Engineering Manual

MCW / MCR

Modular Chillers

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Introduction

This Engineering Manual covers the Creotech Industries Inc. modular line of dependable, cost effective modular chillers. The MTW water-cooled and MTR remote air-cooled chillers range in size from 20 to 60 nominal tons each, and can operate alone or in combination with other chiller modules to increase cooling capacity as needed.

The MTW and MTR models use tandem Copeland Compliant Scroll compressors using R-410A refrigerant. The design incorporates brazed plate evaporators and brazed plate condensers (in the case of water-cooled units) and state-of-the-art control system to provide ease of use, operating efficiency and reliability in an expandable, modular configuration.

This engineering manual is designed for the design professional, contractor or facilities manager, and is intended to provide the information necessary to develop an expandable, reliable cooling system. The modular nature of the MTW and MTR chiller line allows for better full load efficiencies, (n+1) redundancy and the ability to service modules while under load and operating conditions.

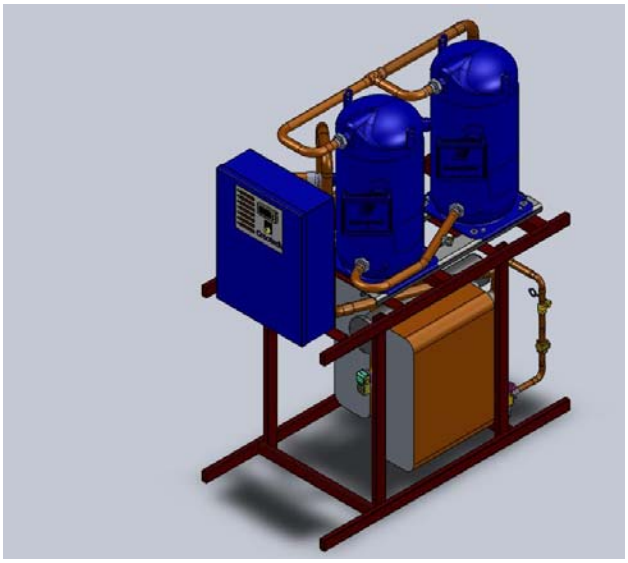
The following sections have been created to assist and guide the cooling design professional with the selection of the appropriate chiller and system design solution, but on occasion there may be questions or concerns.

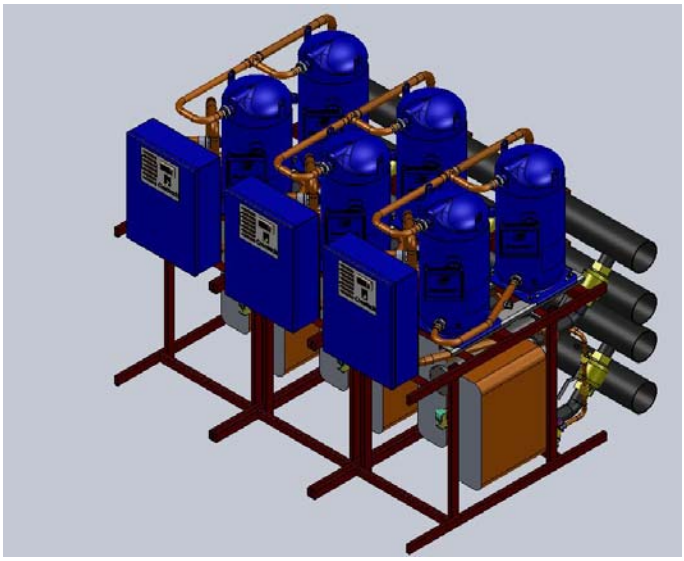
If such a situation arises, please contact us in one of the following ways:

1. Our web site on the World-Wide-Web
   http://www.creotechind.com

2. By Email
   sales@creotechind.com

3. Telephone or Fax
   Telephone: (866) 303-1647
   Fax: (647) 258-9661



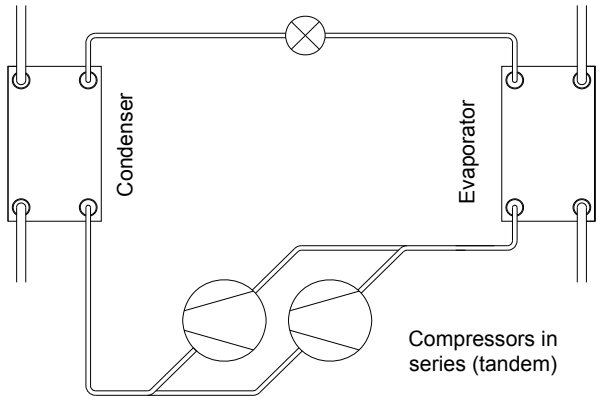


Unit Description

Standard Configuration

The Creotech water chillers are completely factory assembled, piped, wired and shipped in one piece, ready for field connection of power and water piping (refrigerant piping connections required on remote condenser models). Each modular chiller consists of at least two compressors connected in tandem, an insulated brazed plate evaporator and a centralized electrical control panel containing all necessary equipment protection and operating controls. The MTW modular chillers come complete with installed, water-cooled condensers. The MTR remote air-cooled modular chillers can be provided with an optional air-cooled condensers that is sized to the chiller unit ‘s capacity. This condenser is shipped separately for field location and installation.

CreoTech modular chillers are design as compact as possible without sacrificing access to serviceable components, and as a result, have small foot-prints thereby allowing the units to be located in almost any location.



All CreoTech MTW and MTR chillers are designed to ASHRAE 90-1 2004 IPLV efficiency levels.

Standard Equipment

CreoTech modular chillers are built and tested with the following standard equipment:

- Epoxy coated rugged fabricated metal base.
- Tandem Scroll Compressor, c/w:
  - Hi/Lo pressure ports
  - Crankcase Heater
  - Rubber isolation mounts
  - Unitary frame for Tandem compressors
  - Manifold pipe for Tandem compressors
- Liquid line solenoid & ball valve
- Sealed filter-drier
- Liquid Line Site Glass
- Thermal Expansion Valve
- Brazed-Plate Heat Exchanger Evaporator (and water-cooled condenser)
- Insulated Suction Line
- Remote MTR Units also include:
  - Discharge Check Valve
  - Refrigerant Isolation Valves

Standard Electrical Controls

- Component over current protection
- Hi/Lo pressure switches
- Freeze stat
- Flow Switch (Evaporator and Condenser—water-cooled)
- Anti-cycling
- Compressor rotation (FI/FO)
- Dry Contacts for Evaporator Pump and either Condenser Pump or AC Condenser
- Remote Alarm Contact.
-

Refrigerant

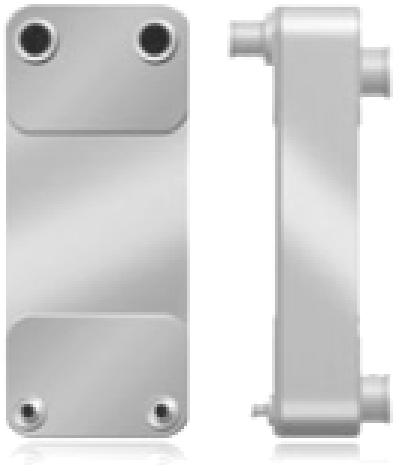
The MTW and MTR modular chillers utilize R-410A refrigerant[i]; environmentally friendly with no phase-out date.

Unit Description (cont'd)

Evaporator & Water-Cooled Condensers

The evaporator and water-cooled condenser are compact, high efficiency, brazed-plate type heat exchangers consisting of parallel stainless steel plates, with a design pressure of 630psig.

They are designed and constructed according to, and listed by, Underwriters Laboratories (UL). They are complete with vent and drain connections for proper priming and drainage of water lines.



Condensers are designed and constructed according to, and listed by, Underwriters Laboratories (UL). They are complete with vent and drain connections for proper priming and drainage of water lines.

Compressor

The scroll compressors are configured in a single circuit, tandem arrangement (i.e. two compressors in series in one refrigerant circuit).. These rugged hermetic compressors are constructed with an integral cast iron frame, cast iron scrolls, three Teflon® impregnated bearings, and three oil filtration devices for each compressor.

Using scroll tandems provides two steps of capacity modulation. Either compressor can run, depending on the load of the system, resulting in excellent part-load efficiency. Each tandem refrigerant circuit has specially designed oil and gas equalization lines to control oil migration.

This well protected compressor includes a solid-state motor protection module, 4 individual motor-winding sensors, a patented internal discharge temperature sensor, and a patented shutdown feature that prevents reverse rotation. An internal discharge check valve helps prevent shutdown noise and comes standard with high and low pressure taps with Schrader valves, a sight glass and an off cycle crankcase heater.

Units are available in 60-hertz with voltages from 208, 460 and 575 volt.

Unit Description (cont'd)

Air-Cooled Condensers

The air-cooled condensers sized for the MTW and MTR units are configures with vertical

discharge fans.

They are packed with features offering tangible benefits to owners, such as:

- A complete range of capacities from 20 to 60 tons
- Circuits sized and matched to chillers
- Direct drive fan motors at 550 & 780 RPM for low sound levels
- A patented floating tube design to eliminate tube sheet leaks
- High efficiency coil and fan motor design
- Internal baffles between all fan cells
- Weatherproof control panel
- G90 painted galvanized steel cabinets
- A single-point power connection
- Independent fusing and contactors for each fan motor
- Integral pre-piped sub-cooler circuit

Refrigerant Line Components

Each chiller's refrigerant circuit has a manual liquid line shutoff valve, solenoid valve, liquid line sight glass/moisture indicator, optional hot-gas bypass solenoid valve, and thermal expansion valve. The MTR chiller models with remote air-cooled condenser can also include an optional head pressure control valve and liquid receiver. As a precaution, a high-side pressure relief valve must be field installed in the discharge line.

Part Load Efficiencies

Part load efficiencies and Integrated Part Load Values (IPLV) for MTW & MTR units are calculated according to the requirements of the latest ARI Standard 550/590-2003 and in reference to ASHRAE Efficiency Standard 90.1. Since most air conditioning systems operate at less than design full load a majority of the time, IPLV is an excellent method for comparing the efficiencies of chillers.

Noise

All Creotech MTW and MTR modular chillers are equipped with hermetic scroll compressors with inherently low sound levels (Please consult "Performance Data" Tables for more specific information).

Electrical Panel

The electrical panel contains a microprocessor controller providing operating and equipment protection controls plus motor starting equipment, factory wired, operationally tested, and ready for operation.

Standard components include control transformer with primary and secondary fusing, microprocessor transformers with integral fusing, compressor contactors, over current protection on the standard single-point wiring arrangement and switches for each circuit, pump-down and unit control power. The control panel has a hinged tool-locked door.

Unit Description (cont'd)

Chiller Unit Controller (Local)

The MTW and MTR modular chiller controller is equipped with a powerful microprocessor and state-of-the art software for precise control. The controller has a range of digital and analog I/O's to support a variety of temperature sensors and actuators. Each chiller module can operate independently with its local controller.

Easy User Interface

The controller features a built-in user interface, allowing the temperature set-points and alarms to be easily monitored and/or adjusted. The integral user interface includes 4 push buttons and an 8 x 22 character LCD touch-screen that allows the display of graphical status and touch control icons.

Standard Display Parameters

In running mode, the controller displays:

- In and out temperatures for both the evaporator and the condenser
- Suction and discharge line refrigerant pressures,
- Chiller run hours
- Historical error log.

Capacity Control

The modular chiller have tandem compressors that can be staged on and off with modulating hot-gas bypass allowing further capacity control. The compressor is allowed a maximum of 6 starts per hour. The compressors on a tandem assembly include compressor rotation based on FIFO functionality.

Chiller Protection

The CreoTech modular chillers are protected by monitoring alarms that shut the unit down in the case of potentially dangerous or damaging operating conditions. These conditions require a physical manual reset. The shut down activates an alarm signal.

Shut Down Alarms

- No evaporator flow
- No condenser flow
- Low refrigerant pressure
- High refrigerant pressure
- Evaporator freeze protection
- Phase voltage protection (optional)

Digital Inputs

- Unit off switch
- Remote On/Off (Optional)
- Flow switch

Digital Outputs

- Shut down alarms
- Evaporator pump
- Condenser pump/or Condenser fan control

Networking (Building Automation)

The local unit controller has the (optional) capability to communicate with a supervisor through a standard RS485 serial line. Several platforms are available such as; SNMP, HTMI, BACnet, Modbus and TCP/IP. Please consult CreoTech Industries for your specific Building Automation System (BAS) requirements

Unit Description (cont'd)

Master Modular Chiller Controller

If more than one CreoTech modular chiller is incorporated into the cooling system, then a MASTER CONTROLLER is required to regulate the system (please see schematic below).

In essence, the Master Controller performs the duties of the "Local" chiller module controller (as outlined in the previous section), but for the WHOLE system. In other words, the Master Controller now becomes the brains for the complete modular chilling system.

Specifically, the Master Controller controls and monitors:

- The whole modular chilling system set-point temperature
- Any alarm conditions (as noted in the previous section) in any of individual chiller modules and notifies operators of that condition. Furthermore, if the alarm condition causes any refrigeration circuit in any chiller module to go OFFLINE, the Master Controller will automatically compensate for the missing module by taking it out of the compressor staging sequence.
- Staging of ALL the compressors in the whole chilling system based on FIFO functionality

As the central controller for the whole chilling system, the Master Controller provides a single, centralized location for the cooling system operator to access all the relevant information for the system.

The Master Controller can display the following:

- (Default) overall operating parameters for the whole chilling system
- Any operating parameters from any of the chiller modules in the cooling system
- Any alarm condition in any module in the system and alert system operators of the condition.
- A historical log of the system operation, including operating for each compressor in the system.

When the Master Controller is running, the individual, local controllers are locked out and display a message referring the operator to the Master Controller. This prevents any communication confusion between the local and master controllers.

Benefits of Modular Chillers

The principle of modular chiller design is that a smaller, individual chiller (a module) can be connected with another, to create a larger chilling system, either initially or over time.

There are numerous advantages of using modular chillers over a large, single chiller:

- **Expandability** - The chilling system can expand over time, thereby allowing the chiller system to grow with the cooling load.
- **Redundancy** - Modular systems allow one to build in redundancy (extra capacity) so that the overall cooling system if not affected when a module is taken out of service if it needs regular service or repair.
- **Better Capacity Control** – With more than one module, and therefore more than one compressor, the modular chiller cooling system can better match the ever-varying cooling load of the system.

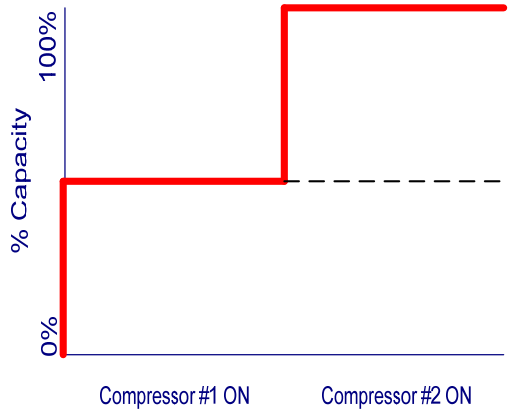
Creotech's modular chiller design maximizes the operating efficiencies through selection of efficient components matched with each compressor model. All MTW and MTR models are single circuited units with compressors mounted in tandem (see Section titled "*Benefits of Tandem Compressors*" for more information). Dual-circuited configurations are available as an option.

The Scroll compressors are the most advanced and reliable type of compressor in the market. All chillers are factory tested for operation and safety controls checked and calibrated.

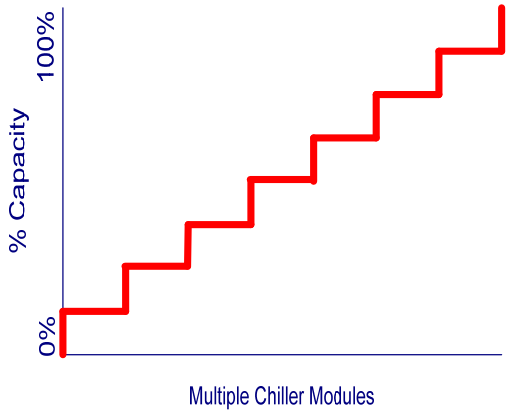
High and low refrigerant pressure switches, low temperature thermostat, flow switches (shipped loose), optional head-pressure control valves, a liquid receiver (optional on remote air-cooled units) and compressor anti-cycling, all provide protection for chiller operation.

The chillers are designed on a single platform where all the components are accessed easily. Standard off-the-shelve components are used to keep both service costs and component delivery times to a minimum.

The MTW and MTR model chillers are constructed and/or rated with ANSI/ASHRAE 15 Safety Code, C-UL approved electrical components, and TSSA approved assembly procedure.



Capacity Control on Single Chiller



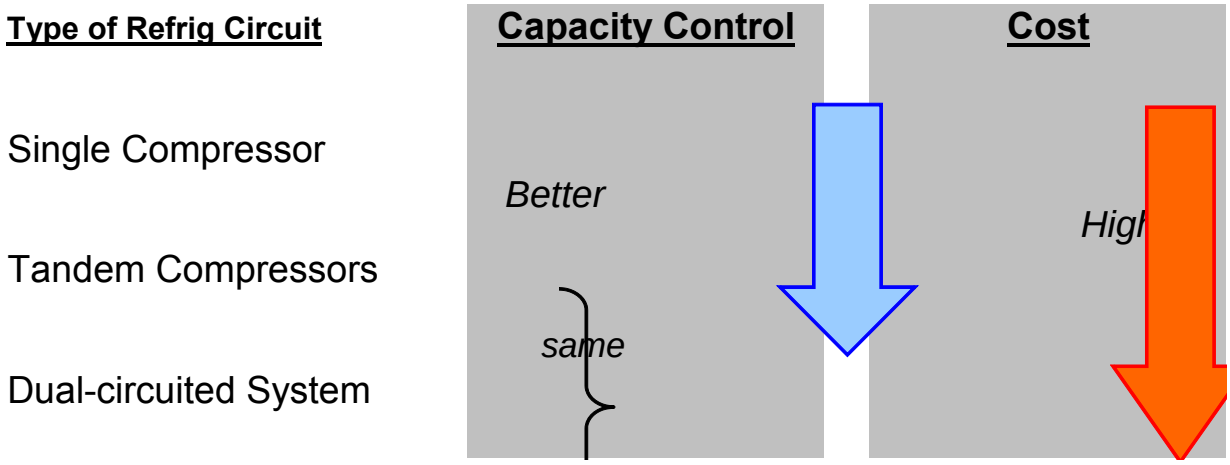
Capacity Control with Multiple Chiller Modules

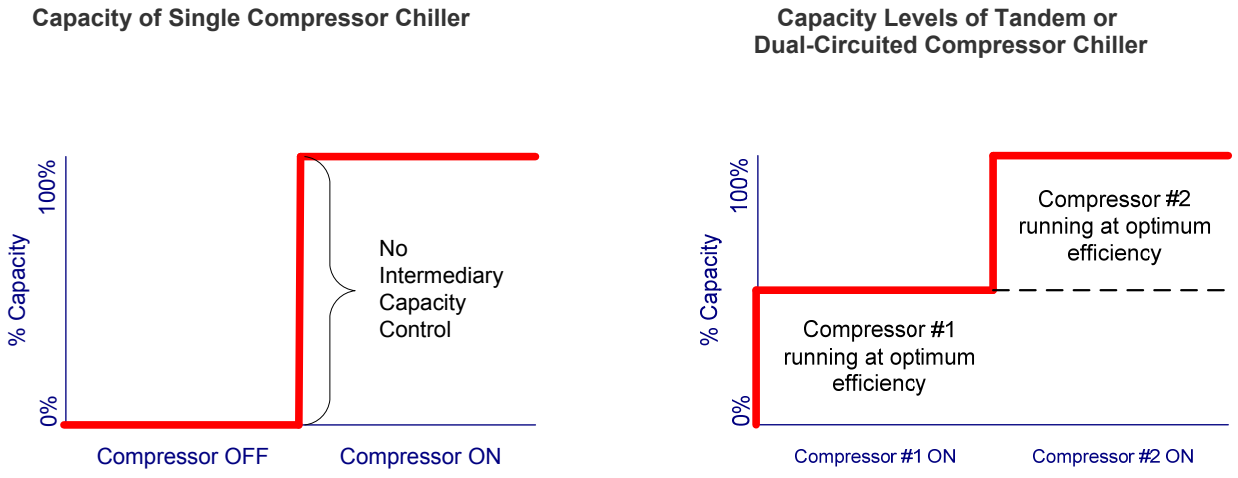
Benefits of a Tandem Compressor Arrangement

There are three (3) practical configurations for designing a refrigerant circuit. Each deals with a different way of configuring the compressor(s) to meet the total required cooling capacity.

They are:

1. **One (1) Single Compressor** - matched to the maximum required cooling load.
2. **Two (2) Compressors in Tandem** - , meaning the compressors are in series in the refrigeration circuit with a total capacity matched to the total cooling load required.
3. **Dual Circuited** - Two (2) compressors, each with their own refrigeration circuit. Both circuits run independently, but in sum, match the total required cooling load. Each of the two refrigeration circuits have duplicate hardware. They simply share a dual-circuited evaporator and use a single, expanded electronic controller. In effect you have two complete refrigeration circuits tied together.





Refrigeration circuits with two compressors have better capacity control

Creotech Benefits – Service While Operating

There are numerous advantages to using a Creotech Industries Inc. modular chiller system:

- **Dependability** – Creotech Modular chillers are built with rugged, tested and durable components. They have been chosen for their proven stamina and longevity in the field.

- **Accessibility** - Creotech modular chillers are designed for easy access to components requiring routine maintenance. Design layout is a high priority in order to limit service labour costs to the end user. Access to components should be easy and simple. For example, refrigerant driers are mounted in the front of the unit. and sight glass and compressor oil levels are easily visible.

- **Service while under full operation** – The Creotech modular chilling system has been specifically design to allow service to any of the major components of any of the individual chiller components, **while the system is under operation**.

Module Removal While Operating

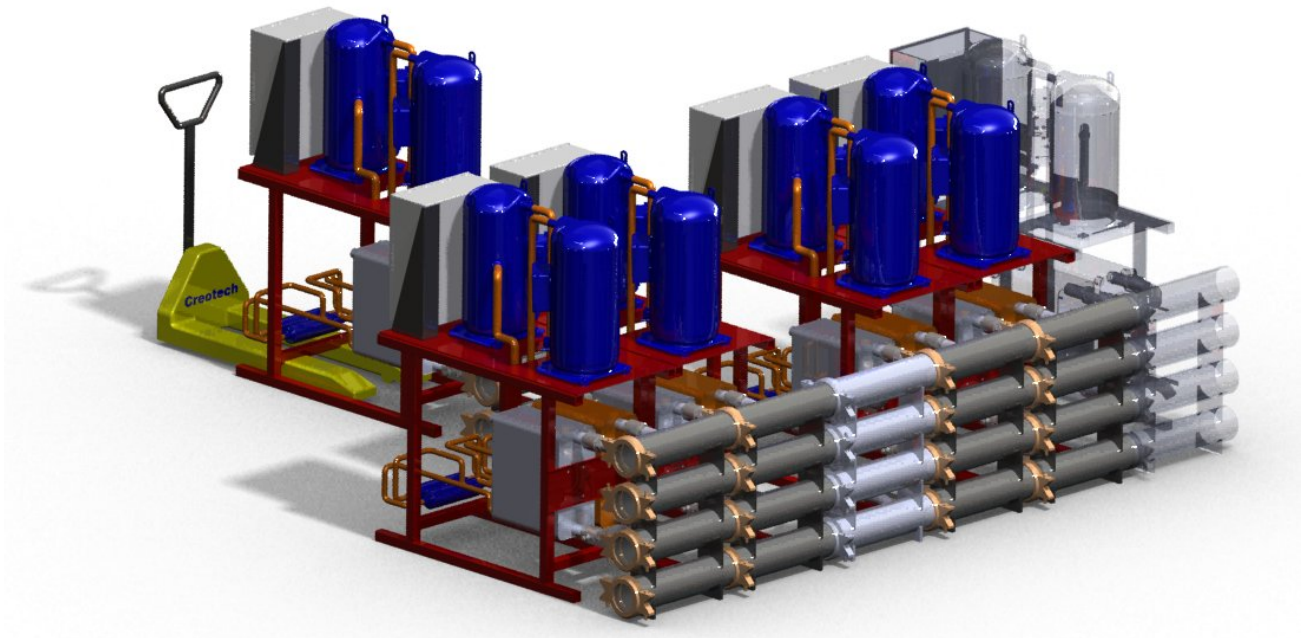
Creotech modular chillers were specifically designed to be removable for complete access service, even while the modular system continues to cool. This is how:

Piping - Each module is connected to the pipe header assembly by rubber couplings via isolation valves. The isolation valves are closed, the module is drained of water via a ½" low-point drain valve.

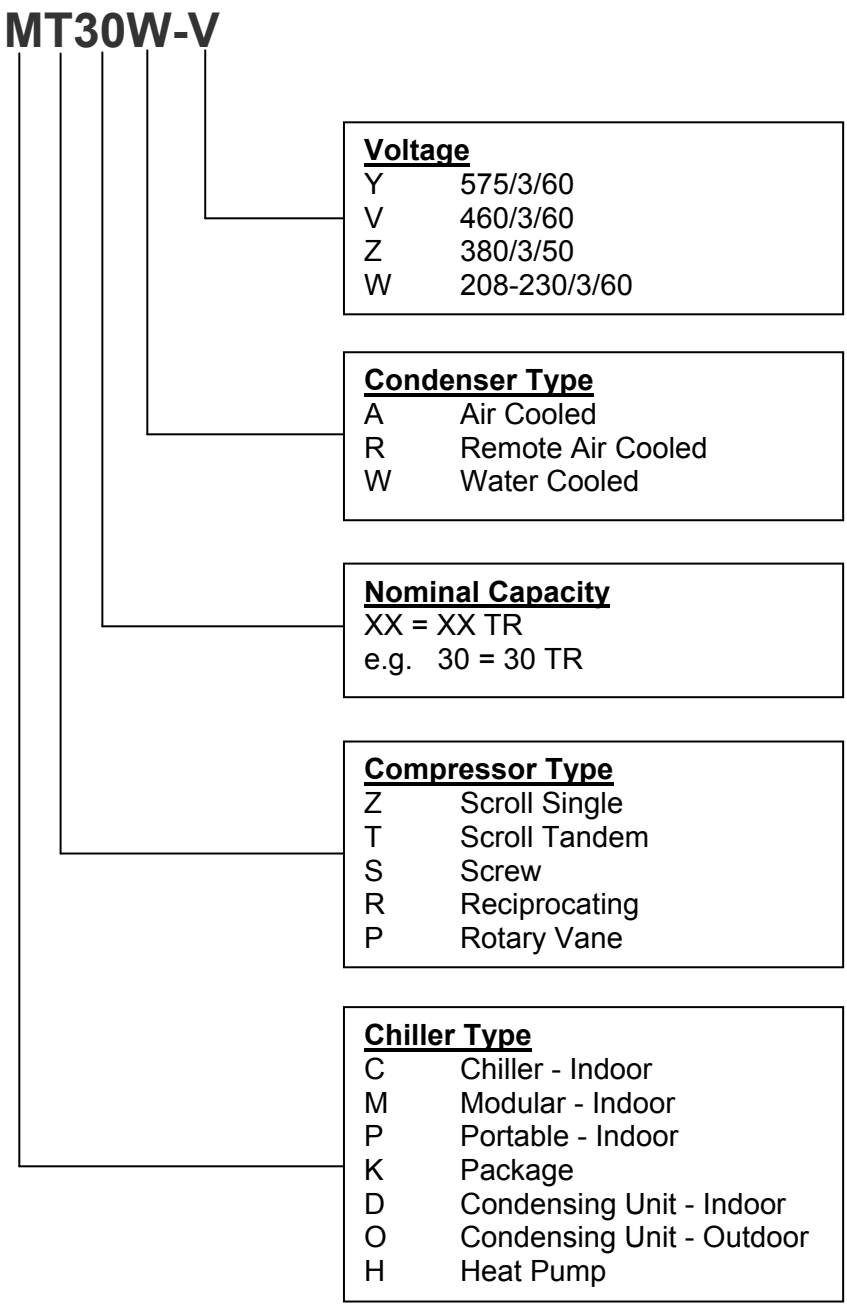
Electrical – Shut the power disconnect to the unit and disconnect the power lines from the terminal block in the electrical cabinet.

Controls – The modular unit to be serviced is taken offline on the master controller and the control lines are disconnected from the control, terminal block. The master controller takes into account the time the serviced unit has been offline.

Removal – Once the anchor bolts are removed, the modular chiller can be slide out of position with the use of a simple hand pump-lift.



Chiller / Heat Pump Model Number Nomenclature



Model MTW - Water-Cooled Tandem Modular Chiller

Model			MCT20W	MCT30W	MCT40W	MCT50W	MCT60W
Nominal Tonnage			20T	30T	40T	50T	60T
Capacity	kBtu/hr. (kW)		261 (77)	380 (111)	488 (143)	615 (180)	788 (231)
THR	kBtu/hr. (kW)		315 (92)	462 (135)	593 (174)	748 (219)	961 (282)
Input Power	kW		15.8	24.0	30.8	39.2	50.9
EER			16.50	15.80	15.80	15.70	15.50
IPLV			20.2	19.3	19.9	19.4	19.5
MCA	Amps	575/3/60	32.2	59.4	61.7	87.1	123.8
Evaporator	flow	Usgpm (l/s)	52.3 (13.8)	75.8 (20)	97.4 (25.7)	122.9 (32.5)	157.4 (41.6)
	pres.	psi (kPa)	4 (27.6)	4.2 (29)	4.5 (31)	4.7 (32.4)	5.9 (40.7)
	header connection		6"	6"	6"	6"	6"
Condenser	flow	Usgpm (l/s)	63.1 (16.7)	92.3 (24.4)	118.6 (31.3)	149.7 (39.5)	192.3 (50.8)
	pres.	psi (kPa)	1.6 (11)	1.8 (12.4)	2.2 (15.2)	2.7 (18.6)	4 (27.6)
	header connection		6"	6"	6"	6"	6"
Sound	average	dBa	79	82	87	90	89
	maximum	dBa	84	87	92	95	94
Weight	weight	lbs. (kg)	920 (420)	1020 (460)	1440 (650)	1550 (700)	1710 (780)
Unit Size	length	in. (mm)	52" (1321)	52" (1321)	52" (1321)	52" (1321)	52" (1321)
	width	in. (mm)	26" (660)	26" (660)	26" (660)	26" (660)	26" (660)
	height	in. (mm)	74.5" (1890)	74.5" (1890)	74.5" (1890)	74.5" (1890)	74.5" (1890)

NOTE: Operating conditions for chiller: 44°F/54°F circulating water temperature; 85°F/95°F condenser water temperature.

Model MTR - Remote Air-Cooled Tandem Modular Chiller

Model			MCT20R	MCT30R	MCT40R	MCT50R	MCT60R
Nominal Tonnage			20T	30T	40T	50T	60T
Capacity	kBtu/hr. (kW)		239 (70)	350 (103)	447 (131)	565 (166)	725 (212)
THR	kBtu/hr. (kW)		302 (89)	444 (130)	567 (166)	719 (211)	924 (271)
Input Power	kW		18.4	27.5	35.1	45.0	58.4
EER			13.0	12.7	12.7	12.6	12.4
IPLV			18.5	17.8	18.1	17.8	17.5
MCA	Amps	575/3/60	32.2	59.4	61.7	87.1	123.8
Evaporator	flow	Usgpm (l/s)	47.8 (12.6)	70.1 (18.5)	89.3 (23.6)	113 (29.9)	145 (38.3)
	pres.	psi (kPa)	3.3 (22.8)	3.6 (24.8)	3.7 (25.5)	3.9 (26.9)	5 (34.5)
	header connection		6"	6"	6"	6"	6"
Condenser Line Sizes * (ODS,ACR)	discharge line		3/4"	3/4"	7/8"	7/8"	7/8"
	liquid line		1/2"	1/2"	1/2"	5/8"	5/8"
Sound	average	dBa	79	82	87	90	89
	maximum	dBa	84	87	92	95	94
Weight	weight	lbs. (kg)	790 (360)	840 (380)	1230 (560)	1320 (600)	1430 (650)
.Unit Size	length	in. (mm)	52" (1321)	52" (1321)	52" (1321)	52" (1321)	52" (1321)
	width	in. (mm)	26" (660)	26" (660)	26" (660)	26" (660)	26" (660)
	height	in. (mm)	74.5" (1890)	74.5" (1890)	74.5" (1890)	74.5" (1890)	74.5" (1890)

NOTE: Operating conditions for chiller: 44°F/54°F circulating water temperature; 115°F saturated discharge temperature.

Performance Data - MCTW

Performance data for the Tandem series chillers with a water-cooled condenser.

MCT20W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	21.3	14.2	18.0	305	20.3	15.8	15.4	297	19.0	17.8	12.8	289
42 ºF	22.1	14.3	18.5	314	21.0	15.8	16.0	306	19.8	17.8	13.3	298
44 ºF	22.8	14.3	19.2	323	21.8	15.8	16.5	315	20.5	17.8	13.8	307
46 ºF	23.6	14.4	19.7	332	22.6	15.9	17.0	325	21.3	17.9	14.3	317
48 ºF	24.4	14.4	20.3	342	23.3	15.9	17.6	334	22.1	17.9	14.8	326
50 ºF	25.2	14.4	21.0	352	24.1	16.0	18.1	344	22.8	18.0	15.2	336

MCT30W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	30.8	21.6	17.1	444	29.5	23.8	14.9	435	27.9	26.5	12.6	425
42 ºF	32.0	21.7	17.7	458	30.5	23.9	15.3	448	28.9	26.5	13.1	438
44 ºF	33.1	21.8	18.2	471	31.6	24.0	15.8	462	30.0	26.6	13.5	451
46 ºF	34.2	22.0	18.7	486	32.8	24.2	16.2	476	31.1	26.8	13.9	464
48 ºF	35.4	22.1	19.2	501	33.9	24.3	16.7	490	32.2	27.0	14.3	478
50 ºF	36.7	22.3	19.7	516	35.0	24.5	17.1	504	33.3	27.1	14.7	492

MCT40W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	39.8	27.8	17.2	573	37.7	30.6	14.8	557	35.4	33.8	12.6	541
42 ºF	41.4	27.9	17.8	592	39.1	30.7	15.3	574	36.9	34.0	13.0	558
44 ºF	42.9	28.0	18.4	611	40.6	30.8	15.8	593	38.3	34.1	13.5	576
46 ºF	44.5	28.1	19.0	630	42.2	31.0	16.3	612	39.8	34.3	13.9	594
48 ºF	46.2	28.3	19.6	651	43.8	31.2	16.8	631	41.2	34.6	14.3	613
50 ºF	47.9	28.4	20.2	672	45.3	31.4	17.3	650	42.8	34.8	14.7	632

MCT50W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	50.0	35.2	17.1	720	47.6	39.0	14.7	705	44.9	43.4	12.4	687
42 ºF	51.9	35.3	17.7	744	49.4	39.1	15.1	726	46.7	43.5	12.9	709
44 ºF	53.8	35.5	18.2	766	51.2	39.2	15.7	748	48.4	43.7	13.3	730
46 ºF	55.7	35.7	18.7	791	53.1	39.4	16.2	771	50.2	43.9	13.7	752
48 ºF	57.8	35.9	19.3	816	55.0	39.7	16.6	795	52.0	44.1	14.2	775
50 ºF	59.8	36.1	19.9	841	56.8	39.9	17.1	818	53.9	44.3	14.6	798

MCT60W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	64.2	45.4	17.0	925	61.2	50.4	14.6	906	57.7	56.1	12.3	884
42 ºF	66.6	45.7	17.5	955	63.3	50.6	15.0	932	59.9	56.4	12.7	911
44 ºF	68.9	46.0	18.0	983	65.6	50.9	15.5	961	62.1	56.6	13.2	938
46 ºF	71.4	46.4	18.5	1,015	68.0	51.2	15.9	991	64.3	57.0	13.5	966
48 ºF	73.9	46.7	19.0	1,047	70.4	51.6	16.4	1,021	66.6	57.3	13.9	995
50 ºF	76.6	47.0	19.5	1,079	72.8	51.9	16.8	1,050	68.9	57.6	14.4	1,024

Performance Data - MCDW

Performance data for the Dual series chillers with a water-cooled condenser.

MCD20W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	20.7	14.1	17.7	297	19.7	15.7	15.1	290	18.5	17.6	12.6	282
42 ºF	21.5	14.1	18.3	306	20.4	15.7	15.6	298	19.2	17.6	13.1	290
44 ºF	22.2	14.2	18.8	315	21.2	15.7	16.2	308	19.9	17.7	13.5	300
46 ºF	23.0	14.2	19.4	324	21.9	15.7	16.8	317	20.7	17.7	14.0	309
48 ºF	23.8	14.3	19.9	334	22.7	15.8	17.2	326	21.4	17.8	14.4	318
50 ºF	24.6	14.3	20.6	343	23.4	15.9	17.7	335	22.2	17.8	15.0	327

MCD30W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	30.2	21.5	16.8	435	28.8	23.7	14.6	427	27.2	26.3	12.4	417
42 ºF	31.3	21.6	17.4	449	29.8	23.8	15.1	439	28.3	26.4	12.9	430
44 ºF	32.4	21.7	17.9	463	31.0	23.9	15.5	453	29.3	26.5	13.3	442
46 ºF	33.5	21.8	18.5	477	32.1	24.0	16.0	467	30.4	26.6	13.7	456
48 ºF	34.7	22.0	18.9	492	33.2	24.2	16.5	481	31.5	26.8	14.1	469
50 ºF	35.9	22.2	19.4	507	34.3	24.4	16.9	495	32.6	27.0	14.5	483

MCD40W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	38.8	27.8	16.7	560	36.7	30.6	14.4	544	34.5	33.9	12.2	529
42 ºF	40.3	27.9	17.3	579	38.1	30.8	14.8	562	35.9	34.1	12.6	547
44 ºF	41.8	28.0	17.9	597	39.6	30.9	15.4	580	37.3	34.2	13.1	564
46 ºF	43.4	28.2	18.5	617	41.1	31.1	15.8	599	38.7	34.5	13.5	582
48 ºF	45.0	28.3	19.1	637	42.6	31.3	16.3	618	40.1	34.7	13.9	600
50 ºF	46.7	28.4	19.7	657	44.1	31.4	16.9	636	41.6	34.9	14.3	619

MCD50W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	50.5	35.0	17.3	725	48.0	38.8	14.8	708	45.2	43.2	12.6	690
42 ºF	52.4	35.2	17.9	749	49.7	38.9	15.3	729	47.0	43.3	13.0	711
44 ºF	54.3	35.3	18.4	772	51.6	39.0	15.9	753	48.7	43.4	13.5	733
46 ºF	56.2	35.5	19.0	796	53.5	39.2	16.4	776	50.5	43.6	13.9	755
48 ºF	58.3	35.7	19.6	821	55.4	39.5	16.8	800	52.3	43.8	14.3	777
50 ºF	60.4	35.9	20.2	847	57.3	39.7	17.3	823	54.2	44.1	14.8	801

MCD60W	Cond IN (75 ºF)				Cond IN (85 ºF)				Cond IN (95 ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	65.9	45.5	17.4	946	62.8	50.4	15.0	926	59.4	56.1	12.7	904
42 ºF	68.4	45.7	17.9	976	65.1	50.5	15.5	953	61.6	56.2	13.2	931
44 ºF	70.8	45.9	18.5	1,006	67.5	50.8	15.9	983	63.9	56.5	13.6	960
46 ºF	73.3	46.2	19.0	1,037	69.9	51.1	16.4	1,013	66.2	56.8	14.0	988
48 ºF	76.0	46.6	19.6	1,071	72.4	51.4	16.9	1,044	68.5	57.1	14.4	1,017
50 ºF	78.6	46.9	20.1	1,104	74.8	51.8	17.3	1,074	70.9	57.5	14.8	1,047

Performance Data - MCTR

Performance data for the Tandem series chillers with a remote air cooled condenser.

MCT20W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	19.2	17.3	13.3	290	18.6	18.4	12.1	286	17.9	19.7	10.9	282
42 ºF	20.0	17.3	13.9	299	19.3	18.4	12.6	295	18.7	19.7	11.4	291
44 ºF	20.8	17.4	14.3	309	20.1	18.4	13.1	304	19.4	19.6	11.9	300
46 ºF	21.6	17.4	14.9	318	20.9	18.5	13.5	314	20.2	19.6	12.3	309
48 ºF	22.3	17.4	15.4	328	21.7	18.5	14.1	323	21.0	19.6	12.8	318
50 ºF	23.2	17.4	16.0	337	22.5	18.5	14.6	333	21.8	19.7	13.2	328

MCT30W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	28.1	25.9	13.0	426	27.3	27.3	12.0	421	26.4	28.9	11.0	416
42 ºF	29.2	26.0	13.5	439	28.4	27.4	12.4	434	27.5	28.9	11.4	428
44 ºF	30.3	26.1	13.9	452	29.4	27.5	12.8	447	28.5	29.0	11.8	441
46 ºF	31.4	26.2	14.4	466	30.5	27.6	13.3	460	29.6	29.1	12.2	454
48 ºF	32.6	26.3	14.9	480	31.6	27.7	13.7	474	30.7	29.2	12.6	468
50 ºF	33.7	26.4	15.3	495	32.8	27.8	14.2	488	31.8	29.3	13.0	482

MCT40W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	35.8	33.1	13.0	542	34.7	34.9	11.9	536	33.6	36.8	11.0	529
42 ºF	37.2	33.3	13.4	560	36.1	35.0	12.4	553	34.9	37.0	11.3	546
44 ºF	38.7	33.4	13.9	578	37.5	35.2	12.8	570	36.3	37.1	11.8	563
46 ºF	40.2	33.5	14.4	597	39.0	35.3	13.3	589	37.8	37.2	12.2	580
48 ºF	41.8	33.7	14.9	616	40.5	35.5	13.7	607	39.2	37.4	12.6	599
50 ºF	43.4	33.8	15.4	636	42.1	35.6	14.2	627	40.8	37.5	13.0	617

MCT50W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	45.4	42.5	12.8	689	44.0	44.8	11.8	681	42.6	47.4	10.8	673
42 ºF	47.1	42.6	13.3	711	45.7	44.9	12.2	702	44.3	47.5	11.2	694
44 ºF	48.9	42.7	13.7	733	47.5	45.0	12.7	723	46.0	47.6	11.6	714
46 ºF	50.8	42.8	14.2	755	49.3	45.1	13.1	745	47.7	47.7	12.0	736
48 ºF	52.7	42.9	14.7	778	51.1	45.3	13.5	768	49.6	47.8	12.4	758
50 ºF	54.6	43.0	15.2	802	53.0	45.4	14.0	791	51.4	47.9	12.9	780

MCT60W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	58.2	55.0	12.7	886	56.5	58.1	11.7	876	54.7	61.4	10.7	866
42 ºF	60.4	55.2	13.1	913	58.6	58.3	12.1	903	56.8	61.6	11.1	892
44 ºF	62.7	55.4	13.6	942	60.9	58.4	12.5	930	59.0	61.7	11.5	918
46 ºF	65.0	55.6	14.0	970	63.2	58.6	12.9	958	61.2	61.9	11.9	945
48 ºF	67.4	55.8	14.5	1,000	65.5	58.8	13.4	986	63.4	62.1	12.3	973
50 ºF	69.9	56.0	15.0	1,030	67.9	59.0	13.8	1,016	65.8	62.3	12.7	1,002

Performance Data - MCDR

Performance data for the Dual series chillers with a remote air cooled condenser.

MCD20W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	18.7	17.2	13.0	283	18.0	18.3	11.8	279	17.4	19.5	10.7	275
42 ºF	19.4	17.2	13.5	292	18.8	18.3	12.3	288	18.1	19.5	11.1	284
44 ºF	20.2	17.2	14.1	301	19.5	18.3	12.8	297	18.8	19.5	11.6	292
46 ºF	20.9	17.2	14.6	310	20.3	18.3	13.3	306	19.6	19.5	12.0	301
48 ºF	21.7	17.2	15.2	319	21.0	18.3	13.8	315	20.3	19.5	12.5	311
50 ºF	22.5	17.3	15.6	329	21.8	18.3	14.3	325	21.1	19.5	13.0	320

MCD30W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	27.5	25.8	12.8	418	26.7	27.2	11.8	413	25.8	28.7	10.8	408
42 ºF	28.5	25.8	13.3	431	27.7	27.3	12.2	426	26.8	28.8	11.2	421
44 ºF	29.6	25.9	13.7	444	28.8	27.3	12.6	438	27.9	28.9	11.6	433
46 ºF	30.7	26.0	14.2	457	29.8	27.4	13.1	452	28.9	28.9	12.0	446
48 ºF	31.8	26.1	14.6	471	31.0	27.5	13.5	465	30.0	29.0	12.4	459
50 ºF	33.0	26.2	15.1	486	32.1	27.6	13.9	479	31.1	29.1	12.8	473

MCD40W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	34.8	33.2	12.6	531	33.7	35.0	11.6	524	32.6	37.0	10.6	518
42 ºF	36.2	33.4	13.0	549	35.1	35.2	12.0	541	34.0	37.1	11.0	534
44 ºF	37.7	33.5	13.5	566	36.5	35.3	12.4	559	35.3	37.3	11.4	551
46 ºF	39.1	33.6	14.0	584	38.0	35.4	12.9	576	36.8	37.4	11.8	569
48 ºF	40.7	33.8	14.4	603	39.4	35.6	13.3	595	38.2	37.5	12.2	586
50 ºF	42.2	33.9	15.0	623	41.0	35.7	13.8	614	39.7	37.7	12.6	605

MCD50W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	45.7	42.2	13.0	692	44.3	44.6	11.9	683	42.8	47.1	10.9	675
42 ºF	47.4	42.3	13.5	713	46.0	44.7	12.3	704	44.5	47.2	11.3	695
44 ºF	49.2	42.5	13.9	736	47.7	44.8	12.8	726	46.2	47.3	11.7	716
46 ºF	51.1	42.6	14.4	759	49.6	44.9	13.2	748	48.0	47.4	12.1	737
48 ºF	53.0	42.7	14.9	782	51.4	45.0	13.7	771	49.8	47.5	12.6	760
50 ºF	55.0	42.8	15.4	806	53.4	45.1	14.2	794	51.7	47.6	13.0	782

MCD60W	Saturated Discharge Temp (110 ºF)				Saturated Discharge Temp (115 ºF)				Saturated Discharge Temp (120ºF)			
Evap OUT (F)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)	Cap (TR)	Work (kW)	EER	THR (kBtu/h)
40 ºF	59.9	54.8	13.1	906	58.2	57.9	12.1	895	56.3	61.2	11.0	885
42 ºF	62.2	55.0	13.6	934	60.4	58.1	12.5	923	58.5	61.4	11.4	912
44 ºF	64.5	55.2	14.0	963	62.7	58.3	12.9	951	60.7	61.6	11.8	939
46 ºF	66.9	55.4	14.5	992	65.0	58.5	13.3	980	63.0	61.7	12.3	967
48 ºF	69.4	55.6	15.0	1,022	67.4	58.7	13.8	1,009	65.3	61.9	12.7	995
50 ºF	71.9	55.8	15.5	1,053	69.9	58.9	14.2	1,039	67.7	62.1	13.1	1,025

Selection Procedure

System Capacity

Two out of the following three pieces of information must be known in order to properly size a chiller:

1. The required chilled water capacity (tons),
2. The chilled water temperature range (ΔT°F), and
3. The flow (USgpm)

They are related in the following formula: $$\textbf{Tons} = \frac{\textbf{Flow x } \Delta\textbf{T}}{\textbf{24}}$$

Note: **ΔT** is the difference between the water temperature entering and leaving the chiller.

Enter the two known factors and solve for the third. Please note, if glycol is used or if the system is operating at unusual altitudes, please consult the section titled: *"Performance Adjustment Factors"*.

Select the necessary chiller from the **Tons** determined above.

Condenser Sizing

Once you have the required chiller capacity in **Tons**, you will require the following to size the proper condenser:

1. The entering condenser water temperature, and ***either***
2. The condenser water temperature range (ΔTc °F)

or

The Flow (gpm), they relate in the following formula

They are related in the following formula:

$$\textbf{Condenser Flow} = \frac{\textbf{THR}}{\textbf{500 x } \Delta\textbf{Tc}} = \frac{\textbf{Tons x 30}}{\Delta\textbf{Tc}}$$

Note: - **ΔTc** is the difference between the water temperature entering and leaving the chiller condenser.
- **THR** is the total amount of heat per unit time rejected by the condenser. THR not only includes the heat removed from the circulating water passing through the evaporator, but also the heat added by the compressor when compressing the refrigerant gas.

Use the Performance Data Table to determine the water cooled chiller selection, and the corresponding compressor power input, condenser water flow rate, the EER125 and the THR. The selection procedure is the same for a remote air-cooled chiller. The condensers are pre-selected to perform at ARI conditions for each chiller size. Operating outside of the ARI conditions will change the performance capacity and power input.

Assumptions:
Ratings are based on ARI Standard 550/590-2003.
Ratings in the Performance Tables can be interpolated for any chilled water temperature between 40°F and 50°F (4.4°C and 10.0°C) but cannot be extrapolated.
Chilled water flow are based on a 10°F (5.6°C) chilled water range (2.4 gpm/ton).
The maximum/minimum flow rate is based on a 6°F range as maximum flow and 16°F as minimum flow. The maximum flow is based on pressure drop across the evaporator and problems resulting from very small control bands and limited start-up/shut-off temperature changes. The minimum flow is based on a full load and minimum flow to maintain turbulent flow across the evaporator. The minimum flow rates assume that the flow will be reduced proportionally to the cooling load.
Ratings are based on a 0.0001 fouling factor for the evaporator. For applications using a glycol solution see the tables referring to glycol mix below.
Ratings are based on a condenser flow of 3gpm/ton (10°F, 5.6°C ΔT) and 0.00025 fouling factor.

Altitude Correction Factors

As altitude rises, density of the air decreases. This affects the capacity of the remote air-cooled condenser and thereby decreases the capacity (and power) of the cooling system. For systems located at altitudes significantly higher than sea level, de-rating correction factors should be used. Please consult the table below.

Table 1 - Altitude Correction Factors

	1000 ft.	2000 ft.	3000 ft.	4000 ft.	5000 ft.	6000 ft.
Capacity	0.997	0.994	0.991	0.988	0.983	0.978
Power	1.0063	1.0126	1.0196	1.0266	1.0336	1.0406

Ethylene and Propylene Glycol Correction Factors

MTW and MTR units are designed to operate with a leaving chilled fluid temperature from 21°F (-6.1°C) to 60°F (16°C). Leaving chilled fluid temperatures below 40°F (4.6°C) result in suction temperatures at or below the freezing point of water and a glycol anti-freeze solution is required. The use of glycol in the evaporator will reduce the performance of the unit. The reduction in performance depends upon the glycol concentration and temperature. This should be taken into consideration during initial system design.

Creotech Industries encourages a minimum concentration of 25% be provided on all glycol applications. Glycol concentrations below 25% are too diluted for long-term corrosion protection of ferrous metals and corrosion inhibitors need to be recalculated and possibly added to the system. Glycol in the condenser will have a negligible effect on performance because glycol at these higher temperatures will perform with characteristics similar to water.

Table 2 - Adjustment Factor for Ethylene Glycol

Percent E.G.	Freeze Point		Cap.	Power	Flow (GPM)	Pressure Drop
	°F	°C				
10%	26	-3	0.991	0.996	1.013	1.070
20%	18	-8	0.982	0.992	1.040	1.129
30%	7	-14	0.972	0.986	1.074	1.181
40%	-7	-22	0.961	0.976	1.121	1.263
50%	-28	-33	0.946	0.966	1.178	1.308

Table 3 - Adjustment Factor for Propylene Glycol

Percent P.G	Freeze Point		Cap.	Power	Flow (GPM)	PressureDrop
	°F	°C				
10	26	-3	0.987	0.992	1.010	1.068
20	19	-7	0.975	0.985	1.028	1.147
30	9	-13	0.962	0.978	1.050	1.248
40	-5	-21	0.946	0.971	1.078	1.366

NOTE: Glycol applications are not included in the ARI certification program.

Evaporator Fouling Factors
As per ARI 550/590-2003, performance tables for chiller evaporators are based on a fouling factor of

$$\frac{0.0001 \text{ feet}^2 \text{ x hour x } ^\circ\text{F}}{\text{BTU}}$$

As fouling of the chiller evaporator increases, the heat transfer characteristics of the evaporator decreases. Please contact CreoTech Industries for more information.

Selection Example
Water-cooled chiller
Using 30% ethylene glycol, 70% chilled water solution
Chiller water delivery temperature of 44ºF and return temperature of 54ºF
Evaporator flow rate of 720USgpm
Condenser entering water temperature of 85ºF, and **ΔTc** of 10ºF

Determine the chilled water temperature differential, **ΔT**:

ΔT = 54ºF – 44ºF = 10ºF

Determine the capacity of the chilling system required for pure water:

Tons = $\frac{\text{Flow x } \Delta T}{24} = \frac{720\text{USgpm x } 10^\circ\text{F}}{24}$ = 300 tons

Increase the amount of cooling required because of the decreased heat transfer of the chilled water solution containing 30% ethylene glycol:

Actual Tons Needed = $\frac{30 \text{ Tons}}{0.972}$ = 308.7 tons

Determine water-condenser flow for complete chilling system

Total Condenser flow = $\frac{\text{Actual Tons X } 30}{\Delta Tc} = \frac{308.7 \text{ x } 30}{10}$ = 926USgpm

Determine combination of CreoTech modular chillers required

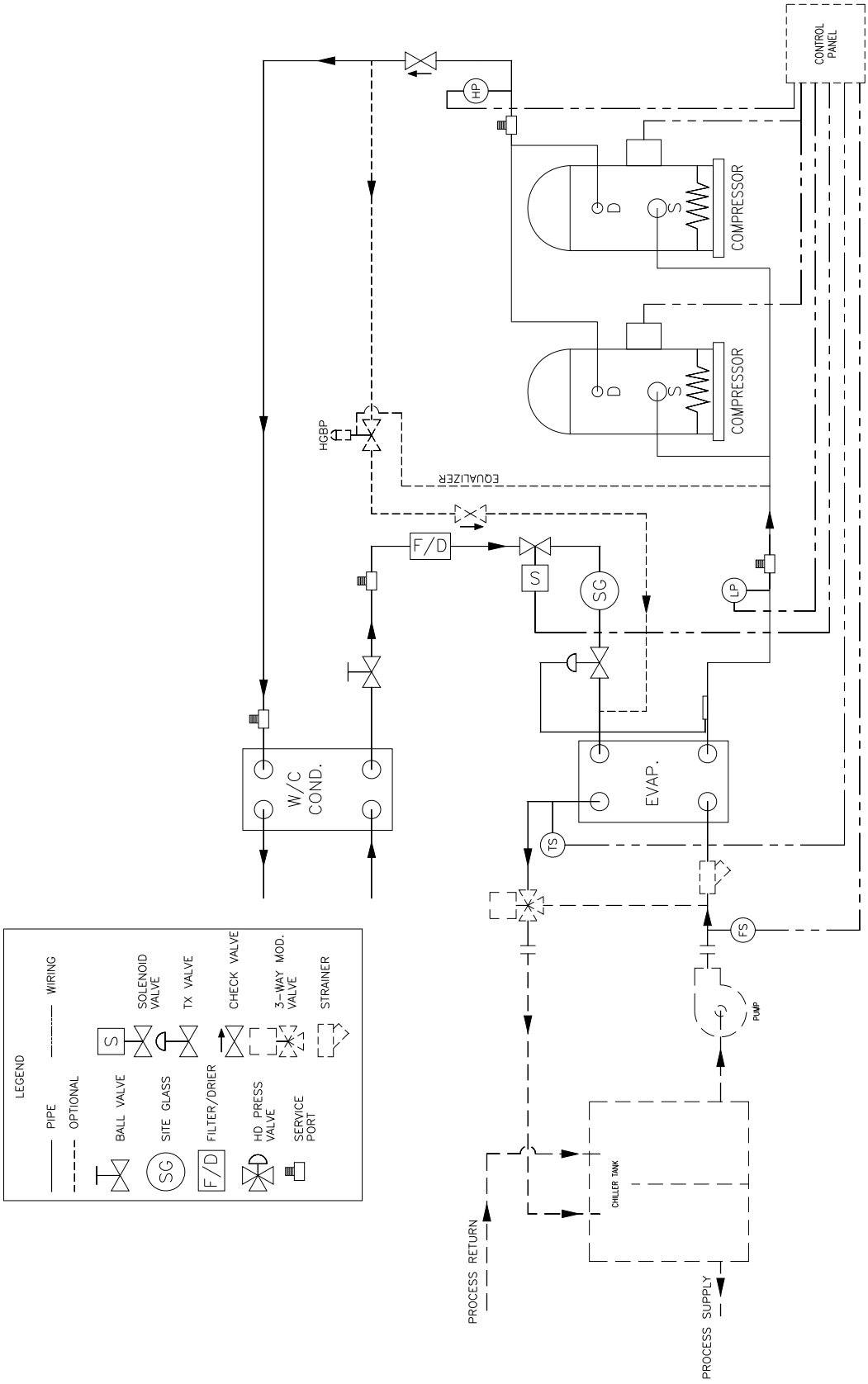
From the *System Selection Table* below, select the appropriate combination of modular chillers. For 308 Tons a 320 ton system would be required consisting of **five (5) MT60W** chiller modules.

System Selection Table

Model	MT20W	MT30W	MT40W	MT50W	MT60W
Cooling (tons)	Number of Units Required				
20	1				
30		1			
40			1		
50				1	
60					1
70		1	1		
80			2		
90			1	1	
100				2	
110				1	1
120					2
130					2
140			1	2	
150				3	
160				2	1
180				1	2
200					3
220			1	1	2
240				1	3
260					4
280				3	2
300			1		4
320					5
340				3	3
360				2	4
380					6
400			1	2	4
420				2	5
440				1	6
460			1	2	5
480			1	1	6
500				1	7
520					8

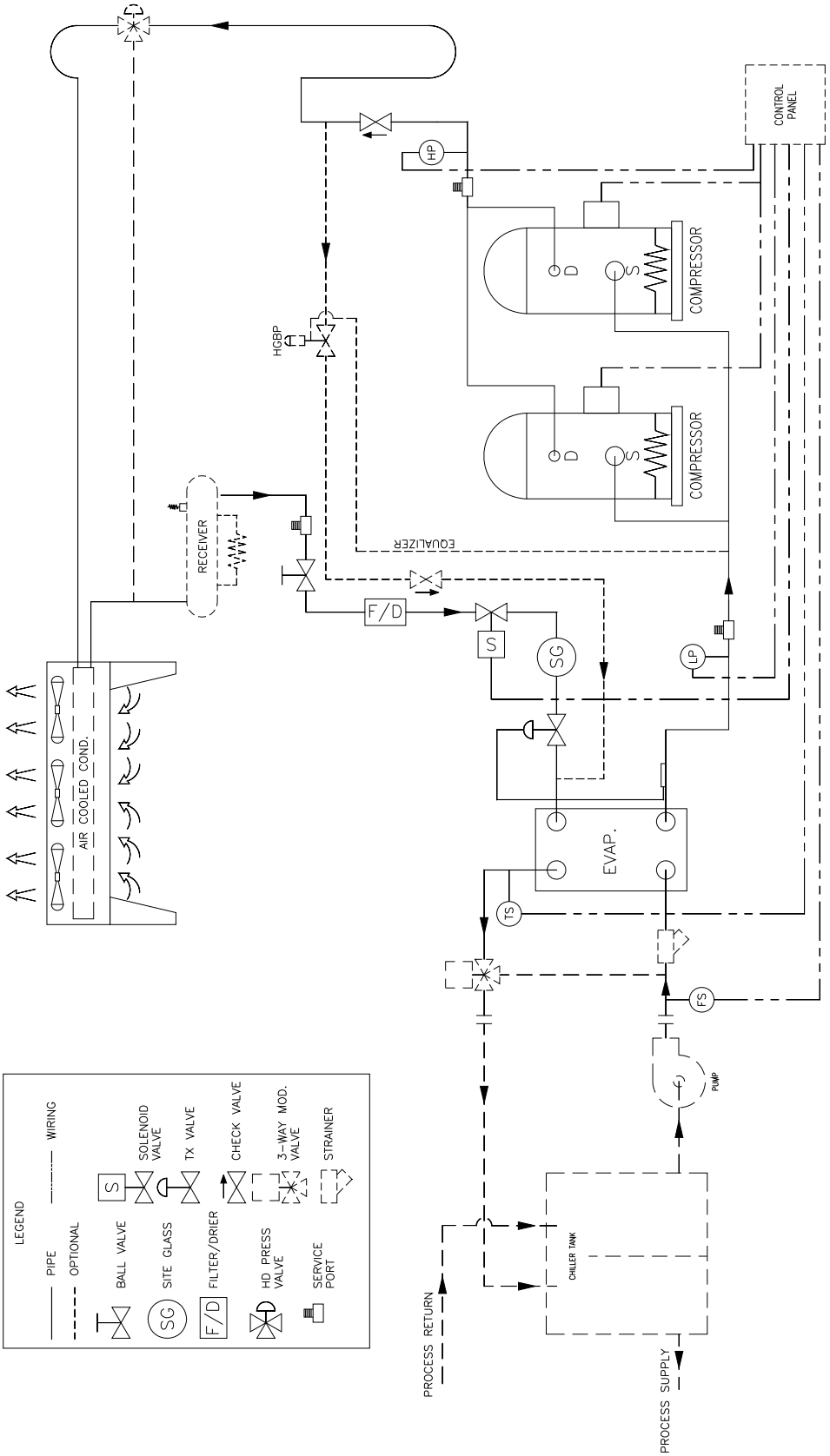
Piping & Instrumentation Diagram

MTW – Water-Cooled Modular Chiller

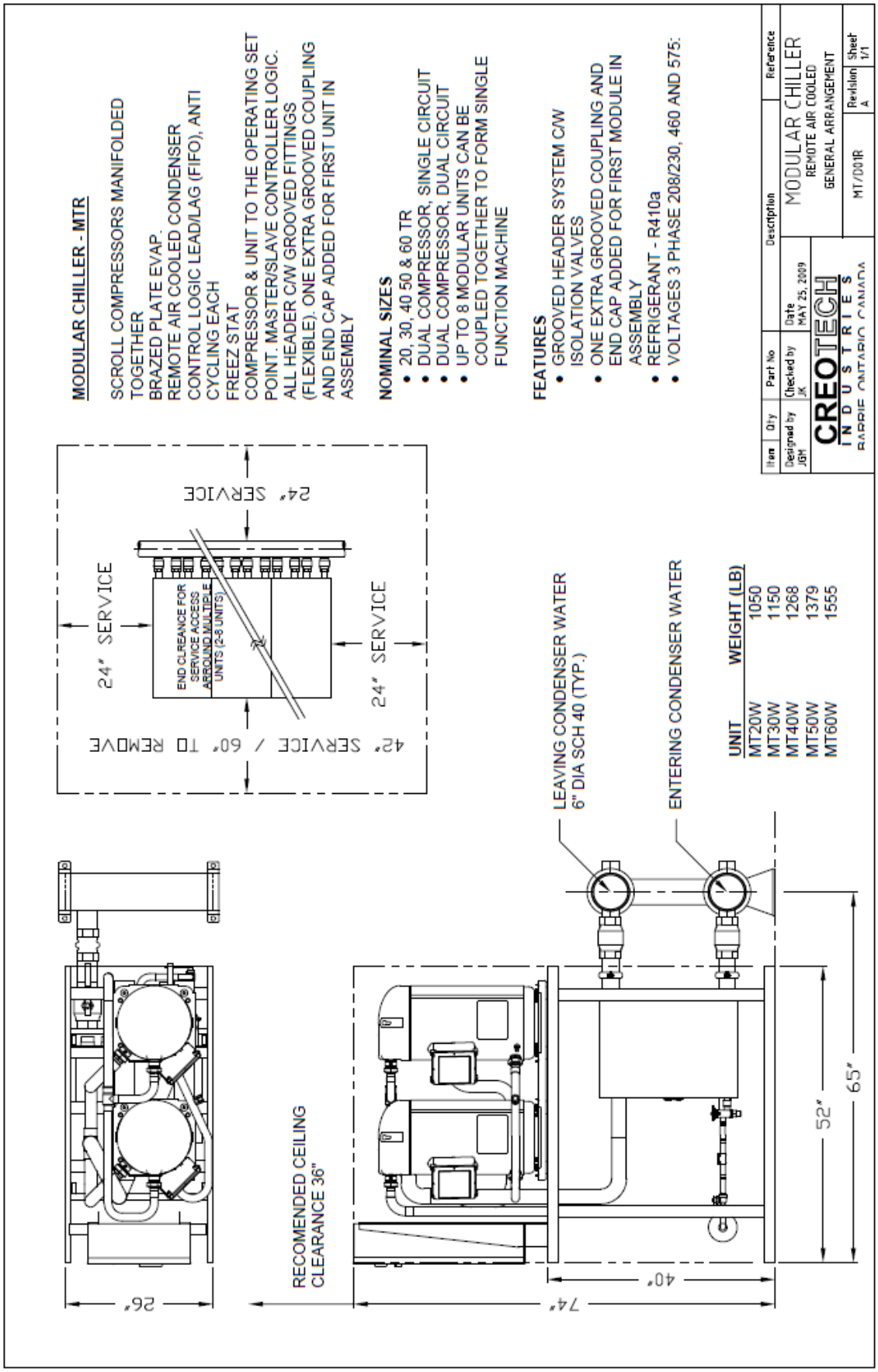


Piping & Instrumentation Diagram (cont'd)

MTR – Remote Air-Cooled Modular Chiller



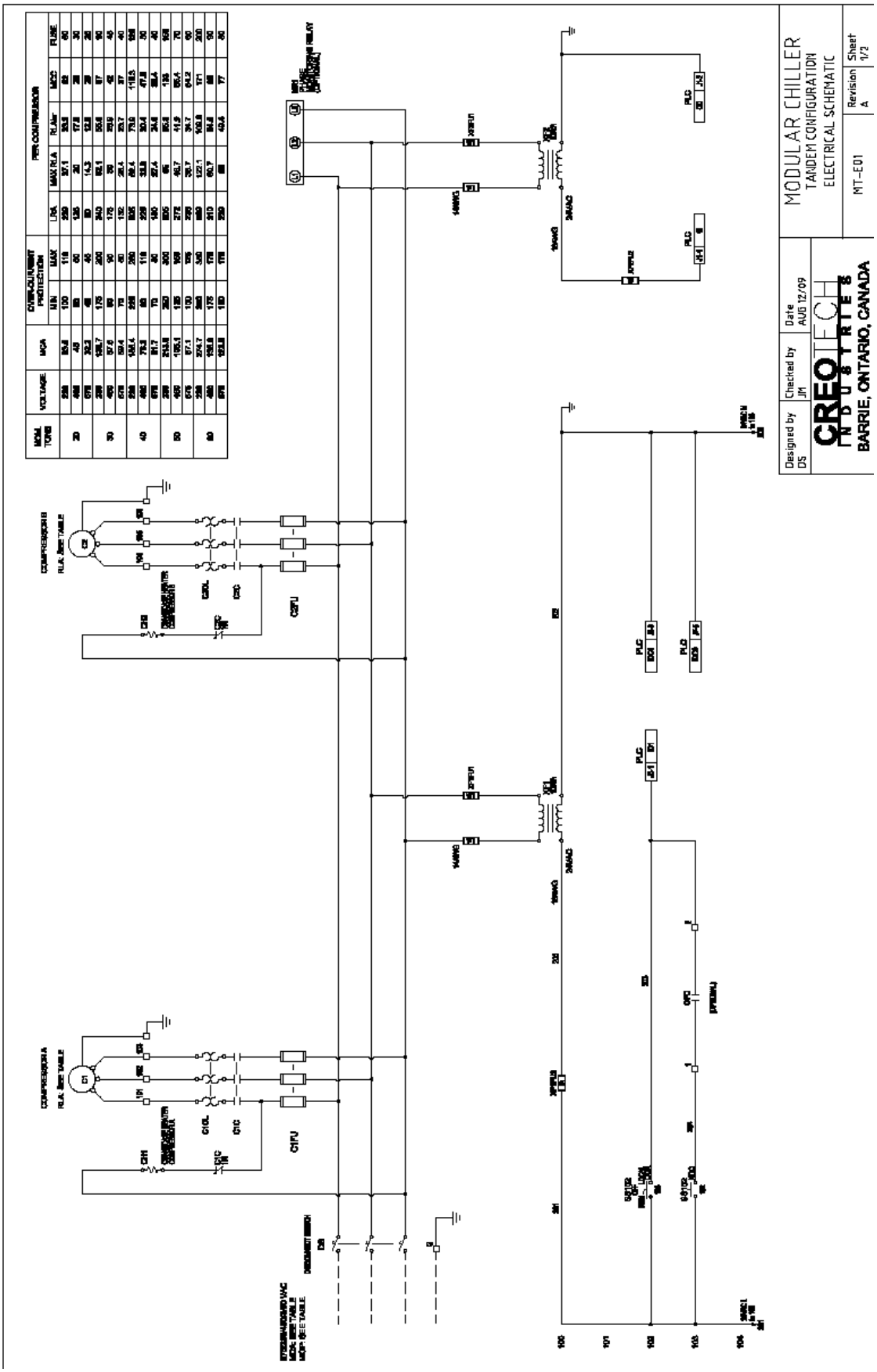
Dimensional Drawings & Clearances



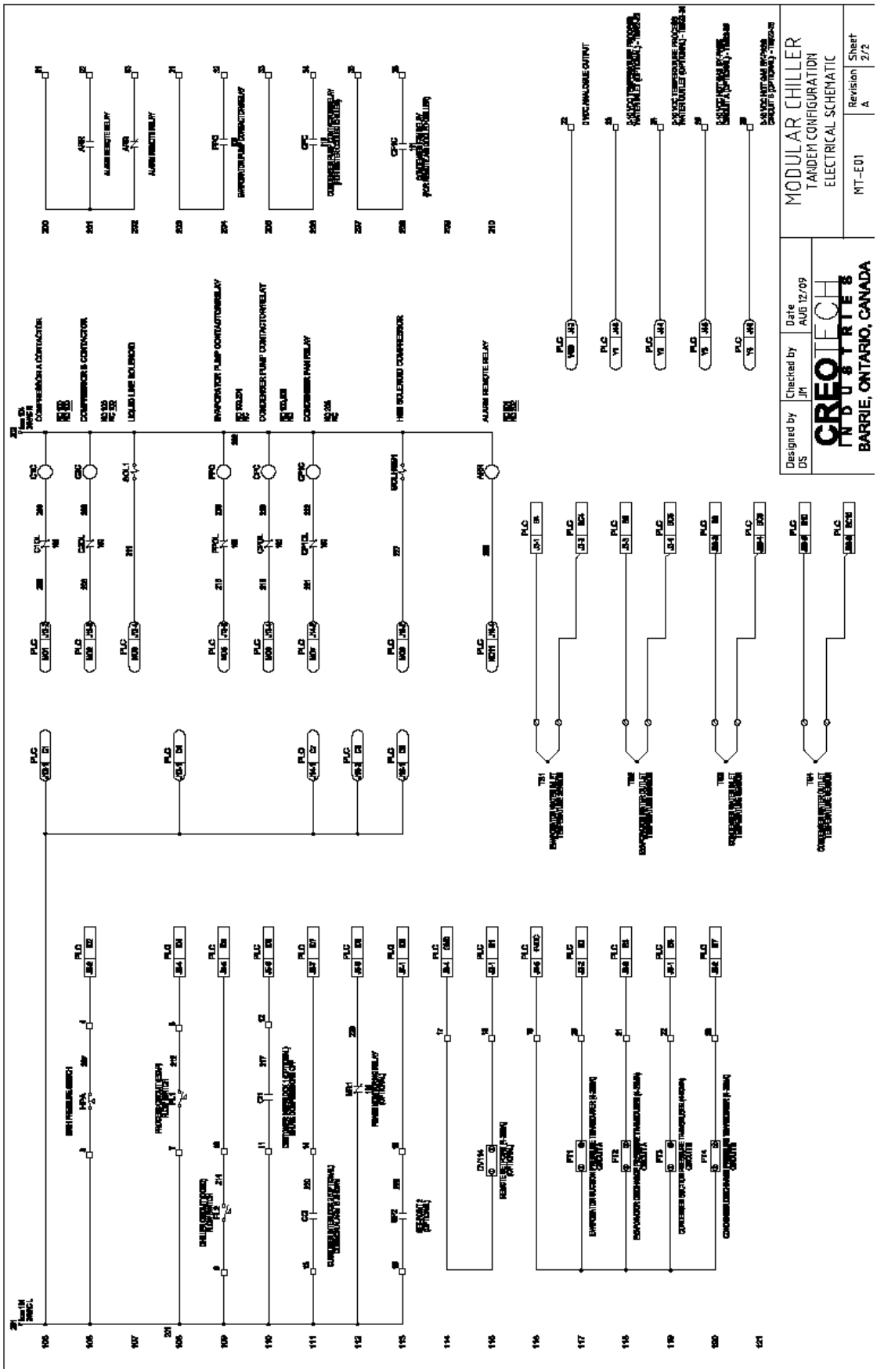
Electrical Information

	Nom. Tons	Voltage	MCA	Over-Current Protection		Per Compressor				
				Min	Max	LRA	Max RLA	RLAbr	MCC	Rec. Fuse
MT20W	20T	230/3/60	83.5	100	110	239	37.1	33.3	52	60
		460/3/60	45.0	50	60	125	20	17.9	28	30
		575/3/60	32.2	40	45	80	14.3	12.8	20	25
MT30W	30T	230/3/60	139.7	175	200	340	62.1	55.8	87	90
		460/3/60	67.5	80	90	173	30	26.9	42	45
		575/3/60	59.4	70	80	132	26.4	23.7	37	40
MT40W	40T	230/3/60	185.4	225	250	505	82.4	73.9	115.3	125
		460/3/60	76.3	90	110	225	33.9	30.4	47.5	50
		575/3/60	61.7	70	80	180	27.4	24.6	38.4	40
MT50W	50T	230/3/60	213.8	250	300	605	95	85.3	133	150
		460/3/60	105.1	125	150	272	46.7	41.9	65.4	70
		575/3/60	87.1	100	125	238	38.7	34.7	54.2	60
MT60W	60T	230/3/60	274.7	350	350	599	122.1	109.6	171	200
		460/3/60	136.6	175	175	310	60.7	54.5	85	90
		575/3/60	123.8	150	175	239	55	49.4	77	80
MT20R	20T	230/3/60	83.5	100	110	239	37.1	33.3	52	60
		460/3/60	45.0	50	60	125	20	17.9	28	30
		575/3/60	32.2	40	45	80	14.3	12.8	20	25
MT30R	30T	230/3/60	139.7	175	200	340	62.1	55.8	87	90
		460/3/60	67.5	80	90	173	30	26.9	42	45
		575/3/60	59.4	70	80	132	26.4	23.7	37	40
MT40R	40T	230/3/60	185.4	225	250	505	82.4	73.9	115.3	125
		460/3/60	76.3	90	110	225	33.9	30.4	47.5	50
		575/3/60	61.7	70	80	180	27.4	24.6	38.4	40
MT50R	50T	230/3/60	213.8	250	300	605	95	85.3	133	150
		460/3/60	105.1	125	150	272	46.7	41.9	65.4	70
		575/3/60	87.1	100	125	238	38.7	34.7	54.2	60
MT60R	60T	230/3/60	274.7	350	350	599	122.1	109.6	171	200
		460/3/60	136.6	175	175	310	60.7	54.5	85	90
		575/3/60	123.8	150	175	239	55	49.4	77	80

Electrical Schematic



Electrical Schematic (cont'd)



Application and Recommended Installation

Location and Space Requirements
The units are designed for indoor application and must be located in a space where the temperature is 40°F (4.4° C) or above. Provide clearance of 3 ft. (914 mm) on each side and end for piping and to provide space for servicing the unit.

Foundation
Mount the unit on a level concrete foundation. Floors must be strong enough to support the operating weight of the unit. If necessary, use structural supports to transfer the weight to the nearest beams.

Vibration Isolation
Vibration mounts are recommended for upper floor installations or where compressor noises are required to me minimized (next to occupied spaces). Pipe vibration eliminators may be required for water piping connected to the unit to minimize transmission of water or pump noise into occupied spaces.

System Water Volume
It is important to have adequate water volume in the system to provide an opportunity for the chiller to sense a load change, adjust to the change and stabilize. As the expected load change becomes more rapid, a greater water volume is needed. The system water volume is the total amount of water in the evaporator, air handling products and associated piping. If the water volume is too low, operational problems can occur, including rapid compressor cycling, rapid loading and unloading of compressors, erratic refrigerant flow in the chiller, improper motor cooling, shortened equipment life and other undesirable occurrences.
For normal comfort cooling applications where the cooling load changes relatively slowly, we recommend a minimum system volume of two to three times the flow rate (GPM). For example, if the design chiller flow rate is 120 GPM, we recommend a minimum system volume of 240 to 360 gallons.
For process applications where the cooling load can change rapidly, additional system water volume is needed. A process example would be the cooling of hot metal objects. The load would be very stable until the hot metal is dipped into the water tank. Then, the load would increase drastically.

Since there are many other factors that can influence performance, systems can successfully operate below these suggestions. However, as the water volume decreases below these values, the possibility of problems increases.

Varying Flow Through Evaporator
Reducing evaporator flow in proportion to load can reduce system power consumption. Certain restrictions apply to the amount and rate of flow change. The rate of flow change should be a maximum of 10 percent of the change per minute. Do not reduce flow lower than the minimum flow for 16°F ΔT.

Electrical Connection
Every chiller requires field installation of the main supply power plus mandatory flow switch interlock and optional pump starter auxiliary contact interlock.

See “Electrical Data” for field electrical hookups. The information shown represents all chillers. Each unit is provided with its specific wiring diagram in the control panel. All wiring must be done according to local and national codes.

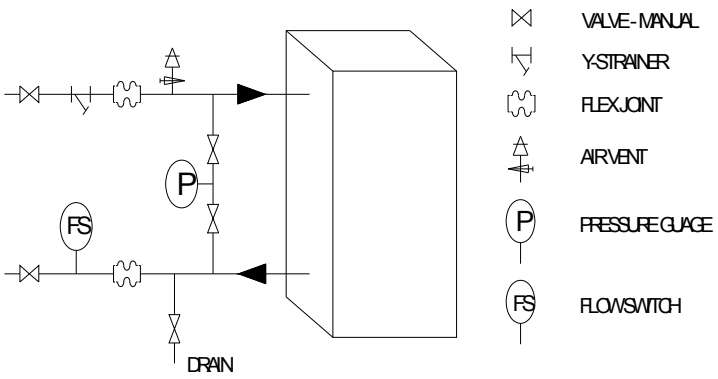
Main Power Supply Disconnect
Every chiller with the standard single-point power supply is equipped with compressor overcurrent protection as standard. A field-supplied and installed remote non-fused disconnect switch is required by NEC/CSA code.

Chilled Water Piping
The factory supplied flow switch should be installed in the horizontal piping of the system supply (evaporator outlet) water line.
Provide drain connections at low points in the system to permit complete drainage of the system. Locate air vents at the high points in the system to purge air out of the system. Use the vent connections the evaporator to purge air from the water system before unit start-up ensuring adequate flow through the evaporator.

(Note: Install a strainer – 40 mesh – before the inlet to the evaporator – can be factory supplied.)

Flush the system water piping thoroughly before making connections to the unit evaporator. Design the water piping so the chilled water circulating pump discharges into the evaporator inlet.

Install pressure gauges in the inlet and outlet water lines to the evaporator. Measure the pressure drop through the evaporator to calculate proper flow. Vibration eliminators are recommended in both the supply and return water lines. Insulate chilled water piping to reduce heat loss and prevent condensation.



Typical Chilled Water Piping

Condenser Water (MTW Models)

Be aware of labeling on water cooled condenser. Make water-in and water-out connections accordingly. Head pressure control must be provided if the entering condenser water can fall below 60° F (water regulating valve—factory supplied option). Install a 20-mesh strainer in the condenser inlet line.

Series or Parallel Operation

Consider system pressure drop when designing the water piping. Parallel piped systems have half of the total system flow going through the evaporator of each chiller, reducing the individual unit and total system pressure drop for a two chiller installation.
Series piped evaporators require that the total system water flows through both evaporators. Not only is the pressure drop through each evaporator increased but the pressure drops must be added together to obtain the total evaporator pressure drop. Series piped evaporators normally require larger circulating pumps for the chilled water system.

Application Limitations

Maximum allowable condenser water pressure is 232 psig (1599 kPa). Maximum design saturated discharge temperature (SDT) is 140°F (60°C). SDT=Condensing temperature + discharge line loss.Maximum allowable water temperature to evaporator when not operating is 100°F (37.8°C).

Maximum entering water temperature for operating cycle is 90°F (32.2° C) (during system changeover from heating to cooling cycle).Minimum design leaving water temperature from the evaporator without anti-freeze protection is 40°F (4.4°C). Contact your Creotech representative for operation with tower condenser water entering the chiller below 60°F (15.6°C). The maximum altitude for air-cooled condensers is 8,000 feet.

Consult factory for ambient operation below -20°F (-28.8°C) for air-cooled applications.

Remote Condenser Refrigerant Piping

Careful design of refrigerant piping is necessary for proper system operation. The refrigerant piping should be designed to accomplish the following:
Assure proper refrigerant feed to the evaporator.
Provide practical and economical refrigerant line sizes without excess pressure drop. Consult factory for line size recommendations.
Maintain uniform oil return to the compressor under all load conditions.
Refer to the latest version of the ASHRAE Handbook for recommended piping practice.
Limit the length of refrigerant piping by locating the condenser as close to the chiller as possible.
Avoid all unnecessary changes in direction or elevation.
NOTE: Do not run refrigerant piping underground.

Liquid Line

Where there is a vertical lift from the condenser to the chiller, adequate sub-cooling must be provided to prevent liquid flashing before the expansion valve. A shutoff valve should be installed in the liquid line to allow isolation of the remote condenser.

Discharge line

The discharge line should be trapped at the compressor and looped at the condenser (inverted trap) to prevent liquid refrigerant from draining back to the compressor. Pressure drop should be held at a minimum. The remote air-cooled chiller is standard equipped with a discharge check valve.

Recommended Line Sizing

Consult factory for field sizing of refrigerant lines.

Optional Features

CONTROLS

Network Communication Card - An optional network communication card can be supplied to be used in a N2-based, BACNet or LonWorks based building automation system.

RS-232 Communication Card - By adding the RS-232 communication card, you can connect an external GSM modem for remote dial-out. This can send SMS (short message service) messages to report and notify alarms and events.

REFRIGERATION

Head Pressure Control Kit - Head pressure control valves are available for field installation with remote air-cooled chillers.

Low Ambient Kit - The low ambient kit consists of a refrigerant receiver (installed) on the chiller base and the head pressure control kit. This will maintain minimum head pressure to -20ºF ambient temperature.

Remote Air-cooled Condenser - A remote air-cooled condenser matched to the chiller capacity is available as a purchased option.

ELECTRICAL

Phase Loss Detection - Factory install phase loss protection can be supplied with fault indication.

Hours of Operation - An hour meter that indicates the number of hours each compressor has run.

CSA certification - The electrical control panel is available with CSA certification.

Disconnect - A through-door, non-fused rotary disconnect switch sized for the chiller capacity.

WATER SIDE

Water Regulating Valve - The water regulating valve is to ensure that the water-cooled condenser head pressure is maintain for safe operation in applications where the condenser water may drop below 60°F.

Y-Strainers - 40 Mesh strainer for the evaporator and 20 mesh strainer for the water-cooled condenser are available to protect the evaporator and condenser from contamination.

Isolation/Balancing Valves - Ball valves can be supplied with the chiller to minimize installation requirement.

MOUNTING OPTIONS

Sheet Metal Housing - A sound insulated, epoxy coated sheet metal mounted housing is available for aesthetic and protective purposes for the chiller.

Product Specifications
Modular Water-Cooled Chiller (Model MTW)

1. GENERAL

1.1. SUMMARY

1.1.1. Section includes design, performance criteria, refrigerants, controls, and installation requirements for water-cooled scroll compressor packaged chillers.

1.2. REFERENCES

1.2.1. Standards/Codes of ARI 550/590-98, ANSI/ASHRAE 15,

1.2.2. ASME Section VIII, NEC, and OSHA as adopted by the State.

1.2.3. Efficiency standards of ASHRAE Standard 90.1.

1.3. SUBMITTALS

1.3.1. Submit shop drawings and product data in accordance with contract specifications.

1.3.2. Submittals shall include the following:

- Dimensioned plan and elevation view drawings, required clearances, and location of all field connections.
- Summary of all auxiliary utility requirements such as: electricity, water, etc. Summary shall indicate quality and quantity of each required utility.
- Single-line schematic drawing of the power field hookup requirements, indicating all items that are furnished.
- Schematic diagram of control system indicating points for field connection. Diagram shall fully delineate field and factory wiring.
- Installation manual.

1.4. QUALITY ASSURANCE

1.4.1. Qualifications: Equipment manufacturer must specialize in the manufacture of the products specified and have five years experience with similar equipment and the refrigerant offered.

1.4.2. Regulatory Requirements: Comply with the codes and standards specified.

1.5. DELIVERY AND HANDLING

1.5.1. Chillers shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

1.5.2. Comply with the manufacturer's instructions for rigging and handling equipment.

1.6. WARRANTY

1.6.1. The equipment manufacturer’s warranty shall be for a period of one year from date of equipment start-up but not more than 18 months from shipment. The warranty shall cover defective material and workmanship within the above period, excluding refrigerant.

2. PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

2.1.1. Creotech Industries Inc.

2.1.2. Approved Equal

2.2. UNIT DESCRIPTION

2.2.1. Provide and install as shown on the plans factory assembled, factory charged, and factory run tested water-cooled scroll compressor packaged chillers in the quantity specified. Each chiller shall consist of hermetic scroll compressors, brazed plate evaporator, brazed plate water-cooled condensers, control system and all components necessary for controlled unit operation. Refrigerant shall be R-410A.

2.3. DESIGN REQUIREMENTS

2.3.1. General: Provide a complete scroll packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.02 and any local codes in effect.

2.3.2. Performance: Refer to the schedule of performance on the drawings. Performance shall be in accordance with applicable ARI Standard.

2.3.3. Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. The manufacturer shall provide the necessary sound treatment to meet these levels if required. Sound data shall be provided with the quotation. Test shall be in accordance with ARI Standard 575.

2.4. CHILLER COMPONENTS

2.4.1. Compressors: The compressors shall be sealed hermetic scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, and two-pole, with inherent thermal protection on all three phases.

2.4.2. Evaporator: The evaporator shall be direct expansion type with stainless steel plates brazed together. It shall be insulated with 3/4 inch (19mm) closed cell polyurethane insulation and have 435 psi (3000kPa) water side working pressure.

2.4.3. Condenser: The condenser shall be direct expansion type with stainless steel plates brazed together. It shall be designed for 435 psi (3000kPa) water side working pressure and 435 psig (3000kPa) refrigerant side pressure.

2.4.4. Refrigerant Circuit: Refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.

2.4.5. Control Panel: The control panel shall contain a microprocessor controller providing operating and equipment protection controls plus motor starting equipment, factory wired, operationally tested, and ready for operation. Standard components shall include a control transformer with primary and secondary fusing, microprocessor transformers with integral fusing, compressor contactors, over current protection, single-point wiring arrangement and switches for each circuit pump-down and unit control power. The control panel shall have a hinged tool-locked door.

2.4.6. The control system shall stage the compressors based on the set-point temperature. Equipment protection devices controlled by the microprocessor include motor protection, high pressure, loss of refrigerant, loss of water flow, freeze protection and low refrigerant pressure. Controls shall include off/on selector switch, chilled water set-point adjustment, anti-cycle timer, and digital display with water temperature and set-point, operating temperatures and pressures, and diagnostic messages. The following features and functions shall be included:

- Critical parameters shall have their own section of control.

- A soft load function to prevent the system from operating at full load during the chilled water pull down period.
- Auto restart after a power failure, not requiring external battery backup or auxiliary power for maintaining program memory.
- Start-to-start and stop-to-start timers to provide minimum compressor off-time with maximum motor protection.
- Capability of communication with a PC or remote monitoring through a twisted pair RS-485 interface.(Optional)
- Automatic compressor rotation based on FIFO requirements will be provided.
- The controller shall contain the following features as a minimum:
    - Equipment Protection: The unit shall be protected by alarms that shut the unit down and require manual reset to restore unit operation. Shutdown alarms shall activate an alarm signal.
    - Shutdown Alarms:
        - No evaporator water flow
        - Low evaporator pressure
        - High condenser pressure
        - Motor protection system
        - Phase voltage protection (Optional)
        - Evaporator freeze protection
    - Digital Inputs
        - Unit off switch
        - Remote start/stop
        - Flow switch
        - Motor protection
    - Digital Outputs
        - Evaporator pump; field wired, starts pump when unit is set to start
        - Condenser pump; field wired, starts pump when unit is set to start
        - Air-cooled condenser; field wired, condenser when unit is set to start
    - Optional Building Automation System (BAS) Interface - The unit shall be equipped with an optional factory-installed BAS communication module (Optional). The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
    - The following options are to be included:
        - Condenser Water Regulating Valve
        - Water Isolation Valves
        - Y-Strainer for the Evaporator Inlet
        - Y-Strainer for the Condenser Water Inlet
        - Vibration isolators for field installation per plans.
        - Disconnect switch
        - Phase loss protection
        - Compressor Run Hour Meter
        - BAS interface module

- RS-232 Communication

3. **EXECUTION**

3.1. INSTALLATION

3.1.1. Install in strict accordance with local codes, manufacturer's requirements, shop drawings and Contract Documents.

3.1.2. Adjust and level chiller in alignment on supports.

3.1.3. Coordinate electrical installation with electrical contractor.

3.1.4. Coordinate controls with control contractor.

3.1.5. Provide all appurtenances required to ensure a fully operational and functional chiller.

3.2. START-UP

3.2.1. Ensure proper charge of refrigerant and oil.

3.2.2. Provide testing, and starting of machine, and instruct the Owner in its proper operation and maintenance.

Product Specifications
Modular Air-Cooled Chiller (Model MTR)

1. GENERAL

1.1. SUMMARY

1.1.1. Section includes design, performance criteria, refrigerants, controls, and installation requirements for water-cooled scroll compressor packaged chillers.

1.2. REFERENCES

1.2.1. Standards/Codes of ARI 550/590-98, ANSI/ASHRAE 15,

1.2.2. ASME Section VIII, NEC, and OSHA as adopted by the State.

1.2.3. Efficiency standards of ASHRAE Standard 90.1.

1.3. SUBMITTALS

1.3.1. Submit shop drawings and product data in accordance with contract specifications.

1.3.2. Submittals shall include the following:

- Dimensioned plan and elevation view drawings, required clearances, and location of all field connections.
- Summary of all auxiliary utility requirements such as: electricity, water, etc. Summary shall indicate quality and quantity of each required utility.
- Single-line schematic drawing of the power field hookup requirements, indicating all items that are furnished.
- Schematic diagram of control system indicating points for field connection. Diagram shall fully delineate field and factory wiring.
- Installation manual.

1.4. QUALITY ASSURANCE

1.4.1. Qualifications: Equipment manufacturer must specialize in the manufacture of the products specified and have five years experience with similar equipment and the refrigerant offered.

1.4.2. Regulatory Requirements: Comply with the codes and standards specified.

1.5. DELIVERY AND HANDLING

1.5.1. Chillers shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

1.5.2. Comply with the manufacturer's instructions for rigging and handling equipment.

1.6. WARRANTY

1.6.1. The equipment manufacturer’s warranty shall be for a period of one year from date of equipment start-up but not more than 18 months from shipment. The warranty shall cover defective material and workmanship within the above period, excluding refrigerant.

2. **PRODUCTS**

2.1. ACCEPTABLE MANUFACTURERS

2.1.1. Creotech Industries Inc.

2.1.2. Approved Equal

2.2. UNIT DESCRIPTION

2.2.1. Provide and install as shown on the plans factory assembled, factory charged, and factory run tested water-cooled scroll compressor packaged chillers in the quantity specified. each chiller shall consist of hermetic scroll compressors, brazed plate evaporator, brazed plate water-cooled condensers, control system and all components necessary for controlled unit operation. Refrigerant shall be R-410A.

2.3. DESIGN REQUIREMENTS

2.3.1. General: Provide a complete scroll packaged chiller as specified herein and as shown on the drawings. The unit shall be in accordance with the standards referenced in section 1.2 and any local codes in effect.

2.3.2. Performance: Refer to the schedule of performance on the drawings. Performance shall be in accordance with applicable ARI Standard.

2.3.3. Acoustics: Sound pressure levels for the unit shall not exceed the following specified levels. The manufacturer shall provide the necessary sound treatment to meet these levels if required. Sound data shall be provided with the quotation.Test shall be in accordance with ARI Standard 575.

2.4. CHILLER COMPONENTS

2.4.1. Compressors: The compressors shall be sealed hermetic scroll type with crankcase oil heater and suction strainer. The compressor motor shall be refrigerant gas cooled, high torque, hermetic induction type, and two-pole, with inherent thermal protection on all three phases.

2.4.2. Evaporator: The evaporator shall be direct expansion type with stainless steel plates brazed together. It shall be insulated with 3/4 inch (19mm) closed cell polyurethane insulation and have 435 psi (3000kPa) water side working pressure.

2.4.3. Condenser: The condenser shall be direct expansion type with stainless steel plates brazed together. It shall be designed for 435 psi (3000kPa) water side working pressure and 435 psig (3000kPa) refrigerant side pressure.

2.4.4. Refrigerant Circuit: Refrigerant circuit shall include a liquid line shutoff valve, replaceable core or sealed filter-drier, sight glass with moisture indicator, liquid line solenoid valve, thermal expansion valve, and insulated suction line.

2.4.5. Control Panel: The control panel shall contain a microprocessor controller providing operating and equipment protection controls plus motor starting equipment, factory wired, operationally tested, and ready for operation. Standard components shall include a control transformer with primary and secondary fusing, microprocessor transformers with integral fusing, compressor contactors, over current protection, single-point wiring arrangement and switches for each circuit pump-down and unit control power. The control panel shall have a hinged tool-locked door.

2.4.6. The control system shall stage the compressors based on the set-point temperature. Equipment protection devices controlled by the microprocessor include motor protection, high pressure, loss of refrigerant, loss of water flow, freeze protection, and low refrigerant pressure. Controls shall include off/on selector switch, chilled water set-point adjustment, anti-cycle timer, and digital display with water temperature and set-point, operating temperatures and pressures, and diagnostic messages. The following features and functions shall be included:

- Critical parameters shall have their own section of control.
- Soft loads function to prevent the system from operating at full load during the chilled water pull down period.
- Auto restart after a power failure, not requiring external battery backup or auxiliary power for maintaining program memory.
- Start-to-start and stop-to-start timers to provide minimum compressor off-time with maximum motor protection.
- Capability of communication with a PC or remote monitoring through a twisted pair RS-485 interface.(Optional)
- Automatic compressor rotation based on FI/FO requirements will be provided.
- The controller shall contain the following features as a minimum:
  - Equipment Protection: The unit shall be protected by alarms that shut the unit down and require manual reset to restore unit operation. Shutdown alarms shall activate an alarm signal.
  - Shutdown Alarms
    - No evaporator water flow
    - Low evaporator pressure
    - High condenser pressure
    - Motor protection system
    - Phase voltage protection (Optional)
    - Evaporator freeze protection
  - Digital Inputs
    - Unit off switch
    - Remote start/stop
    - Flow switch
    - Motor protection
  - Digital Outputs
    - Evaporator pump; field wired, starts pump when unit is set to start
    - Condenser pump; field wired, starts pump when unit is set to start
    - Air-cooled condenser; field wired, condenser when unit is set to start
  - Optional Building Automation System (BAS) Interface - The unit shall be equipped with an optional factory-installed BAS communication module (Optional). The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
  - The following options are to be included:

- o Water Isolation Valves
- o Y-Strainer for the Evaporator Inlet
- o Y-Strainer for the Condenser Water Inlet
- o Vibration isolators for field installation per plans.
- o Disconnect switch
- o Phase loss protection
- o Compressor Run Hour Meter
- o BAS interface module
- o RS-232 Communication

3. EXECUTION

3.1. INSTALLATION

3.1.1. Install in strict accordance with local codes, manufacturer's requirements, shop drawings and Contract Documents.

3.1.2. Adjust and level chiller in alignment on supports.

3.1.3. Coordinate electrical installation with electrical contractor.

3.1.4. Coordinate controls with control contractor.

3.1.5. Provide all appurtenances required to ensure a fully operational and functional chiller.

3.2. START-UP

3.2.1. Ensure proper charge of refrigerant and oil.

3.2.2. Provide testing, and starting of machine, and instruct the Owner in its proper operation and maintenance.