YES*** ***NO***
   EVAPORATOR: ***YES*** ***NO***
10. Install System sensors and apply thermal paste? ***YES*** ***NO***

ELECTRICAL AND CONTROLS CHECKLIST

1. All electrical connections tight and correct? ***YES*** ***NO***
2. Power wiring sufficient to carry F.L.A.? ***YES*** ***NO***
3. Voltage levels: ***PHASES:*** ***1+2*** _____ ***2+3*** _____ ***1+G*** _____ ***2+G*** _____ ***3+G*** _____
4. Set module board addresses, run communication wire, do factory reset on Master Control? ***YES*** ***NO***
5. Program system variable to site connections, date and time? ***YES*** ***NO***
6. Verify demand for cooling? ***YES*** ***NO***
7. Check temperature and pressure sensors through microprocessor display? ***YES*** ***NO***
8. Check interlock operation: Stop chilled water pump? ***YES*** ***NO***
   Stop condenser water pump? ***YES*** ***NO***
9. Provide training to contractor or owner? ***YES*** ***NO***
9. Leave system in full operation? ***YES*** ***NO***
10. Notify contractor of any problems? ***YES*** ***NO***

Start-up Service Technician

_____

Owner or Contractor Acceptance

_____

Start-Up Data Log, Cont'd

Actual Setpoints

1. ECHW (Upset)_____
2. LCHW (Loset) _____
3. VSP_____
4. Control_____
5. TDIFF_____
6. Flush Dur. _____

*PCO Program Version _____
(Go to main menu screens then push PRG & UP buttons)

Measured Readings

1. CHW P Drop_____
2. CW P Drop_____

Factory Setup

1. Program Type_____
2. Chiller Type _____
3. Refrigerant _____
4. Flow Faults: CHW_____
   CW_____
5. Circuit Type _____
6. Variable Flow _____
   A. Valve Display _____
   B. CHW Output_____
   C. CHW Bypass _____
   D. CHW Min Output _____
   E. CW Output_____
   F. CW Bypass _____
   G. CW Set point_____
   H. CW Min Output _____
   I. CW PID _____
   J. CHW PID _____

MODULE		CURRENT			TEMPERATURE				HP	LP
		A	B	C	Suct	LoChw	SYS LCHW	ECHW		
1	A									
	B									
2	A									
	B									
3	A									
	B									
4	A									
	B									
5	A									
	B									
6	A									
	B									
7	A									
	B									
8	A									
	B									
9	A									
	B									
10	A									
	B									
11	A									
	B									
12	A									
	B									

Operation

The Multistack chiller provides chilled water to an external load, based on return water temperature to the Multistack Master Control. When the entering chilled water temperature sensor sends a signal to the master controller that cooling is needed, compressors will start and begin to produce chilled water. A compressor start is determined by the entering chilled water (ECHW) upper set point and the variable set point setting in the Master Control System Variables menu. When the ECHW sensor senses that the chilled water temperature has dropped below the set point, compressors will begin to cycle off.

Chiller modules equipped with modulating butterfly valves on the chilled water side are controlled from the leaving chilled water set point (lower set point) in the System Variables menu. The module slave board(s) send a 2-10 VDC output to each actuator to modulate the water valve to maintain lower set point. When a module is not running, valves close to prevent bypassing water at the operating chiller modules.

For variable flow applications one or more valves may remain open at all times to provide minimum flow through the chiller. The valve that stays open will always be the lead compressor for that day, eliminating the need for an external bypass installed at the chiller. If modulating butterfly valves are used on the condenser side of each module, the valves will control to a discharge pressure setting selected from the Factory Setup menu. This is also a 2-10 VDC output each module board sends to the valve actuator. If the condenser pump cycles off while no modules are running, minimum flow doesn't need to be considered. If the condenser pump runs at minimum flow, the condenser bypass should be enabled in the Factory Setup menu.

N/A
Eddie
10/10/19.

Sequence of Operation, Leaving Chilled Water Temperature Control

The Multistack chiller is equipped with a microprocessor based supply water temperature controller. The chiller operates in response to leaving chilled water (LCHW) set points.

AUTO (Toggle switch on machine)

In AUTO mode, the compressors operate as needed to maintain the LCHW set point. Cooling temperature control with CONTROL TO: set to LEAVING is based on: LCHW SET POINT

LCHW OFFSET LCHW STAGE OFF

1. The Leaving Chilled Water (LCHW) set point default is 45 degrees F with a 35 to 80 degree ranges. The controller maintains this value within ___ +/- of the LCHW Offset.
2. The LCHW Offset default is 2 degrees F with a range of 0.5 to 10 degrees. This is the value above and below the LCHW Set point that compressors are staged on and off.
3. The LCHW Stage Off delay is defaulted to 30 seconds with a 5 to 180 second range. This allows for a delay between the shutting off of compressors in Leaving Chilled Water control. If the system leaving temperature drops too far too quickly (2 degrees below where the previous compressor was to shut off) the controls will allow one more compressor to shut off within that 30 seconds. That should be enough to back off the leaving temperature so the over shoot condition doesn't continue.

Modulating valves on the modules will control to the following in AUTO MODE:

The SYSTEM VARIABLE of CONTROL TO: Set to a value of LEAVING.

Evaporator valve will control to the LCHW SET POINT.

Variable Flow Chilled Water and/or Variable Flow Condenser Water

Motorized actuating valves for varying water flow through the evaporators and or condensers are factory installed on each heat exchanger. To accomplish VFD chilled water and/or condenser water flow the system must control the chilled water pump and/or condenser water pump based on pressure drop across the chiller. As a compressor starts a valve is opened and pressure drop decreases. The pump should then speed up to match the desired pressure drop. Control of the pump is external to the chiller. Additionally, the chilled water loop must have a minimum flow bypass at the end of the loop (by others) to maintain minimum flow through the chiller.

The valves on a Multistack chiller are dual purpose. First, a user defined number of valves can be programed to remain open at all times as a minimum flow bypass through the chiller. This is selectable at the master controller or through the BAS with an optional web-portal. Second, the motorized valves modulate to maintain leaving chilled water temperature control out of each heat exchanger. The bypass valve(s) will follow the lead compressor and remain locked in a bypass position and rotate with the lead compressor. Remaining valves will open when corresponding compressors start. The compressor will then modulate for leaving water temperature control. Valves close when corresponding compressors shut off. When there is no demand for cooling all valves are closed with only the pre-selected number of bypass valves remaining open for a minimum flow chiller bypass.

If all evaporators and condensers are equipped with variable flow valves the master controller, in conjunction with each corresponding slave controller, will modulate the valves for simultaneous leaving chilled water and condenser head pressure control from each heat exchanger (with the exception of the heat exchanger(s) programmed as the minimum flow chiller bypass).

Factory Setup/Commissioning

Go to the System Variables Menu and select Factory Settings to access the program type and other setup information. Setup is to be done by the Multistack authorized startup technician. Setup parameters are factory set to default values. Jobsite conditions must be configured at startup. To change these settings requires a password that is available to authorized service technicians by calling Multistack at (608-366-2400).

The Standard Program should be used on applications where no glycol is used in the chilled water side. In this mode the chilled water temperature cutout is set at 34°F.

The Low Temperature Program should only be used in applications that have a minimum of 25 percent glycol in the chilled water loop. Cutout on low water temperature in this mode is 20°F and the suction temperature cutout setting (with R-410A refrigerant) is set at 15°F.

Condenser Water Set-Point: If power-actuated butterfly valves are used on the condenser side, this value should be set for the desired discharge pressure. Depending on the condenser water inlet temperature this will adjust the valve to maintain the desired pressure.

Variable Flow: Select ENABLE if doing variable flow on the chilled or condenser side. If not, select DISABLE. To do variable flow, water control valves must be installed on each module between the water header pipe and heat exchanger.

Bypass: Select ENABLE to leave the valve on the lead module open for minimum flow bypass. Select CHILLED WATER or CONDENSER WATER bypass. If no valves are installed on the module keep this variable in the DISABLE MODE.

For information on basic control setup of the modules see the Multistack Comput 600 User manual.

Pressure Readings

The operating suction and discharge pressures in the system are directly related to water flow, condenser temperature, chilled water set-point, and system cleanliness. Standard operating conditions with 95°F leaving condenser water and 45°F leaving chilled water temperature are discharge pressure at 325 psig (102°F saturated) and suction pressure at 114 psig (38°F saturated).

All water-cooled modules have a high pressure (HP) cutout safety device and a backup HP cutout switch. The HP cutout is 475 psig for a standard water-cooled module with R-410A.
Each module also includes a low pressure (LP) safety cutout. The LP cutout is set in the module program at 50 psig.

If circuits are experiencing HP faults first check to see that the cooling tower fan is operating. Next, verify proper water flow to the brazed plate heat exchanger and confirm the strainer and filters are clean and free flowing.

A LP fault is an indication of low refrigerant charge in the system. If a circuit trips out on a LP fault check the static pressure of the system while the circuit is in the off mode. If pressures are low, check the circuit for possible leaks. The circuit can be pressurized to 15 psig with refrigerant and topped to 160 psig with dry Nitrogen.

Maintenance

Use proper safety equiment, tools and procedures when operating and servicing this equipment. Be sure to review all safety warnings, cautions and notes found on Pg. 3 of this manual.

Preventive Maintenance

Multistack publication MAINT-002-0416 provides heat exchanger preventative maintenance guidelines. Contact your Multistack representative for more information. Multistack water cooled chillers, especially those with brazed plate heat exchangers, require careful control of the chilled and condensing water circuits to prevent heat exchanger fouling. Refer to Multistack publication MAINT-001-0416 for water sample collection information.

DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tagouts.

Strainer Cleaning, Heat Exchanger Cleaning

All Multistack modules have a 30-mesh filter strainer in the condenser and evaporator inlet headers. The purpose of the strainer is to prevent debris from entering the heat exchanger. An external "Y" or basket type system strainer should also be installed as a pre-filter to the Multistack strainers. There is no pre-determined time for cleaning the strainer cartridges. The frequency of this process is dependant on the water quality in the condenser and/or evaporator loop. Normally, debris in a water loop is takes the path of least resistance and accumulates in the last modules to receive water.

Multistack modules include the Multiflush automatic blow down system installed on the condenser side of the last module in the chiller array. The Multiflush system is controlled by a timer in the Master Control and opens once a day to remove debris from the loop. Multiflush does not eliminate the need to pull and clean the strainers, but reduces the frequency.

The effect of debris buildup in the condenser water inlet filter cartridge will create nuisance HP (high pressure) faults. By checking the pressure differential between the inlet and outlet of the condensers, it can be determined if the strainers are contaminated. Refer to the MS 010-085X Product Data Catalog for correct pressure drop of your model. For an MS070X module with a 10° F Delta T, the condenser side pressure drop should be 17' / 7.4 psi; for chilled water 16' / 7 psi. To keep HP faults from repeating, the strainers will need to be pulled and cleaned. If HP faults still occur after cleaning the strainer cartridges the condenser pump should be checked for proper flow. If flow is not a problem the heat exchangers may need to be cleaned. Refer to Multistack Heat Exchanger Cleaning Bulletin (MAINT-003-0416). Use this procedure to remove and clean the filter cartridges on the condenser side.

1. Turn off the chiller, shut down the condenser pump, and close the butterfly/gate valves to the condenser.
2. Drain the water remaining in the condensers and header pipes by opening the drain valve in the pipe stubs or by removing the end grooved fitting cap on the Multiflush system.
3. Remove the first filter in the Multiflush and remove all remaining filters in the bottom condenser header pipes.
4. Slowly open the top butterfly / gate valve, allowing water to flow through the condensers and onto the floor for approximately 30 seconds. This will push out any debris trapped in the bottom of the heat exchanger as the filters are removed.
5. Clean the filters with a hose, power washer, or wire brush as needed and re-install. Slide filters in until contacting the filter stop ring on the first module. Keep an extra set of strainers for quick re-installation. These filters are available for purchase through Multistack representatives.
6. Close the system by installing any grooved fitting clamps previously removed.
7. Open the ¼-inch petcock bleed valves on the pipe stubs.
8. Fill the system by opening the bottom butterfly/gate valve and filling from the bottom up. Close the ¼-inch petcock valves and open the top butterfly/gate valve after air has been bled from the system.
9. Start the condenser pump. Bleed any remaining air in the system once the pump has started and start the chiller.

If circuits trip out on Low Suction Temperature, or Low Chilled Water Temperature, check the chilled water inlet filter cartridge. The strainers are located in the top header on the chilled water side. The previous instructions on condenser strainer removal do not need to be exactly followed. If the strainers are clean the fault may be caused by a low flow condition or a low set point in the Master Control. If these possibilities are eliminated the evaporator heat exchangers may need cleaning.

Compressor Oil Level

All compressors on water-cooled modules have an oil level sight glass on each compressor. Each module is run tested and the oil level is set at the factory. R-410A scroll compressors are single stage and oil level is set at ⅛ – ¼ full sight glass. The compressor uses POE oil. Use Copeland type 998-E022 or Nu Calgon 32-3MA. Call Multistack service at (608)366-2400 for factory oil charge for each compressor.

Refrigerant Charge / Evacuation

All water-cooled modules are factory charged to recommended refrigerant volumes. Prior to charging, each circuit is evacuated to 150 microns and held 15 minutes. The proper refrigerant charge for each module can be found on the module data plate. For proper charge on water-cooled modules, the circuit should be charged until the sight glass clears.

Model	Refrigerant Lbs. Per Circuit	Oil Charge Per Circuit (in Pints)*
MS010X	8	3.5
MS015X	8	6.9
MS020X	8	6.9
MS030X	12	6.9
MS040X	15	9.5
MS050X	18	9.5
MS070X	24	13.3
MS085X	28	13.3

* Based on Copeland compressors

Filter Driers

Multistack modules contain very short piping runs to the major components. Only a micro refrigerant charge (0.6 lbs. per ton) is used, and all circuits are evacuated to 150 microns. For this reason a liquid line filter drier is not factory installed in the unit. When changing a major component in the system, a replaceable core suction line filter kit can be added to reduce contamination. The suction filter kit can be purchased from Multistack through your local representative.

Superheat/Subcooling

Subcooling is necessary in the system to prevent flash gas as the refrigerant enters the expansion valve. Multistack uses a mechanical-type expansion valve on all modules. Clockwise adjustment of the valve increases superheat. On water-cooled modules, superheat is set at 10°-12°F during the factory run test. Multistack condensers are sized so that liquid refrigerant subcooling occurs without a separate subcooler. The general range of subcooling is 10°-20°F.

Daily Log Sheet

Log sheets foud at the back of this manual can be used daily, weekly or as desired to record operation characteristics of the chiller. The information recorded on the log sheet can also help diagnose potential system problems.

Annual Maintenance

DANGER: To avoid the risk of electrical shock, personal injury or death, disconnect all electrical power to the unit before performing any maintenance or service. The unit may have more than one electrical power supply. Assume all electrical wires are live, energized wires. Use lockout/tagouts.

Annual maintenance requirements for Multistack Chillers involve proper shut-down of the machine and cleaning of the heat exchangers. The Preventative Maintenance bulletin (MAINT-002-0416) and Heat Exchanger Cleaning bulletin (MAINT-003-0416) describe the recommended procedures for both processes. Multistack makes available the 151A Cleaning Kit to assist with this process. Refer to the 151A Cleaning Kit bulletin for more details.

Also check annually:

- All electrical components (contactors, fuses, relays, etc.) to identify any signs of excessive wear. Check for tight connections.
- Superheat, pressure gauges, oil levels, Master Controller condition, and sensor accuracy should also be checked.
- Exercise all isolation valves, manual or power operated.

Compressors

In the event of a compressor failure, determine the cause. A motor burn due to a fault in the motor insulation is quite rare. Most burnouts are actually caused by a mechanical condition or lubrication problem. In the event of a burnout, proper clean up procedures should be followed.

1. Check all electrical components of the circuit (contactors, fuses, wires, etc.)
2. If necessary do a system clean up. Nu-Calgon RX-11 flush, or Sporlan System Cleaner work well.
3. Install a suction filter drier with burnout core.
4. Evacuate the system to a minimum of 500 microns and hold for 20 minutes.
5. Charge the circuit with virgin refrigerant. Charge with liquid into the discharge side. See proper refrigerant charge on nameplate data of unit.
6. Run the system 2-3 weeks with burnout filter core. Replace with standard core drier

Heat Exchanger Cleaning

Multistack publication MAINT-003-0416 provides procedures for cleaning heat exchangers. Contact your Multistack representative for more information.

Troubleshooting

Multistack modular chillers use the Carel PC03 master control. A user manual for the PC03 controller is supplied with the submittal package. The user manual details the different status screens and explanations of system or module faults. Use the following guide to troubleshoot modules and the PC03 controller.

Fault	Solution
No Display on Master Module	• Check main disconnect for power • Check circuit breakers in module • Check transformer in modules • Check for 24V at J1 on board
EX 1,2, Interlock	• Check appropriate interlock component • Check jumpers on TB11 in master control
EX 4 Interlock	• Check for proper rotation, phasing • Check PPM device
Waiting For Chilled Water Flow	• Check CHW pump • Check flow switch operation • Check filter strainers • Check TB11 inputs #3 - #7
Waiting For Condenser Water Flow	• Check CW pump • Check flow switch operation • Check filter strainers • Check TB11 inputs #3 - #8
Low Chilled Water Temp	• Check LCHW sensor • Check set-points in system variables • Check for flow restriction
No Demand	• Check entering CHW sensor • Check set-points in system variables • Check sensor location
100% Demand all the time	• Check entering CHW sensor • Check set-points in system variables

Fault	Solution
100% Demand, chiller won't load	• Turn chiller on • Check sensors • Check load limit setting in system variables
Excessive Cycling	• Check VSP setting is system variables • Check entering CHW sensor location • Look for system problem (low water Volume, low load)
High Discharge Pressure (HP)	• Check strainers in condenser headers • Check condenser water flow
Low Suction Pressure (LP)	• Check refrigerant charge / leaks • Check expansion valve
Low Suction Temperature	• Check suction sensor • Check set-points in system variables • Check for flow restriction
Communication Error	• Check settings in system variables • Check cables at J11 comm ports • Check dip switch settings
Circuit Fault	• Check components in control circuit • Check wire crimps in control circuit • Check ratio of HP to LP
P Lan Error	• Check cables at J11 comm ports • Check for possible power issues

IIIMULTISTACK Chiller Daily Log Sheet

Job Name:						
Job Number:						
Module Serial Numbers:						
Date:						
	Status	Suct. Press	Head Press	Suct. Temp	LoChw Temp	Fault (if any)
Comp #1						
Comp #2						
Comp #3						
Comp #4						
Comp #5						
Comp #6						
Comp #7						
Comp #8						
Comp #9						
Comp #10						
Comp # 11						
Comp #12						
System	Ent. Chw	Lvg. Chw	Ent CW	Lvg. CW	Demand	Capacity
System	Upset	Loset	VSP	Load Limit	Tdiff	Index
Comments:						
CHW P Drop		CW P Drop				

IIIMULTISTACK Chiller Daily Log Sheet

Job Name:						
Job Number:						
Module Serial Numbers:						
Date:						
	Status	Suct. Press	Head Press	Suct. Temp	LoChw Temp	Fault (if any)
Comp #1						
Comp #2						
Comp #3						
Comp #4						
Comp #5						
Comp #6						
Comp #7						
Comp #8						
Comp #9						
Comp #10						
Comp # 11						
Comp #12						
System	Ent. Chw	Lvg. Chw	Ent CW	Lvg. CW	Demand	Capacity
System	Upset	Loset	VSP	Load Limit	Tdiff	Index
Comments:						
CHW P Drop		CW P Drop				

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MS-IOM-001 0317
Supersedes MS-IOM-001 0117
FWB