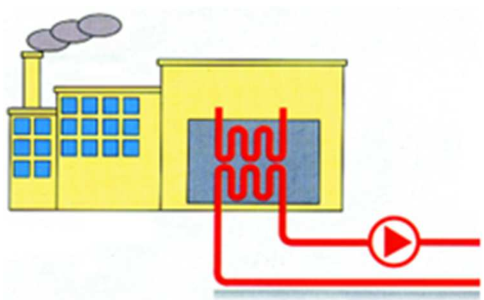
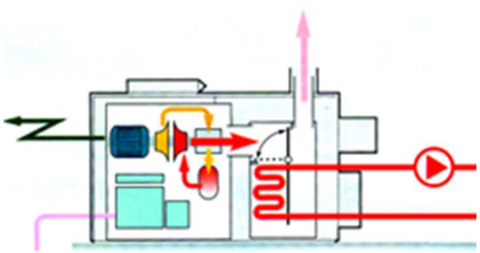
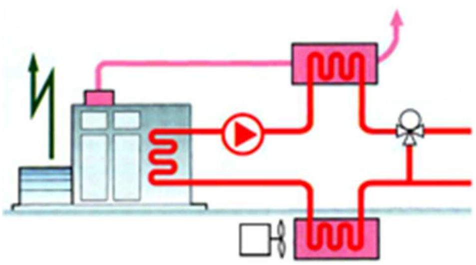
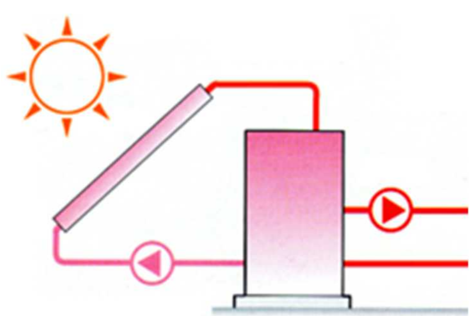
Water-Fired Chiller/Chiller-Heater

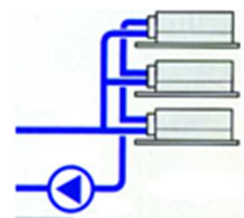
WFC-SC Series: 5, 10, 20, 30 and 50 RT Cooling Capacities **WFC-M Series**: 100 RT Cooling Capacities
WFC-SH Series: 10, 20, and 30 RT Cooling Capacities











WE ARE FRIENDLY TO THE EARTH

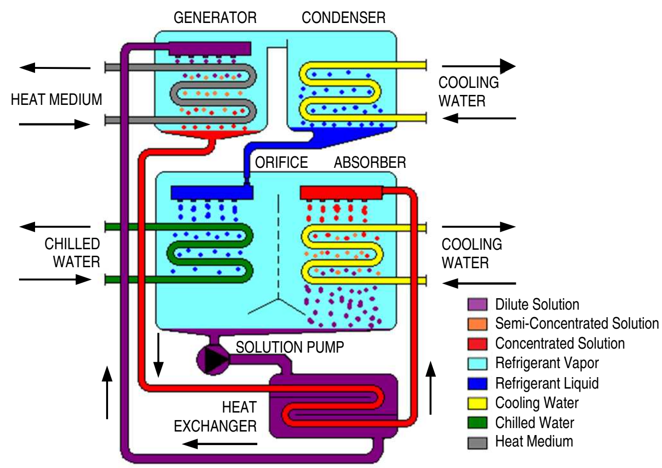
Water-Fired Single-Effect Chiller or Chiller-Heater

Yazaki water-fired SINGLE-EFFECT chillers (with cooling capacities of 5 to 100 tons of refrigeration) produce chilled water for cooling, while chiller-heaters (with cooling capacities of 10 to 30 tons of refrigeration) produce chilled water, but also can provide hot water for heating in comfort air conditioning applications. The absorption cycle is energized by a heat medium (hot water) ranging from 158°F to 203°F from an industrial process, cogeneration system, solar energy, or other heat source. The condenser circuit is water cooled through a cooling tower or ground loop.

Absorption Principle

Yazaki absorption chiller-heaters use a solution of lithium bromide and water, under a vacuum as the working fluid. Water is the refrigerant and lithium bromide (a non-toxic salt) is the absorbent. Refrigerant, liberated by heat from the solution, produces a refrigerating effect in the evaporator when cooling water is circulated through the condenser and absorber.

Cooling Cycle



Generator

When the heat medium inlet temperature exceeds 154.4°F, the solution pump forces dilute solution into the generator. The solution boils on the surface of the generator tubing bundle, releasing refrigerant vapor which rises up and flows over into the condenser. As a result the solution becomes more concentrated and it drops into the generator sump, where it drains down through a heat exchanger before entering the absorber section.

Condenser

Refrigerant vapor is condensed on the surface of the condenser coil and latent heat, removed by the cooling water, is rejected to a cooling tower or ground loop. Refrigerant liquid accumulates in the condenser sump and then passes through an orifice into the evaporator.

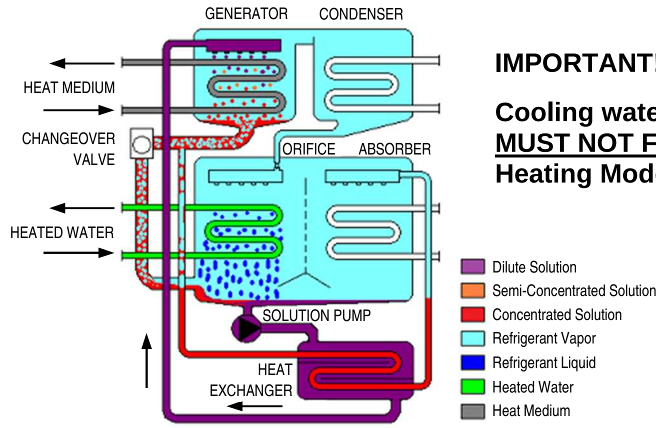
Evaporator

In the evaporator the refrigerant liquid is exposed to a substantially deeper vacuum than in the condenser due to the influence of the absorber. As the refrigerant liquid flows over the surface of the evaporator coil, it boils into vapor and removes an amount of heat from the chilled water circuit equivalent to the latent heat of the refrigerant. The recirculating chilled water is cooled to the selected set point and the refrigerant vapor is attracted to the absorber.

Absorber

A deep vacuum in the absorber is maintained by the affinity of the concentrated solution from the generator for the refrigerant vapor formed in the evaporator. The refrigerant vapor is absorbed by the concentrated lithium bromide solution flowing across the surface of the absorber coil. Heat of condensation and dilution is removed by the cooling water and rejected to a cooling tower. The resulting dilute solution is preheated in a heat exchanger and returned to the generator where the cycle is repeated.

Heating Cycle



IMPORTANT!

Cooling water <u>MUST NOT FLOW</u> during Heating Mode!

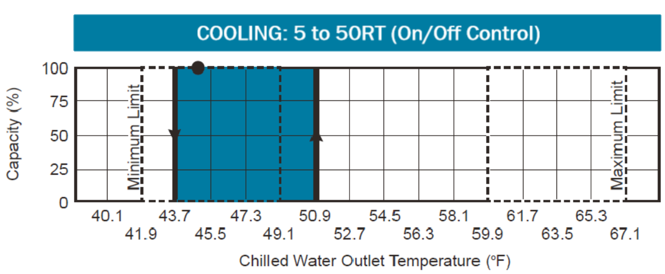
Generator

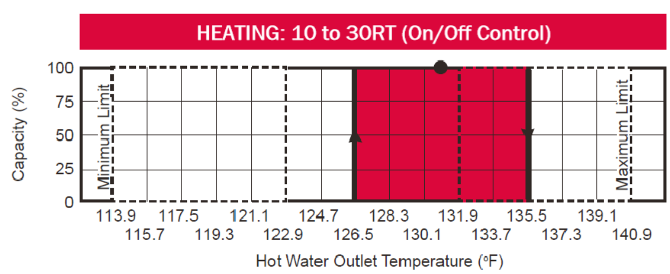
When the heat medium inlet temperature exceeds 154.4°F, the solution pump forces dilute solution into the generator tubing bundle. The solution boils on the surface of the generator, releasing refrigerant vapor, which rises and flows into the condenser. The solution becomes more concentrated as a result and the concentrated solution drops into the generator sump where it drains down through a heat exchanger before entering the absorber section.

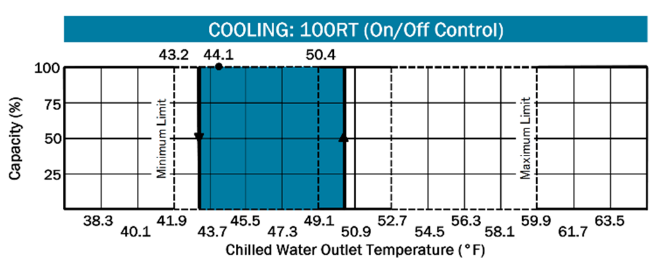
Evaporator

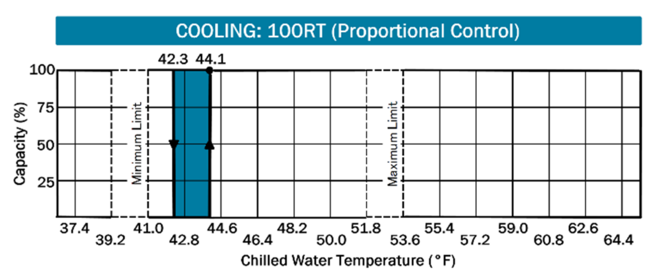
Hot refrigerant vapor condenses on the surface of the evaporator coil and an amount of heat equivalent to the latent heat of the refrigerant is transferred into the hot water circuit. The recirculating water is heated to the selected set point. Refrigerant liquid mixes with concentrated solution and the resulting dilute solution returns to the generator where the cycle is repeated.

Performance Characteristics









● Standard Rating Point   Standard Control Settings

Features and Benefits

- Ideal for heating when used in a two-pipe system with properly sized water coils. (WFC-SH models only)
- Mode and Enable/Disable condition can be selected remotely.
- Only a 30-minute changeover delay between cooling and heating modes. (WFC-SH models only)
- The absorption cycle is energized by hot water. This hot water can be from any source such as cogeneration, solar, or any waste heat source as long as it can be provided to the chiller or chiller-heater at a temperature between 158°F to 203°F.
- Extended capacities available when supplied with cooling water colder than design standard of 87.8°F (WFC-M design standard 85°F) and/or heat medium warmer than design standard of 190.4°F (WFC-M design standard 194°F).
- Faster cold start-up time (as quick as 90 seconds) than similar chillers with flooded generators.
- Working fluids of lithium bromide and water operate under a vacuum at all times and are safe, odorless, and non-toxic.
- Only one rotating part: the hermetically sealed solution pump.
- Vacuum vessel fully hermetically sealed at the factory for a level of vacuum integrity that is unmatched in the industry. No field welding necessary.
- Helps to prevent crystallization by utilizing a solution pump and gravity drain-back design.
- Chilled and hot water outlet temperatures controlled by a built-in microprocessor with outputs to control a 3-way heat medium bypass valve, all relevant pumps, and even the cooling tower fan (if so desired). All valves and pumps are field-supplied. Alternatively, the valves are available as a factory-supplied but field-installed option.
- Built-in logic will shut down the unit under abnormally high heat medium and/or cooling water temperatures to help prevent crystallization and other service-related issues.
- Proprietary solution and inhibitor blends ELIMINATE the need for regular chemical analysis of working fluids within the unit, resulting in much simpler regular maintenance when compared with most other manufacturers.
- All chillers and chiller-heaters are supplied with UL50E Type 3R cabinets that are suitable for indoor or outdoor installation without modification.
- Factory charged and run tested. Solution balancing done at the factory so that it does not need to be done in the field at startup potentially eliminating DAYS of necessary commissioning time when compared with other manufacturers.
- UL Listed as a unit for USA and Canada.

Accessories

Supplied with Chiller/Chiller-Heater:

- **Unit Interface (1):**
  GTR02 Digital Interface
  (with WFC-SC5 only)
  ACT-3 Maintenance Checker
  (WFC-SC/SH 10 thru 30, WFC-SC50)
  Infinity Software Interface Connector
  (with WFC-M100 only)
- L-Anchor Plates
  (WFC-SC50 and WFC-M100 only)
- Leveling Shims (6)
  (except on WFC-SC50 and WFC-M100)
- Lifting Lugs (4)
  (except on WFC-M100)
- Installation Instructions (1)
- Operating Instructions (1)
- Warranty Registration Card (1)
- Wiring Schematic (1)

Factory-Installed Options:

- FS2 Cooling Water Flow Switch
- WTI Inlet Chilled/Hot Water Sensor
  (Standard on WFC-M100)

Optional Field-Installed Accessories:

- Building Management System Interface Adapter (LON-compatible)
- FS2 Cooling Water Flow Switch
- Heat Medium Bypass Valve Kits
  (Included with WFC-M100)
- WTI Inlet Chilled/Hot Water Sensor
- WFC-M or WFC-SC/SH Service Manual

Specifications[5]

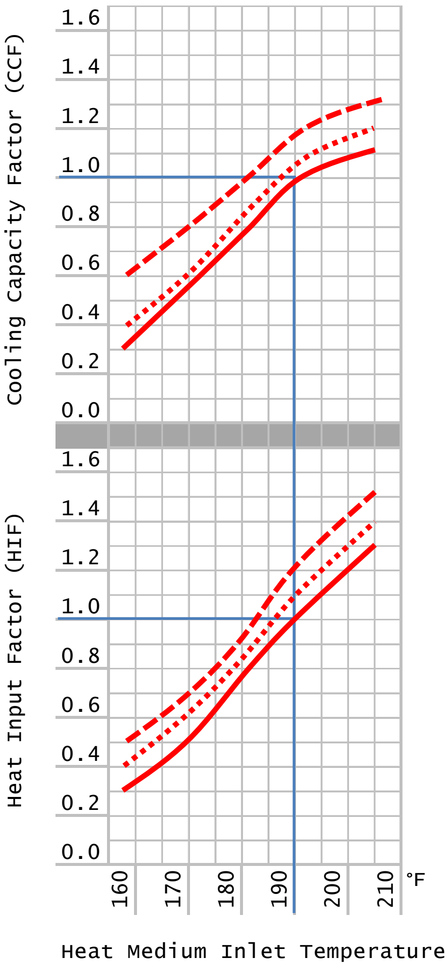
Model			WFC-	SC5	SC/SH10	SC/SH20	SC/SH30	SC50	M100
Cooling			MBTUh	60.0	120.0	240.0	360.0	600.0	1200.0
Heating (WFC-SH only)			MBTUh	---	166.3	332.6	498.9	---	---
Chilled / Hot Water	Cooling		°F	54.5 Inlet / 44.6 Outlet (54.0 Inlet / 44.0 Outlet for M100)					
Chilled / Hot Water	Heating		°F	---	117.3 Inlet / 131.0 Outlet (WFC-SH Models Only)			---	
Chilled / Hot Water	Rated Water Flow		GPM	12.1	24.2	48.4	72.6	121.1	242.5
Chilled / Hot Water	Evaporator Pressure Loss[9]		PSI	7.6	8.1	9.6	10.1	6.4	10.5
Chilled / Hot Water	Maximum Operating Pressure[4]		PSI	150.0					
Chilled / Hot Water	Allowable Water Flow		% Rated	80% - 120%					
Chilled / Hot Water	Water Retention Volume		Gal	2.1	4.5	12.4	19.3	33.6	32.0
Cooling Water	Total Heat Rejection		MBTUh	145.7	291.4	582.8	874.2	1457.0	2917.0
Cooling Water	Temperature		°F	87.8 Inlet / 95.0 Outlet (85.0 Inlet / 95.7 Outlet for M100)					
Cooling Water	Rated Water Flow[1]		GPM	40.4	80.8	161.7	242.5	404.5	539.5
Cooling Water	Allowable Water Flow		% of Rated	100% - 120%					
Cooling Water	Absorber Pressure Loss[9]		PSI	5.6	12.3	6.6	6.7	6.6	9.6
Cooling Water	Condenser Pressure Loss[9]		PSI	5.6	Included in Absorber	6.6	6.7	3.2	Included in Absorber
Cooling Water	Maximum Operating Pressure[4]		PSI	150.0					
Cooling Water	Water Retention Volume		Gal	9.8	17.4	33.0	51.3	87.2	111.5
Heat Medium[6]	Heat Input		Mbtuh	85.7	171.4	342.8	514.2	857.0	1717.0
Heat Medium[6]	Temperature		°F	190.4 Inlet / 181.4 Outlet (194.0 Inlet / 176.0 Outlet for M100)					
Heat Medium[6]	Allowable Temperature		°F	158.0 – 203.0					
Heat Medium[6]	Generator Pressure Loss[9]		PSI	11.2	13.1	6.7	8.8	13.6	4.3
Heat Medium[6]	Maximum Operating Pressure[4]		PSI	150.0					
Heat Medium[6]	Rated Water Flow		GPM	19.0	38.0	76.1	114.1	190.4	195.9
Heat Medium[6]	Allowable Water Flow		% of Rated	30% - 120% (25% - 120% for M100)					
Heat Medium[6]	Water Retention Volume		Gal	2.6	5.5	14.3	22.2	39.7	66.0
Electrical[7]	Power Supply			115/60/1	208VAC / 60 Hz / 3-Phase				
Electrical[7]	Consumption[2]		Watts	48	210	260	310	670	640
Electrical[7]	Minimum Circuit Amps		Amps	0.89	0.6	0.9	2.6	4.7	2.7
Electrical[7]	MOCP – Max. Fuse Size		Amps	15					
Capacity Control				On - Off					Proportional or On/Off
Construction	Dimensions[3]	Width	Inches	23.4	29.9	41.9	54.3	70.3	59.4
Construction	Dimensions[3]	Depth	Inches	29.3	38.2	51.2	60.8	77.2	144.0
Construction	Dimensions[3]	Height	Inches	69.1	74.8	79.1	80.5	82.1	86.6
Construction	Weight	Dry	Lbs	805	1100	2050	3200	4740	10891
Construction	Weight	Operating	Lbs	926	1329	2548	3975	5955	12655
Construction	Cabinet			NEMA 3R, Silver Metallic Pre-Painted Hot Dip Zinc-Coated Sheet Steel					
Construction	Noise Level[8]		dB(A)	38	49		46	51	56
Piping	Chilled / Hot Water		Inches	1-1/4 NPT	1-1/2 NPT	2 NPT		3 NPT	4 Flanged
Piping	Cooling Water		Inches	1-1/2 NPT	2 NPT		2-1/2 NPT	3 NPT	5 Flanged
Piping	Heat Medium		Inches	1-1/2 NPT		2 NPT	2-1/2 NPT	3 NPT	4 Flanged

NOTES:

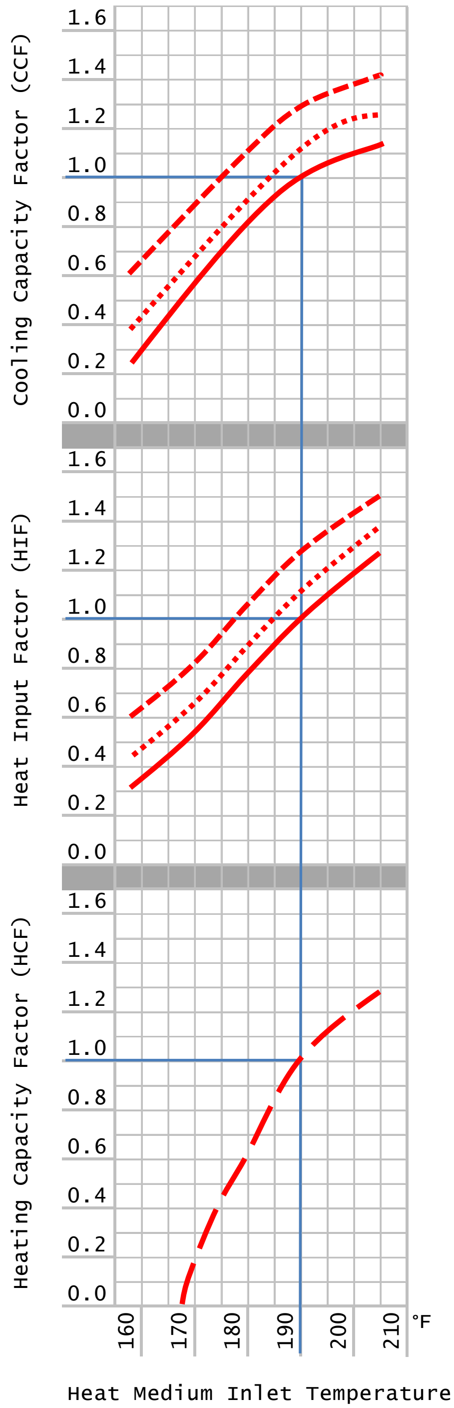
1. Minimum cooling water flow is 100%.
2. Power Consumption does not include external pumps or fan motors.
3. Height does not include removable lifting lugs, but does include level bolts. Width/Depth does not include junction box or mounting plates.
4. Do not exceed 150 PSI (1034 kPa) in any fluid circuit.
5. Specifications are based upon water in all fluid circuits and fouling factor of 0.0005 ft^2-hr-°F/Btu.
6. Density of Heat Medium is 60.47 lbs/ft^3, Specific Heat 1.003 BTU/lbs°F (185°F).
7. Electric field wiring must be made in accordance with local regulation and must be sized to provide less than 2% voltage drop.
8. Noise level is measured in a free field at a point 1m away from the cabinet and 1.5m above ground level.
9. Pressure Loss ratings are +/- 10%.

Performance Characteristics at 44.6°F (7°C)

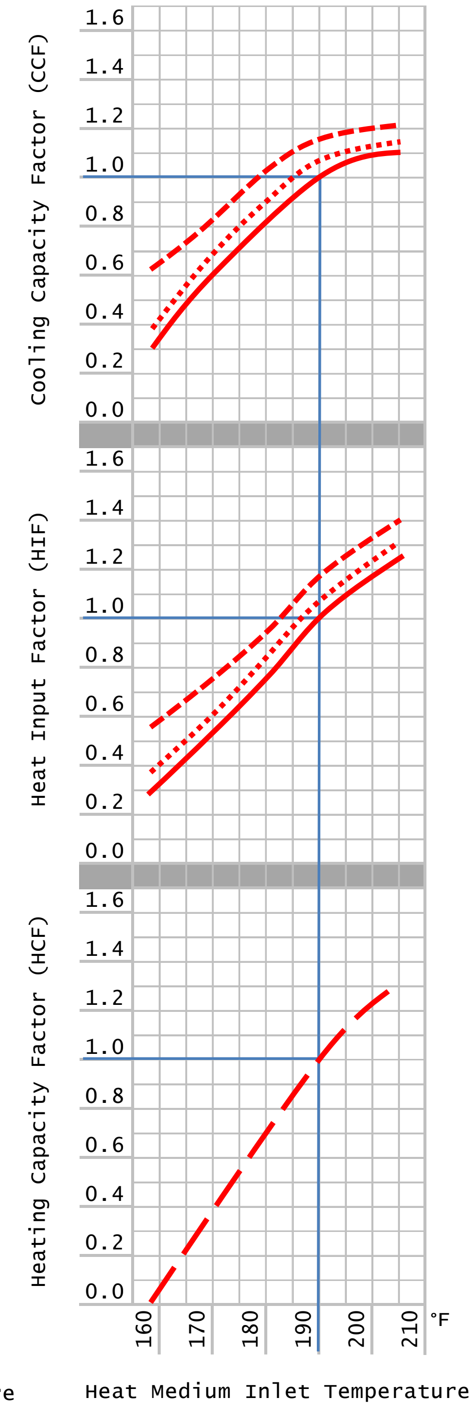
WFC-SC5



WFC-SC/SH10



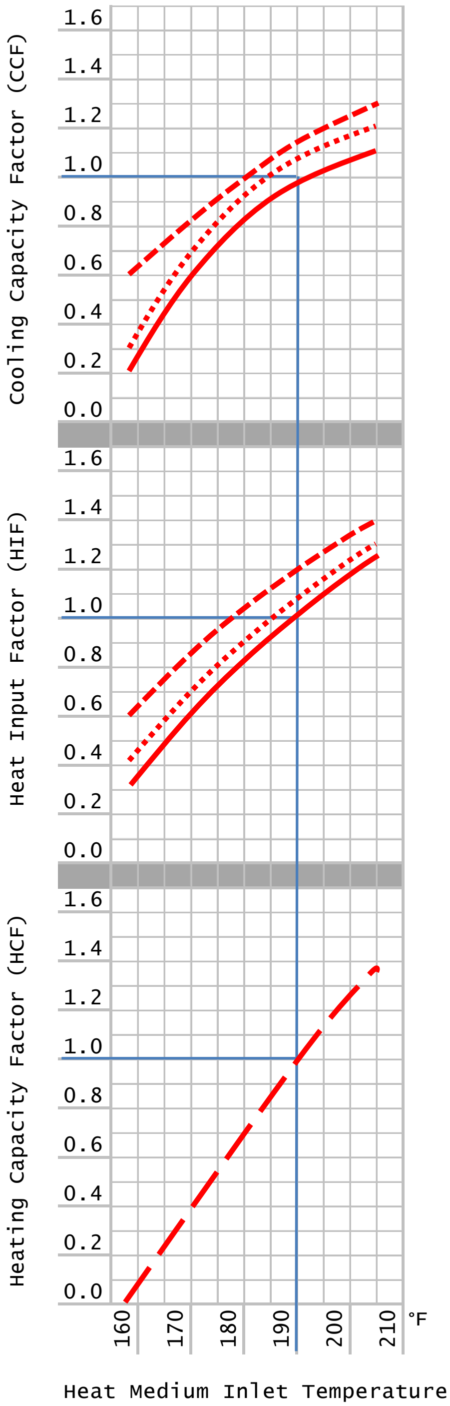
WFC-SC/SH20



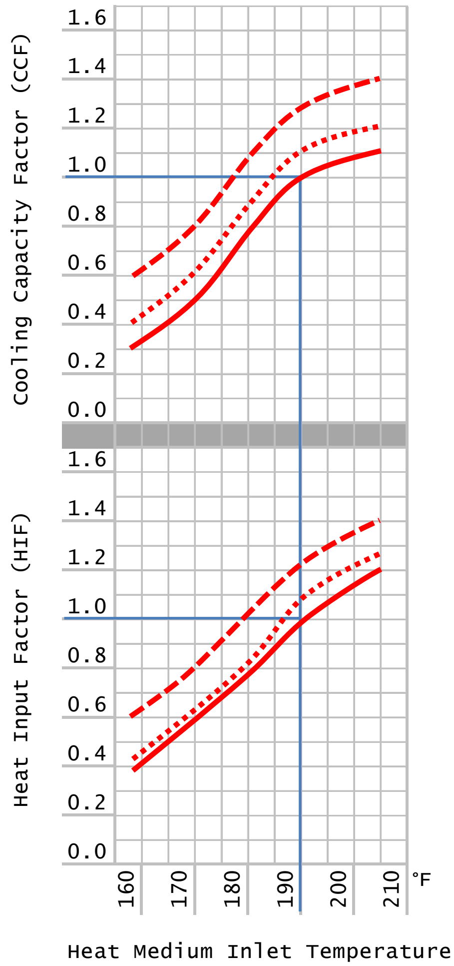
Notes:

1. Blue lines indicate rated design conditions. Where the blue lines cross designates the Standard Rating Point.
2. All curves are based on water in all circuits flowing at rated design condition flow rates.
3. Heating Efficiency = 97%.
4. Performance may be interpolated, but must not be extrapolated from curves.
5. Expanded performance curves are provided for reference only. Contact Yazaki Energy Systems, Inc. to obtain certified performance ratings from the factory or to determine performance at other conditions outside the scope of this publication.
6. Performance data based upon standard fouling factor of 0.0005 $ft^2hr°F/Btu$ in all circuits.

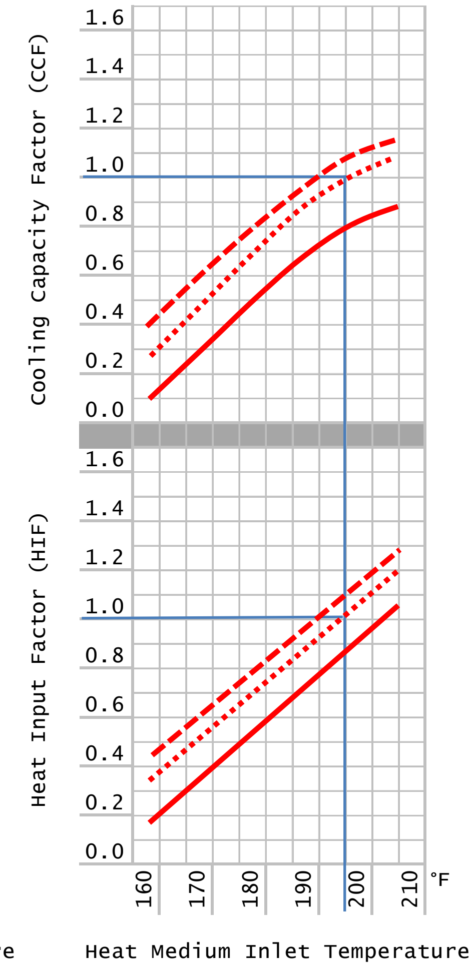
WFC-SC/SH30



WFC-SC50



WFC-M100



Allowable Flow Rates:

Chilled/Hot Water:	80 – 120%
Cooling Water:	100 – 120%
Heat Medium:	30 – 120%

LEGEND

Cooling Water Temperatures

- - - - 80.6°F (27°C)

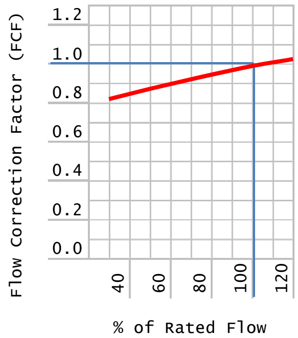
········ 85.1°F (29.5°C)

—— 87.8°F (31°C)

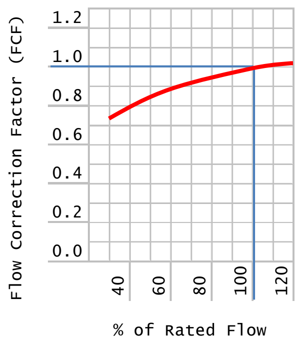
— — — Heating Capacity
No Cooling Water

Heat Medium Flow Rate Correction Charts

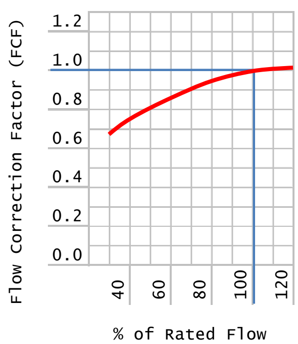
WFC-SC5



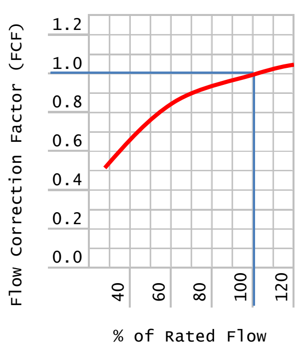
WFC-SC/SH10, 20, & 30



WFC-SC50



WFC-M100



Absorption Chiller Heat Balance

HEAT IN = HEAT OUT

$Q_g + Q_e = Q_c$

Where: Q_g = Actual Heat Input to Generator
Q_e = Actual Cooling Capacity
Q_c = Actual Heat Rejected to Tower

COOLING CAPACITY

Q_e = CCF x HMFCF x RCC

Where: Qe = Actual Cooling Capacity
CCF = Cooling Capacity Factor
HMFCF = Heat Medium Flow Correction Factor
RCC = Rated Cooling Capacity

HEAT INPUT (COOLING)

Q_g = HIF x HMFCF x RHI

Where: Q_g = Actual Heat Input to Generator
HIF = Heat Input Factor
HMFCF = Flow Correction Factor
RHI = Rated Heat Input

HEATING CAPACITY

Q_h = HCF x HMFCF x RHC

Where: Q_h = Actual Heating Capacity
HCF = Heating Capacity Factor
HMFCF = Flow Correction Factor
RHC = Rated Heating Capacity

HEAT INPUT (HEATING)

$Q_g = Q_h / 0.97$

Where: Q_g = Actual Heat Input to Generator
Q_h = Actual Heating Capacity

TEMPERATURE DIFFERENCE (°F)

$\Delta T = Q_x / (0.5 \times F_a)$

Where: ΔT = Temperature Difference
Q_x = Actual BTUH Transferred
F_a = Actual Flow Rate in GPM

PRESSURE DROP FOR NONSTANDARD FLOW RATES (PSI)

$\Delta P_a = \Delta P_r \times (Q_a / Q_r)^2$

Where: ΔP_a = Actual Pressure Drop
ΔP_r = Rated Design Pressure Drop
Q_a = Actual Flow Rate in GPM
Q_r = Rated Design Flow Rate GPM

EXAMPLE

Given:		
	Heat Medium Inlet Temp:	203°F
	Heat Medium Flow:	57.0 GPM
	Cooling Water Inlet Temp:	85.1°F
	Cooling Water Flow:	242.5 GPM
	Chilled Water Outlet Temp:	44.6°F
	Hot Water Outlet Temp:	131°F
	Chilled/Hot Water Flow:	72.6 GPM
	Chiller-Heater Model:	WFC-SH30

Refer to Performance Charts for Curves (Page 7) and to Specifications (Page 5) for Rated Design Information on the Model WFC-SC/SH30.

1. AVAILABLE COOLING CAPACITY:

CCF at 203°F Heat Medium = 1.22
Heat Medium Flow = 57.0/114.1
Heat Medium Flow = 50%
HMFCF for 50% Flow Rate = 0.86

Q_e = 1.22 x 0.86 x 360.0 = 377.7 Mbtuh (31.5 T)

Chilled Water ΔT = 377.7 / (0.5 x 72.6) = 10.4°F
Chilled Water ΔP = $10.1(72.6 / 72.6)^2$ = 10.1 PSI

2. HEAT INPUT (COOLING):

HIF at 203°F Heat Medium = 1.35
HMFCF for 50% Flow Rate = 0.86
Rated Heat Input = 514.2 Mbtuh

Q_g = 1.35 x 0.86 x 514.2 Mbtuh = 597.0 Mbtuh Heat Input

Heat Medium ΔT = 597.0 / (0.5 x 57.0) = 20.9°F
Heat Medium ΔP = $8.8(57.0 / 114.1)^2$ = 2.2 PSI

3. HEAT REJECTED TO COOLING TOWER:

$Q_c = Q_g + Q_e$

Qc = 597.0 + 377.7 = 974.7 Mbtuh
Required minimum flow rate = 242.5 GPM

The cooling tower selected must be capable of rejecting a minimum of 974.7 Mbtuh at a minimum flow rate of 242.5 GPM.

Cooling Water ΔT = 974.7 / (0.5 x 242.5) = 8.0°F
Cooling Water ΔP = $6.7(242.5 / 242.5)^2$ = 6.7 PSI

4. AVAILABLE HEATING CAPACITY:

HCF at 203°F Heat Medium = 1.33
HMFCF for 50% Flow Rate = 0.86
Rated Heating Capacity = 498.9 Mbtuh

Q_h=1.33 x 0.86 x 498.9 Mbtuh = 570.6 Mbtuh

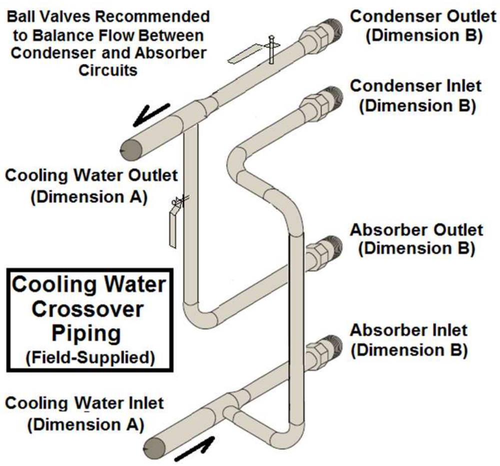
Hot Water ΔT = 570.6/(0.5 x 72.6) = 15.7°F
Hot Water ΔP = $10.1(72.6/72.6)^2$ = 10.1 PSI

5. HEAT INPUT (HEATING):

$Q_g = Q_h$ / 0.97 = 570.6/0.97 = 588.2 Mbtuh Heat Input

Heat Medium ΔT = 588.2/(0.5 x 57.0) = 20.6°F
Heat Medium ΔP = $8.8(57.0/114.1)^2$ = 2.2 PSI

Cooling Water Crossover Piping



MODEL	COPPER TUBING		STEEL TUBING	
WFC-	A	B	A	B
SC5	2"	1-1/2"	2"	1-1/2"
SC/SH20	3"	2"	3-1/2"	2-1/2"
SC/SH30	3"	2-1/2"	4"	3"
SC50	4"	3"	5"	3-1/2"

The condenser and absorber of the WFC-SC/SH Series are connected in parallel by cooling water crossover piping that is field-fabricated with field-supplied parts and installed by others at the jobsite. The only exception is the WFC-SC/SH10 model which only has one inlet and one outlet for cooling water.

The cooling water crossover piping should be installed per these recommendations to ensure balanced and controllable flow through the condenser and absorber.

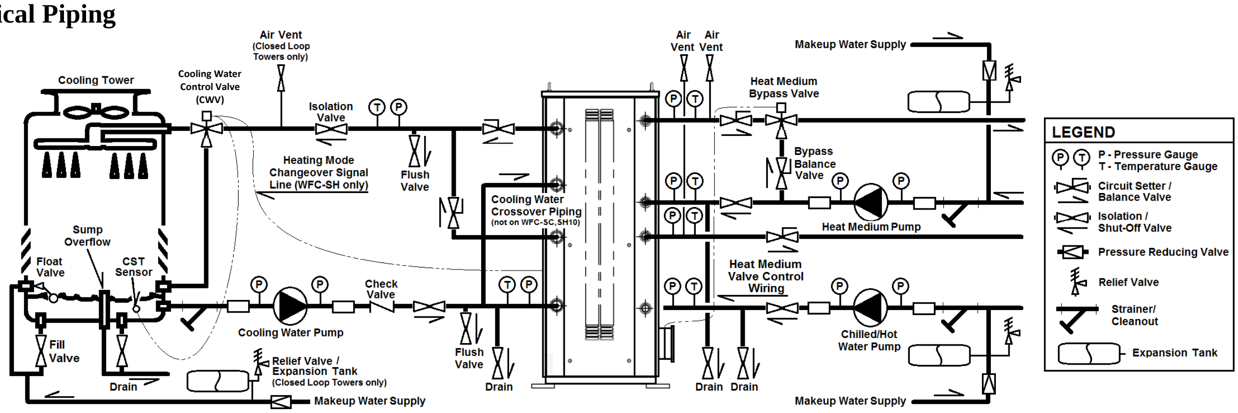
Due to differing flow characteristics of copper and steel tubing, the sizes of the pipe required to field-fabricate the cooling water crossover may differ. The chart here presents the minimum size of pipe for the model indicated.

Dimension A is also referred to as the Common side. This is where the cooling tower typically connects to the crossover piping.

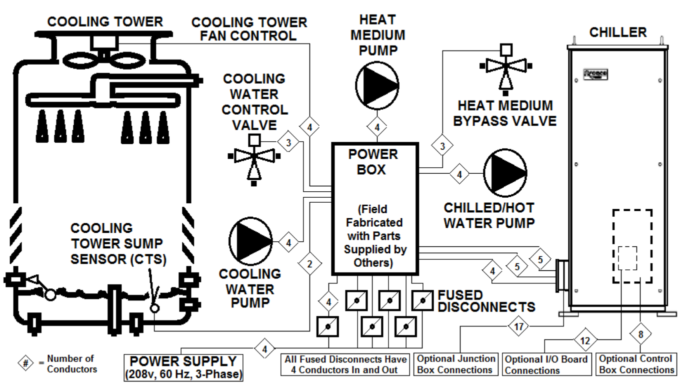
Dimension B is also referred to as Branch Piping and connects directly to the unit. If the size indicated by the chart is larger than the size of the connection at the unit, make the reduction as close to the unit as possible.

Application

Typical Piping



Typical Field Wiring

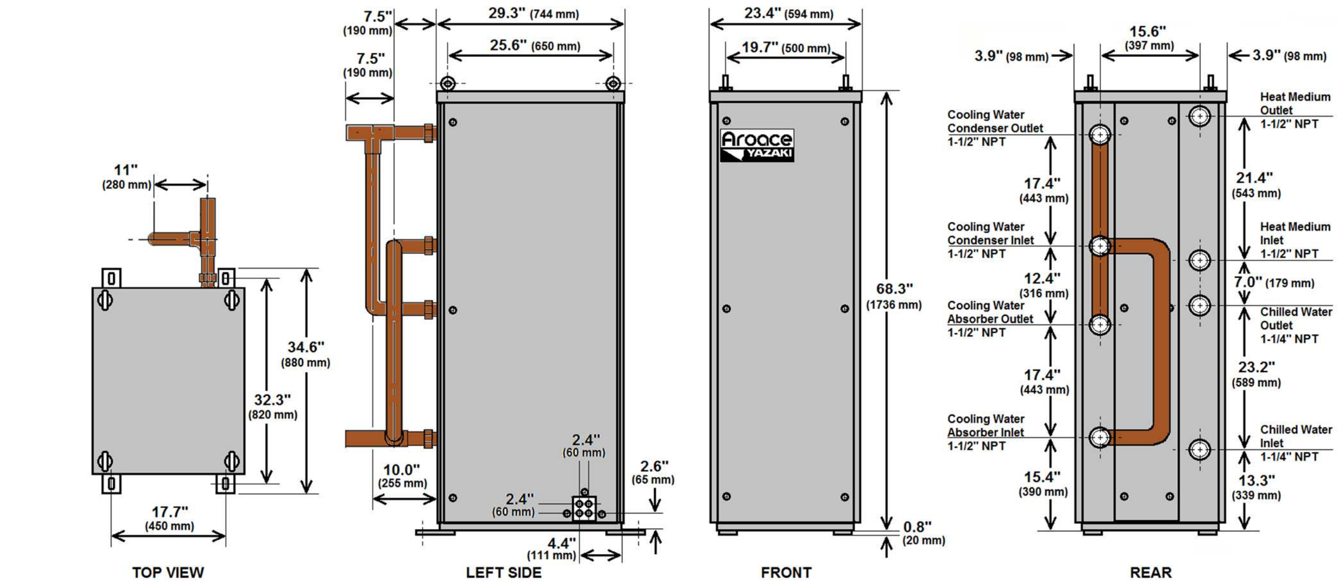


YAZAKI

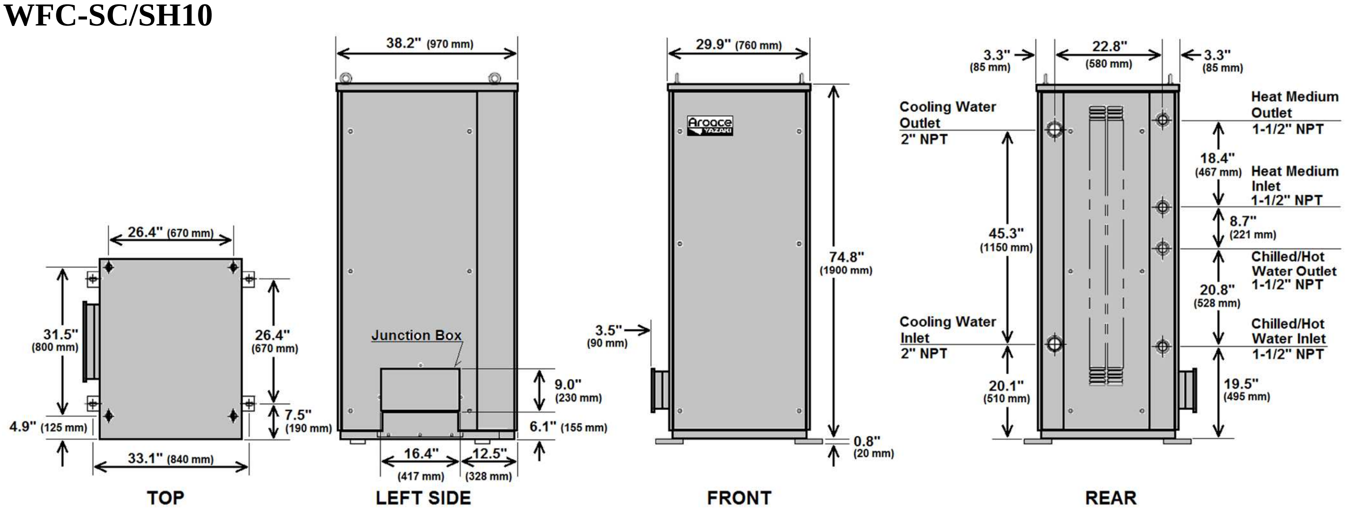
Equipment Dimensions

Drawings are not to scale. Piping shown is all field-supplied. All metric values are converted from Imperial units.

WFC-SC5



WFC-SC/SH10



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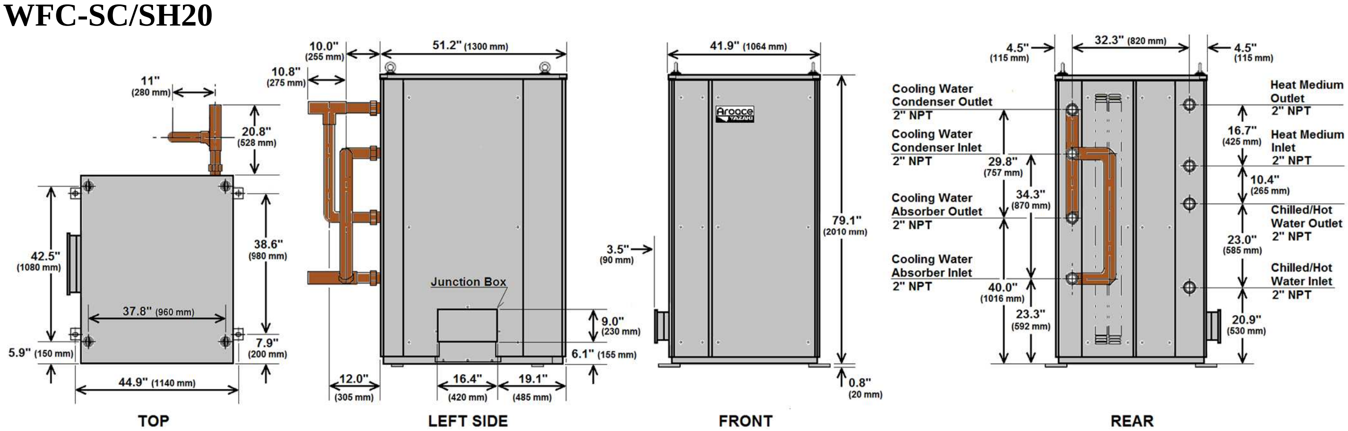
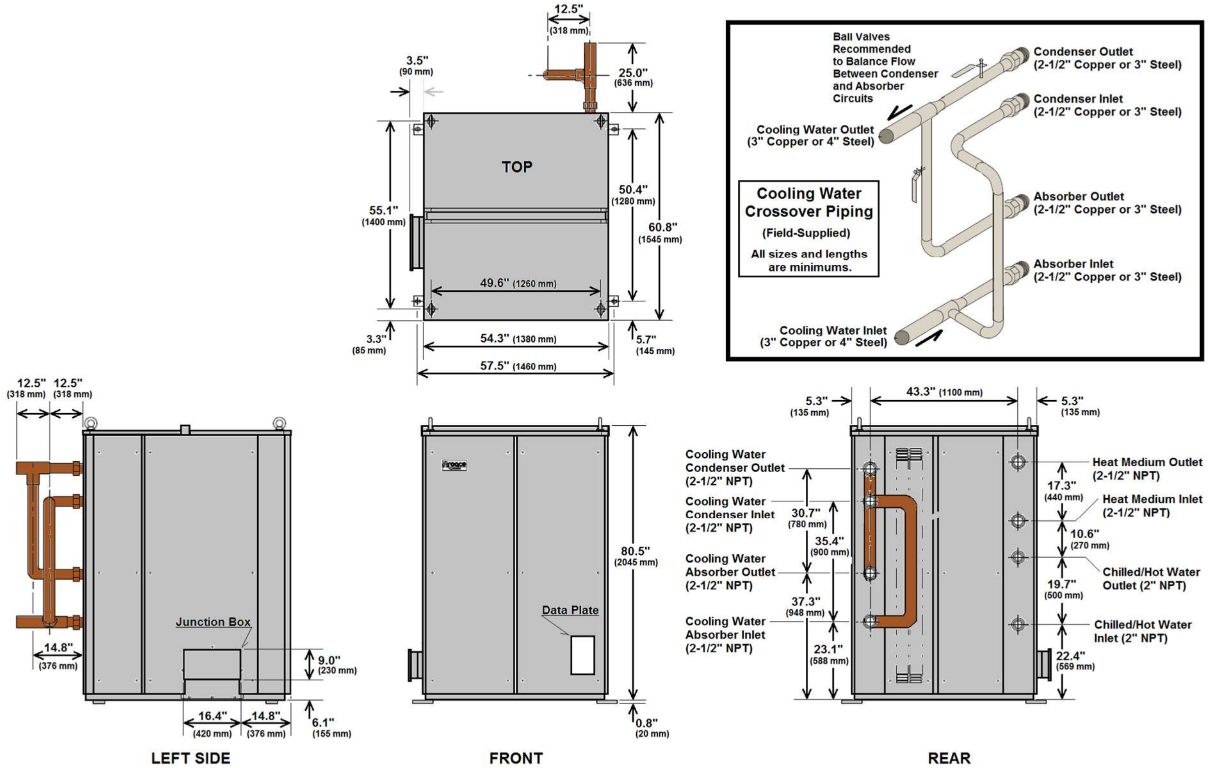


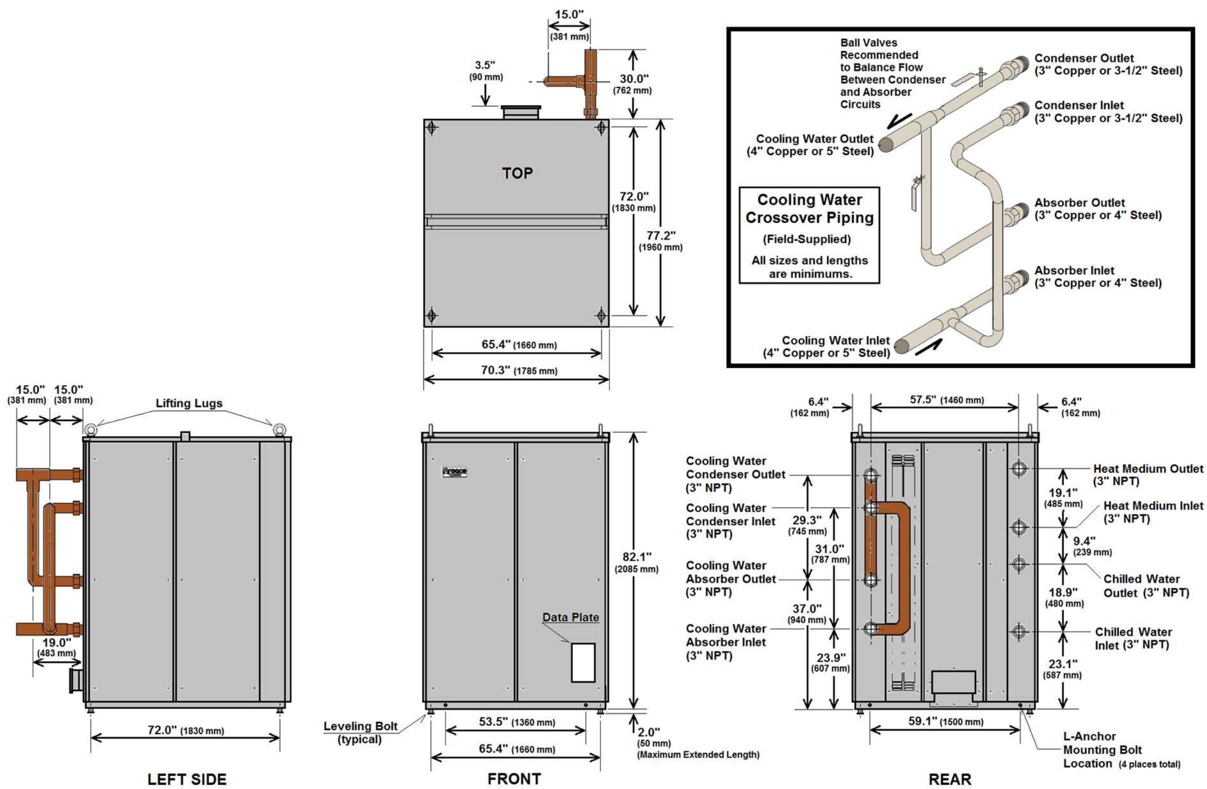
Equipment Dimensions

Drawings are not to scale. Piping shown is all field-supplied. All metric values are converted from Imperial units.

WFC-SC/SH30



WFC-SC50

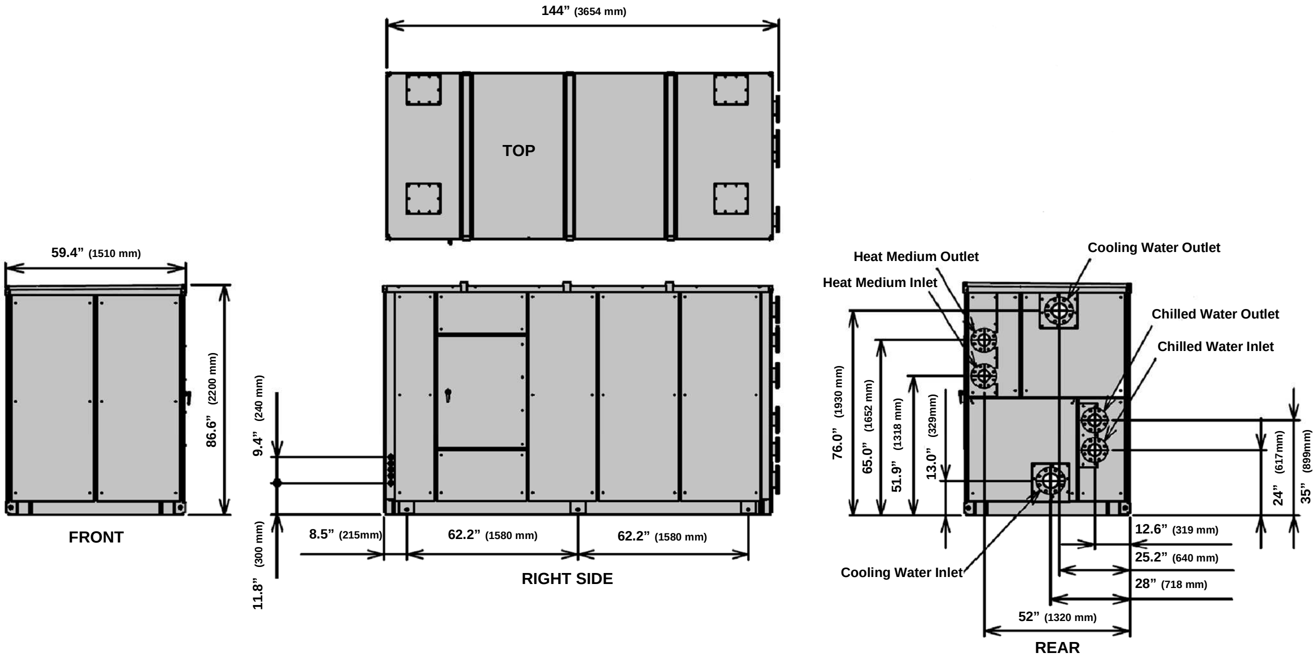


YAZAKI

Equipment Dimensions

Drawings are not to scale. Piping shown is all field-supplied. All metric values are converted from Imperial units.

WFC-M100



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