THERMAL CARE

Superior equipment, Exceptional service

Product Catalog

TC Series Centrifugal Variable-Speed Central Chillers

Contents

Standard Features

Variable-Speed Compressor
Direct-drive variable-speed centrifugal compressor technology continuously adjusts speed to match load to reduce operating costs.

Magnetic Bearing
A magnetic field levitates the drive shaft and eliminates the friction of conventional bearings for higher efficiencies and an oil-free refrigeration system.

Integral Variable-Speed Drive
High-efficiency brushless DC motor with built-in variable-speed drive technology is refrigerant cooled, compact, and energy efficient.

Soft-Start
The variable-speed drive limits soft-starts to 2 amps inrush current per compressor to reduce peak energy demand and extend compressor motor life.

Low Noise Operation
The magnetic bearings keep the drive shaft in position under high-speed operation for virtually no structural vibration and noise levels as low as 72 dBA.

Stainless Steel Evaporator
High-efficiency stainless steel plates with copper brazing provide maximum performance, long life, and an enhanced level of protection from harsh process conditions.

Evaporator Inlet Strainer
The evaporator inlet strainer removes any debris present in the process fluid to prevent costly downtime and repair due to a clogged chiller evaporator.

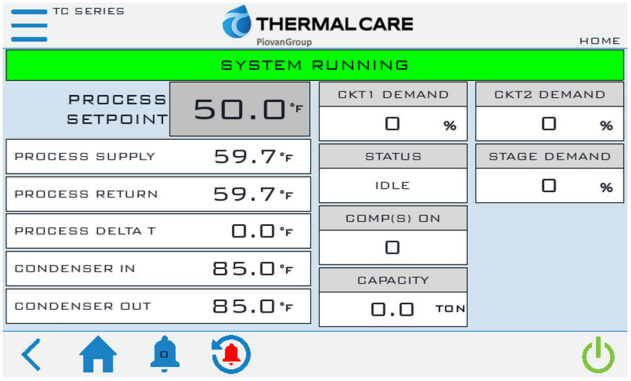
Fits through Doors
Single circuit chillers up to 90 tons are compact and easily fit through standard 36-inch wide doors for easy maneuvering into tight installation spaces.

Dual Circuit Manifolds
Dual circuit chillers include evaporator manifolds and water-cooled condenser units include condenser water manifolds for quick and easy installation.

Modular Expandable System
Our modular system design provides for system expansion to over 1,400 tons using up to six chillers and twelve refrigeration circuits.

Single or Multiple Circuit Configurations
Dual-circuit chillers for redundancy and back up for critical processes or systems and single-circuit chillers for dedicated loads.

Color Touch-Screen Display
A high-resolution, high-speed, 7-inch color touch-screen with English text clearly shows chiller operation for quick and easy monitoring and control of the system.



Standard PLC Home Screen

CONNEX4.0 Ready Controls
Every chiller is equipped with an Ethernet port and is fully compatible with the CONNEX4.0 plant-wide equipment control and monitoring system.

Compressor Rotary Circuit Breaker
A through-the-door rotary circuit breaker for each compressor allows easy maintenance of a compressor without the need to shut down power to the chiller.

UL 508A Industrial Control Panel
Every chiller has a UL label certifying our panel design and components comply with UL 508A standards ensuring the panels are safe and consistent for reliable operation.

Warranty
1 year entire unit parts
1 year labor

Available Options

12 inch HMI

Replaces the standard 7-inch screen with a 12-inch, high resolution, color screen with a built-in industrial computer to allow for remote monitoring and control using Teamviewer software installed on any remote Windows based PC or smart phone.

12-inch HMI and CONNEX4.0 Master Controller

Replaces the standard 7-inch screen with a 12-inch, high resolution, color screen with a built-in industrial computer to allow for remote monitoring and control using Teamviewer software installed on any remote Windows based PC or smart phone. This package also adds a second PLC to allow for connection of up to 15 total Thermal Care Connex4.0 ready devices for many ways to interact with the connected equipment such as smart phone/tablet control, configurable email and text alerts for alarms, warnings, event alerts, and data collection.

BACnet Communications Port

Adds a ModBUS to BACnet gateway which is wired to a RS-485 connector on the chiller control panel.

Physical Data

Water Cooled Condenser Single-Circuit Chillers Physical Data

	TCW300C	TCW300E	TCW300J	TCW300M	TCW350Q	TCW350S
Cooling Capacity Range (ton)[1]	30 to 90	30 to 90	30 to 90	30 to 90	40 to 120	40 to 120
Set Point Range (°F)	40 to 75	40 to 75	40 to 75	40 to 75	40 to 75	40 to 75
Compressor (qty)	1	1	1	1	1	1
Condenser Water Inlet & Outlet Flange (in)	4	4	4	4	4	4
Process Fluid Inlet & Outlet Flange (in)	3	3	4	4	4	4
Length (in)	118	118	120	120	141	145
Width (in)	29	29	29	29	37	37
Height (in)	77	77	77	77	75	75
Shipping Weight (lbs)	1,800	1,900	2,100	2,400	2,774	2,825
Operating Weight (lbs)	2,000	2,100	2,300	2,600	3,071	3,208

[1]Cooling capacity when cooling water with 50°F set point, 60°F return, 85°F condenser water, R134a refrigerant.

Water Cooled Condenser Dual-Circuit Chillers

	TCW600C	TCW600E	TCW600J	TCW600M	TCW700Q	TCW700S
Cooling Capacity Range (ton)[1]	30 to 180	30 to 180	30 to 180	30 to 180	40 to 240	40 to 240
Set Point Range (°F)	40 to 75	40 to 75	40 to 75	40 to 75	40 to 75	40 to 75
Compressor (qty)	2	2	2	2	2	2
Condenser Water Inlet & Outlet Flange (in)	6	6	6	6	6	6
Process Water Inlet & Outlet Flange (in)	4	4	6	6	6	6
Length (in)	124	124	124	126	136	164
Width (in)	54	54	54	54	73	73
Height (in)	77	77	77	77	63	63
Shipping Weight (lbs)	3,700	3,800	4,100	4,700	5,548	5,650
Operating Weight (lbs)	4,000	4,200	4,600	5,200	6,588	6,863

[1]Cooling capacity when cooling water with 50°F set point, 60°F return, 85°F condenser water, R134a refrigerant.

Remote Air-Cooled Condenser Single-Circuit Chillers

	TCR300C	TCR300D	TCR300H	TCR350K	TCR350Q	TCR350S
Cooling Capacity Range (ton)[1]	30 to 80	30 to 80	30 to 80	40 to 120	40 to 120	40 to 120
Set Point Range (°F)	45 to 75	45 to 75	45 to 75	45 to 75	45 to 75	45 to 75
Compressor (qty)	1	1	1	1	1	1
Refrigerant Liquid Line (in)	1⅜	1⅜	1⅝	1⅝	2⅛	2⅛
Refrigerant Discharge Line (in)	2⅛	2⅛	2⅝	2⅝	3⅛	3⅛
Process Fluid Inlet & Outlet Flange (in)	3	3	4	4	4	4
Length (in)	105	105	109	109	129	129
Width (in)	29	29	29	29	37	37
Height (in)	77	77	77	77	75	75
Shipping Weight (lbs)	1,800	1,900	2,100	2,400	2,067	2,129
Operating Weight (lbs)	2,000	2,100	2,300	2,600	2,176	2,286

[1]Cooling capacity when cooling water with 50°F set point, 60°F return, 95°F condenser air, R134a refrigerant.

Remote Air-Cooled Condenser Dual-Circuit Chillers

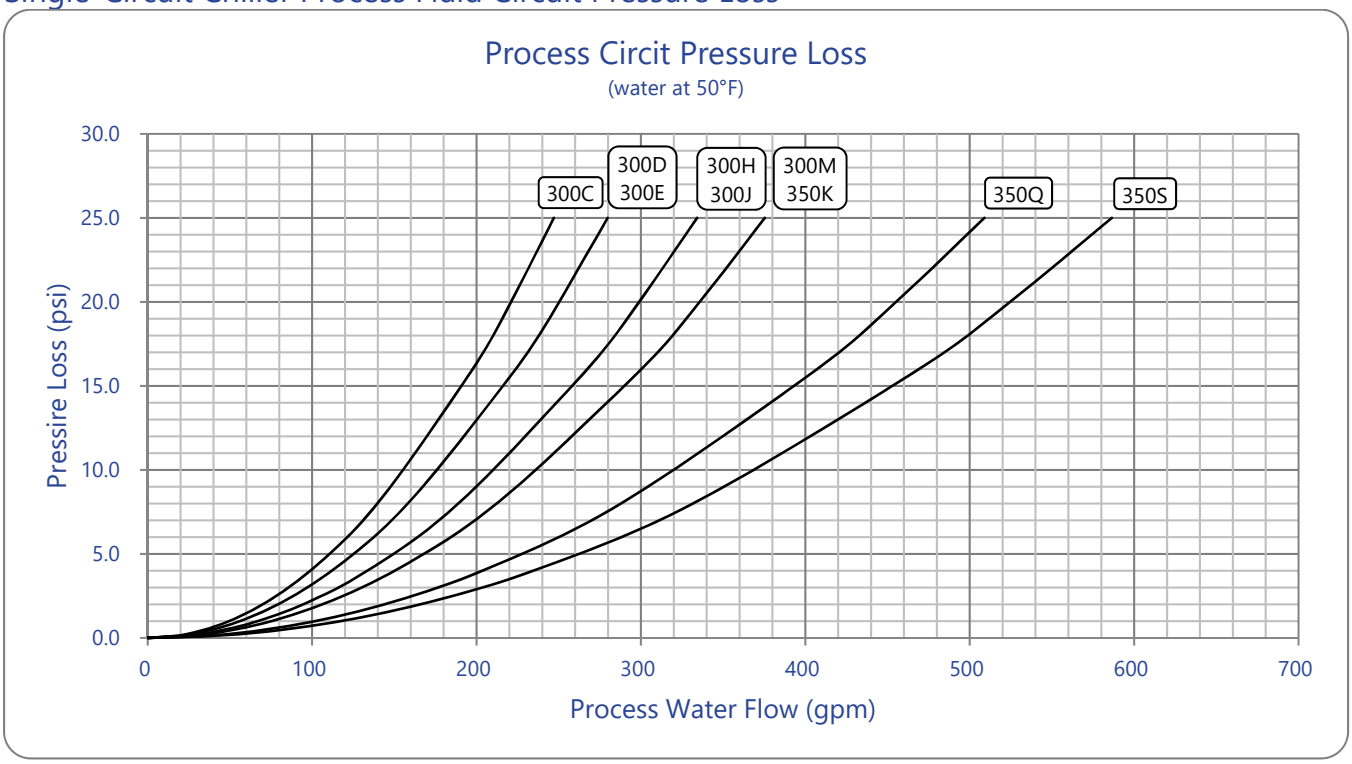
	TCR600C	TCR600D	TCR600H	TCR700K	TCR700Q	TCR700S
Cooling Capacity Range (ton)[1]	30 to 160	30 to 160	30 to 160	40 to 240	40 to 240	40 to 240
Set Point Range (°F)	45 to 75	45 to 75	45 to 75	45 to 75	45 to 75	45 to 75
Compressor (qty)	2	2	2	2	2	2
Refrigerant Liquid Line Per Circuit (in)	1⅜	1⅜	1⅝	1⅝	2⅛	2⅛
Refrigerant Discharge Per Circuit (in)	2⅛	2⅛	2⅝	2⅝	3⅛	3⅛
Process Fluid Inlet & Outlet Flange (in)	4	4	6	6	6	6
Length (in)	112	112	120	120	139	145
Width (in)	56	56	56	56	73	73
Height (in)	77	77	77	77	63	63
Shipping Weight (lbs)	3,700	3,800	4,100	4,700	4,134	4,258
Operating Weight (lbs)	4,000	4,200	4,600	5,200	4,526	4,746

[1]Cooling capacity when cooling water with 50°F set point, 60°F return, 95°F condenser air, R134a refrigerant.

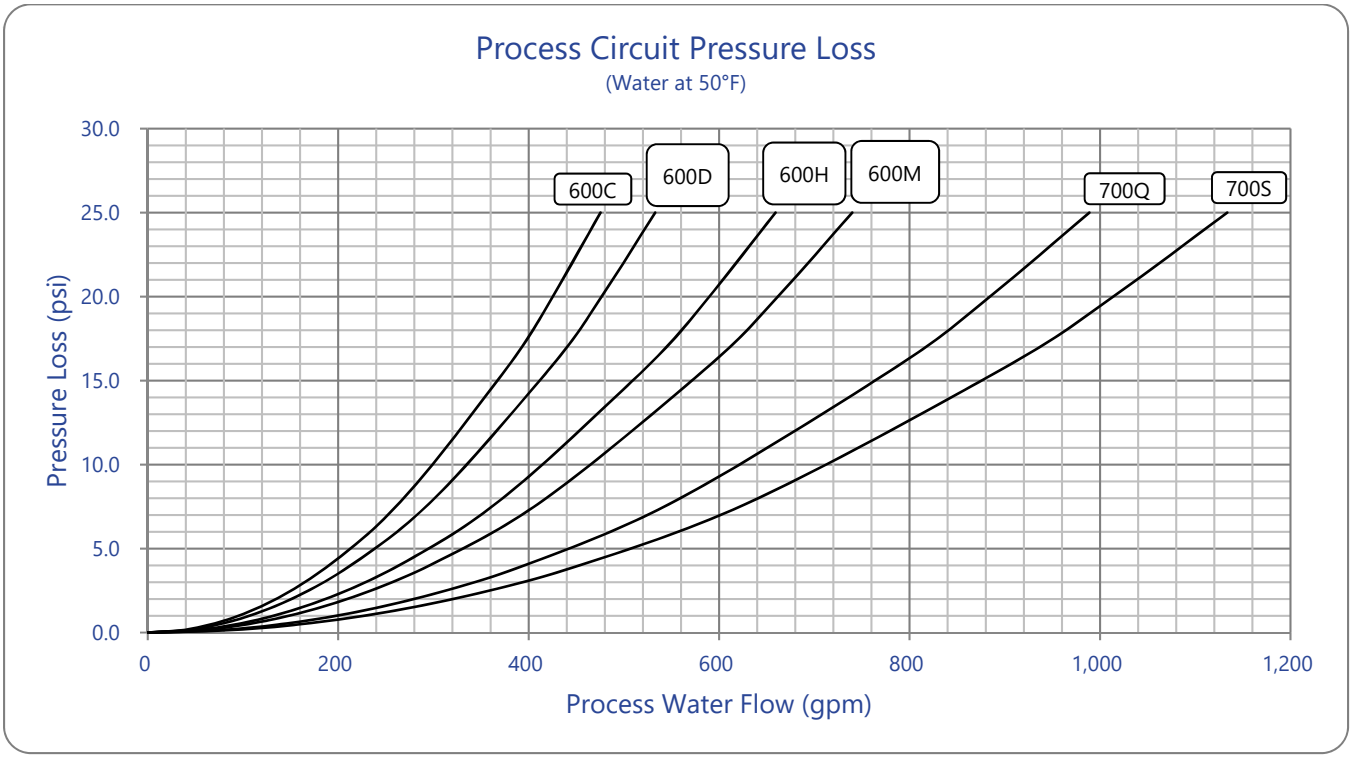
Remote Air-Cooled Condensers

	LEVF-16410	LAVF-24310	LAVF-24410	LAVF-25312	LAVF-25412	LEVF-26410
Quantity Required	1 for TCR300C 1 for TCR300D	1 forTCR300H 2 for TCR600H	1 for TCR350K 2 for TCR700K	1 for TCR350Q 2 for TCR700Q	1 for TCR350S 2 for TCR700S	1 for TCR600C 1 for TCR600D
Number of Fans	6	8	8	10	10	12
Inlet Line Per Circuit (in)	3⅛	3⅛	3⅛	3⅛	3⅛	3⅛
Outlet Line Per Circuit (in)	3⅛	3⅛	3⅛	3⅛	3⅛	3⅛
Length (in)	342	234	234	290	290	342
Width (in)	45	91	91	91	91	91
Height (in)	61	61	61	61	61	61
Shipping Weight (lbs)	2,800	2,700	2,900	4,100	4,100	5,300
Operating Weight (lbs)	Varies based on refrigerant piping design, refrigerant charge, and operating conditions					

Single-Circuit Chiller Process Fluid Circuit Pressure Loss



Dual-Circuit Chiller Process Fluid Circuit Pressure Loss



Electrical Data

Water Cooled Condenser Chiller Electrical Data (60Hz)

Water-Cooled Chillers				Remote Air-Cooled Condenser Chillers			
Model	Rated Voltage 3-phase[1]	Unit Data		Model	Rated Voltage 3-phase[1]	Unit Data	
		MCA[2]	MOPD[3]			MCA[2]	MOPD[3]
TCW300C	460	104	175	TCR300C	460	173	300
	575	94	150		575	142	250
TCW300E	460	104	175	TCR300D	460	173	300
	575	94	150		575	142	250
TCW300J	460	129	225	TCR300H	460	173	300
	575	104	175		575	142	250
TCW300M	460	154	250	TCR350K	460	192	300
	575	129	225		575	-	-
TCW350Q	460	229	400	TCR350Q	460	229	400
	575	-	-		575	-	-
TCW350S	460	229	400	TCR350S	460	229	400
	575	-	-		575	-	-
TCW600C	460	184	250	TCR600C	460	308	400
	575	166	225		575	252	350
TCW600E	460	184	250	TCR600D	460	308	400
	575	166	225		575	252	350
TCW600J	460	229	300	TCR600H	460	308	400
	575	184	250		575	252	350
TCW600M	460	274	350	TCR700K	460	342	450
	575	229	300		575	-	-
TCW700Q	460	409	500	TCR700Q	460	409	500
	575	-	-		575	-	-
TCW700S	460	409	500	TCR700S	460	409	500
	575	-	-		575	-	-

[1]Allowable voltage is ± 10% from rated voltage.
[2]MCA is Minimum Circuit Amps, used for minimum wire size requirement.
[3]MOP is Maximum Overcurrent Protection, used for sizing main power protection device.

Remote Air-Cooled Condenser Electrical Data (60 Hz)

Remote Condenser Model	Rated Voltage 3-Phase[1]	Unit Data	
		MCA[2]	MOCP[3]
LEVF-16410	460	22	30
LAVF-24310	460	29	35
LAVF-24410	460	29	35
LAVF-25312	460	36	45
LAVF-25412	460	36	45
LEVF-26410	460	43[4]	55[4]

[1]Allowable voltage is ± 10% from rated voltage. 575/3/60 remote condensers require special selection, consult factory for details.
[2]MCA is Minimum Circuit Amps, used for minimum wire size requirement.
[3]MOP is Maximum Overcurrent Protection, used for sizing main power protection device.
[4]This is a dual-circuit condenser with two panels, one per circuit; each requires a power feed for 50% of the MCA and MOP shown.

Application Considerations

When designing a chilled water system it is important all aspects of the system are considered to ensure steps are taken to provide stable and reliable operation. The following provides some general guidelines for designing a system.

Foundation

Install the unit on a rigid, non-warping mounting pad, concrete foundation, or level floor suitable to support the full operating weight of the equipment. When installed the equipment must be level within ¼ inch over its length and width.

Chiller Unit Location

Proper ventilation is an important consideration when locating the condenser. In general, locate the unit in an area that will not rise above 110°F.

To ensure proper airflow and clearance space for proper operation and maintenance allow a minimum of 36 inches of clearance between the sides of the equipment and any walls or obstructions. Avoid locating piping or conduit over the unit to ensure easy access with an overhead crane or lift to lift out heavier components during replacement or service. In addition, ensure the condenser and evaporator refrigerant pressure relief valves can vent in accordance with all local and national codes.

Remote Air-Cooled Condenser Location

The remote air-cooled condenser is for outdoor use. Locate the remote condenser in an accessible area. The vertical air discharge must be unobstructed. Allow a minimum of 48 inches of clearance between the sides and ends of the condenser and any walls or obstructions. For installations with multiple condensers, allow a minimum of 96 inches between condensers placed side-by-side or 48 inches for condensers placed end-to-end.

When locating the condenser it is important to consider accessibility to the components to allow for proper maintenance and servicing of the unit. Avoid locating piping or conduit over the unit to ensure easy access with an overhead crane or lift to lift out heavier components during replacement or service.

Avoid areas that can create a "micro-climate" such as an alcove with east, north, and west walls that can be significantly warmer than surrounding areas. The condenser needs to have unrestricted airways so it can easily move cool air in and heated air away. Consider locating the condenser where fan noise and vibration transmission into nearby workspaces is unlikely.

Process Fluid Piping

Proper insulation of chilled process fluid piping is crucial to prevent condensation. The formation of condensation adds a substantial heat load to the chiller.

The importance of properly sized piping cannot be overemphasized. See the ASHRAE Handbook or other suitable design guide for proper pipe sizing. In general, run full size piping out to the process and reduce pipe size at connections as needed. One of the most common causes of unsatisfactory chiller performance is poor piping system design. Avoid long lengths of hoses, quick disconnect fittings, and manifolds wherever possible as they offer high resistance to water flow. When manifolds are required, install them as close to the use point as possible. Provide flow-balancing valves at each machine to assure adequate water distribution in the entire system.

Process Fluid Temperature

The chiller can operate with a variety of different supply and return temperatures. The chiller is able to start and pull down with short-term entering fluid temperatures up to 20°F warmer than the maximum set point of the chiller. This allows the chiller to pull down the temperature of a reservoir or process fluid loop on start-up. Under normal operation it is recommended that the entering water temperature not exceed 10°F warmer than the maximum set point temperature of the chiller.

Process Fluid Flow Rate

The nominal performance of the chiller is based on a temperature rise of 10°F through the process. The chiller is capable of operating with different operating temperature differentials provided certain flow limitations are not exceeded and correction to capacity, pressure drops, and other operating parameters are taken into consideration when selecting the proper unit for the application. The minimum flow rate to prevent fouling and to ensure the chiller stays within normal refrigerant operating

conditions is approximately 1.2 gpm per nominal ton of cooling capacity. The fouling factor used to calculate the ratings of the vessels are 0.00010 Ft^2 • Hr • °F/Btu.

If the process flow requirement is less than 1.2 gpm per nominal ton of cooling capacity use a primary pumping loop for the lower flow at a higher temperature rise and a secondary pumping loop for a higher flow and lower temperature drop through the chiller. If a secondary pumping loop is used, the mixed temperature of coolant entering the evaporator must be a minimum of 5°F above the design set point of the chiller.

The maximum flow limitation is determined based upon a 5°F drop through the chiller at the maximum capacity of the chiller; however, the flows often times result in impractical pressure drops through the chiller and are therefore not likely for system design. If the process flow requirement is higher than the maximum flow limitation use a bypass around the chiller or a primary pumping loop designed for the high flow at a lower temperature rise and a secondary pumping loop for a lower flow and high temperature drop through the chiller. If a secondary pumping loop is used, the mixed temperature of coolant entering the chiller must be a minimum 5°F above the design set point of the chiller.

The use of varying chiller flows is sometimes necessary; however, a dedicated evaporator circulation pump provides increased system stability. If the flow through the chiller is varied, the minimum fluid loop volume must be in excess of 3 gallons of coolant per ton of cooling and the flow rate must change at a rate of no greater than 10% per minute in order to maintain an acceptable level of temperature control. If the chiller sees a net rate of change greater than 10% per minute it may result in temporary supply temperature fluctuations greater than 1°F.

Condenser Water Temperature and Flow

All water-cooled condenser chillers include a factory mounted condenser water-regulating valve to regulate the flow of condenser water to maintain the proper refrigerant pressures. The minimum flow rate is approximately 0.5 gpm per nominal cooling ton to prevent fouling and to ensure the chiller stays within normal refrigerant operating conditions. The fouling factor used to calculate the ratings of the vessels are 0.00025 Ft^2 • Hr • °F/Btu.

The chiller will start and operate with an inlet water temperature between 55°F and 95°F. The actual flow requirements will vary. Lowering the condenser water supply temperature below 85°F is an effective way to reduce the overall cooling system input power requirements.

Condenser Air Temperature

All remote air-cooled condenser chillers come with a factory selected remote air-cooled condenser to meet the needs of the chiller module to which it is connected. The chiller is designed to allow the unit to start and operate with an inlet air temperature range between -20°F and 100°F. The minimum ambient air temperature at which the chiller can be started is -20°F based on still air.

System Fluid Chemistry Requirements

The properties of water make it ideal for heat transfer applications. It is safe, non-flammable, non-poisonous, easy to handle, widely available, and inexpensive in most industrialized areas.

When using water as a heat transfer fluid it is important to keep it within certain chemistry limits to avoid unwanted side effects. Water is a “universal solvent” because it can dissolve many solid substances and absorb gases. As a result, water can cause the corrosion of metals used in a cooling system. Often water is in an open system (exposed to air) and when the water evaporates, the dissolved minerals remain in the process fluid. When the concentration exceeds the solubility of some minerals, scale forms. The life giving properties of water can also encourage biological growth that can foul heat transfer surfaces.

To avoid the unwanted side effects associated with water cooling, proper chemical treatment and preventive maintenance is required for continuous plant productivity.

Unwanted Side Effects of Improper Water Quality

- Corrosion
- Scale
- Fouling
- Biological Contamination

Cooling Water Chemistry Properties

- Electrical Conductivity
- pH
- Alkalinity
- Total Hardness
- Dissolved gases

Chillers at their simplest have two main heat exchangers: one that absorbs the heat from the process (evaporator) and one that removes the heat from the chiller (condenser). All our chillers use stainless steel brazed plate evaporators. Our air-cooled chillers use air to remove heat from the chiller; however, our water-cooled chillers use either a tube-in-tube or shell-in-tube condenser which has copper refrigerant tubes and a steel shell. These, as are all heat exchangers, are susceptible to fouling of heat transfer surfaces due to scale or debris. Fouling of these surfaces reduces the heat-transfer surface area while increasing the fluid velocities and pressure drop through the heat exchanger. All of these effects reduce the heat transfer and affect the efficiency of the chiller.

The complex nature of water chemistry requires a specialist to evaluate and implement appropriate sensing, measurement and treatment needed for satisfactory performance and life. The recommendations of the specialist may include filtration, monitoring, treatment and control devices. With the ever-changing regulations on water usage and treatment chemicals, the information is usually up-to-date when a specialist in the industry is involved.

Fill Water Chemistry Requirements

Water Characteristic	Quality Limitation
Alkalinity (HCO3-)	70-300 ppm
Aluminum (Al)	Less than 0.2 ppm
Ammonium (NH3)	Less than 2 ppm
Chlorides (Cl-)	Less than 300 ppm
Electrical Conductivity	10-500µS/cm
Free (aggressive) Carbon Dioxide (CO2)†	Less than 5 ppm
Free Chlorine(Cl2)	Less than 1 PPM
HCO3-/SO42-	Greater than 1.0
Hydrogen Sulfide (H2S)	Less than 0.05 ppm
Iron (Fe)	Less than 0.2 ppm
Manganese (Mn)	Less than 0.1 ppm
Nitrate (NO3)	Less than 100 ppm
pH	7.5-9.0
Sulfate (SO42-)	Less than 70 ppm
Total Hardness (dH)k	4.0-8.5

† Dissolved carbon dioxide calculation is from the pH and total alkalinity values shown below or measured on the site using a test kit. Dissolved Carbon Dioxide, PPM = TA x $2^{[(6.3-pH)/0.3]}$ where TA = Total Alkalinity, PPM as $CaCO_3$

Recommended Glycol Solutions

Chilled Water Temperature	Percent Glycol By Volume
50°F (10°C)	Not required
45°F (7.2°C)	5 %
40°F (4.4°C)	10 %
35°F (1.7°C)	15 %
30°F (-1.1°C)	20 %
25°F (-3.9°C)	25 %
20°F (-6.7°C)	30 %

CAUTION: When your application requires the use of glycol, use industrial grade glycol specifically designed for heat transfer systems and equipment. Never use glycol designed for automotive applications. Automotive glycols typically have additives engineered to benefit the materials and conditions found in an automotive engine; however, these additives can gel and foul heat exchange surfaces and result in loss of performance or even failure of the chiller. In addition, these additives can react with the materials of the pump shaft seals resulting in leaks or premature pump failures.

WARNING: Ethylene Glycol is flammable at higher temperatures in a vapor state. Carefully handle this material and keep away from open flames or other possible ignition sources.

Over-Sizing Chillers

Over-sizing chillers is sometimes done to allow for future growth. While this practice may be necessary it is highly recommended that chillers not be oversized by more than 15% at design conditions to avoid unwanted reductions in system efficiency and excessive electrical power use and/or compressor cycling due to reduced chiller loading. If the system design requires prolonged periods of time operating at reduced loads it is recommended that two smaller chillers be considered as operating smaller chillers at higher loads is preferred to operating one larger chiller at or near its minimum load capacity.

Strainers

Each evaporator is provided with a 20 mesh inlet strainer to protect the evaporator. All water-cooled condensers should be filtered with a minimum of a 20 mesh filtering system to protect the condenser from contamination.

Remote Condenser Selection

Chillers using remote air-cooled condensers include a properly sized and selected remote condenser so there is no need for a separate remote condenser selection. For installation and line size guidelines please refer to the Installation and Operation manual of the chiller.

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