

MULTISTACK[®]

Originators. Innovators. Never the Imitators.SM



Water Cooled Centrifugal Chiller

Product Data Catalog for MS-80T1



Made in U.S.A.





Cutting Edge Compressor Technology

- MagLev™; magnetic levitation
- Oil Free design
- Quieter than typical background noise
- Soft start; pulls only 2 amps at 460V
- Superior part load efficiency
- Integrated VFD control
- Uses environmentally friendly R-134A refrigerant

Superior Dependability

- Multiple independent systems for redundancy
- Comprehensive computer monitoring
- Automatic lead-lag
- Automatic fault recording

Easy Installation

- Compact modules fit through most doorways and into freight elevators
- Modules connect quickly and easily
- Factory charged and run tested
- Micro refrigerant charge compliant with ASHRAE 15 in most cases

High Flexibility

- Service can be performed on a convenient, non-emergency basis
- Install only the capacity required at the time
- Operates only the capacity required by the load
- Integrates fully with building management through BACnet®, ModBus®, N2, or LON

GENERAL DATA PER MODULE		
MODEL	MS-80T1	
Capacity (kW)	281.3	
Power Input (kW)	56	
COP (W/W)	5.02	
NPLV (W/W)	7.90	
Compressor	Type	MagLev™ Centrifugal
	Dry weight (kg)	120
	Quantity	1
Evaporator	Type	Brazed Plate
	Weight (kg)	189
	Water Storage (L)	43.53
	Quantity	1
	Water Pressure Drop (kPa)	31
	Header System (L)	57.16
	Flow Rate (L/s)	12.2
Condenser	Type	Brazed Plate
	Weight (kg)	220
	Water storage (L)	47.7
	Quantity	1
	Water Pressure Drop (kPa)	54
	Header System (L)	57.16
	Flow Rate (L/s)	14.6
Refrigerant Type	R-134A	
Refrigerant Charge (kg./circuit)	20.41	
Number of Circuits	1	
Operating Weights (kg.)	1,203	
Shipping Weight (kg.)	996	

Nominal Values based on:

- Chilled Water Leaving Temp. 7°C
- Chilled Water Entering Temp. 12.5°C
- Condenser Water Leaving Temp. 35°C
- Condenser Water Entering Temp. 29.5°C

Note:

- Minimum Chilled Leaving Water Temp. 4°
- Maximum Chilled Leaving Water Temp. 45°C

For selection outside nominated values contact Multistack Ltd.

Figure 1: Performance Adjustment Factor

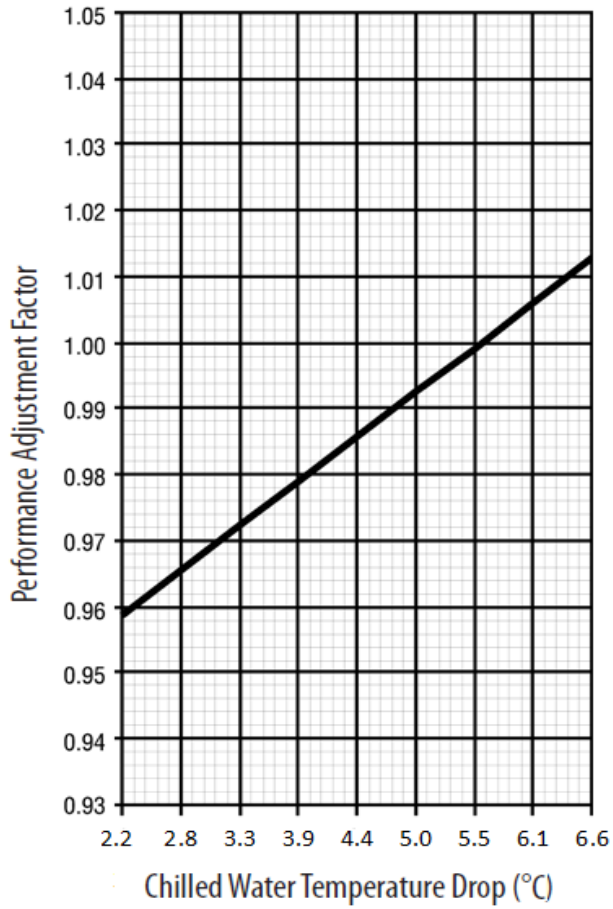
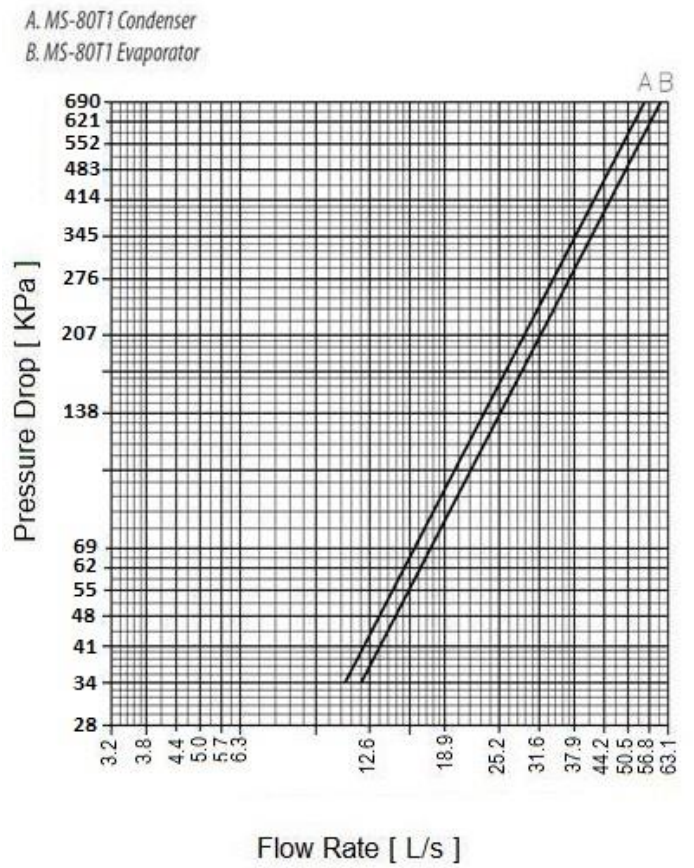


Figure 2: Water Pressure Drop



Selection

To select a MULTISTACK MS-80T1 Centrifugal Water Cooled Chiller, the following information is requested:

1. Capacity in kW.
2. Chilled water temperature drop.
3. Leaving chilled water temperature.
4. Entering condenser water temperature.

Capacity Tables

Capacity tables are based on a 5.5°C temperature drop through the evaporator and a capacity of 281.3kW at all chilled and condenser water temperatures. The module is optimized to provide 281.3kW at the maximum efficiency. If the system load is less than 281.3kW, the chiller will unload to provide the smaller required capacity at a theoretically higher efficiency. For other than 5.5°C temperature drop, apply the respective performance adjustment factors from Figure 1 to determine the theoretical improvements resulting from a broader temperature difference.

Water Flow Rates

Evaporator water flow can be determined as follows:

$$\text{Flow Rate (L/s)} = 0.2392 \times [\text{CAP (kW)}/\text{Temperature Drop (}^{\circ}\text{C)}]$$

Condenser water flow should always be determined using a 5.5°C temperature rise as follows:

$$\text{Flow Rate (L/s)} = 0.04305 \times \text{CAP} + 0.04315 \times \text{Compressor Input}$$

Waterside Pressure Drop

Evaporator and condenser waterside pressure drops are provided in Figure 2. To use Figure 2, divide the total water L/s by the number of modules in the chiller.

Chilled Water Selection

Example: System Capacity = 1583kW. Chilled water drop of 6.67°C. Leaving water temperature of 7.5°C. Entering condensed water temperature of 29.5°C.

1. Use Figure 1 adjustment factor to convert capacity to load at 5.5°C. Hence Adjustment factor is 1.012
Capacity = $1583/1.012 = 1564$ kW
2. Select the appropriate performance table based on module to be used. Read the Capacity and Compressor Input of a single module at the water temperature specified.
Capacity = 281.3 kW, Input = 53.6 kW
3. To find the number of modules required, divide equivalent capacity required at 5.5°C temperature drop by single module capacity from table:
Modules required = $1564/281.3 = 5.6$ or 6 modules
Chiller capacity = $(281.3)(6) = 1687.8$ kW
Power input = $(53.6)(6) = 321.6$ kW
4. At 6.67°C evaporator temperature drop, applying Figure 1 performance adjustment factors result in:
Capacity = $(1687.8)(1.012) = 1708.1$ kW vs. system load
5. To determine evaporator and condenser water pressure drops, first determine GPM:
Evaporator
Flow Rate = $0.2392 \times 1708.1 \text{ kW} / 6.67^{\circ}\text{C} = 61.28$ L/s

Condenser

$$\text{Flow Rate} = 0.04305 \times 1708.1 \text{ kW} + 0.04315 \times 321.6 \text{ kW}$$

$$= 87.41 \text{ L/s}$$

6. With a six-module chiller, evaporator and condenser pressure drops are read from Figure 2 as follows:

$$\text{Evaporator} = (\text{L/s})/\text{module} = 61.28/6 = 10.21 \text{ L/s}$$

$$\text{Pressure drop} = 12.85 \text{ kPa}$$

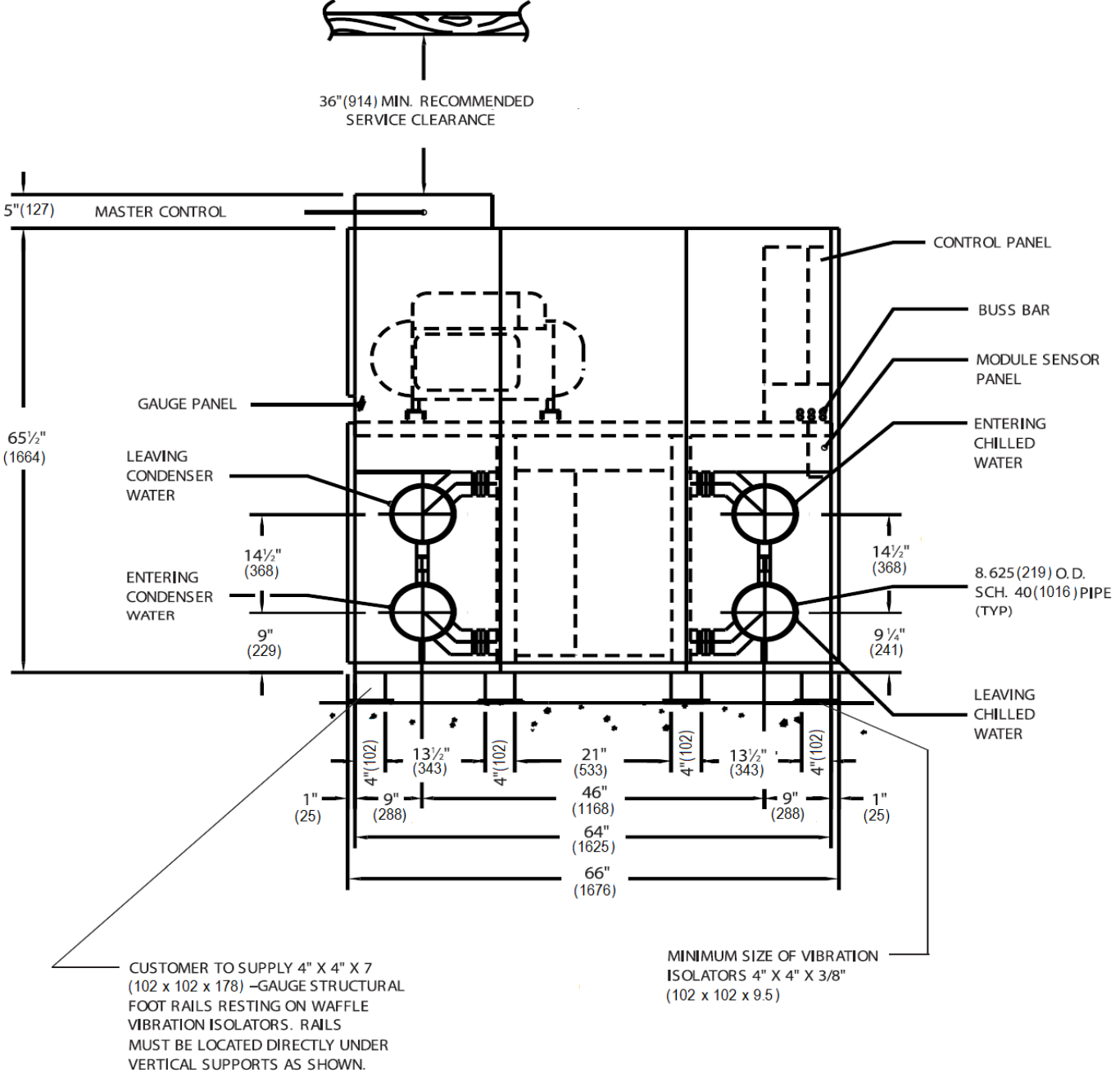
$$\text{Condenser} = (\text{L/s})/\text{module} = 87.41/6 = 14.57 \text{ L/s}$$

$$\text{Pressure drop} = 21.52 \text{ kPa}$$

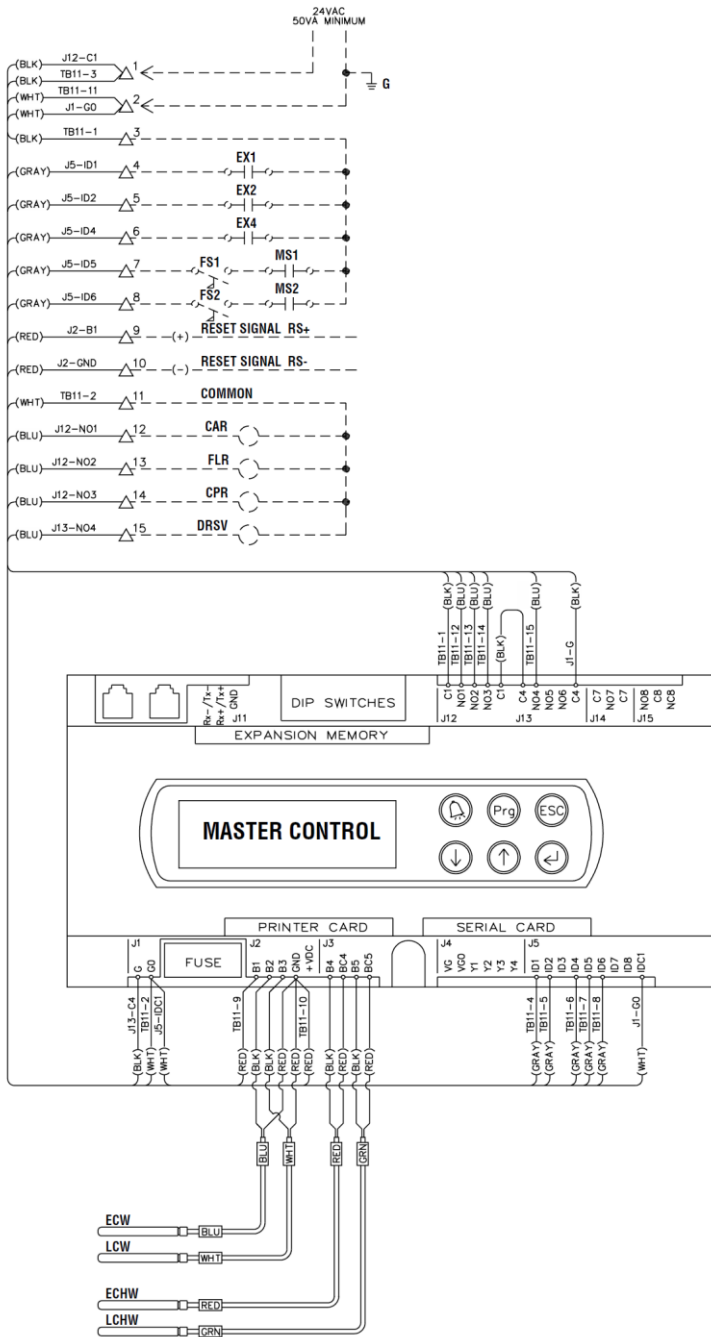
Note: The above calculations represent theoretical changes in performance based on well-established empirical data. In reality, these calculated points may never be observed in operation since the MS-80T1 will modulate to meet the required capacity and achieve its leaving chilled water set point.

MULTISTACK WATER COOLED CENTRIFUGAL
CHILLER

End Elevation



Note: Bracketed Dimensions provided in mm



System Wire and Fuse Sizing

Model No.	Volts/Hz/PH	CAP (kW)	Compressor	
			RLA (A)	LRA (A)
MS-80T1	460/60/3	281.3	96	132
MS-80T1	400/50/3	281.3	110	145

CAP: Capacity

RLA: Rating Load Amperage

LRA: Locked Rotor Amperage

Wiring Sizing

MCA=minimum circuit ampacity
 $MCA = (1.25 \times RLA1^*) + RLA2 + RLA3$

Fuse Sizing

MF = maximum fuse size
 $MF = (2.25 \times RLA1^*) + RLA2 + RLA3$

Notes:

- *RLA1 = RLA of the largest motor in the system. RLA2 & RLA3 = RLA of other motors in the system.
- Wire sizing is based on National Electrical Code (NEC) rating for 75°C wire, with 3 wires per conduit.
- Wiring distance from branch circuit shall not exceed 100 feet (30,480mm).

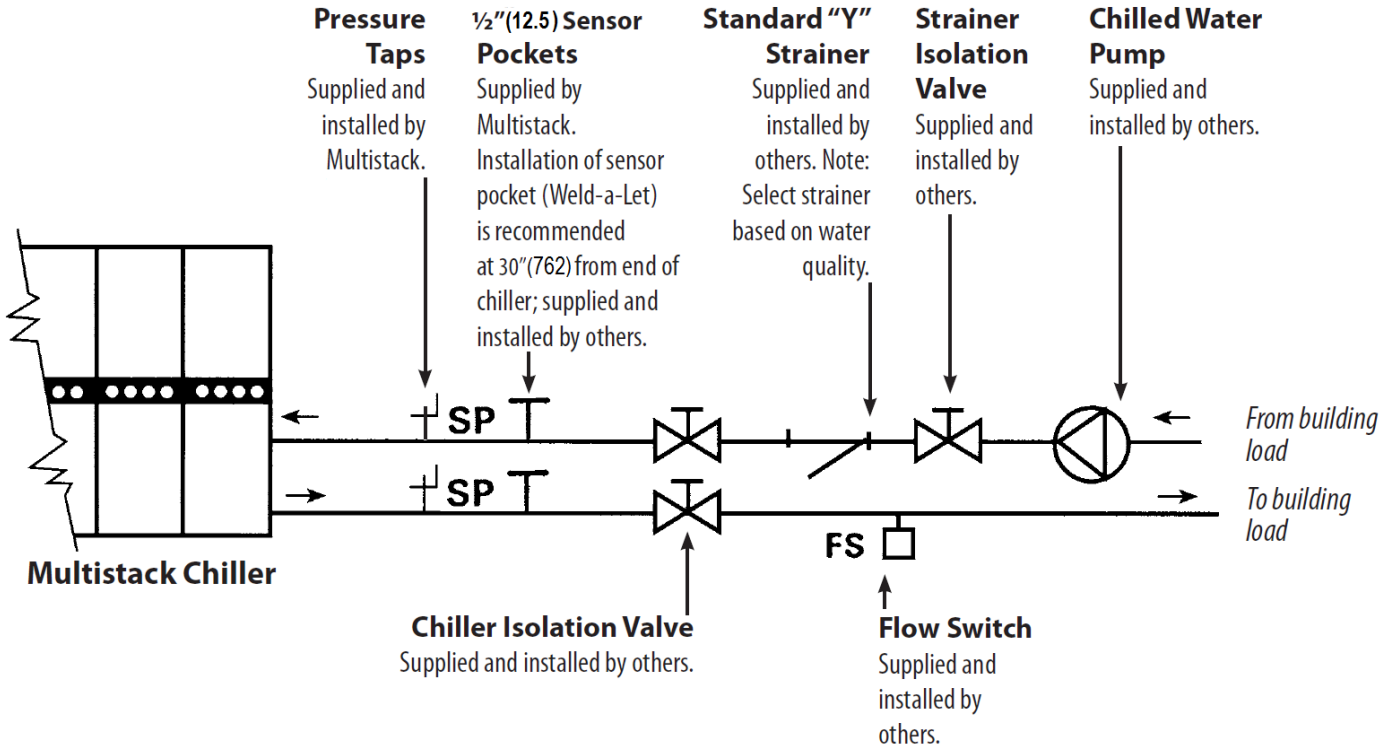
LEGEND

- Components and wiring by others. (18 AWG Min. wire).
- Inputs to terminals 4 through 8 of TB11 must be wired closed if not used.
- External inputs (Closed to operate).
 EX1 Manual reset required 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).
- External outputs.
 CAR Customer alarm relay (24 VAC, 5 VA max).
 CPR Condenser pump relay (24 VAC, 5 VA max).
 FLR Full load relay (24 VAC, 5 VA max).
 DRSV Debris removal solenoid valve (24 VAC, 6 W, 16VA)
 Max of (2) DRSV in this circuit.
- Sensor Inputs
 ECW Entering condenser water.
 LCW Leaving condenser water.
 ECHW Entering chilled water.
 LCHW Leaving chilled water.

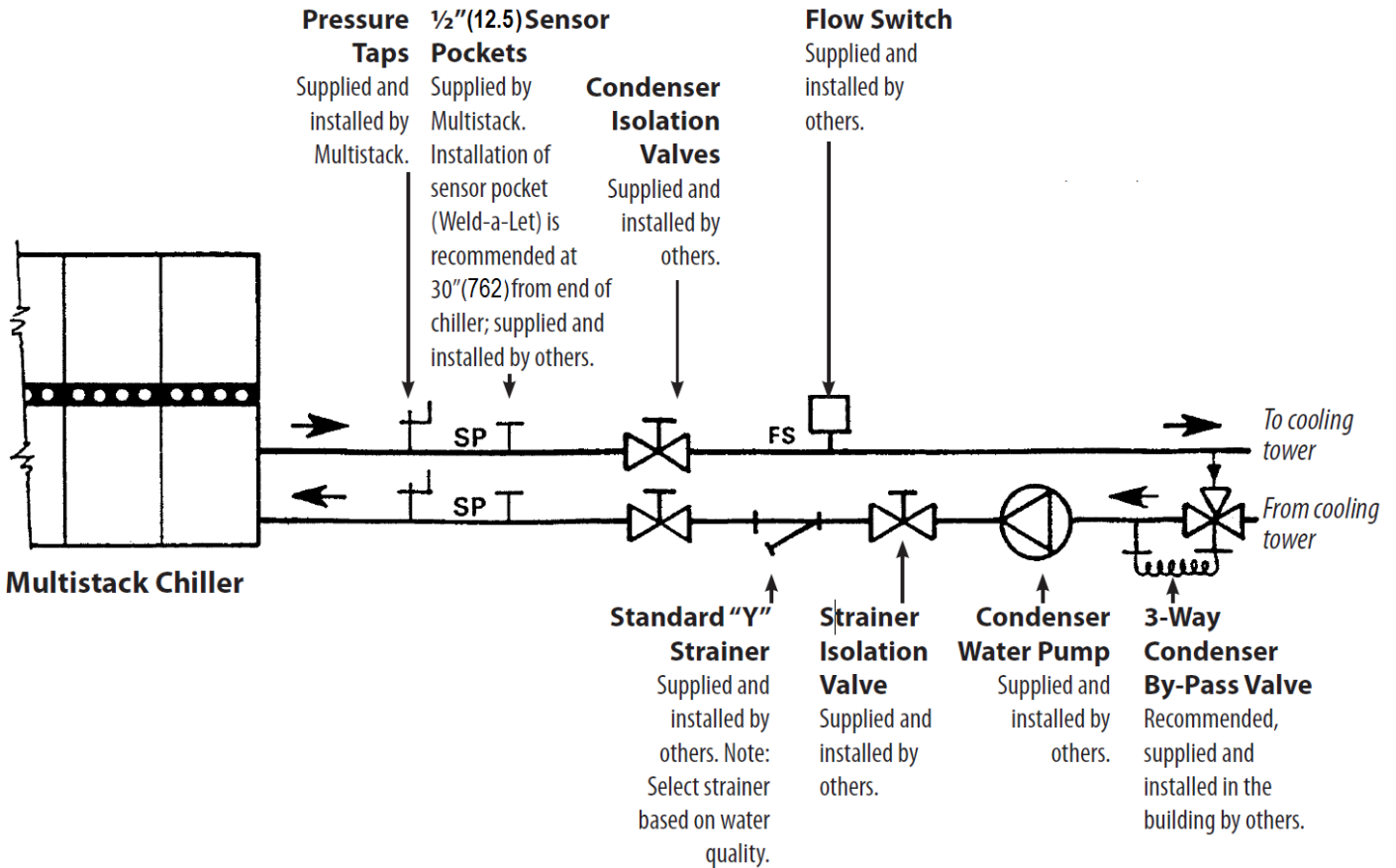
For additional information, see installation manual and master control user manual.

MCA	3 Conductor 1 Conduit	6 Conductor 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

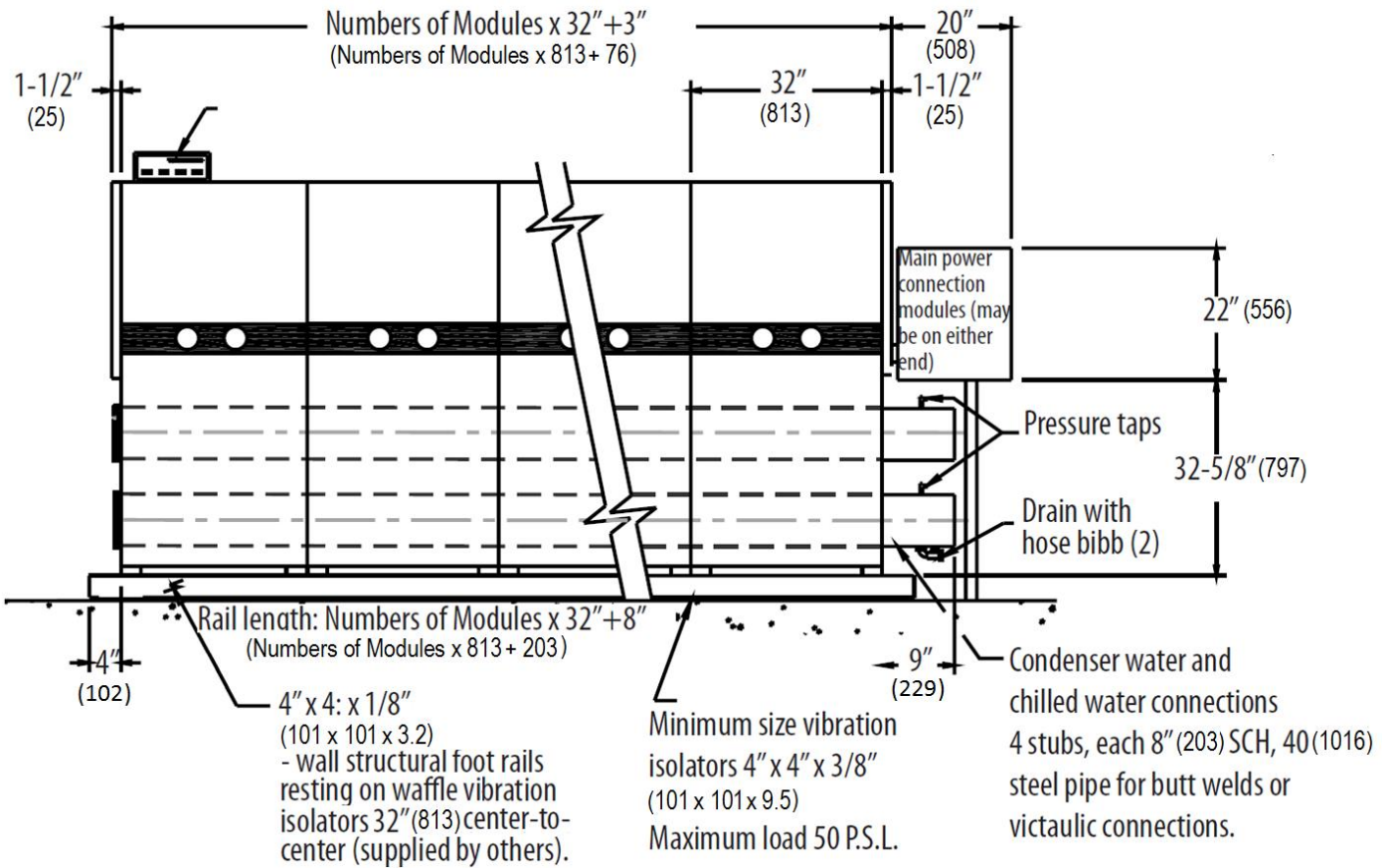
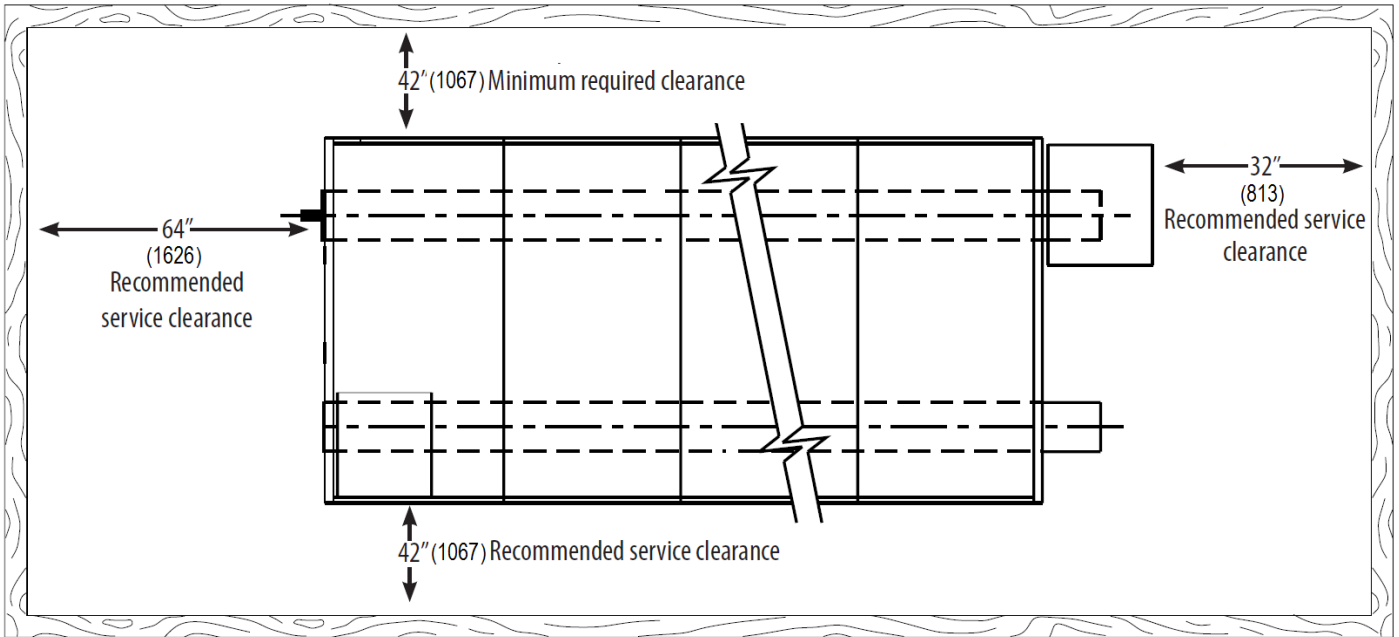
Required Chilled Water Piping



Condenser Schematic with Head Pressure Control



Note: Bracketed Dimensions provided in mm



Note: Bracketed Dimensions provided in mm

System Description

Chiller shall incorporate two stage centrifugal Compressor with magnetic bearings and consist of single 281.3 kW refrigerant circuits. Each refrigerant circuit shall consist of an individual compressor, condenser, evaporator, electronic expansion valve, and control system. Each circuit shall be constructed to be independent of other circuits from a refrigeration and electrical standpoint. The chiller system 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 24.95 kg. of refrigerant.

General

1. Chiller Modules shall be ETL/US listed in accordance with UL Standard 1995, CSA Standard C22.2#236, and bear the ASME UM stamp on all heat exchangers.
2. Modules shall ship wired and charged with refrigerant. All modules shall be factory run tested prior to shipment.
3. Compressors, heat exchangers, piping and controls shall be mounted on a heavy gauge steel frame. Electrical controls, and associated components for each module shall be mounted within that module.

Chilled and Condenser Water Mains

Each module shall include supply and return mains for both chilled and condenser water. Grooved end connections are provided for interconnection to eight inch standard (219 mm outside diameter) piping with Victaulic type couplings.

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 ASME code for 2068 kPa working pressure on the evaporator and 2482 kPa working pressure on the condenser. 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.

Compressor

1. Unit shall have a direct drive oil-free two-stage semi hermetic centrifugal compressor complete with an active / passive magnetic bearing system. Casing shall be constructed from aluminium and shall not weigh more than 136.1 kg each. The electronic soft starters, compressor controls, inverter power electronics, bearing and motor control shall be fully integrated into the compressor and shall be digitally controlled. The magnetic bearing system must be fully protected in the case of a power outage with its own inbuilt power generation system.
2. The impeller shall be statically and dynamically balanced. The compressor shall be vibration tested and not exceed a level of 0.14 IPS.
3. The capacity control should primarily be achieved by varying the compressors operating speed and a movable inlet guide vane shall only be used in the case of a surge or choke condition arising during normal operation. The moveable inlet guide vane shall be of the electromechanical type.
4. Bearing System: The compressor shall use an oil-free bearing system of the digitally controlled homo-pole magnetic bearing type. The bearings shall have an fully integrated back up bearing system and shall have a self-generating power

system so that the bearings shall be able to stay levitated in the case of a power failure. No sump heater is to be required. The bearing system shall use no more than 500 watts of energy during its normal operation and it must also have an auto balance capability in the case of any external vibration or out of balance event occurring.

5. Prime Mover: A direct drive synchronous permanent magnet brushless DC motor of the hermetic type of sufficient size to efficiently fulfill compressor horsepower requirements. Motor shall be liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase.
6. Motor Starter: The main motor starter is to be fully integrated into the compressor and shall be of the softstart type with a maximum starting current of 20% of the full load current of the compressor. It must be fully integrated with the motors variable speed control system and it must be factory tested during the run test of the unit.
7. Variable Frequency Drive: The chiller shall be equipped with a fully integrated Variable Frequency Drive (VFD) to automatically regulate compressor speed in response to cooling load and compressor pressure lift. The chiller control shall coordinate compressor speed and guide vane position to optimize chiller efficiency.
 - a. Digital regulator shall provide V/Hz control.
 - b. The VFD shall have 110% continuous overload of continuous amp rating with no time limit, PWM (pulse width modulated output, IGBT (insulated gate bipolar transistors) power technology, full power rating at 2 kHz, DC bus inductor (choke), and wireless construction. The inverter unit shall be refrigerant cooled and shall be fully integrated into the compressor package.

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 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. Each module shall have a dedicated sub-controller and handoff/ auto switch such that in the event of loss of communications with the master controller, each module is capable of operating independently to meet chilled water load.

Power Connections

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. Cooling Alarm

Additionally, chiller shall be integrateable with building management systems through BacNet®, ModBus®, N2, or LON.

Inlet Headers

Each inlet header shall incorporate a built in 30-mesh in-line strainer system to prevent heat exchanger fouling. This system shall include an automatic self-cleaning debris blow down system (MultiFlush™) for on-line cleaning of the in-line strainers

Master Controller

Stages and monitors the status of up to 8 modules. Provides interface with all system variables and set points.

LCD Display

4X20 character backlit LCD displays system and chiller variables. A complete picture of both compressor and chiller system performance is available at the display. This includes but is not limited to refrigerant temperatures and pressures, water temperatures, compressor speeds (actual and desired), detailed fault information, compressor run hours, and theoretical system capacity.



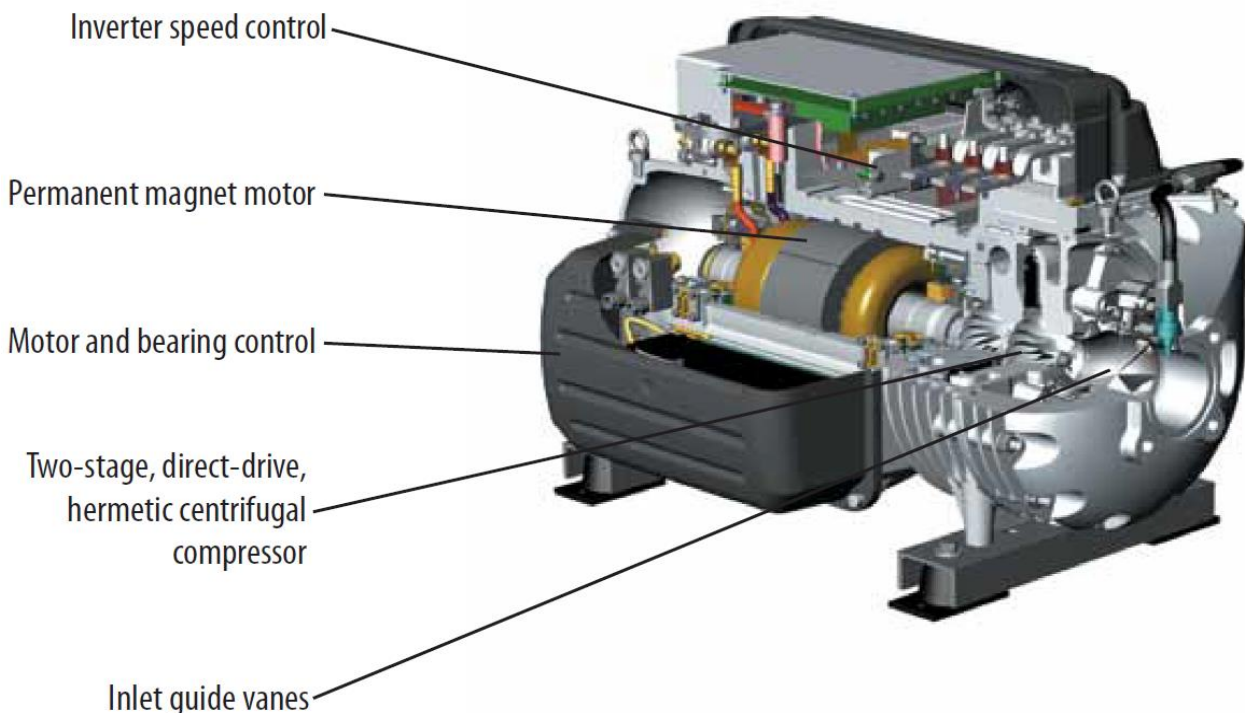
System Interface Portal

Integrates chiller with building management system through BacNet®, ModBus®, N2, or LON.

Module Controller and Hand-Off/Auto Control

Receives direction from the master controller and provides the capability of standalone operation if the master controller fails or if communication with the master controller is lost. Each module controller communicates directly with its module's MagLev™ compressor through ModBus® providing a more redundant means of multiple compressor control.

MagLev. Compressor





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Since MULTISTACK INTERNATIONAL LIMITED has a policy of continuous product improvement,
it reserves the right to change design and specification without notice.

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