WCFX-E Series 50Hz

Water Cooled Rotary Screw Water Chillers

Cooling Capacity: 58 to 823 TR (205 to 2893 kW)



R134a

AHRI CERTIFIED
www.ahridirectory.org
Water-Cooled Chillers
AHRI Standard 550/590

DUNHAM-BUSH

Products that perform...By people who care

INTRODUCTION

The Dunham-Bush WCFX-E Water Cooled Rotary Screw Flooded Chillers are available from 58 to 823 TR [205 to 2893 kW]. These units are supplied with rotary screw compressors that are backed by more than 40 years of experience. In fact, a one-year parts warranty is provided on the entire unit at no extra cost.

All units are factory run tested before shipment.

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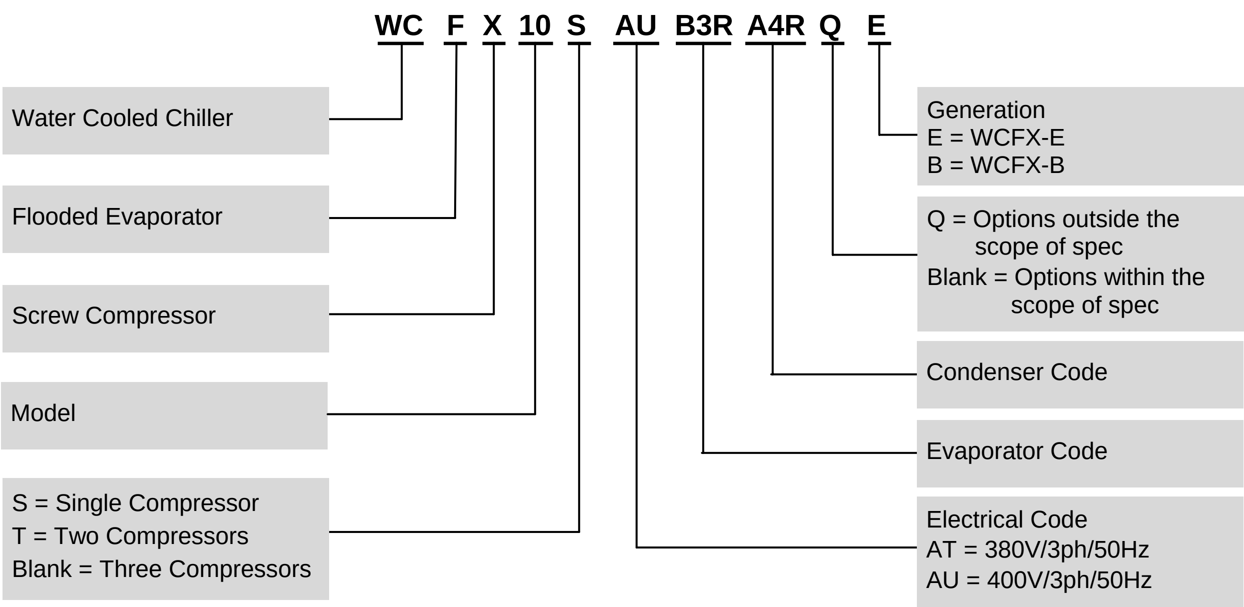
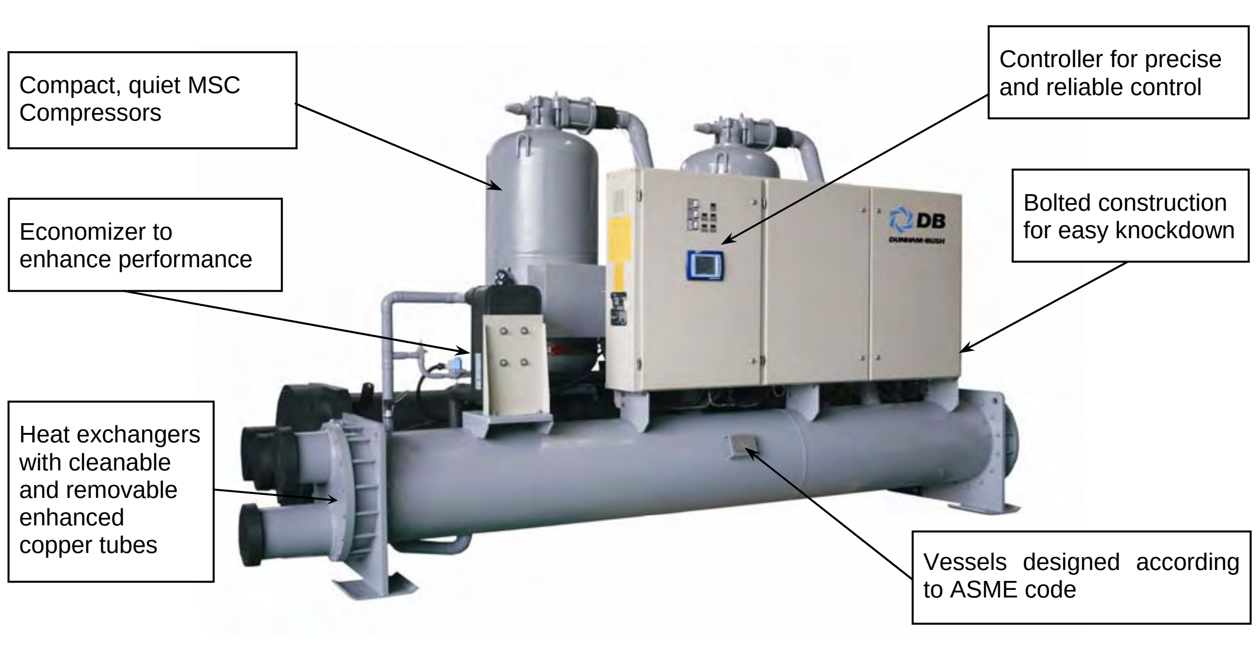
NOMENCLATURE



COMPONENTS



STANDARD FEATURES

Size/Range

- 33 Models from 58 to 823 TR [205 to 2893 kW].
- Multiple compressor units provide redundancy, and favorable part load efficiency.
- One-year parts warranty at no extra cost.

Compressor(s)

- Improved, quiet, reliable MSC Vertical Rotary Screw Compressors with up to 2 integral oil separators.
- Optimized for R134a and optimized volume ratio for best efficiency.
- Improved rpm and noise level.
- Optimized rotor drive.
- Improved rotor and anti-reverse rotation bearing design.
- Optimized VI port position and geometry.
- Multiple rotary screw compressors design for better reliability and redundancy.
- Welded hermetic design with no requirement for internal parts service, no periodic compressor tear down and overhaul, and eliminates casing leakages.
- Consistent loading and unloading with dependable slide valve mechanism.
- No external oil pump required.
- Double-delta motor winding with 1/3 lock-rotor amps at start-up. Star-delta motor winding for MSC 226 mm series.
- Faulty or damaged compressors reworkable at minimal cost at various Dunham-Bush's authorized compressors reworked facilities. To ensure minimum downtime during rework of faulty or damaged compressor, Dunham-Bush can arrange to provide a substitute reworked compressors while the faulty compressor is being reworked or repaired.
- Vapor injection cycle to increase capacity and improve efficiency.

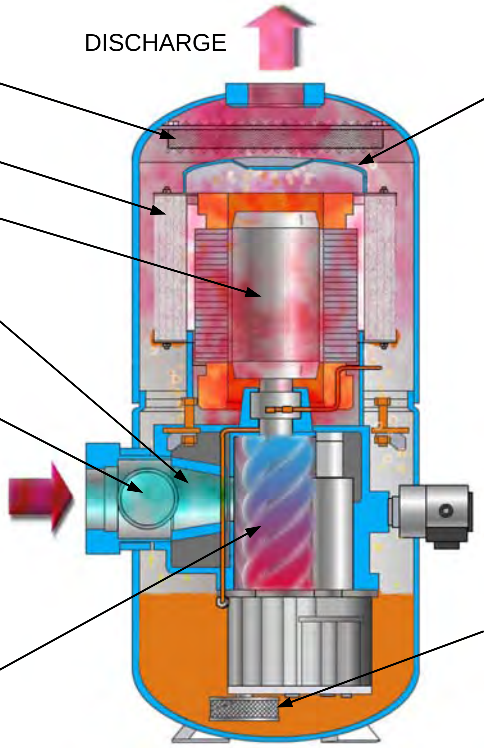
Evaporator/Condenser

- Cleanable and Removable Integral Fin Copper Tubes.
- One, Two or Three Water Passes Available.
- Removable Water Heads.
- Victaulic Groove Water Connections.
- Vessel designed according to ASME Code, approved and certified by JKKP.
- Relief Valves(s) standard - 3/4" FPT or 1” PPT.
- Full Pump Down Capacity in Condenser.

Controller/ Electrical

- Proactive Advanced Controller adapts to abnormal operating conditions.
- Tolerant and accommodating of extreme conditions at start-up.
- Capable of controlling multiple chillers, cooling towers, pumps, etc.
- Circuit Breaker on each multiple compressor unit.
- Unit Mounted Contactor and Time Delay for reduced Inrush Start.
- Current and Voltage transformers.
- Under Voltage Phase Failure Relay.
- Indicator lights for Compressor Overloads, Micro Alarm, Control Power, Compressor Control Circuit.

UNIT FEATURES



Compressor Assembly

The Dunham-Bush rotary screw compressor is a positive displacement helical-axial design for use with high-pressure refrigerants.

- The compressor consists of two intermeshing helical grooved rotors, a female drive rotor and a male driven rotor, in a stationary housing with suction and discharge gas ports.
- Uniform gas flow, even torque and positive displacement, all provided by pure rotary motion contributes to vibration-free operation over a wide range of operating conditions. Intake and discharge cycles overlap, effectively producing a smooth, continuous flow of gas.
- No oil pump is required for lubrication or sealing purposes. Oil is distributed throughout the compressor by the pressure differetial between the suction and the discharge cavities.

Simplified Capacity Control

The slide valve mechanism for capacity modulation and part load operation is an outstanding feature:

- The moving parts are simple, rugged and trouble-free. The slide mechanism is hydraulically actuated.
- Package capacity reduction can be down to as low as 8.5% without HGBP by progressive movement of slide valves away from their stops.
- Capacity reduction is programmed by an exclusive electronically initiated, hydraulically actuated control arrangement.

Positive Displacement Direct Connected

The compressor is directly connected to the motor without any complicated gear systems to speed up the compressor and thus detract from the overall unit reliability.

Oil Separation

Each compressor is provided with up to 2 integral oil separator/impingement plate located below the discharge gas port.

- The separator is a multi-layered mesh element which effectively separates oil from the gas stream.
- The oil drains into the sump and the discharge gas passes around the deflection plate. An oil drain valve is located near the bottom of the oil sump.

Oil is also returned to the compressor after it is separated from the refrigerant at the oil separator located at the discharge of the compressor.

Main Bearings

Each rotor is fitted with a set of anti-friction tapered roller bearings. They carry both radial and thrust loads. Anti-reverse rotation bearings are used.

Rotors

The latest asymmetrical rotor profiles of patented Dunham-Bush design assure operation at highest efficiencies. Rotors are precision machined from high strength alloy steel and precision ground, in house.

Castings

All housings are manufactured of high grade, low porosity and cast iron.

Solid State Motor Protection

The motor winding protection module used in conjunction with sensors embedded in the compressor motor windings is designed to prevent the motor from operating at unsafe operating temperatures. The overloads for the motor are also solid state.

UNIT FEATURES

FIG. A

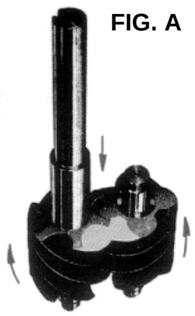


FIG. B

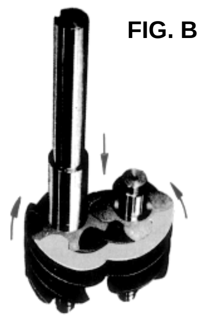


FIG. C

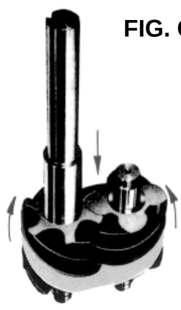


FIG. D

Compressor Operation

Note: For clarity reasons, the following account of the compressor operation will be limited to one lobe on the male rotor and one interlobe space of the female rotor. In actual operation, as the rotors revolve, all of the male lobes and female interlobe spaces interact similarly with resulting uniform, non-pulsating gas flow.

Suction Phase

As a lobe of the male rotor begins to unmesh from an interlobe space in the female rotor, a void is created and gas is drawn in tangentially through the inlet port -- Fig. A. -- As the rotors continue to turn the interlobe space increases in size -- Fig. B -- and gas flows continuously into the compressor. Just prior to the point at which the interlobe space leaves the inlet port, the entire length of the interlobe space is completely filled with drawn in gas -- Fig C.

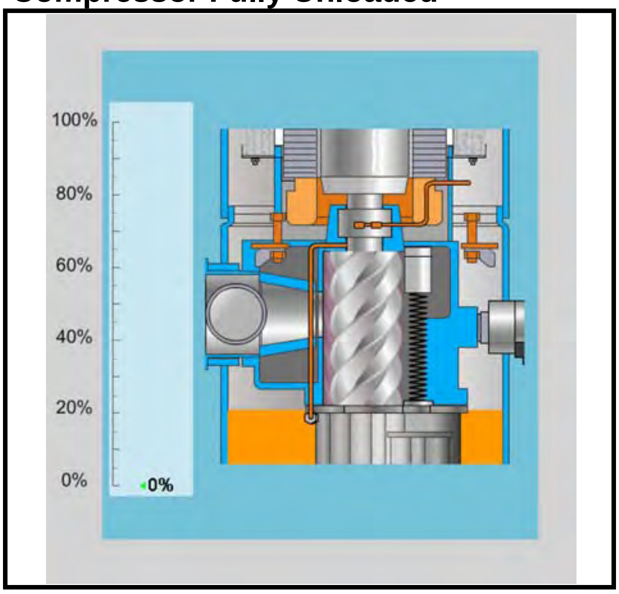
Compression Phase

As rotation continues, the gas in the interlobe space is carried circumferentially around the compressor housing. Further rotation meshes a male lobe with the interlobe space on the suction end and squeezes (compresses) the gas in the direction of the discharge port. Thus the occupied volume of the trapped gas within the interlobe space is decreased and the gas pressure consequently increased

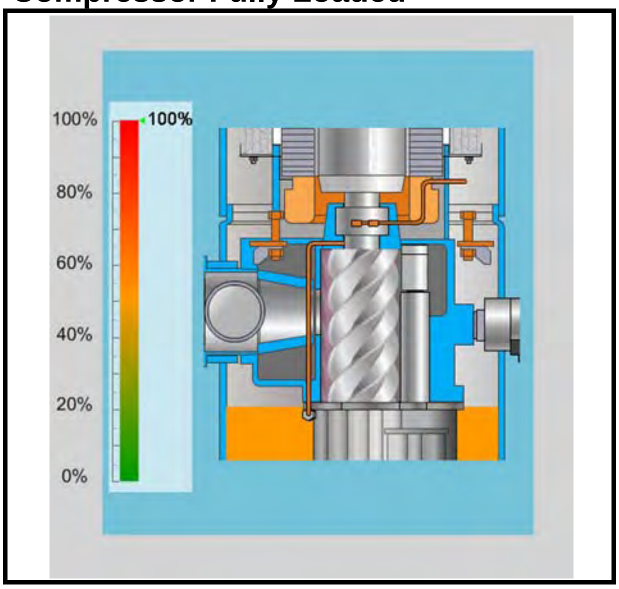
Discharge Phase

At a point determined by the designed "built-in" compression ratio, the discharge port is covered and the compressed gas is discharged by further meshing of the lobe and interlobe space - Fig. D. While the meshing point of a pair of lobes is moving axially, the next charge is being drawn into the unmeshed portion and the working phases of the compressor cycle are repeated.

Compressor Fully Unloaded



Compressor Fully Loaded



Slide Valve Control

Movement of the slide valve is programmed by an exclusive Dunham-Bush electronically initiated (by variations in leaving chilled water temperature) hydraulically actuated control arrangement. When the compressor is fully loaded, the slide valve is in the closed position. Unloading starts when the slide valve is moved back away from the valve stop. Movement of the valve creates an opening in the side of the rotor housing.

Suction gas can then pass back from the rotor housing to the inlet port area before it has been compressed. Since no significant work has been done on this return gas, no appreciable power losses are incurred. Reduced compressor capacity is obtained from the gas remaining in the rotors which is compressed in the ordinary manner. Enlarging the opening in the rotor housing effectively reduces compressor displacement.

UNIT FEATURES

ADVANCED CONTROLLER

Vision 2020i a flexible and advance programmable electronic controller designed specifically for the applications and precise control of Dunham-Bush Rotary Screw compressor chillers.

The controller board is provided with a set of terminals that connected to various devices such as temperature sensors, pressure and current transducers, solenoid valves, compressors and fans contactors, control relays and etc. Three sizes of controller boards are provided to handle different number of input and output requirements: DB3-S small board, DB3-M medium board and DB3-L large board.

The unit algorithm program and operating parameters are stored in FLASH-MEMORY that does not require a back-up battery. The program can be loaded through PC or programming key.

Vision2020i controller is equipped with a user friendly terminal with 320 x 240 pixel, 256 color LCD graphical display and dedicated touch keys that provides easy access to the unit operating conditions, control set points and alarm history.

Each unit's controller can be configured and connected to the local DBLAN network that allows multiple units sequencing control without additional hardware. The DBLAN is local area network made up of several chillers' controller.

Display and User Terminal

Vision2020i controller is design to work with a user friendly 320 x 240 pixel, 256 color DBG3 graphical display panel connected with controller through shielded twisted pair cable. The terminal allows carrying out all program operations. The user terminal allows displaying the unit working conditions, compressor run times, alarm history and modifying the parameters. The display also has an automatically self-test of the controller on system start-up. Multiple messages will be displayed by automatically scrolling from each message to the next. All of these messages are spelled out in English language on the display terminal.

There are 7 dedicated physical buttons and 13 touch keys enable user to access information, base on the security level of the password. For more detail operation of the DBG3 Display Terminal, please refer to the Unit Operation Manual.

Easily accessible measurements include:

- Leaving chilled water temperature
- Leaving chiller water temperature derivative
- Evaporator Pressure
- Condenser Pressure
- Compressor amp draw of each compressor
- Compressor elapsed run time of each compressor
- Compressor starts status
- Oil level sensor status
- Water temperature reset value
- Water flow switch status
- External start/stop command status
- Trend graph for leaving chilled water temperature

Optional entering chilled water temperature, leaving and entering condenser water temperature are available. With this option the operator can quickly and accurately read all significant water temperatures and eliminate the need for often-inaccurate thermometers. Voltage readout is also offered as an optional feature.

Capacity Control

Leaving chilled water temperature control is accomplished by entering the water temperature setpoint and placing the controller in automatic control. The unit will monitor all control functions and move the slide valve to the required operating position. The compressor ramp (loading) cycle is programmable and may be set for specific building requirements. Remote adjustment of the leaving chilled water setpoint is accomplished through either direct connection of other Dunham-Bush control packages to the controller through either the RS485 long distance differential communications port, via terminal or modem connected to the RS232 communication port, or from an external Building Automation System supplying a simple 4 to 20mA signal. Remote reset of compressor current limit may be accomplished in a similar fashion.

System Control

The unit may be started or stopped manually, or through the use of an external signal from a Building Automation System. In addition, the controller may be programmed with seven-day operating cycle or other Dunham-Bush control packages may start and stop the system through inter-connecting wiring.

System Protection

The following system protection controls will automatically act to insure system reliability:

- Low suction pressure
- High discharge pressure
- Freeze protection
- Low differential pressure
- Low oil level
- Compressor run error
- Power loss
- Chilled water flow loss
- Sensor error
- Compressor over current
- Compressor Anti-recycle

The controller can retains up to 99 alarm conditions complete with time of failure together data stamping on critical sensor readings in alarm history masks. This tool will aid service technicians in troubleshooting tasks enabling downtime and nuisance trip-outs to be minimized.

UNIT FEATURES

Remote Monitoring

Vision 2020i controller can be completed with an optional RS485 communications card and NETVISOR software for remote monitoring and controlled from a PC terminal and optional phone modem.

With various optional add-on cards the Vision2020i controller can also be interfaced directly to the Building Management System (BMS) with the standard open communication protocols using MODBUS, LONWORKS, BACNET MSTP as well as over IP.

This sophisticated feature makes servicing easier and more convenient to the system. The controller as standard is additionally equipped with history files which may be used to take logs which may be retrieved via the phone modem or internet connection periodically. Now owners of multiple buildings have a simple and inexpensive method of investigating potential problems quickly and in a highly cost effective manner.

REFRIGERATION CYCLE

Dunham-Bush Water Cooled Screw Flooded Chillers are designed for efficiency and reliability. The rotary screw compressor is a positive displacement, variable capacity compressor that will allow operation over a wide variety of conditions.

Even at high head and low capacity, a difficult condition for centrifugal compressors, the rotary screw performs easily. It is impossible for this positive displacement compressor to surge.

The refrigerant management system, however, is very similar to centrifugal water chillers and is shown in the refrigerant cycle diagram below.

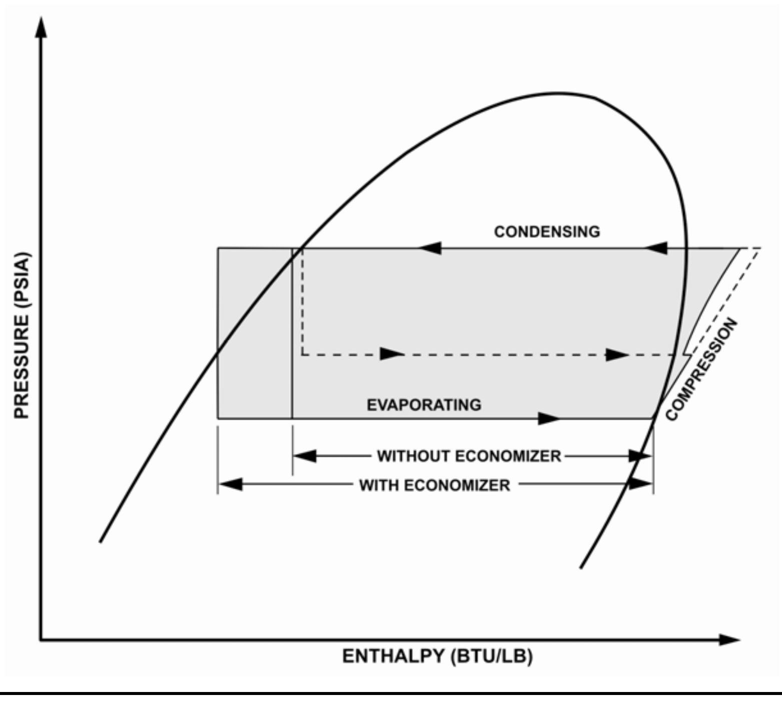
Liquid refrigerant enters the flooded evaporator uniformly where it absorbs heat from water flowing through the evaporator tubes. The vaporized refrigerant is then drawn into the suction port of the compressor where the positive displacement compression begins.

This partially compressed gas is then joined with additional gas from the economizer as the rotors rotate past the vapor injection port at an intermediate pressure. Compressed gaseous refrigerant is then discharged into the integral oil separator where oil which is contained in the refrigerant vapor, is removed and resumed to the oil sump.

Fully compressed and superheated refrigerant is then discharged into the condenser, where water in the condenser tubes cools and condenses the refrigerant. A potion of liquid refrigerant is tapped passes through the first expansion device and into the economizer for further subcooling of main liquid refrigerant flow.

The gaseous refrigerant is then drawn out of the flash economizer and into the vapor injection port of the compressor. The remaining liquid refrigerant then passes through a second expansion device which reduces 'refrigerant pressure to evaporator levels where it is then distributed evenly into the evaporator.

This delivers outstanding efficiency and total energy savings through the utilization of economizer cycle. Increases capacity by as much as 12% with only 7% extra absorbed power.



UNIT FEATURES

PART LOAD PERFORMANCE

Through the use of economizer and multiple compressors, Dunham-Bush Water Cooled Screw Flooded Chillers some of the best part-load performance characteristics in the industry when measured in accordance with AHRI Standard 550/590-2003.

In most cases, actual building system loads are significantly less than full load design conditions, therefore chillers operate at part load most of the time.

Dunham-Bush Rotary Screw Water Chillers combine the efficient operation of multiple rotary screw compressors with economizer and controller control to yield the best total energy efficiency and significant operating savings under any load.

When specifying air conditioning equipment, it is important to consider the system load characteristics for the building application. In a typical city, the air conditioning load will vary according to changes in the ambient temperature. Weather data compiled over many years will predict the number of hours that equipment will operate at various load percentages.

The Air Conditioning and Refrigeration Institute (AHRI) has established a system, in AHRI Standard 550/590-2003, for measuring total chiller performance over full and part-load conditions. It defines the Integrated Part-Load Value (IPLV) as an excellent method of comparing diverse types of equipment on an equal basis. The IPLV is a single number estimate of a chiller's power use weighted for the number of hours the unit might spend at each part-load point. IPLV's are based on Standard Rating Conditions.

The formula for calculating an IPLV is:

$$IPLV = \frac{1}{\frac{0.01}{A} + \frac{0.42}{B} + \frac{0.45}{C} + \frac{0.12}{D}}$$

where: A= kW/ton at 100% load point

B= kW/ton at 75% load point

C= kW/ton at 50% load point

D= kW/ton at 25% load point

GLYCOL FREEZE PROTECTION

If the chiller or fluid piping may be exposed to temperatures below freezing, glycol protection is recommended if the water is not drained. The recommended protection is 15°F below the minimum ambient temperature in the equipment room and around piping. Use only glycol solutions approved for heat exchanger duty. DO NOT use automotive anti-freezing.

If the equipment is being used for applications below 38°F, glycol should be used to prevent freeze damage. The freeze protection level should be 15°F lower than the leaving brine temperature.

Table 1 and 2 are to be used to calculate performance and power input with the addition of glycol. Table 3 and 4 are to be used to calculate performance and power input with different fouling factor.

Table 1 : Ethylene Glycol

% E. G. By Weight	Freeze Point		C1 Capacity Factor	K1 kW Rate	G1 Flow Factor	P1 P.D. Factor
	°F	°C				
10	26.2	-3.2	0.995	0.998	1.019	1.050
15	22.4	-5.3	0.991	0.997	1.030	1.083
20	17.8	-7.9	0.988	0.996	1.044	1.121
25	12.6	-10.8	0.984	0.995	1.060	1.170
30	6.7	-14.1	0.981	0.994	1.077	1.219
35	0.0	-17.8	0.977	0.992	1.097	1.275
40	-10.0	-23.3	0.973	0.991	1.116	1.331
45	-17.5	-27.5	0.968	0.990	1.138	1.398
50	-28.9	-33.8	0.964	0.989	1.161	1.466

Table 2 : Propylene Glycol

% P. G. By Weight	Freeze Point		C2 Capacity Factor	K2 kW Rate	G2 Flow Factor	P2 P.D. Factor
	°F	°C				
10	26.1	-3.3	0.988	0.994	1.005	1.019
15	22.8	-5.1	0.984	0.992	1.008	1.031
20	19.1	-7.2	0.978	0.990	1.010	1.051
25	14.5	-9.7	0.970	0.988	1.015	1.081
30	8.9	-12.8	0.962	0.986	1.021	1.120

Table 3: Evaporator Fouling Factor

Fouling Factor		Capacity Correction Factor	kW Correction Factor
hr-ft. - °F/BTU	m².°C/kW		
0.00010	0.018	1.000	1.000
0.00025	0.044	0.995	0.998
0.00050	0.088	0.985	0.995
0.00075	0.132	0.975	0.991
0.00100	0.176	0.964	0.987

Table 4: Condenser Fouling Factor

Fouling Factor		Capacity Correction Factor	kW Correction Factor
hr-ft. - °F/BTU	m².°C/kW		
0.00025	0.044	1.000	1.000
0.00050	0.088	0.998	1.007
0.00075	0.132	0.996	1.010
0.00100	0.176	0.995	1.014

OPERATING BENEFITS

EFFICIENCY & RELIABILITY

Compressor Experience

- More then 40 years of rotary screw experience and dedicated technological advancements. Compressors are CE listed.
- Simply designed for high reliability with only two rotating parts. No gears to fail.
- Insured continuous oil flow to each compressor through integral high efficiency oil separation for each compressor.
- Chillers use multiple rotary screw compressors for fail-safe reliability and redundancy.

Energy Efficiency

- Designed to provide the greatest amount of cooling for the least kilowatt input over the entire operating range of your building.
- Delivers outstanding efficiency and total energy savings through the utilization of economizer and controller controlled staging producing greater capacity with fewer compressors.
- Maximized performance through computer matched components and multiple compressors on a single refrigerant circuit.
- High efficiency oil recovery system guarantees removal of oil carried over in the refrigerant and maintains the heat exchangers at their maximum efficiency at both full and part load.

Installation Ease

- Side-by-side evaporator/condenser plus snug arrangement of rotary screw compressors result in an extremely compact work envelope.
- Units feature optional split design to allow easy fit through any standard commercial doorway.
- Dramatic payback in reduced maintenance and overhaul costs both in down time and in labor expenditures.
- Ease of troubleshooting through controller retention of monitored functions.
- Factory run tested.

Safety Code Compliance:

- ASME Boiler and Pressure Vessel Code, Section VIII Division 1 "Unfired Pressure Vessels"
- JKKP code
- ASME Standard B31.5 Refrigeration Piping
- ASHRAE Standard 15 Safety Code for Mechanical Refrigeration
- National Electric Code
- IEEE
- Safety quality license for import boiler & pressure vessel, China
- Optional PED

Refrigerant Compatibility

- Designed to operate with environmentally safe and economically smart HFC-134a with proven efficiency and reliability.
- Consult factory for use with new HFC refrigerants.

Control Flexibility

- Controller-based with DDC (direct digital control) features precise push button control over every aspect of operation with built-in standard features that allow extra energy savings on start-up and throughout the life of your equipment.
- Insured uniform compressor loading and optimal energy efficiency through controller controls which utilize pressure transducers to measure evaporator and condenser pressure.
- Lower energy costs resulting from automatic load monitoring and increased accuracy and efficiency in compressor staging.
- Monitor your chiller's key functions from a remote location with a simple, phone modem.
- Proactive control by controller that anticipates problems and takes corrective action before they occur. Controls will unload compressor(s) if head or suction pressure approach limits. This will enable unit to stay on the line while warning operator of potential problems.

Computer Performance Ratings

Dunham-Bush WCFX-E Water Cooled Screw Flooded Chillers are available from 58 to 823 TR [205-2893kW]. The vast number of combinations of heat exchangers, compressors and motors make it impractical to publish tabular ratings for each combination. A chiller may be custom matched to certain building requirements by your Dunham-Bush Sales Representatives utilizing the WCFX-E Computer Selection Program. Data which can be provided to you will include:

- Chiller Capacity
- kW Input
- Evaporator and Condenser Water
- Pressure Drop
- Evaporator and Condenser Tube Water Velocities
- Motor Electrical Data
- Part-Load Performance

Contact our local Dunham-Bush Sales Representative to discuss what Custom Solutions Dunham-Bush can offer to solve your chiller selection questions.

TYPICAL SEQUENCE OF OPERATION

The Dunham-Bush Water Cooled Screw Flooded Chiller depends mainly on its on-board controller for control. Operation described is for a two- compressor unit and is very similar for single or three-compressor units.

For initial start-up, the following conditions must be met:

- Power supply to unit energized
- Compressor circuit breakers in the "on" position
- Control power switch on for at least 15 minutes.
- Compressor switches on
- Reset pressed on controller key pad
- Chilled water pump running and chilled water flow switch made
- Leaving chilled water temperature at least 2°F above setpoint
- All safety conditions satisfied

After all above conditions are met, the controller will call for the lead compressor and the condenser water pump to start. After a one-minute delay, the first contactor (e.g. 1 M-1) is energized followed by the second contactor (e.g. 1 M-2) after one second time delay. This provides reduced inrush stepped start.

The compressor 15-minute anti-recycle timer is initiated at compressor start.

The controller monitors compressor amps, volts, leaving water temperature, and evaporator and condenser pressures. The compressor cooling capacity is controlled by pulsed signals to load and unload solenoid valves on the compressor. When the compressor starts, it is fully unloaded, about 25% of its full load capacity. As the computer gives it load signals, capacity gradually increases. The rate of compressor loading is governed by ramp control which is adjustable in the computer.

The computer responds to leaving chilled water temperature and its rate of change which is proportional and derivative control. If leaving chilled water temperature is within the deadband (+/-0.8°F from setpoint), no load or unload commands are given. If chilled water temperature is above deadband, the computer will continue loading the compressor until a satisfactory rate of decline is observed. If leaving chilled water temperature is below the deadband, the compressor is commanded to unload. Thus the compressor capacity is continuously modulated to match applied load and hold leaving chilled water temperature at setpoint.

If the applied load is greater than one compressor can handle, it will load fully and then the controller will call for a second compressor. After one minute, the second compressor will start in the same manner as the first. Then both compressors will be commanded to adjust load to 50%. They are gradually loaded up together until the applied load is satisfied. In this way the two compressors share the load equally.

If the applied load decreases to the point that both compressors are running at about 40% capacity, the computer shuts down the lag compressor and loads the remaining compressor to about 90%. If applied load decreases further, the remaining compressor unloads-proportionally. If applied load decreases to less than the minimum capacity of one compressor, the leaving chilled water temperature will decline to 2°F below setpoint, at which time the lead compressor will shut down. It will restart automatically if leaving chilled water temp rises to 2°F above setpoint and both 15 minute anti-recycle and one minute start delay timers are satisfied.

During operation, the computer monitors the difference between condenser and evaporator pressures to insure that a minimum of 30 psi differential is available for compressor lubrication. If the difference falls below a minimum of 30 psi, the computer closes refrigerant flow control valves, starving the evaporator, causing evaporator pressure to drop, increasing differential pressure. This is especially helpful at startup, when warm chilled water and cold condensing water would cause a low head situation. This feature is called EPCAS: Evaporator Pressure Control at Startup. It is one of several proactive control features of the controller which overcome potential problems while continuing operation.

Two additional proactive features are low suction and high discharge pressure override. If operating pressures approach trip level, compressors are unloaded as necessary to continue operation.

PHYSICAL SPECIFICATIONS

Model WCFX-E		10S	12S	15S	18S	20S	23S	24S	27S	30S
Capacity	kW	204.6	256.4	310.7	379.8	491.5	538.1	635.0	587.3	723.4
	RT	58.2	72.9	88.3	108.0	139.8	153.0	180.6	167.0	205.7
	10^4kcal/h	17.6	22.0	26.7	32.7	42.3	46.3	54.6	50.5	62.2
Min % Unit Capacity		25%	25%	25%	25%	25%	25%	25%	25%	25%
Power		400V/3P/50Hz								
Compressor										
Model(Qty.)		1210(1)	1212(1)	1215(1)	1218(1)	1222(1)	1222(1)	1227(1)	1227(1)	1230(1)
Input Power	kW	38.0	45.0	53.8	66.8	82.1	90.1	106.5	97.5	120.1
RLA, Each		74	99	123	146	146	146	183	183	213
LRA, Each		413	573	628	749	696	696	859	859	949
Evaporator										
Water Flow Rate	USgpm[m³/hr]	139.8[31.7]	175.2[39.8]	212.2[48.2]	259.5[58.9]	335.8[76.2]	367.6[83.5]	433.8[98.5]	401.3[91.1]	494.3[112.2]
Pressure Drop	ft.wg[kPa]	3.8[11.4]	4.0[12.0]	3.9[11.7]	3.7[11.1]	9.4[28.1]	10.0[29.9]	11.5[34.4]	7.8[23.3]	10.2[30.5]
Design Pressure	psi	150								
Connection Size	inches[mm]	4[102]	5[127]	6[152]	6[152]	6[152]	6[152]	6[152]	8[203]	8[203]
Condenser										
Water Flow Rate	USgpm[m³/hr]	174.5[39.6]	218.7[49.6]	265.0[60.2]	324.0[73.6]	419.2[95.2]	459.0[104.2]	541.7[123.0]	501.0[113.7]	617.1[140.1]
Pressure Drop	ft.wg[kPa]	4.9[14.6]	4.9[14.6]	5.2[15.5]	5.4[16.1]	10.8[32.3]	11.7[35.0]	13.8[41.2]	9.7[29.0]	11.2[33.5]
Design Pressure	psi	150								
Connection Size	inches[mm]	4[102]	5[127]	5[127]	6[152]	6[152]	6[152]	6[152]	8[203]	8[203]
General Information										
Length	Inches[mm]	145 [3683]	145 [3683]	139 [3531]	144 3/4[3677]	176 3/4[4489]	176 3/4[4489]	176 7/8[4493]	176 7/8[4493]	176 7/8[4493]
Width	Inches[mm]	58 3/16[1478]	58 3/16[1478]	60 5/8[1540]	63 1/8[1603]	64[1626]	64[1626]	66 1/2[1689]	69[1753]	69[1753]
Height	Inches[mm]	67 5/8[1718]	67 5/8[1718]	67 5/8[1718]	67 5/8[1718]	77 1/2[1969]	77 1/2[1969]	77 1/2[1969]	77 1/2[1969]	77 1/2[1969]
Shipping Weight	lbs[kg]	6559[2975]	7000[3175]	7694[3490]	7854[3563]	9689[4395]	10302[4673]	10196[4625]	10792[4895]	11078[5025]
Operating Weight	lbs[kg]	6823[3095]	7330[3325]	8223[3730]	8543[3875]	10404[4719]	11069[5021]	11078[5025]	11629[5275]	11850[5375]
Approx. R134a Ref. Charge	lbs[kg]	128[58]	161[73]	194[88]	238[108]	309[140]	337[153]	399[181]	368[167]	454[206]

Model WCFX-E		33T	36S	36T	41S	41T	46T	50T	54T
Capacity	kW	672.0	844.4	765.4	960.2	903.9	1082.8	1181.2	1279.5
	RT	191.1	240.1	217.6	273.0	257.0	307.9	335.9	363.8
	10^4kcal/h	57.8	72.6	65.8	82.6	77.7	93.1	101.6	110.0
Min % Unit Capacity		12.5%	25%	12.5%	25%	12.5%	12.5%	12.5%	12.5%
Power		400V/3P/50Hz							
Compressor									
Model(Qty.)		1215(1) 1218(1)	2233(1)	1218(2)	2236(1)	1218(1) 1222(1)	1222(2)	1222(1) 1227(1)	1227(2)
Input Power	kW	122.2	138.4	131.3	157.8	154.2	177.2	193.2	208.9
RLA, Each		123/146	246	146/146	294	146/146	146/146	146/183	183/183
LRA, Each		628/749	1311	749/749	1730	696/749	696/696	696/859	859/859
Evaporator									
Water Flow Rate	USgpm[m³/hr]	459.1[104.2]	576.9[130.9]	522.9[118.7]	656.0[148.9]	617.5[140.2]	739.8[167.9]	807.0[183.2]	874.1[198.4]
Pressure Drop	ft.wg[kPa]	9.9[29.6]	11.2[33.5]	11.0[32.9]	11.1[33.2]	10.0[29.9]	11.0[32.9]	11.1[33.2]	11.6[34.7]
Design Pressure	psi	150							
Connection Size	inches[mm]	8[203]	8[203]	8[203]	8[203]	8[203]	8[203]	10[254]	10[254]
Condenser									
Water Flow Rate	USgpm[m³/hr]	573.2[130.1]	720.2[163.5]	652.9[148.2]	819.0[185.9]	771.0[175.0]	923.7[209.7]	1007.6[228.7]	1091.4[247.7]
Pressure Drop	ft.wg[kPa]	10.4[31.1]	11.9[35.6]	11.3[33.8]	11.8[35.3]	10.5[31.4]	12.0[35.9]	11.8[35.3]	11.6[34.7]
Design Pressure	psi	150.00							
Connection Size	inches[mm]	8[203]	8[203]	8[203]	8[203]	8[203]	8[203]	10[254]	10[254]
General Information									
Length	Inches[mm]	189 9/16[4815]	202 13/16[5151]	189 9/16[4815]	202 13/16[5151]	191 3/8[4861]	191[4851]	191 5/16[4859]	191 9/16[4866]
Width	Inches[mm]	65 9/16[1665]	78 1/8[1984]	65 9/16[1665]	78 1/8[1984]	71[1803]	73[1854]	75[1905]	75[1905]
Height	Inches[mm]	75 3/8[1915]	86 5/8[2200]	75 3/8[1915]	86 5/8[2200]	79 1/2[2019]	81 5/8[2073]	85 5/8[2175]	85 5/8[2175]
Shipping Weight	lbs[kg]	12599[5715]	12952[5875]	12952[5875]	13525[6135]	14495[6575]	16435[7455]	17361[7875]	17802[8075]
Operating Weight	lbs[kg]	13724[6225]	14275[6475]	14275[6475]	14936[6775]	15598[7075]	17626[7995]	18574[8425]	19235[8725]
Approx. R134a Ref. Charge	lbs[kg]	421[191]	529[240]	481[218]	602[273]	567[257]	679[308]	741[336]	802[364]

Notes: 1. This physical specifications table is based on the following operation condition: inlet/outlet cooled water temperature 54/44 °F, inlet/outlet cooling water temperature 85/95 °F, Fouling factor of evaporator 0.0001hr.ft^2.°F/Btu, Fouling factor of condenser 0.00025hr.ft^2.°F/Btu, 2 pass vessels
2. Actual capacity will depend on the specified conditions. To consult nearest Dunham-bush sales office for computer selections.
3. Non-standard chillers can be designed according to different requirements.

PHYSICAL SPECIFICATIONS

Model WCFX-E		57T	60T	69	73	73T	75T	77	81
Capacity	kW	1365.4	1453.7	1626.5	1725.5	1683.7	1798.5	1824.5	1924.3
	RT	388.2	413.3	462.5	490.6	478.7	511.4	518.8	547.1
	10^4kcal/h	117.4	125.0	139.8	148.4	144.8	154.6	156.9	165.5
Min % Unit Capacity		12.5%	12.5%	8.5%	8.5%	12.5%	12.5%	8.5%	8.5%
Power		400V/3P/50Hz							
Compressor									
Model(Qty.)		1227(1) 1230(1)	1230(2)	1222(3)	1222(2) 1227(1)	2233(2)	2233(1) 2236(1)	1222(1) 1227(2)	1227(3)
Input Power	kW	223.3	237.8	269.5	285.6	278.6	297.2	301.7	317.7
RLA, Each		183/213	213/213	146/146/146	146/146/183	246/246	246/294	146/183/183	183/183/183
LRA, Each		859/949	949/949	696/696/696	696/696/859	1311/1311	1311/1730	696/859/859	859/859/859
Evaporator									
Water Flow Rate	USgpm[m³/hr]	932.8[211.8]	993.1[225.4]	1111.2[252.2]	1178.9[267.6]	1150.2[261.1]	1228.7[278.9]	1246.5[282.9]	1314.6[298.4]
Pressure Drop	ft.wg[kPa]	12.2[36.5]	11.6[34.7]	13.0[38.9]	13.1[39.2]	12.8[38.3]	13.0[38.9]	13.7[41.0]	13.9[41.5]
Design Pressure	psi	150							
Connection Size	inches[mm]	10[254]	10[254]	10[254]	10[254]	12[305]	12[305]	10[254]	10[254]
Condenser									
Water Flow Rate	USgpm[m³/hr]	1164.7[264.4]	1240.0[281.5]	1387.4[314.9]	1471.9[334.1]	1436.2[326.0]	1534.1[348.2]	1556.3[353.3]	1641.4[372.6]
Pressure Drop	ft.wg[kPa]	11.9[35.6]	12.4[37.1]	13.3[39.8]	13.7[41.0]	13.2[39.5]	12.9[38.6]	13.9[41.5]	13.0[38.9]
Design Pressure	psi	150							
Connection Size	inches[mm]	10[254]	10[254]	10[254]	10[254]	12[305]	12[305]	10[254]	12[305]
General Information									
Length	Inches[mm]	191 9/16[4866]	191 9/16[4866]	198 3/4[5048]	198 3/4[5048]	198 5/16[5037]	199 5/8[5070]	215 3/4[5480]	215 3/4[5480]
Width	Inches[mm]	75[1905]	77[1956]	80 3/4[2051]	80 3/4[2051]	87 7/8[2232]	87 7/8[2232]	80 3/4[2051]	80 3/4[2051]
Height	Inches[mm]	85 5/8[2175]	87 5/8[2226]	92 1/2[2350]	92 1/2[2350]	92 1/2[2350]	92 1/2[2350]	92 1/2[2350]	94 1/2[2400]
Shipping Weight	lbs[kg]	18794[8525]	19015[8625]	23667[10735]	21991[9975]	22674[10285]	22983[10425]	24747[11225]	25849[11725]
Operating Weight	lbs[kg]	19676[8925]	20668[9375]	26180[11875]	24306[11025]	25267[11461]	25739[11675]	27282[12375]	28274[12825]
Approx. R134a Ref. Charge	lbs[kg]	855[388]	911[413]	1019[462]	1082[491]	1056[479]	1127[511]	1144[519]	1206[547]

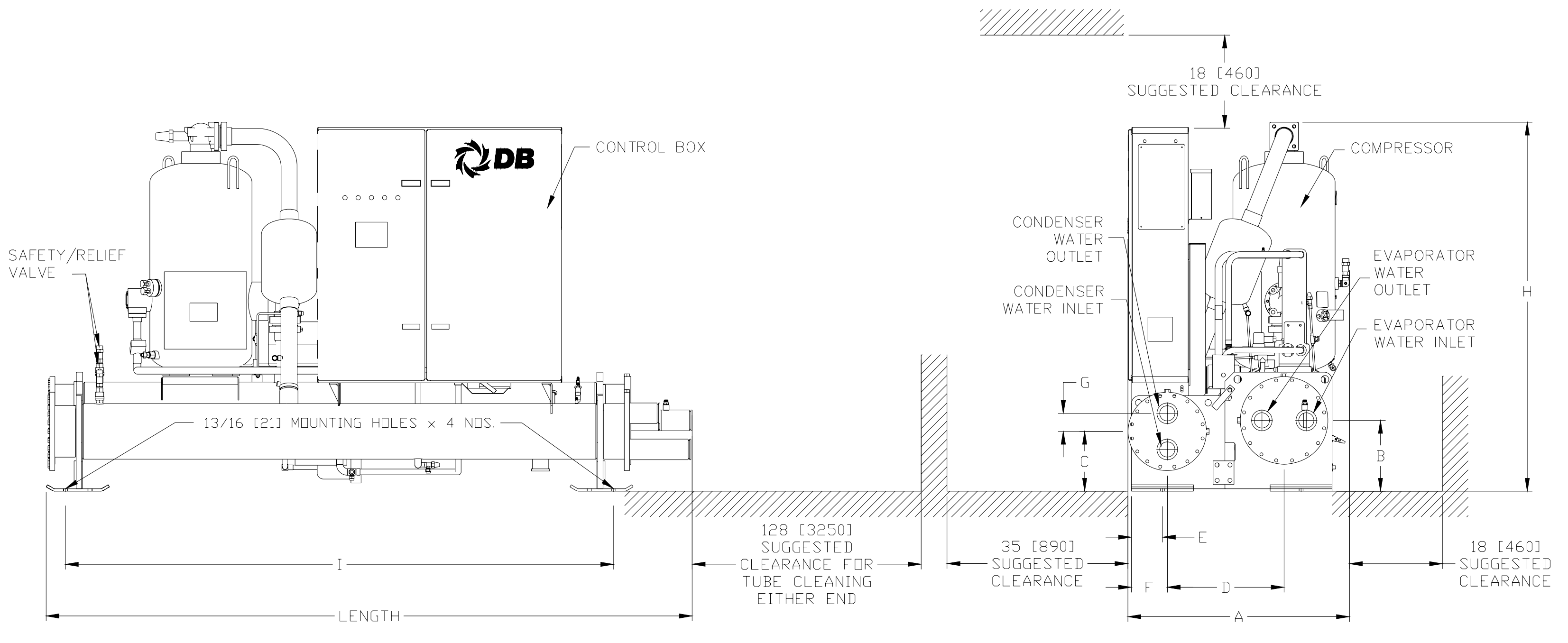
Model WCFX-E		81T	84	87	90	108	113	118	123
Capacity	kW	1917.9	2014.1	2101.9	2186.4	2542.9	2656.1	2773.1	2892.7
	RT	545.3	572.7	597.6	621.7	723.0	755.2	788.5	822.5
	10^4kcal/h	164.9	173.2	180.7	188.0	218.6	228.4	238.4	248.7
Min % Unit Capacity		12.5%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%	8.5%
Power		400V/3P/50Hz							
Compressor									
Model(Qty.)		2236(2)	1227(2) 1230(1)	1227(1) 1230(2)	1230(3)	2233(3)	2233(2) 2236(1)	2233(1) 2236(2)	2236(3)
Input Power	kW	315.8	332.5	346.7	361.8	417.3	436.7	455.3	474.6
RLA, Each		294/294	183/183/213	183/213/213	213/213/213	246/246/246	246/246/294	246/294/294	294/294/294
LRA, Each		1730/1730	859/859/949	859/949/949	949/949/949	1311/1311/ 1311	1311/1311/ 1730	1311/1730/ 1730	1730/1730/ 1730
Evaporator									
Water Flow Rate	USgpm[m³/hr]	1310.3[297.4]	1376.0[312.3]	1436.0[326.0]	1493.7[339.1]	1737.3[394.4]	1814.6[411.9]	1894.5[430.1]	1976.2[448.6]
Pressure Drop	ft.wg[kPa]	11.7[35.0]	12.4[37.1]	12.5[37.4]	13.4[40.1]	11.9[35.6]	12.9[38.6]	13.0[38.9]	12.1[36.2]
Design Pressure	psi	150							
Connection Size	inches[mm]	12[305]	12[305]	12[305]	12[305]	12[305]	12[305]	12[305]	12[305]
Condenser									
Water Flow Rate	USgpm[m³/hr]	1636.0[371.4]	1718.0[390.0]	1792.9[407.0]	1865.0[423.4]	2169.1[492.4]	2265.6[514.3]	2365.5[537.0]	2467.5[560.1]
Pressure Drop	ft.wg[kPa]	12.2[36.5]	14.0[41.8]	12.9[38.6]	13.8[41.2]	12.0[35.9]	12.1[36.2]	11.0[32.9]	10.5[31.4]
Design Pressure	psi	150							
Connection Size	inches[mm]	12[305]	10[254]	10[254]	10[254]	12[305]	12[305]	12[305]	12[305]
General Information									
Length	Inches[mm]	201 3/16[5110]	215 3/4[5480]	216 7/8[5509]	216 7/8[5509]	217 1/16[5513]	217 1/16[5513]	217 1/16[5513]	217 1/16[5513]
Width	Inches[mm]	89 5/8[2276]	82 1/2[2096]	82 1/2[2096]	82 1/2[2096]	95 7/16[2424]	95 7/16[2424]	100 1/8[2543]	100 1/8[2543]
Height	Inches[mm]	96 3/8[2448]	96 3/8[2448]	96 3/8[2448]	96 3/8[2448]	114 5/8[2911]	114 5/8[2911]	125 13/16[3196]	125 13/16[3196]
Shipping Weight	lbs[kg]	25959[11775]	26599[12065]	27172[12325]	27172[12325]	30258[13725]	30919[14025]	33124[15025]	33896[15375]
Operating Weight	lbs[kg]	29266[13275]	29046[13175]	32132[14575]	32132[14575]	34667[15725]	35549[16125]	38525[17475]	39628[17975]
Approx. R134a Ref. Charge	lbs[kg]	1202[545]	1263[573]	1318[598]	1371[622]	1594[723]	1664[755]	1737[788]	1814[823]

Notes:
1. This physical specifications table is based on the following operation condition: inlet/outlet cooled water temperature 54/44 °F, inlet/outlet cooling water temperature 85/95 °F, Fouling factor of evaporator 0.0001hr.ft^2.°F/Btu, Fouling factor of condenser 0.00025hr.ft^2.°F/Btu, 2 pass vessels
2. Actual capacity will depend on the specified conditions. To consult nearest Dunham-bush sales office for computer selections.
3. Non-standard chillers can be designed according to different requirements.

DIMENSIONAL DATA

WCFX-E 10S, 12S, 15S, 18S, 20S, 23S, 24S, 27S, 30S

Model	Length	A	B	C	D	E	F	G	H	I	R	S
WCFX-E 10S	125 [3175]	42 7/8 [1088]	13 11/16 [348]	11 9/16 [294]	22 5/8 [574]	6 [153]	6 15/16 [176]	3 1/2 [89]	71 7/16 [1814]	106 1/16 [2694]	4 [102]	4 [102]
WCFX-E 12S	125 [3175]	44 5/16 [1126]	13 11/16 [348]	12 5/8 [321]	23 1/4 [590]	6 [153]	8 7/16 [215]	4 5/8 [118]	71 3/8 [1812]	106 1/16 [2694]	4 [102]	4 [102]
WCFX-E 15S	119 [3023]	44 5/16 [1126]	14 3/4 [374]	12 5/8 [321]	23 1/4 [590]	6 [153]	8 7/16 [215]	4 5/8 [118]	77 3/4 [1975]	106 1/16 [2694]	4 [102]	4 [102]
WCFX-E 18S	124 13/16 [3170]	46 9/16 [1182]	14 3/4 [374]	13 1/8 [333]	23 7/16 [596]	6 [153]	9 1/16 [230]	4 [102]	77 3/4 [1975]	106 1/16 [2694]	5 [127]	5 [127]
WCFX-E 20S	156 3/4 [3982]	47 1/2 [1206]	15 1/2 [394]	13 1/8 [333]	23 7/16 [596]	6 [153]	9 1/16 [230]	4 [102]	88 1/16 [2237]	138 [3506]	5 [127]	5 [127]
WCFX-E 23S	156 3/4 [3982]	47 1/2 [1206]	15 1/2 [394]	13 1/8 [333]	23 7/16 [596]	6 [153]	9 1/16 [230]	4 [102]	88 1/16 [2237]	138 [3506]	5 [127]	5 [127]
WCFX-E 24S	156 15/16 [3987]	49 1/4 [1252]	17 3/16 [437]	14 7/16 [366]	24 13/16 [630]	6 [153]	9 5/16 [236]	4 5/8 [366]	90 13/16 [2307]	138 [3506]	6 [152]	6 [152]
WCFX-E 27S	156 15/16 [3987]	49 3/8 [1254]	16 7/16 [417]	14 7/16 [366]	24 13/16 [630]	6 [153]	9 5/16 [236]	4 5/8 [366]	90 1/16 [2287]	138 [3506]	6 [152]	6 [152]
WCFX-E 30S	156 15/16 [3987]	49 5/16 [1253]	16 7/16 [417]	14 7/16 [366]	24 13/16 [630]	6 [153]	9 5/16 [236]	4 5/8 [366]	90 1/16 [2287]	138 [3506]	6 [152]	6 [152]



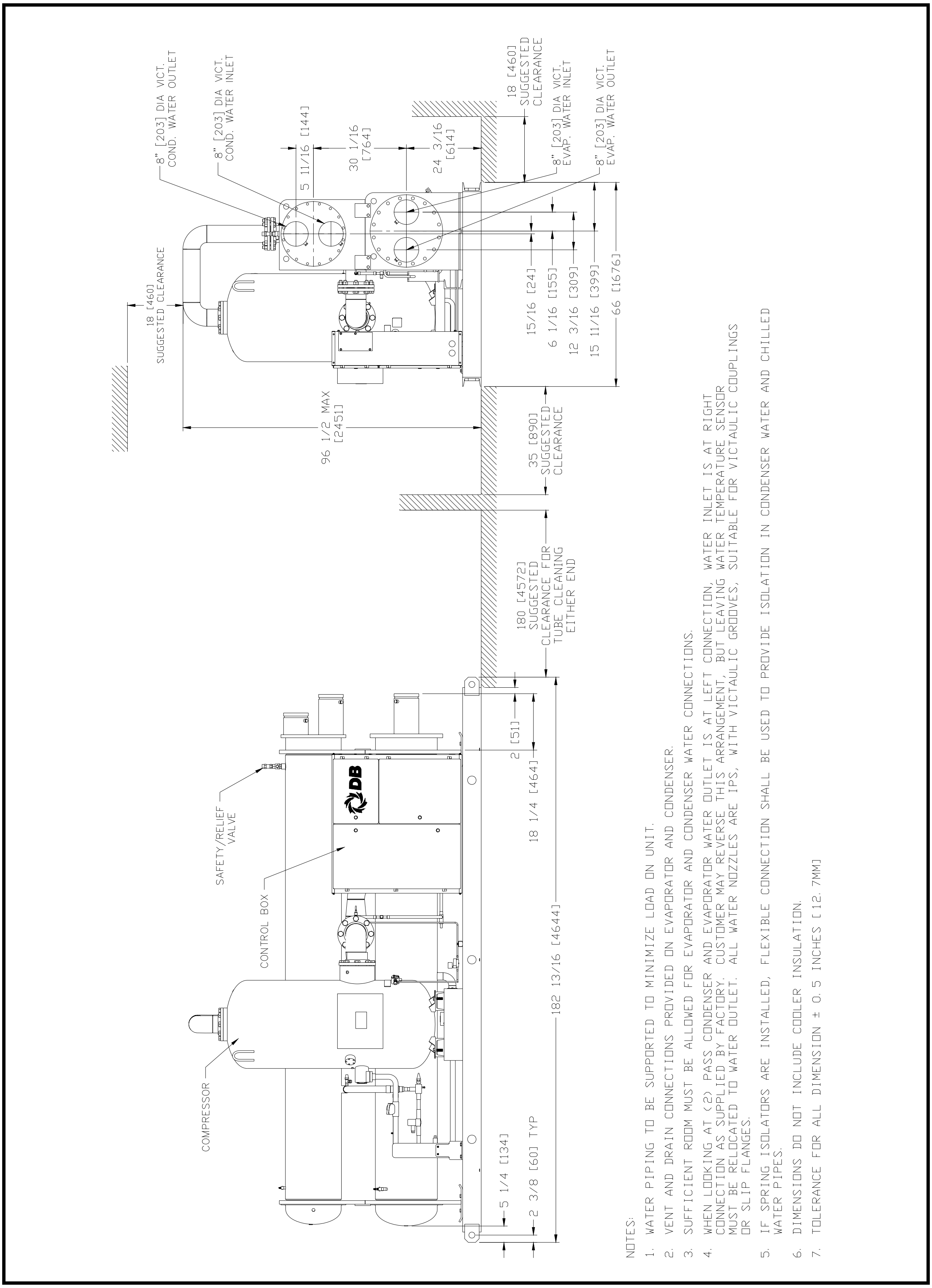
NOTES:

1. WATER PIPING TO BE SUPPORT TO MINIMIZE LOAD ON UNIT.
2. ALL DIMENSIONS ARE IN INCHES [MM].
3. VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER.
4. SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS.
5. WHEN LOOKING AT (2) PASS CONDENSER AND EVAPORATOR WATER OUTLET IS AT LEFT CONNECTION, WATER INLET IS AT RIGHT CONNECTION AS SUPPLIED BY FACTORY. CUSTOMER MAY REVERSE THIS ARRANGEMENT, BUT LEAVING WATER TEMPERATURE SENSOR MUST BE RELOCATED TO WATER OUTLET. ALL WATER NOZZLES ARE IPS, WITH VICTAULIC GROOVES, SUITABLE FOR VICTAULIC COUPLINGS OR SLIP FLANGES.

Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

WCFX-E 36S, 41S

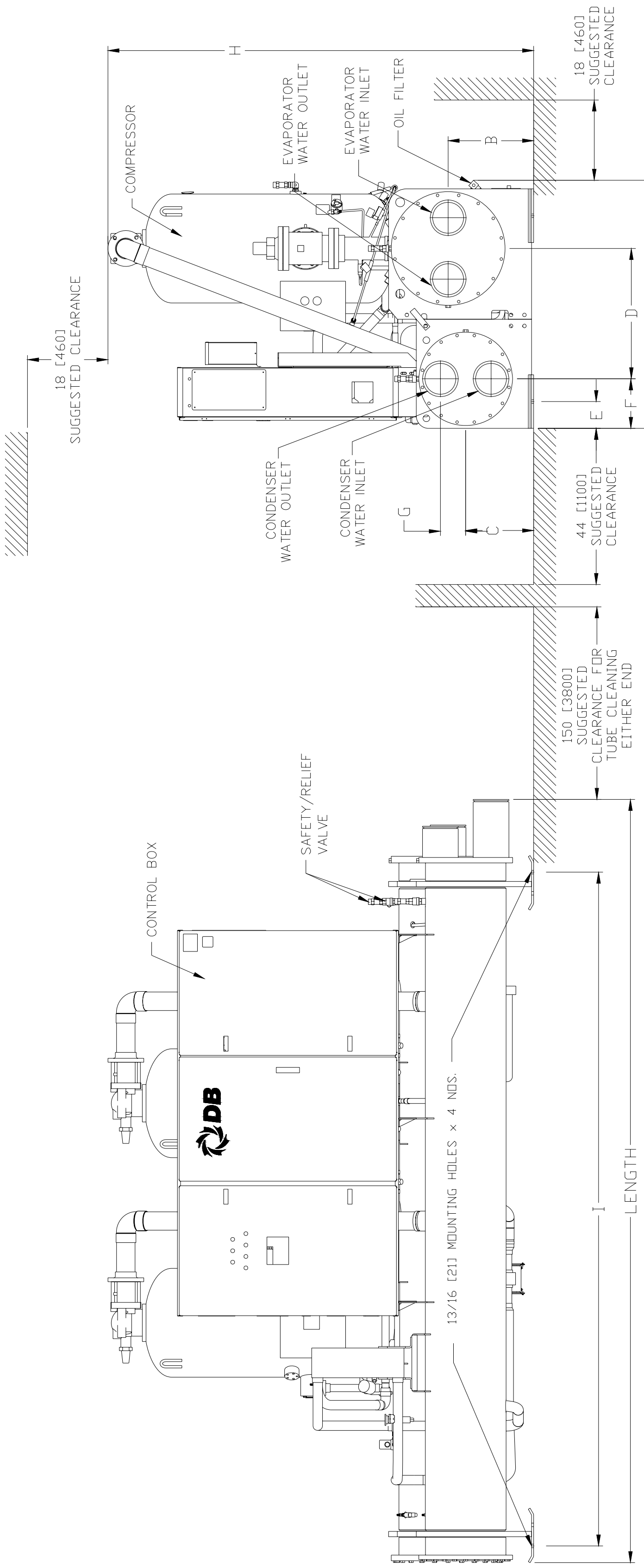


Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

WCFX-E 36T, 41T, 46T, 50T, 54T, 57T, 60T

Model	Length	A	B	C	D	E	F	G	H	I	R	S
WCFX-E 36T	169 9/16 [4308]	51 7/16 [1306]	16 7/16 [417]	15 3/8 [391]	33 1/4 [844]	6 [153]	10 1/16 [256]	4 1/2 [115]	80 1/2 [2045]	151 [3836]	6 [152]	6 [152]
WCFX-E 41T	171 5/16 [4352]	53 3/8 [1355]	18 3/16 [462]	15 1/4 [387]	27 3/8 [695]	6 [153]	11 1/8 [282]	5 11/16 [144]	93 5/16 [2370]	151 [3836]	8 [203]	8 [203]
WCFX-E 46T	171 1/16 [4345]	55 5/8 [1412]	19 3/16 [487]	15 1/4 [387]	29 3/16 [742]	6 [153]	11 1/8 [282]	5 11/16 [144]	95 3/8 [2423]	151 [3836]	8 [203]	8 [203]
WCFX-E 50T	171 5/16 [4352]	54 3/4 [1390]	19 3/16 [487]	16 1/4 [412]	29 [737]	6 [153]	12 3/8 [314]	6 1/16 [155]	95 3/8 [2423]	151 [3836]	8 [203]	8 [203]
WCFX-E 54T	171 9/16 [4357]	57 1/16 [1449]	20 3/16 [513]	16 1/4 [412]	28 13/16 [732]	6 [153]	12 3/8 [314]	6 1/16 [155]	97 3/8 [2474]	151 [3836]	8 [203]	8 [203]
WCFX-E 57T	171 9/16 [4357]	57 1/16 [1449]	20 3/16 [513]	16 1/4 [412]	35 11/16 [907]	6 [153]	12 3/8 [314]	6 1/16 [155]	97 7/16 [2474]	151 [3836]	8 [203]	8 [203]
WCFX-E 60T	171 9/16 [4357]	57 1/16 [1449]	20 3/16 [513]	16 1/4 [412]	28 13/16 [732]	6 [153]	12 3/8 [314]	6 1/16 [155]	97 3/8 [2474]	151 [3836]	8 [203]	8 [203]



NOTES:

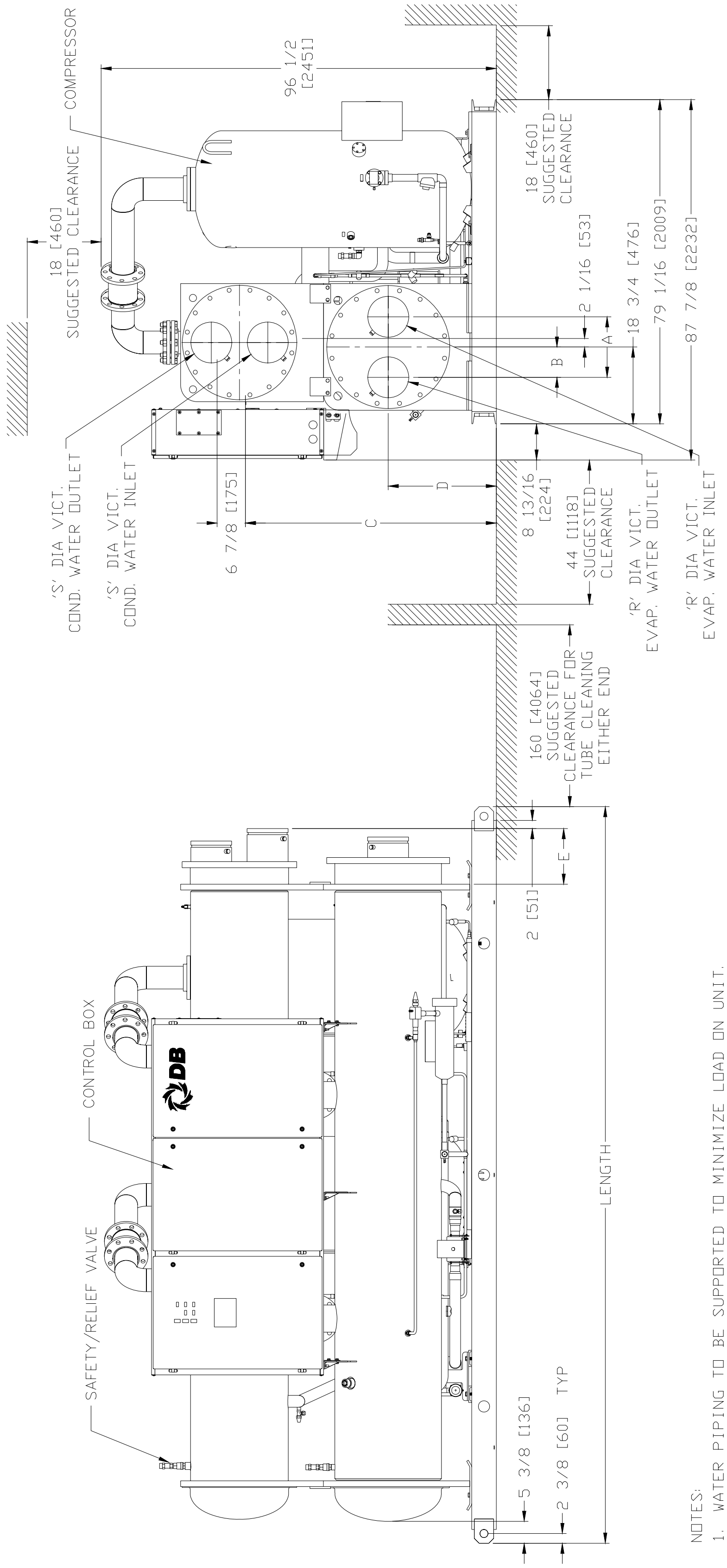
1. WATER PIPING TO BE SUPPORT TO MINIMIZE LOAD ON UNIT.
2. ALL DIMENSIONS ARE IN INCHES [MM].
3. VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER.
4. SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS.
5. WHEN LOOKING AT (2) PASS CONDENSER AND EVAPORATOR WATER OUTLET IS AT LEFT CONNECTION, WATER INLET IS AT RIGHT CONNECTION AS SUPPLIED BY FACTORY. CUSTOMER MAY REVERSE THIS ARRANGEMENT, BUT LEAVING WATER TEMPERATURE SENSOR MUST BE RELOCATED TO WATER OUTLET. ALL WATER NOZZLES ARE IPS, WITH VICTAULIC GROOVES, SUITABLE FOR VICTAULIC COUPLINGS OR SLIP FLANGES.

Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

WCFX-E 73T, 75T, 81T

Model	Length	A	B	C	D	E	R	S
WCFX-E 73T	178 5/16 [4529]	14 3/4 [375]	7 3/8 [187]	61 1/4 [1556]	26 3/8 [670]	12 1/4 [311]	10 [254]	8 [203]
WCFX-E 75T	179 5/8 [4563]	14 3/4 [375]	7 3/8 [187]	61 1/4 [1556]	26 3/8 [670]	13 9/16 [344]	10 [254]	10 [254]
WCFX-E 81T	181 3/16 [4602]	16 1/4 [413]	8 1/8 [207]	63 15/16 [1624]	26 3/16 [666]	14 9/16 [370]	10 [254]	10 [254]



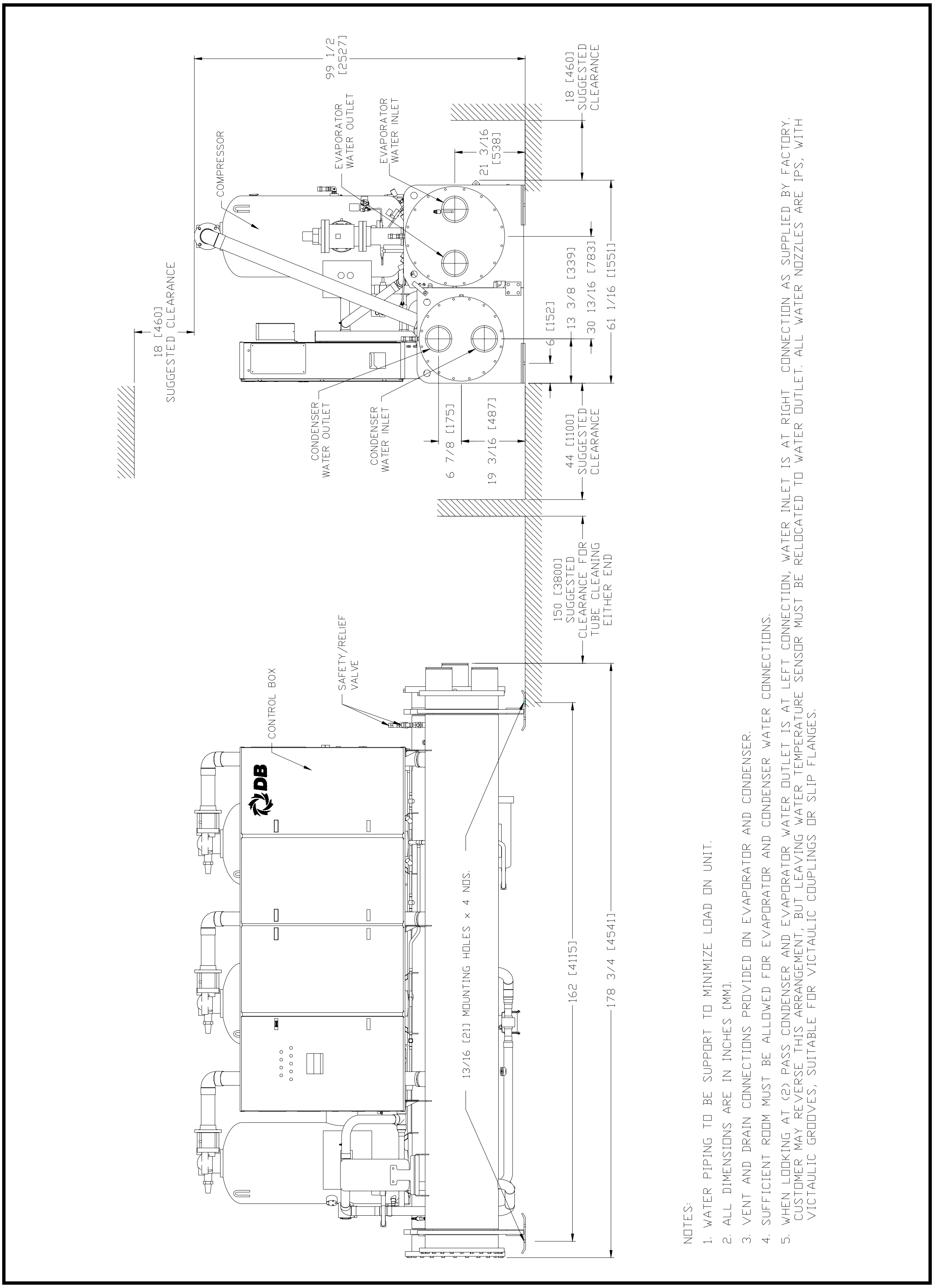
NOTES:

1. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.
2. VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER.
3. SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS.
4. WHEN LOOKING AT (2) PASS CONDENSER AND EVAPORATOR WATER OUTLET IS AT LEFT CONNECTION, WATER INLET IS AT RIGHT CONNECTION AS SUPPLIED BY FACTORY. CUSTOMER MAY REVERSE THIS ARRANGEMENT, BUT LEAVING WATER TEMPERATURE SENSOR MUST BE RELOCATED TO WATER OUTLET. ALL WATER NOZZLES ARE IPS, WITH VICTAULIC GROOVES, SUITABLE FOR VICTAULIC COUPLINGS OR SLIP FLANGES.
5. IF SPRING ISOLATORS ARE INSTALLED, FLEXIBLE CONNECTION SHALL BE USED TO PROVIDE ISOLATION IN CONDENSER WATER AND CHILLED WATER PIPES.
6. DIMENSIONS DO NOT INCLUDE COOLER INSULATION.
7. TOLERANCE FOR ALL DIMENSION ± 0.5 INCHES [12.7MM]

Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

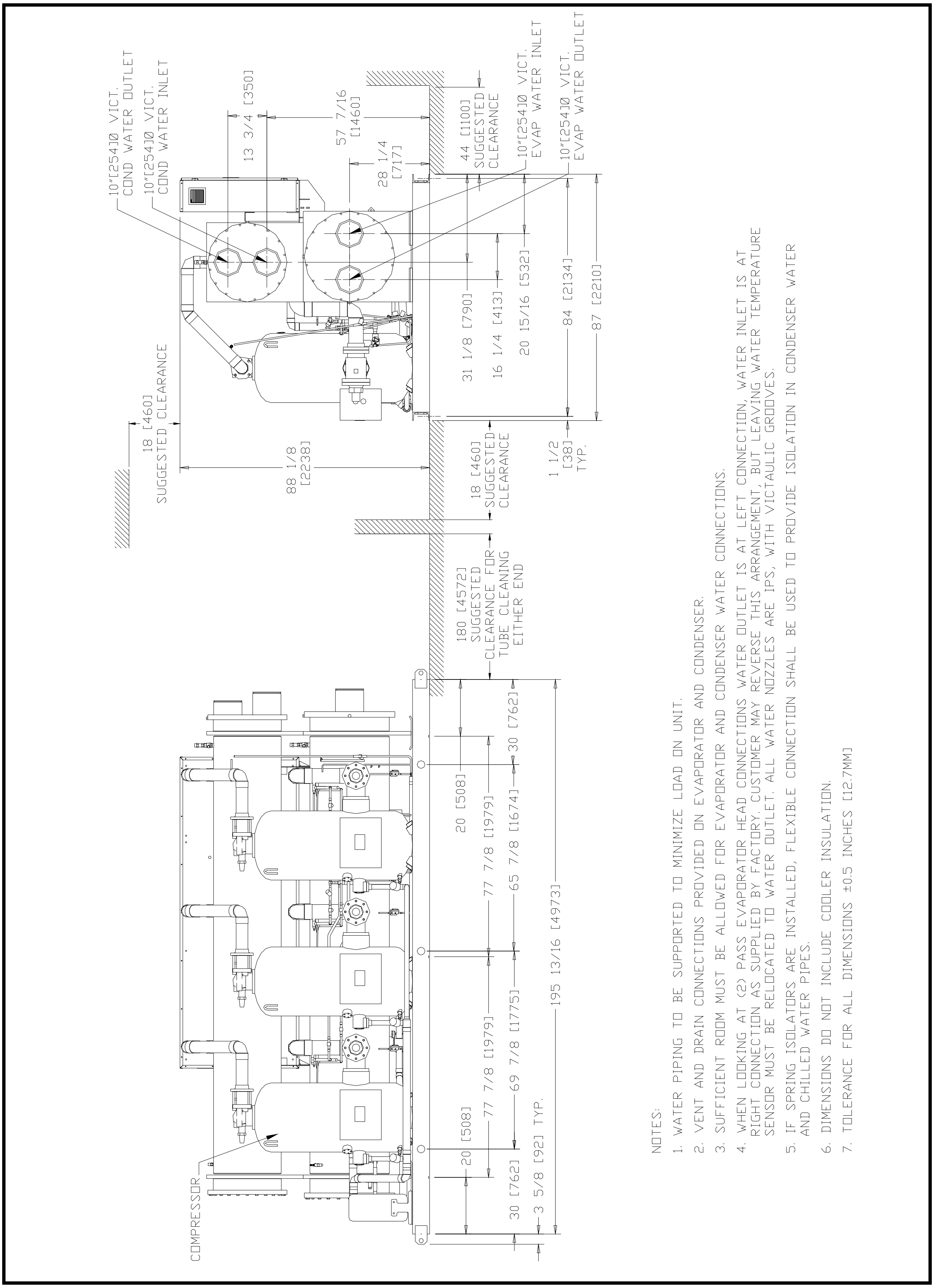
WCFX-E 69, 73



Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

WCFX-E 77, 81

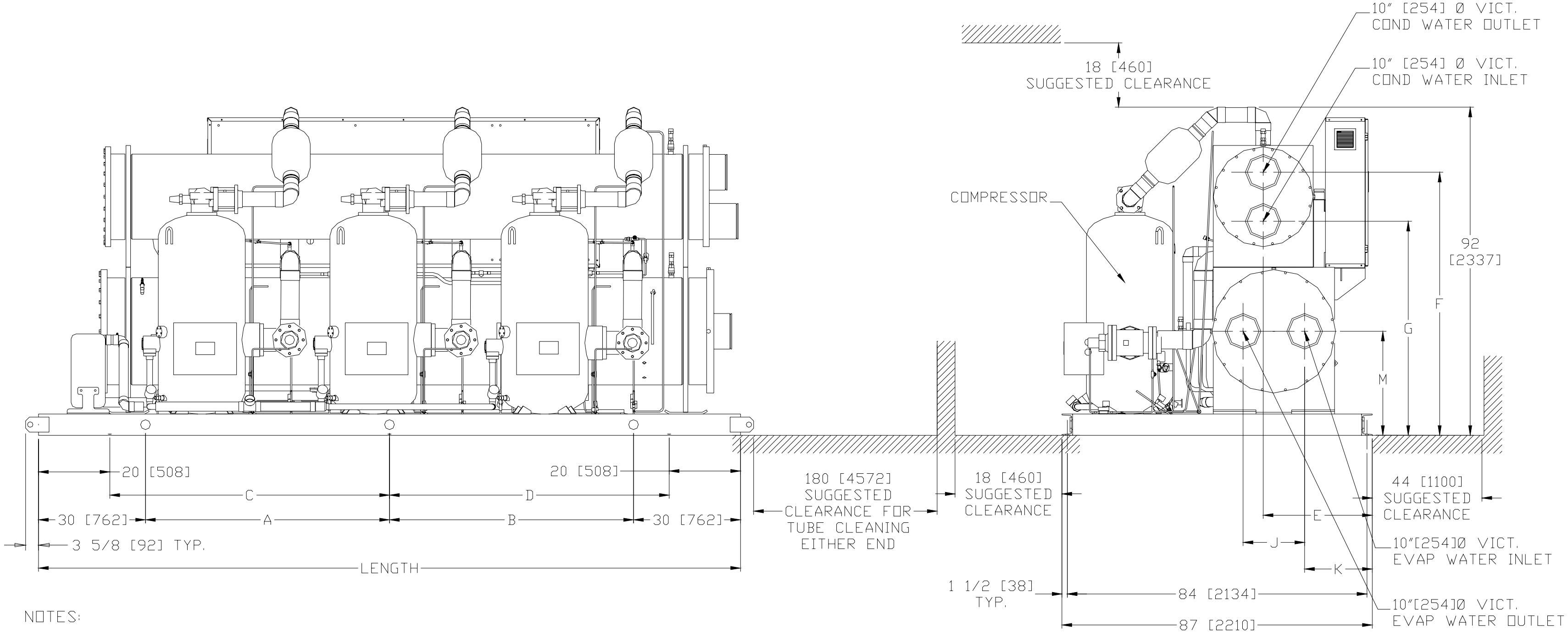


Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

WCFX-E 84, 87, 90

Model	LENGTH	A	B	C	D	E	F	G	J	K	M
WCFX-E 84	195 3/4 [4973]	69 7/8 [1775]	65 7/8 [1674]	77 7/8 [1979]	77 7/8 [1979]	31 1/8 [790]	71 1/4 [1809]	57 1/2 [1460]	16 1/4 [413]	21 [532]	28 1/4 [717]
WCFX-E 87	196 7/8 [5000]	68 3/8 [1738]	68 3/8 [1738]	78 3/8 [1992]	78 3/8 [1992]	30 5/8 [777]	73 3/4 [1874]	60 [1525]	17 1/4 [438]	19 [482]	29 1/4 [741]
WCFX-E 90	196 7/8 [5000]	68 3/8 [1738]	68 3/8 [1738]	78 3/8 [1992]	78 3/8 [1992]	30 5/8 [777]	73 3/4 [1874]	60 [1525]	17 1/4 [438]	19 [482]	29 1/4 [741]



NOTES:

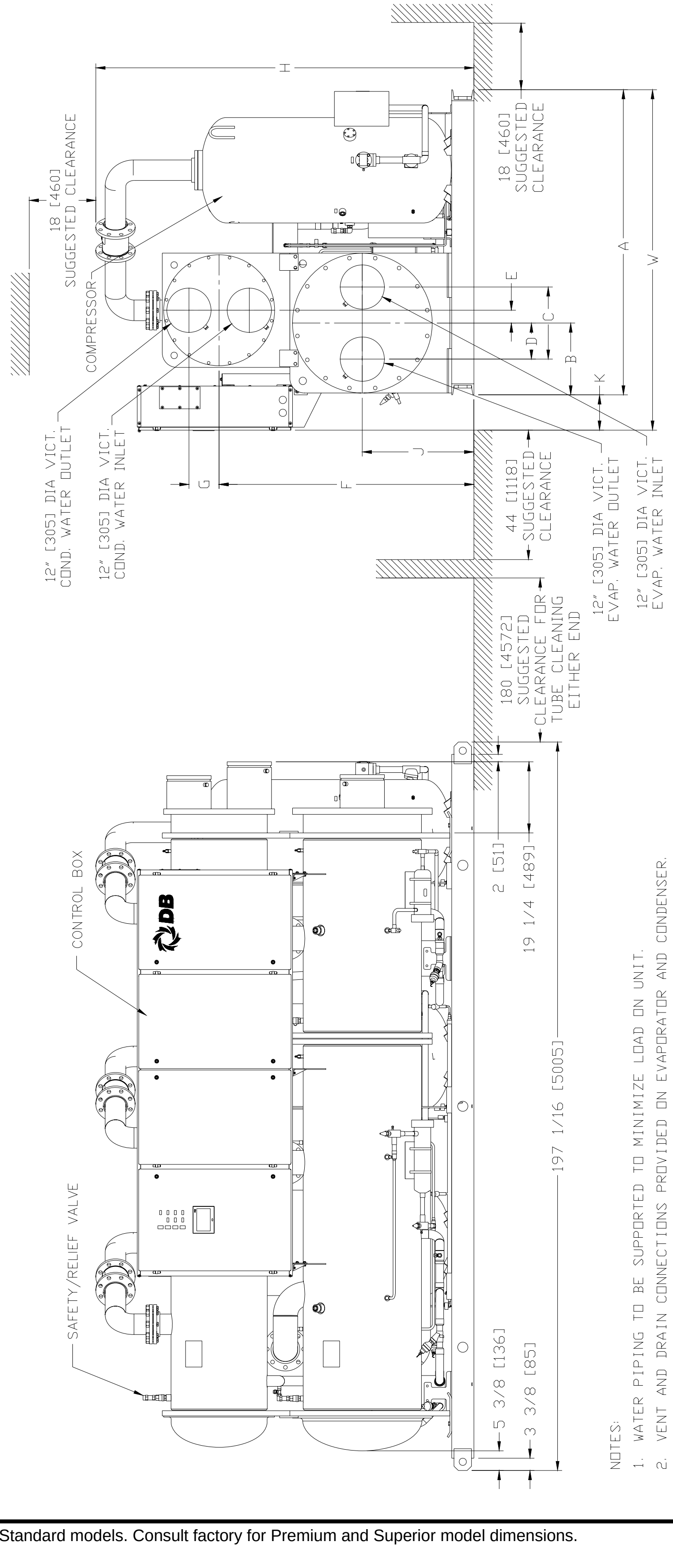
1. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.
2. VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER.
3. SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS.
4. WHEN LOOKING AT (2) EVAPORATOR HEAD CONNECTIONS
   WATER OUTLET IS AT LEFT CONNECTION, WATER INLET IS AT RIGHT CONNECTION AS SUPPLIED BY FACTORY. CUSTOMER MAY REVERSE THIS ARRANGEMENT, BUT LEAVING WATER TEMPERATURE SENSOR MUST BE RELOCATED TO WATER OUTLET. ALL WATER NOZZLES ARE IPS, WITH VICTAULIC GROOVES.
5. IF SPRING ISOLATORS ARE INSTALLED, FLEXIBLE CONNECTION SHALL BE USED TO PROVIDE ISOLATION IN CONDENSER WATER AND CHILLED WATER PIPES.
6. DIMENSIONS DO NOT INCLUDE COOLER INSULATION.
7. TOLERANCE FOR ALL DIMENSIONS ±0.5 INCHES [12.7MM]

Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

DIMENSIONAL DATA

WCFX-E 108, 113, 118, 123

Model	H	W	A	B	C	D	E	F	G	J	K
WCFX-E 108	102 1/4 [2598]	92 1/16 [2339]	82 9/16 [2097]	19 7/16 [493]	19 1/2 [495]	9 3/4 [248]	3 7/16 [88]	68 15/16 [1751]	8 3/16 [208]	30 1/8 [766]	9 9/16 [242]
WCFX-E 113	102 1/4 [2598]	92 1/16 [2339]	82 9/16 [2097]	19 7/16 [493]	19 1/2 [495]	9 3/4 [248]	3 7/16 [88]	68 15/16 [1751]	8 3/16 [208]	30 1/8 [766]	9 9/16 [242]
WCFX-E 118	102 1/4 [2598]	92 1/16 [2339]	82 9/16 [2097]	19 7/16 [493]	19 1/2 [495]	9 3/4 [248]	3 7/16 [88]	68 15/16 [1751]	8 3/16 [208]	30 1/8 [766]	9 9/16 [242]
WCFX-E 123	106 1/8 [2695]	90 3/8 [2302]	84 15/16 [2157]	23 1/4 [590]	20 5/16 [515]	10 1/8 [258]	2 1/2 [64]	71 3/4 [1823]	8 [203]	31 11/16 [806]	5 11/16 [145]

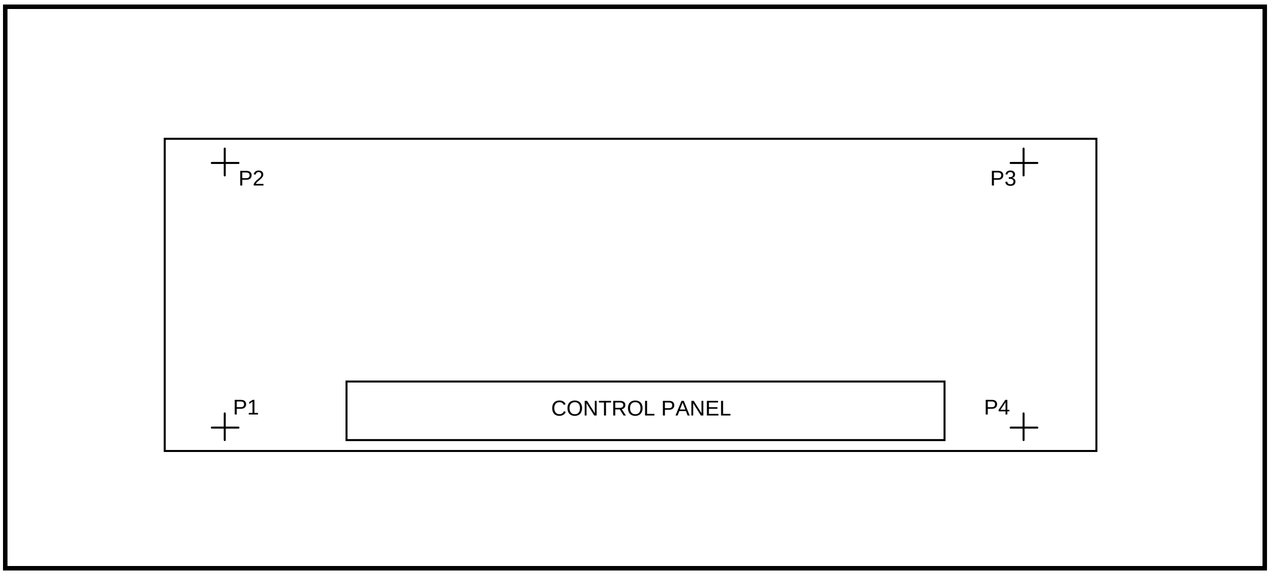


NOTES:

1. WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.
2. VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER.
3. SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS.
4. WHEN LOOKING AT (2) PASS EVAPORATOR HEAD CONNECTIONS, WATER OUTLET IS AT LEFT CONNECTION, WATER INLET IS AT RIGHT CONNECTION AS SUPPLIED BY FACTORY. CUSTOMER MAY REVERSE THIS ARRANGEMENT, BUT LEAVING WATER TEMPERATURE SENSOR MUST BE RELOCATED TO WATER OUTLET. ALL WATER NOZZLES ARE IPS, WITH VICTAULIC GROOVES.
5. IF SPRING ISOLATORS ARE INSTALLED, FLEXIBLE CONNECTION SHALL BE USED TO PROVIDE ISOLATION IN CONDENSER WATER AND CHILLED WATER PIPES.
6. DIMENSIONS DO NOT INCLUDE COOLER INSULATION.
7. TOLERANCE FOR ALL DIMENSION ± 0.5 INCHES [12.7MM]

Note: Above Drawing is for Standard models. Consult factory for Premium and Superior model dimensions.

FLOOR LOADING DIAGRAM



POINT LOAD DATA

Model WCFX-E	P1		P2		P3		P4		Operating Weight	
	lbs	kg	lbs	kg	lbs	kg	lbs	kg	lbs	kg
10S	919	417	1484	673	1186	538	734	333	4323	1961
12S	996	452	1545	701	1241	563	802	364	4586	2080
15S	1177	534	1684	764	1301	590	908	412	5071	2300
18S	1301	590	1755	796	1371	622	1019	462	5445	2470
20S	1493	677	2449	1111	1878	852	1144	519	6964	3159
23S	1623	736	2414	1095	1858	843	1250	567	7145	3241
24S	1512	686	2716	1232	2086	946	1160	526	7474	3390
27S	1545	701	2798	1269	2158	979	1193	541	7694	3490
30S	1662	754	2921	1325	2249	1020	1281	581	8113	3680
33T	1978	897	2687	1219	2776	1259	2041	926	9482	4301
36S	3236	1468	1744	791	1885	855	3499	1587	10364	4701
36T	1978	897	2687	1219	2776	1259	2041	926	9482	4301
41S	3411	1547	1812	822	1960	889	3686	1672	10869	4930
41T	2359	1070	3329	1510	3252	1475	2304	1045	11244	5100
46T	2280	1034	4057	1840	4061	1842	2282	1035	12679	5751
50T	2379	1079	4286	1944	4262	1933	2366	1073	13292	6029
54T	2593	1176	4577	2076	4572	2074	2590	1175	14332	6501
57T	2663	1208	4694	2129	4661	2114	2643	1199	14661	6650
60T	2727	1237	4810	2182	4799	2177	2721	1234	15058	6830
69	3851	1747	6131	2781	5595	2538	3514	1594	19092	8660
73	3951	1792	6274	2846	5686	2579	3580	1624	19491	8841
73T	4045	1835	6252	2836	4883	2215	3161	1434	18342	8320
75T	4103	1861	6808	3088	5434	2465	3276	1486	19621	8900
77	5200	2359	5450	2472	5986	2715	5907	2680	22543	10225
81	5393	2446	5701	2586	6118	2775	6144	2787	23357	10594
81T	4248	1927	7156	3246	3389	1537	5708	2589	20501	9299
84	5440	2468	5742	2605	6285	2851	6222	2822	23689	10745
87	6042	2741	6351	2881	6895	3127	6829	3097	26117	11846
90	6277	2847	6596	2992	7065	3205	7059	3202	26996	12245
108	4182	1897	10809	4903	9123	4138	3530	1601	27644	12539
113	4244	1925	10942	4963	9312	4224	3611	1638	28109	12750
118	4264	1934	11211	5085	9553	4333	3633	1648	28660	13000
123	5115	2320	11327	5138	9665	4384	4363	1979	30470	13821

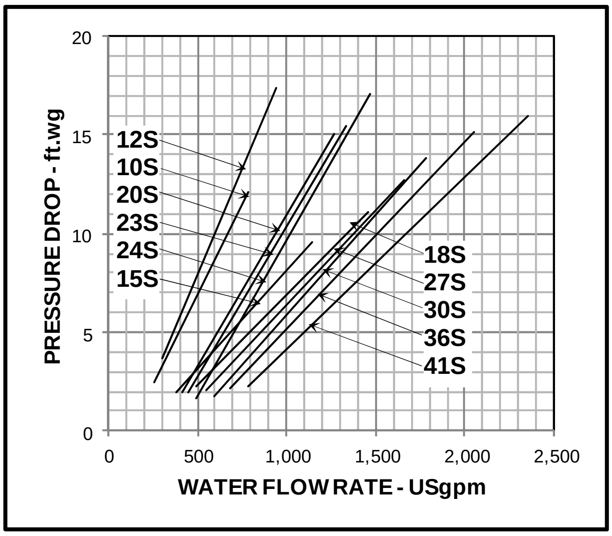
Notes:
1.) Refer to dimensional drawings for location of mounting points.
2.) Unit must be lowered onto mounting springs in a level fashion or spring damage may occur.
3.) Data for Standard models. Consult factory for Premium and Superior model point load data.

WATER PRESSURE DROPS

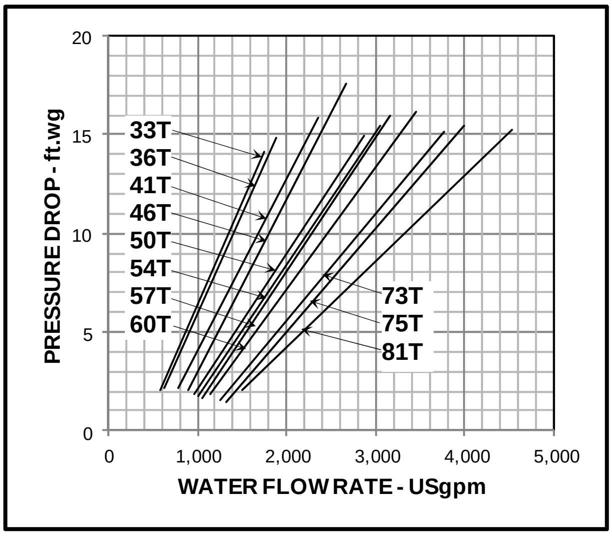
IMPERIAL UNITS

1A.) EVAPORATOR 1 PASS

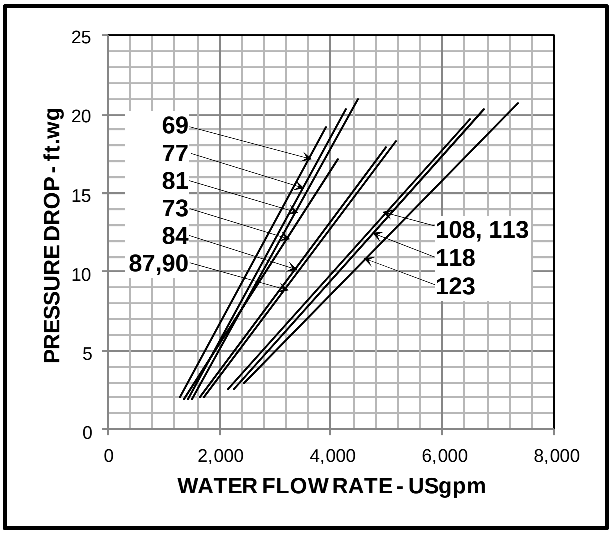
a.) Single Compressor



b.) Twin Compressors

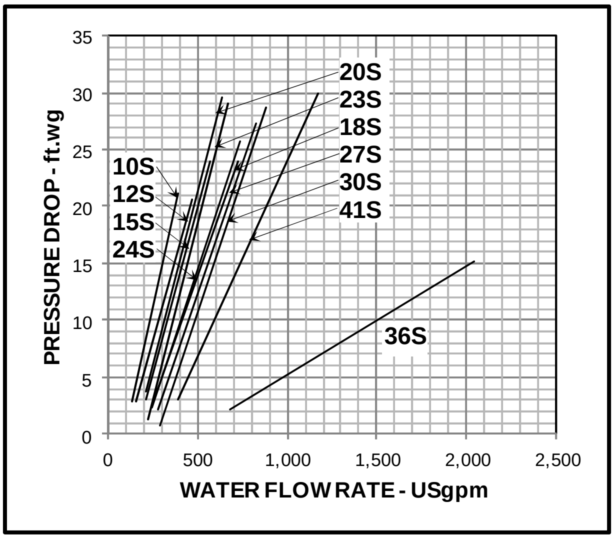


c.) Three Compressors

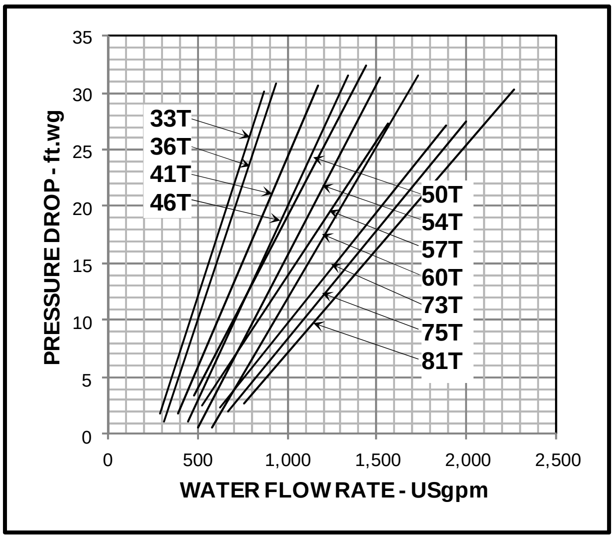


1B.) EVAPORATOR 2 PASS

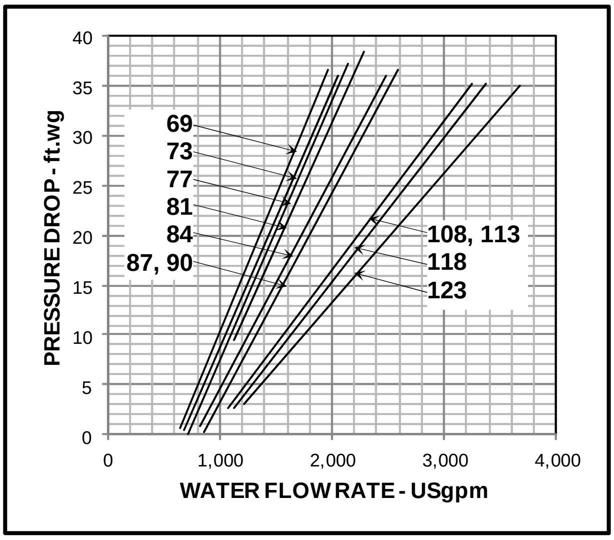
a.) Single Compressor



b.) Twin Compressors



c.) Three Compressors

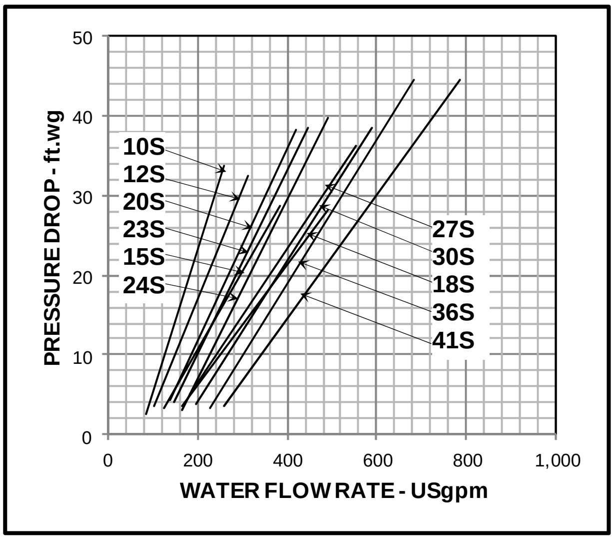


WATER PRESSURE DROP

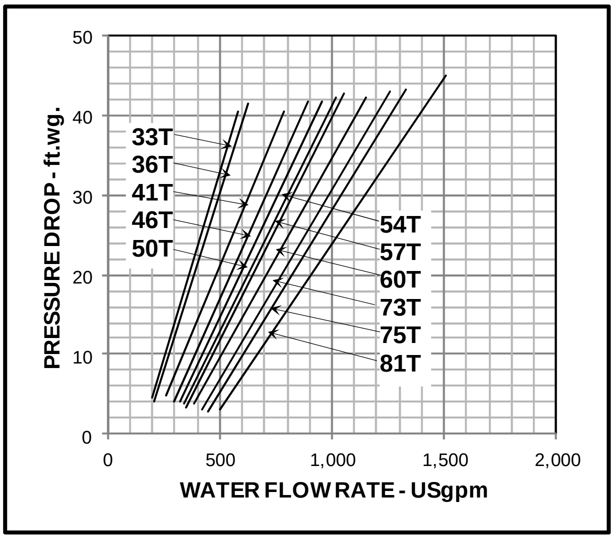
IMPERIAL UNITS

1C.) EVAPORATOR - 3 PASS

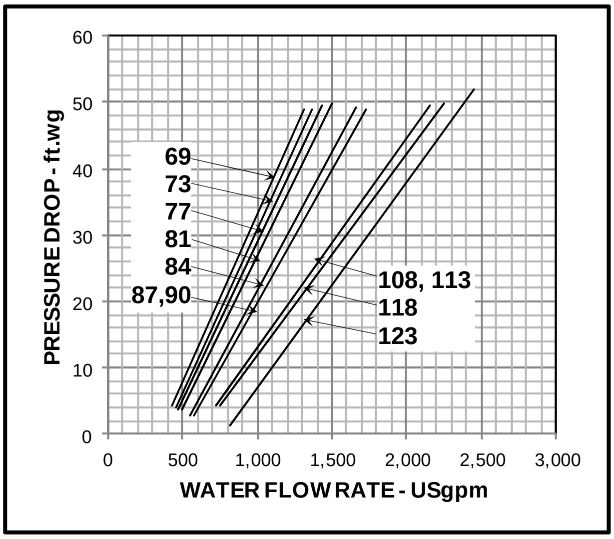
a.) Single Compressor



b.) Twin Compressors

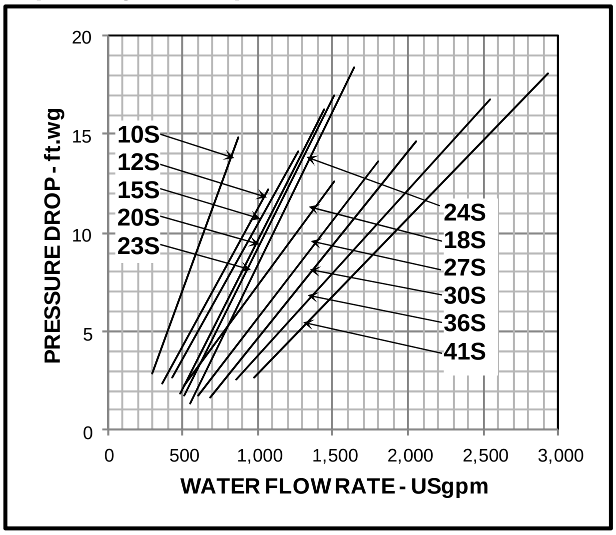


c.) Three Compressors

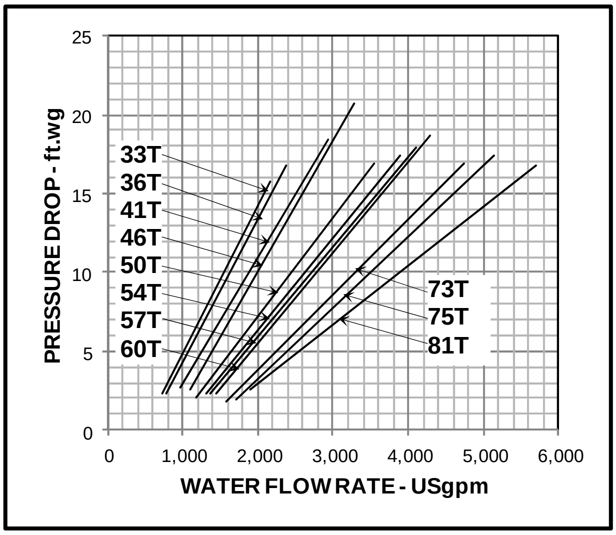


2A.) CONDENSER - 1 PASS

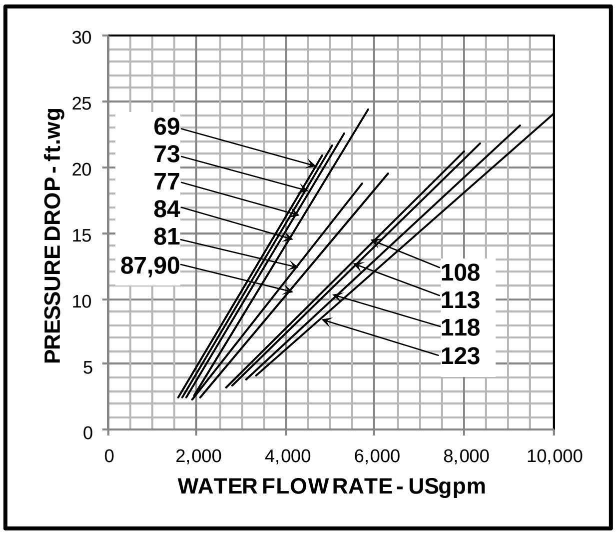
a.) Single Compressor



b.) Twin Compressors



c.) Three Compressors

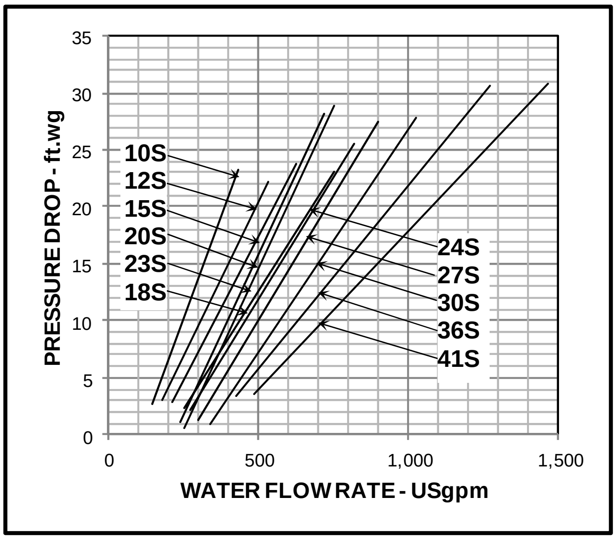


WATER PRESSURE DROP

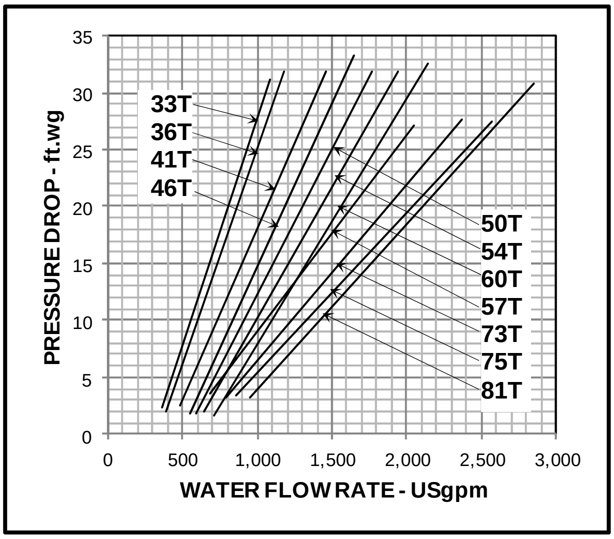
IMPERIAL UNITS

2B.) CONDENSER 2 PASS

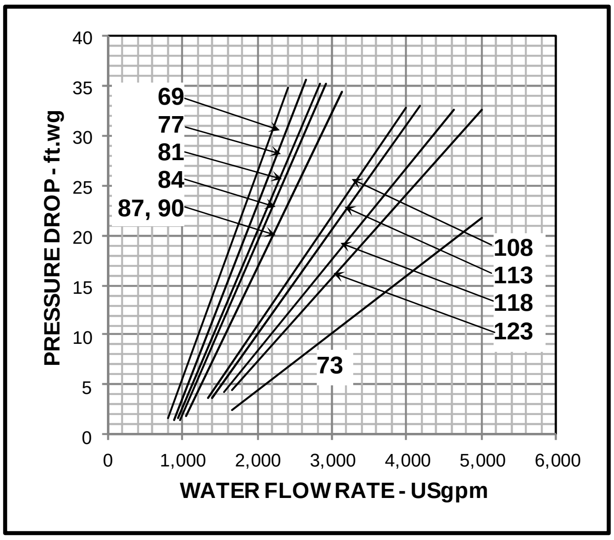
a.) Single Compressor



b.) Twin Compressors

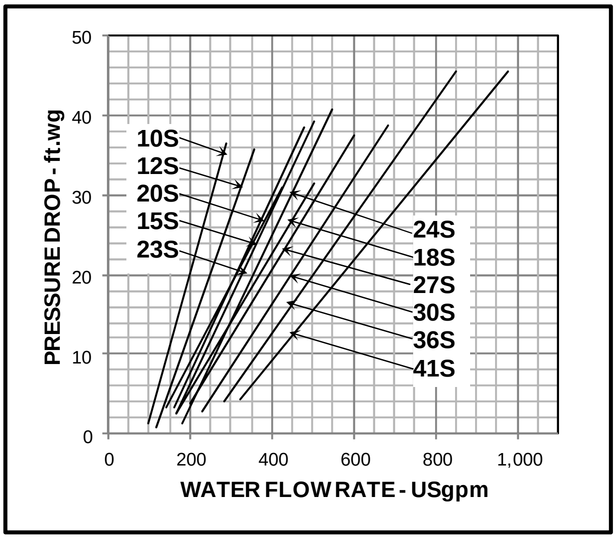


c.) Three Compressors

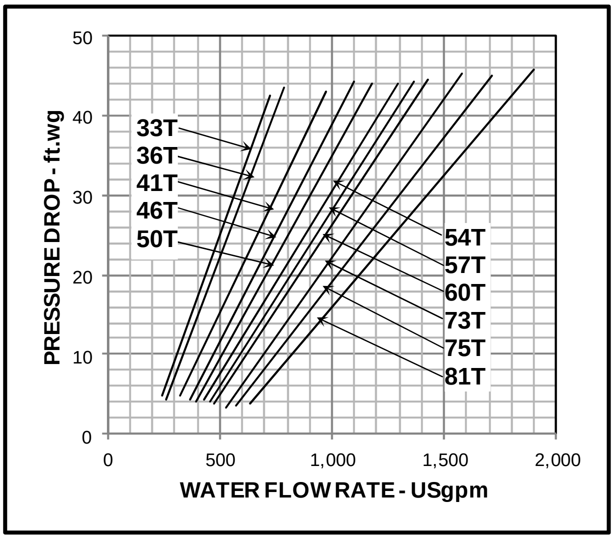


2C.) CONDENSER 3 PASS

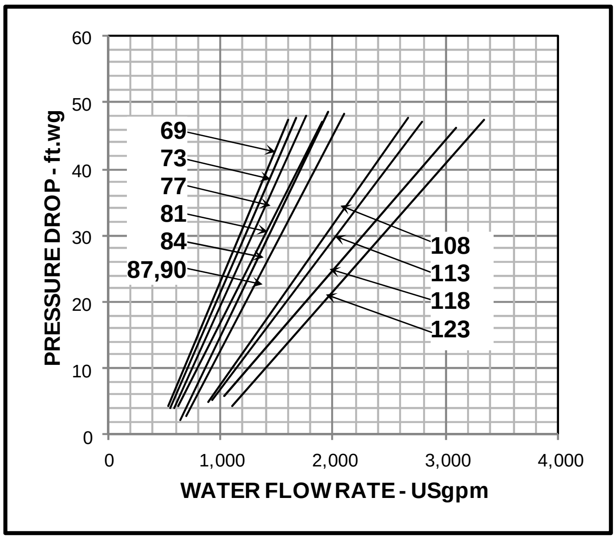
a.) Single Compressor



b.) Twin Compressors



c.) Three Compressors

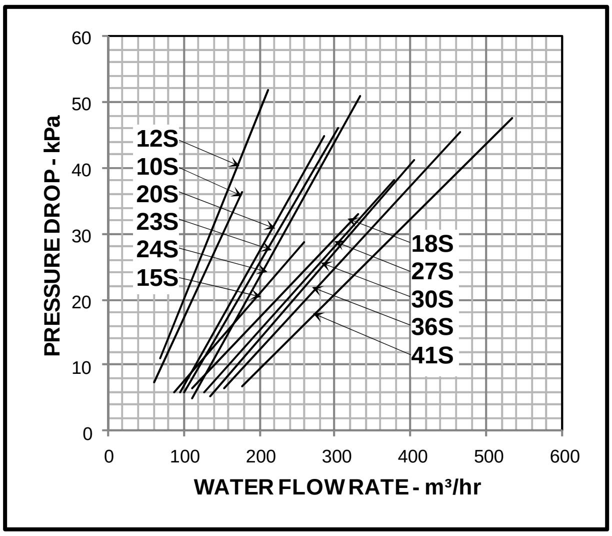


WATER PRESSURE DROP

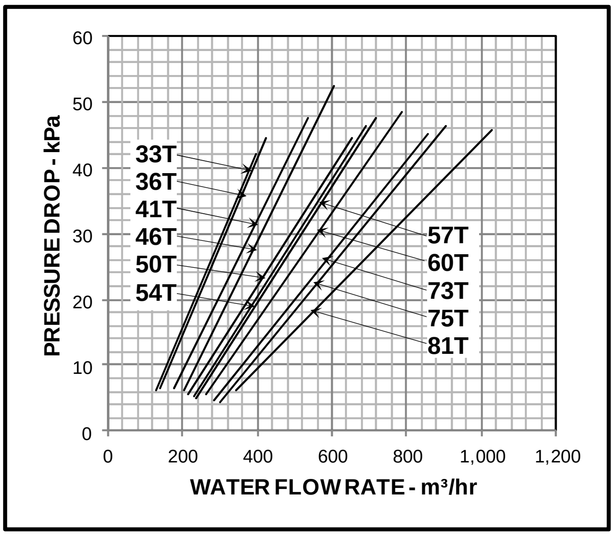
SI UNITS

1A.) EVAPORATOR 1 PASS

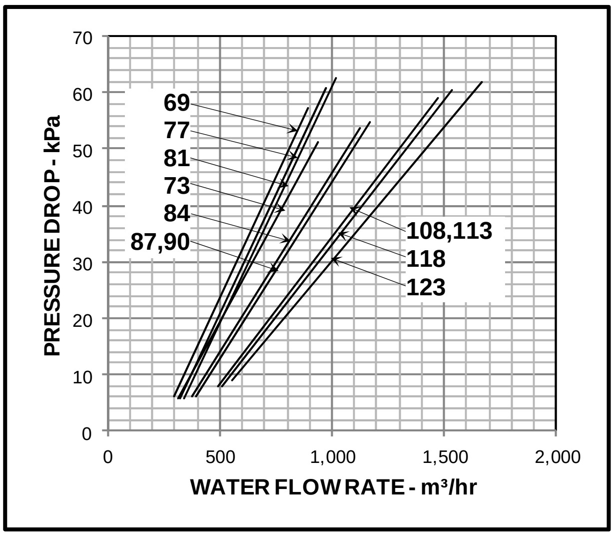
a.) Single Compressor



b.) Twin Compressors

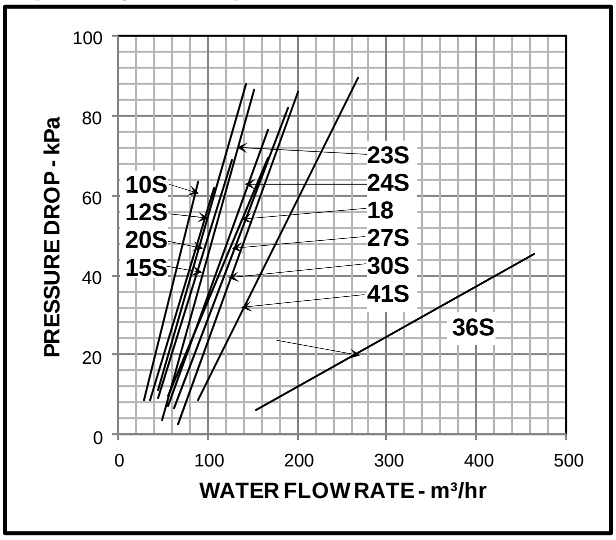


c.) Three Compressors

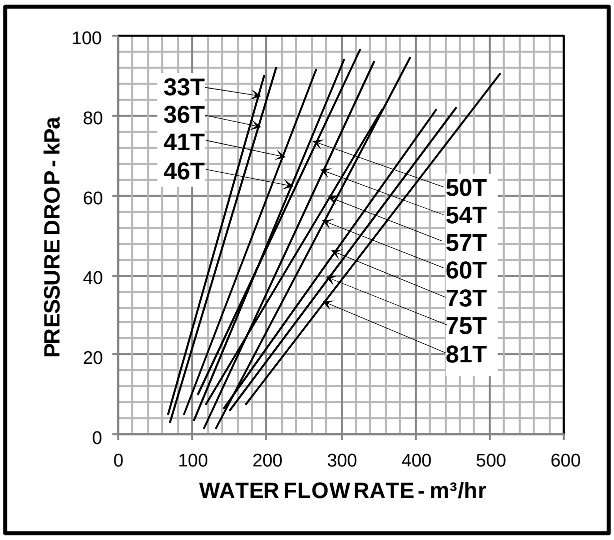


1B.) EVAPORATOR 2 PASS

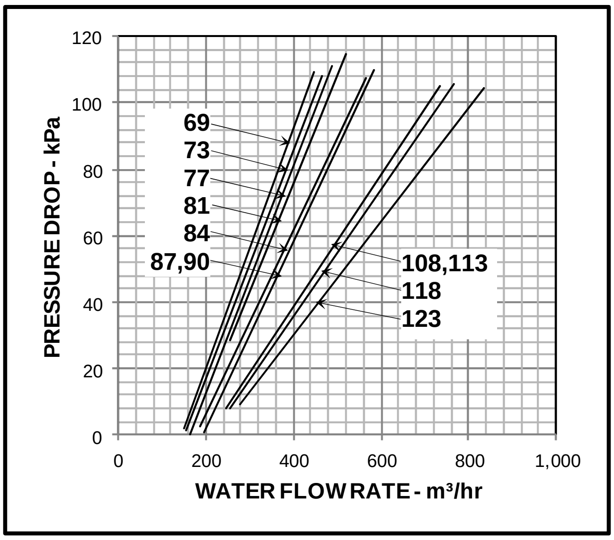
a.) Single Compressor



b.) Twin Compressors



c.) Three Compressors

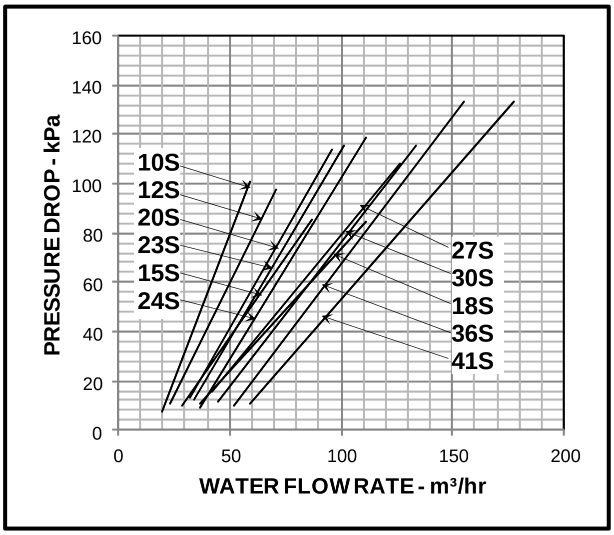


WATER PRESSURE DROP

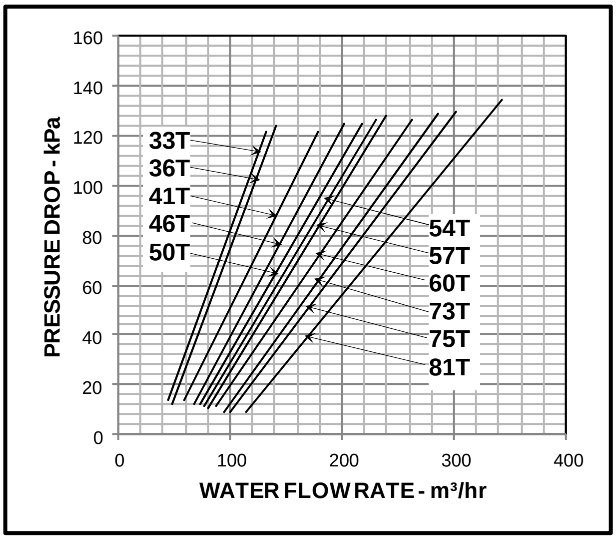
SI UNITS

1C.) EVAPORATOR - 3 PASS

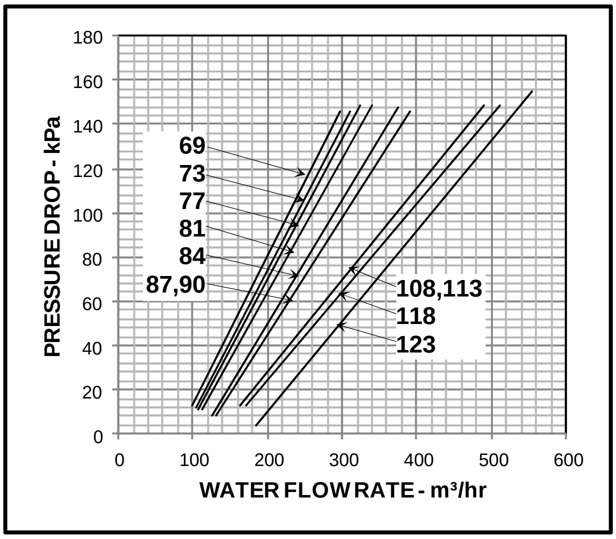
a.) Single Compressor



b.) Twin Compressors

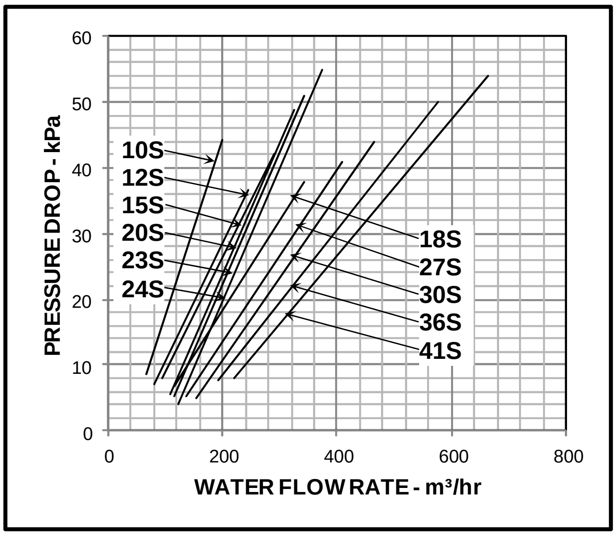


c.) Three Compressors

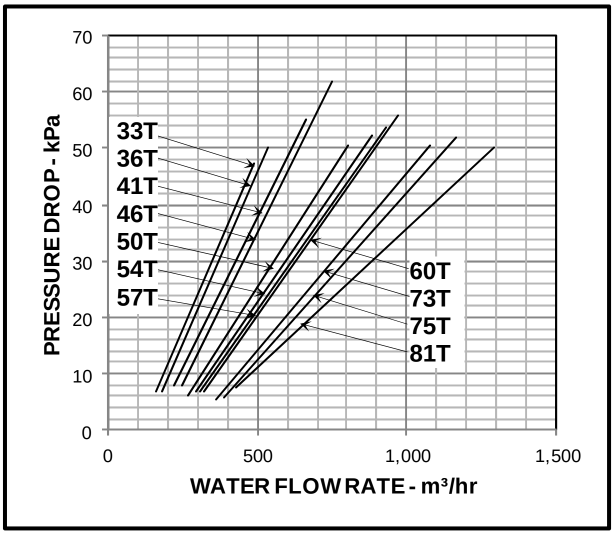


2A.) CONDENSER - 1 PASS

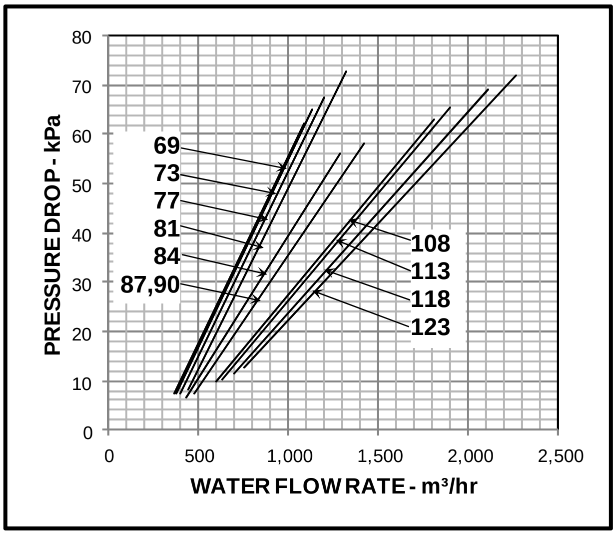
a.) Single Compressor



b.) Twin Compressors



c.) Three Compressors

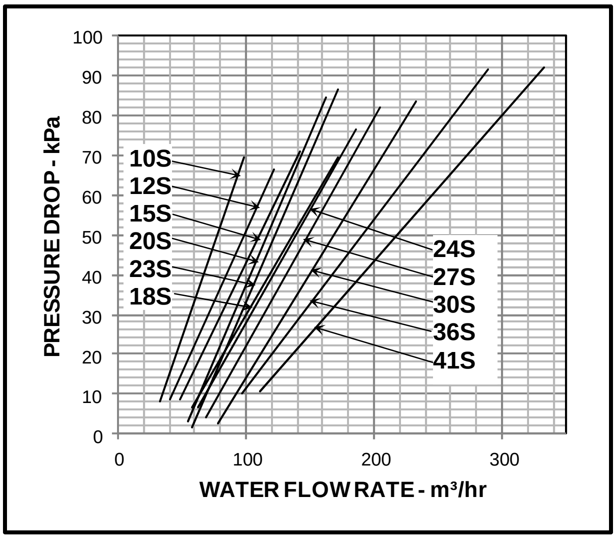


WATER PRESSURE DROP

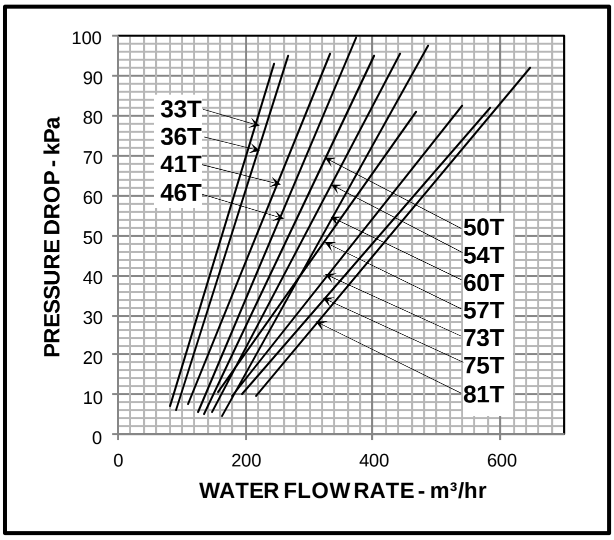
SI UNITS

2B.) CONDENSER 2 PASS

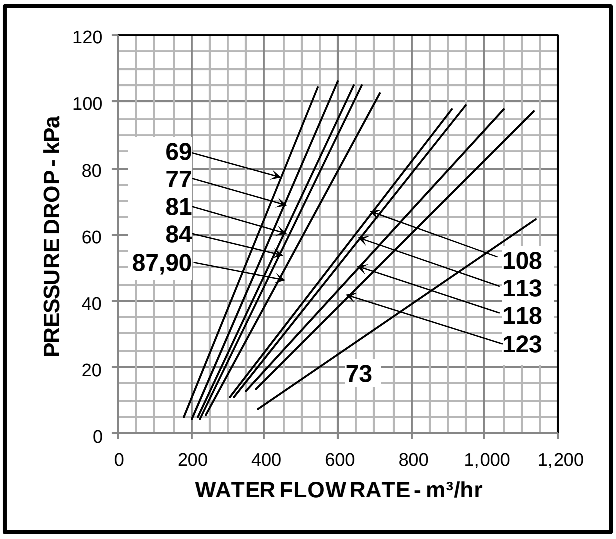
a.) Single Compressor



b.) Twin Compressors

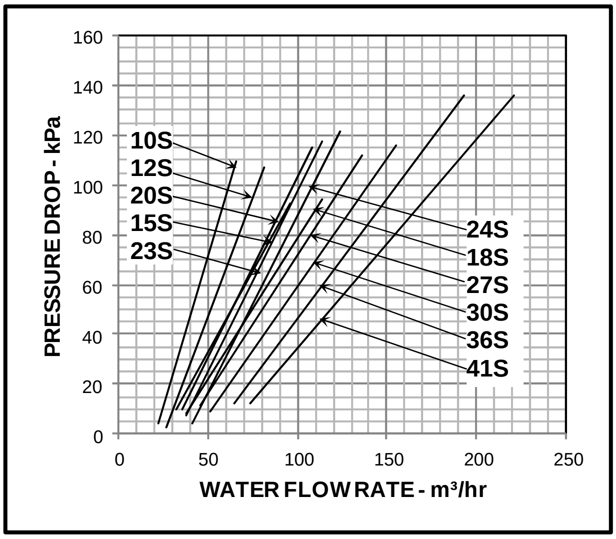


c.) Three Compressors

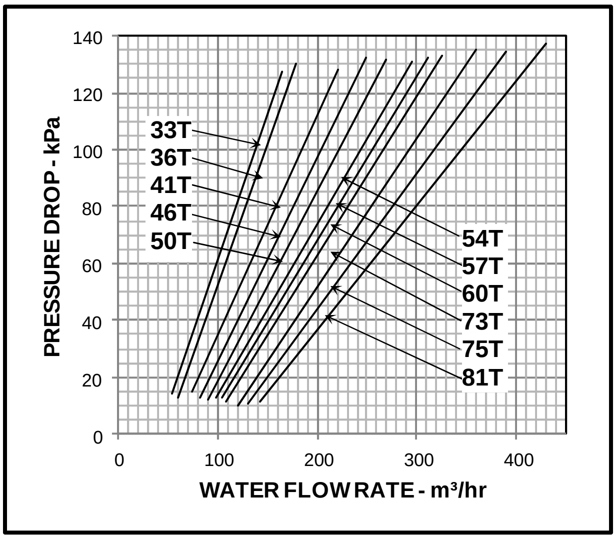


2C.) CONDENSER 3 PASS

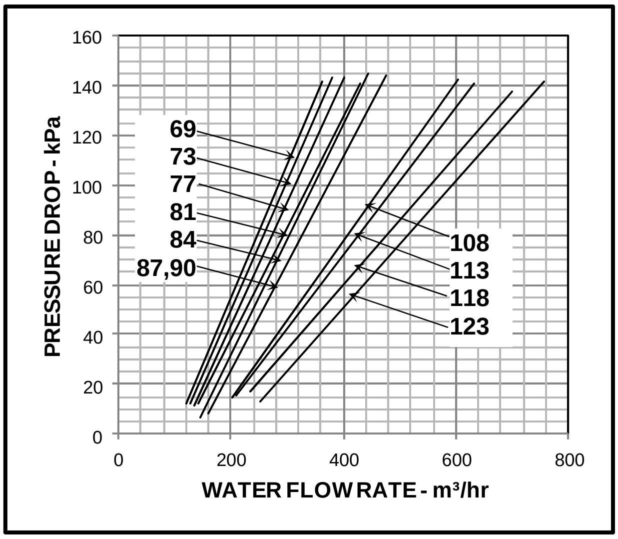
a.) Single Compressor



b.) Twin Compressors



c.) Three Compressors



SOUND PRESSURE DATA

Model WCFX-E	Octave Band (Hz)								Total dB (A)
	63	125	250	500	1000	2000	4000	8000	
10S	71	55	59	67	75	72	62	53	78
12S	71	56	60	67	75	72	62	53	78
15S	72	57	61	69	77	74	64	55	82
18S	72	57	61	69	77	74	64	55	83
20S	71	59	63	71	79	76	66	57	82
23S	71	59	63	71	79	76	66	57	82
24S	72	60	63	72	79	76	66	57	83
27S	72	60	63	72	79	76	66	57	83
30S	72	60	63	72	79	76	66	57	83
33T	74	61	65	73	81	78	68	59	84
36S	72	57	61	69	77	74	64	55	83
36T	74	61	65	73	81	78	68	59	85
41S	72	57	61	69	77	74	64	55	83
41T	74	61	65	73	81	78	68	59	85
46T	73	61	65	73	81	78	68	59	84
50T	73	61	65	73	81	78	68	59	84
54T	73	61	65	73	81	78	68	59	84
57T	74	61	65	73	81	78	68	59	85
60T	74	61	65	73	81	78	68	59	85
69	75	63	67	75	83	80	70	61	86
73	75	63	67	75	83	80	70	61	86
73T	75	63	67	75	83	80	70	61	86
75T	75	63	67	75	83	80	70	61	86
77	75	63	67	75	83	80	70	61	86
81	75	63	67	75	83	80	70	61	86
81T	75	63	67	75	83	80	70	61	86
84	75	63	67	75	83	80	70	61	86
87	75	63	67	75	83	80	70	61	86
90	75	63	67	75	83	80	70	61	86
108	76	64	68	76	84	81	71	62	87
113	76	64	68	76	84	81	71	62	87
118	76	64	68	76	84	81	71	62	87
123	76	64	68	76	84	81	71	62	87

Note: Sound Pressure Level dB(A) @ 3.3ft [1m] (free field) ± 2dBA.

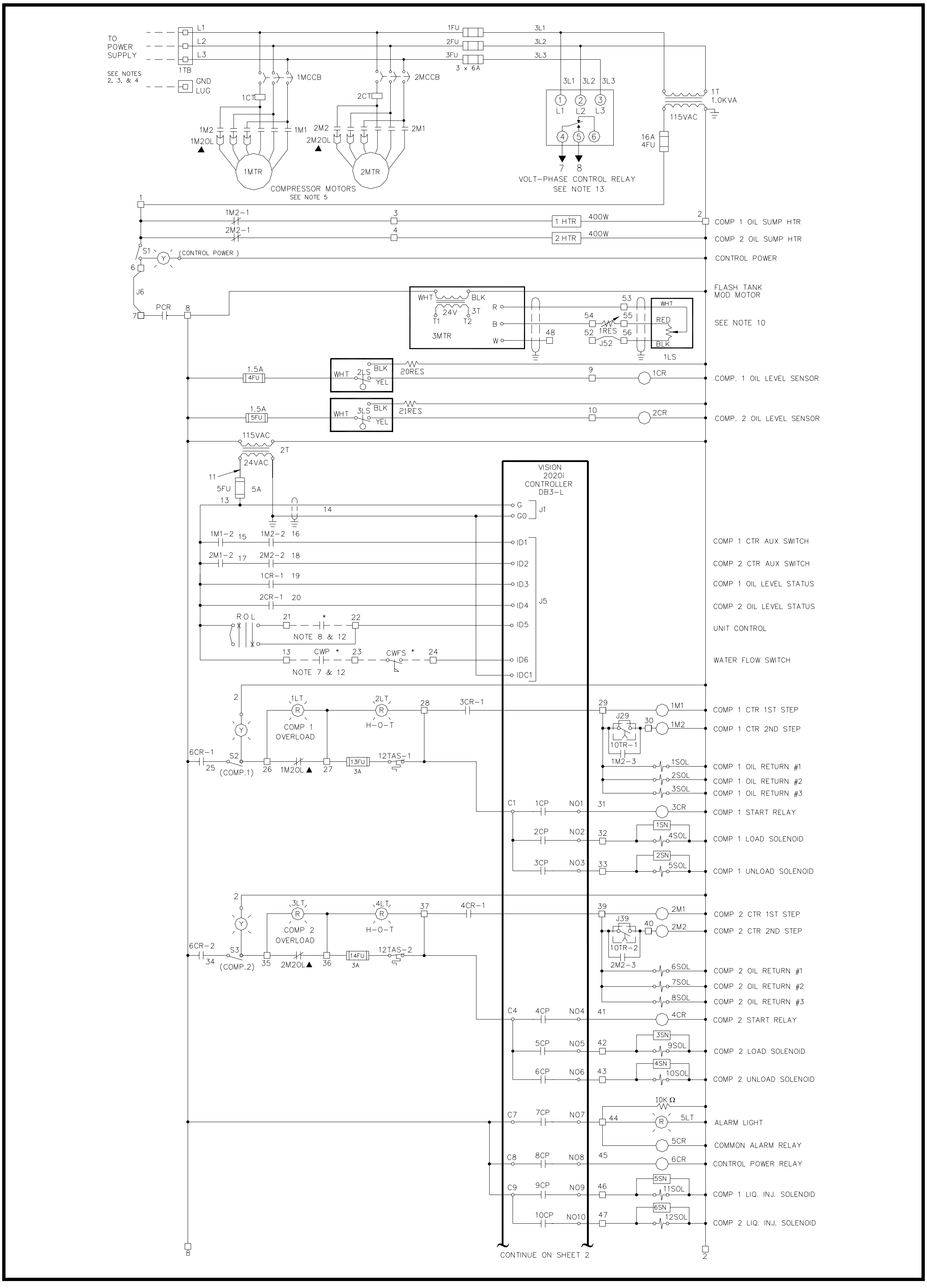
ELECTRICAL DATA

Model WCFX-E	Unit Power Supply	Unit		Each Compressor			
		Max. Fuse Size	Min. Circuit Ampacity	Model	RLA	Inrush Amps	LRA
10S	400VAC±10%	175	93	1210(1)	74(1)	275(1)	413(1)
12S	400VAC±10%	225	124	1212(1)	99(1)	382(1)	573(1)
15S	400VAC±10%	300	153	1215(1)	123(1)	419(1)	628(1)
18S	400VAC±10%	350	183	1218(1)	146(1)	499(1)	749(1)
20S	400VAC±10%	350	183	1222(1)	146(1)	464(1)	696(1)
23S	400VAC±10%	350	183	1222(1)	146(1)	464(1)	696(1)
24S	400VAC±10%	400	229	1227(1)	183(1)	573(1)	859(1)
27S	400VAC±10%	400	229	1227(1)	183(1)	573(1)	859(1)
30S	400VAC±10%	500	266	1230(1)	213(1)	633(1)	949(1)
33T	400VAC±10%	500	305	1215(1)/1218(1)	123(1)/146(1)	419(1)/499(1)	628(1)/749(1)
36S	400VAC±10%	500	308	2233(1)	246(1)	874(1)	1311(1)
36T	400VAC±10%	500	329	1218(2)	146(2)	499(2)	749(2)
41S	400VAC±10%	600	368	2236(1)	294(1)	1153(1)	1730(1)
41T	400VAC±10%	500	329	1218(1)/1222(1)	146(2)	464(1)/499(1)	696(1)/749(1)
46T	400VAC±10%	500	329	1222(2)	146(2)	464(2)	696(2)
50T	400VAC±10%	600	375	1222(1)/1227(1)	146(1)/183(1)	464(1)/573(1)	696(1)/859(1)
54T	400VAC±10%	600	413	1227(2)	183(2)	573(2)	859(2)
57T	400VAC±10%	700	449	1227(1)/1230(1)	183(1)/213(1)	573(1)/633(1)	859(1)/949(1)
60T	400VAC±10%	700	479	1230(2)	213(2)	633(2)	949(2)
69	400VAC±10%	600	475	1222(3)	146(3)	464(3)	696(3)
73	400VAC±10%	700	522	1222(2)/1227(1)	146(2)/183(1)	464(2)/573(1)	696(2)/859(1)
73T	400VAC±10%	800	554	2233(2)	246(2)	874(2)	1311(2)
75T	400VAC±10%	800	614	2233(1)/2236(1)	246(1)/294(1)	874(1)/1153(1)	1311(1)/1730(1)
77	400VAC±10%	700	559	1222(1)/1227(2)	146(1)/183(2)	464(1)/573(2)	696(1)/859(2)
81	400VAC±10%	800	596	1227(3)	183(3)	573(3)	859(3)
81T	400VAC±10%	800	662	2236(2)	294(2)	1153(2)	1730(2)
84	400VAC±10%	800	633	1227(2)/1230(1)	183(2)/213(1)	573(2)/633(1)	859(2)/949(1)
87	400VAC±10%	800	662	1227(1)/1230(2)	183(1)/213(2)	573(1)/633(2)	859(1)/949(2)
90	400VAC±10%	1000	692	1230(3)	213(3)	633(3)	949(3)
108	400VAC±10%	1000	800	2233(3)	246(3)	874(3)	1311(3)
113	400VAC±10%	1000	860	2233(2)/2236(1)	246(2)/294(1)	874(2)/1153(1)	1311(2)/1730(1)
118	400VAC±10%	1200	908	2233(1)/2236(2)	246(1)/294(2)	874(1)/1153(2)	1311(1)/1730(2)
123	400VAC±10%	1200	956	2236(3)	294(3)	1153(3)	1730(3)

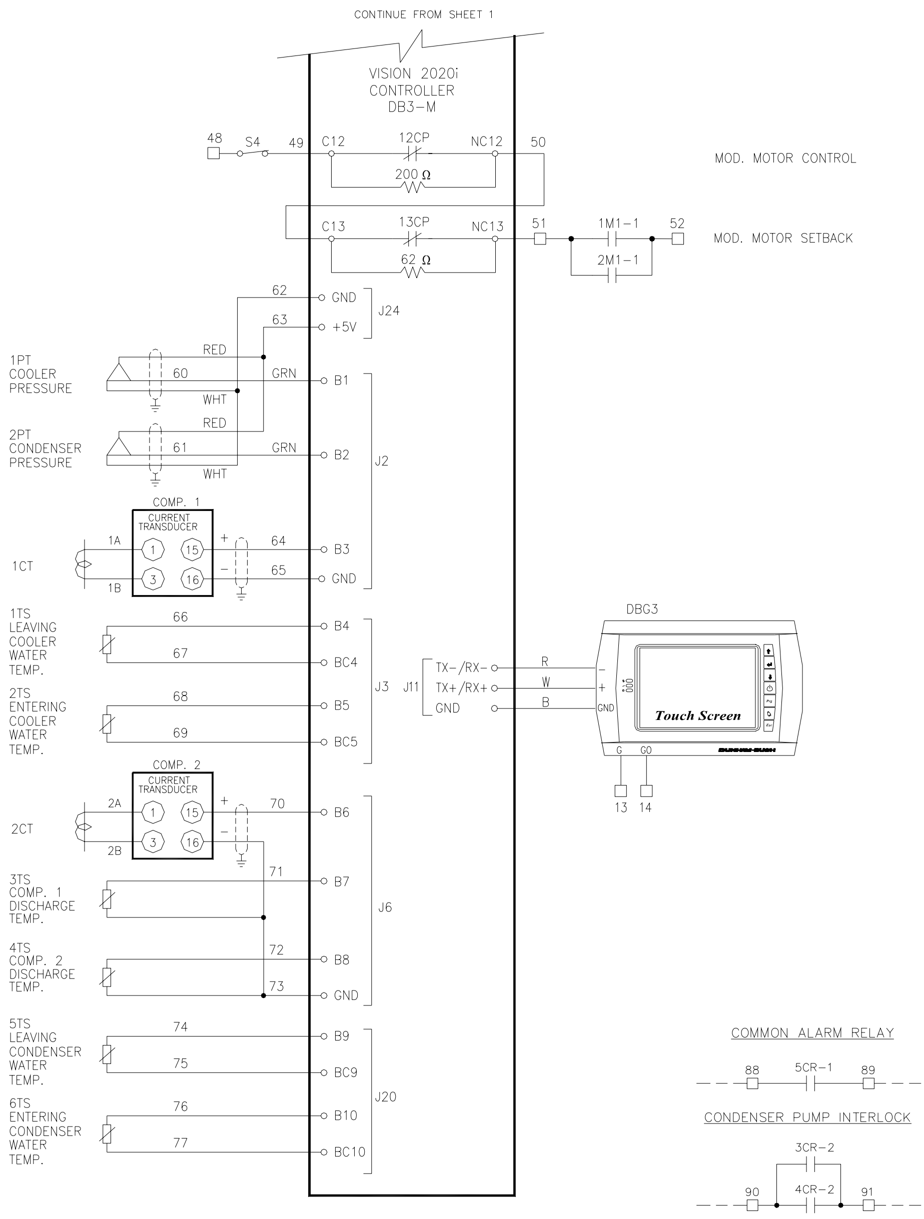
Note: RLA – Rated Load Amps AHRI Cos LRA – Locked Rotor Amps

TYPICAL WIRING SCHEMATIC

Two Compressors Unit

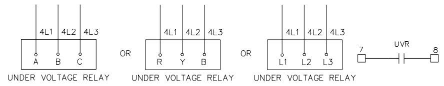


TYPICAL WIRING SCHEMATIC



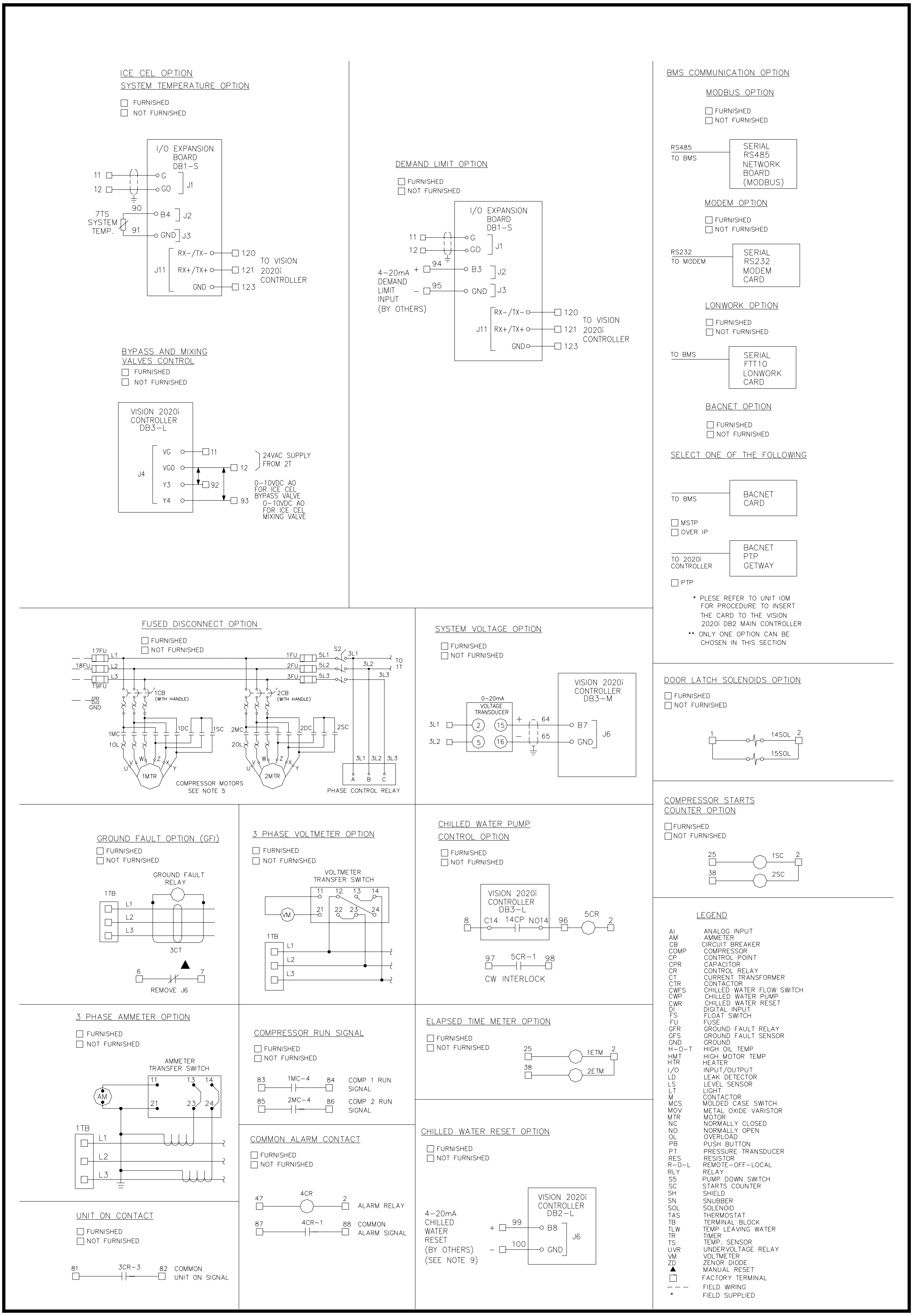
NOTES

1- FUSES SHALL BE TIME DELAY TYPE.
2- ALL FIELD WIRING SHALL COMPLY WITH LOCAL, STATE AND NATIONAL CODES.
3- USE COPPER CONDUCTORS ONLY. CONTROL WIRING 14AWG.
4- DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY INSTALLER
5- IF POWER SUPPLY HAS BEEN INTERRUPTED FOR A PROLONGED PERIOD, OIL SUMP HEATERS MUST BE ENERGIZED FOR 24 HOURS MINIMUM BEFORE STARTING COMPRESSORS.
6- DO NOT RUN CT WIRES IN WIRE BUNDLES.
7- CHILLED WATER FLOW SWITCH AND PUMP INTERLOCK ARE REQUIRED. DO NOT USE THESE SWITCHES TO CONTROL THE PACKAGE.
8- CUSTOMER CONTROL CONTACTS MUST BE WIRED BETWEEN THESE TERMINALS. SELECT POSITION 'R' FOR REMOTE START, POSITION 'O' FOR UNIT SHUT DOWN AND POSITION 'L' FOR LOCAL START.
9- IF 4-20mA CWR IS USED, SET SETPOINT TO RESET DESIRED AT 20mA INPUT.
CAUTION : DO NOT SUPPLY OVER 20mA TO INPUT TERMINAL.
10- 1RES CAN BE WIRED BETWEEN TERMINALS 52 & 56 OR BETWEEN TERMINALS 54 & 55. IF 1RES IS WIRED BETWEEN 52 & 56, J52 MUST BE REMOVED AND A JUMPER WIRE (J54) MUST BE ADDED BETWEEN TERMINALS 54 & 55.
1RES IS FACTORY SET.
DO NOT ADJUST IN THE FIELD.
11- 10TR TIMER JUMPER WIRE IS A CUSTUMER OPTION TO TAKE OUT OR KEEP IN.
12- THE SHIELDED CABLES ARE RECOMMENDED FOR FIELD INSTALLED CONTROL & SIGNAL WIRING, CONNECT ONE END OF THE SHIELD TO GROUND.
13- IF UNDER VOLTAGE RELAY (UVR) IS USED INSTEAD OF PHASE CONTROL RELAY THE CONNECTION DIAGRAM WILL BE AS BLOW :-



14- TO RESET 12TAS HOLD PB FOR 5 SECONDS.

TYPICAL WIRING SCHEMATIC



APPLICATION DATA

HEAT RECOVERY

The Dunham-Bush Water Cooled Screw Flooded Chiller can significantly reduce building operating costs when the heat recovery option is selected. Any building which requires simultaneous heating and cooling may be an excellent candidate for this system.

Hotter Hot Water

Most centrifugal water chillers are limited in producing leaving condenser water temperatures to 105°F or below. Dunham-Bush Water Cooled Screw Flooded Chillers are able to provide leaving water temperatures over 120°F allowing for the installation of smaller heating coils at a lower first cost than systems utilizing centrifugal water chillers. The warmer supply air temperatures available will also improve tenant comfort.

Greater Design Flexibility

Centrifugal water chillers are susceptible to surge conditions during part-load operation and need to be selected to operate in a narrow operating envelope. The heat recovery Dunham-Bush Water Cooled Screw Flooded Chiller, on the other hand, utilizes a positive displacement compressor which will not surge. This chiller is capable of unloading its compressors to their minimum capacity at all head conditions, both cooling and heat recovery, for greater design flexibility. The unit can be modified for Heat Reclaim use.

Lower Energy Consumption

The efficient unloading characteristics of the Dunham-Bush Water Cooled Screw Flooded Chiller compressor make it ideal for heat recovery duty. Heat recovery chillers must be selected to operate at many operating conditions, not just full load heating and full load cooling duties. Heat recovery chillers spend the majority of their time at lower loads, conditions at which centrifugal chillers must often be operating with energy inefficient hot gas bypass.

Free Cooling Not Free Heating

Even greater energy savings can be achieved when the Dunham-Bush Rotary Screw Water Cooled Heat Recovery Chillers are utilized to their maximum benefit. Typically heat recovery chillers had been thought to supply "free heat" while cooling a constant load within a building. The higher head conditions for heat recovery however cause the compressor to draw more power than for cooling only duty. The ideal way to utilize a heat recovery chiller would be to have it operate at only the capacity required for the variable-heating load. This would enable the remainder of the base-cooling load to be handled by a separate chiller utilizing evaporator entering condensing water temperatures and greater energy efficiency. Unfortunately, centrifugal chillers do not have the ability to operate at lower percent loads enabling them to satisfy only the heating load required. As a result, centrifugal heat recovery chillers have typically been operating and satisfying the base cooling load and utilizing only a portion of the recoverable heat to satisfy the variable building-heating load. Dunham-Bush Rotary Screw Compressor characteristics, on the other hand, allow the heat recovery chiller to unload to very low load capacities at the high head conditions created in heat recovery operation. To utilize the Dunham-Bush Rotary Screw Heat Recovery Chillers to their fullest potential, the designer must change his way of thinking to providing chillers that are unloaded to provide only the heating load required and simultaneously supply a portion of free cooling to cover the base cooling load.

Controls

Units can also be provided with optional dual controls so they can control leaving chilled water or leaving condenser water. A dual bundle condenser is provided on a Heat Recovery Water Chiller which minimizes space requirements. Consult your local Dunham-Bush Sales Representative for additional details.

Head Pressure Control

Cooling tower control is increasingly becoming an overlooked subject, and it causes problems. The following is a general recommendation that is applicable to all standard packaged chillers.

Virtually all chiller manufacturers recommend that condenser water be controlled so that its temperature never goes below 60°F (even when the machine is off) and that its rate of change is not rapid. Rapid can be defined as not exceeding 2°F per minute. This is necessary because a chiller operates in a dynamic environment and is designed to maintain a precise leaving chilled water temperature under varying entering conditions. The additional dynamic of rapidly varying condenser water temperature subjects the machine to fluctuating pressure differentials across the evaporator and condenser. This varies the refrigerant flow and, therefore, the capacity. If this occurs faster than the machine can accommodate it, the head pressure or suction pressure will soon exceed their safety setpoints and the machine will shut down.

APPLICATION DATA

The necessary control can sometimes be attained via fan cycling if the tower is rated at the same capacity as the chiller and the machine will operate under heavy load and at design conditions. On multiple chiller jobs, a single tower is oversized relative to the chiller. On other jobs the tower/chiller might be oversized to the design load and the machine and tower frequently cycle under light load. Under these conditions, fan cycling might result in very rapid temperature swings, which creates a dynamic situation that occurs faster than the chiller control system can accommodate it. Thus, in this case, either variable speed fans or modulating valve control should be used to regain control of the condenser water. Either type of control provides precise modulating control of the condenser water rather than on-off step control. The control can be initiated either by a condenser water temperature sensor/controller or, even better, by direct control from the chiller's computer based upon the machine's head pressure.

It is further recommended that the condenser water pump be cycled by the chiller. This is to eliminate potentially very cold water from going through the condenser while the chiller is shut down. At the same time it is probable that relatively warmer chilled water is in the evaporator (an inversion). Refrigerant tends to migrate if there is a difference in pressures within the components of the chiller. It will seek the lowest pressure area of the packaged chiller which, in this case, would be the condenser. Starting of a chiller where the refrigerant has migrated to the condenser is not desirable. The presence of highly subcooled liquid refrigerant in the condenser will cause low suction pressures and possibly liquid slugging of the compressor. If the condenser water pump is off until the machine starts, the water in the condenser is at the machine room ambient, which is usually much closer to the evaporator water temperature. It should be noted that a flow switch in the condenser water is not required.

Our unit wiring diagrams show the condenser water pump interlocked with our chiller and controlled to come on only when a compressor is energized. We also have an optional analog output on the controller that can be used to control the tower directly from the head pressure of the machine. The digital outputs can be used for three-point floating (or tri-state) control and the analog can be used to drive a 0 - 10 vdc actuator.

Thus, even though there has been a trend toward fan cycling control of cooling towers, it is not a device that is suitable to every installation. We recommend that the designer carefully evaluate the system to determine if a more precise method of control is indicated. If there is any doubt, the more precise control is required. We also recommend that the condenser water pump interlock in the chiller control panel be used to enable and disable the condenser water pumps.

Dunham-Bush Water Cooled Chillers have as standard a control feature called EPCAS (Evaporator Pressure Control at Start) which will allow for an inverted start. This occurs when the chilled water loop in a building is at a higher temperature than the condenser/tower loop. This occurs in many buildings after a weekend shut down. The chilled water loop can be as high as 90°F and the condenser/tower loop as low as 60°F. With the EPCAS feature, the valve feeding the evaporator will be throttled to create a pressure differential to help load the compressor.

Ice Storage

With a positive displacement rotary screw compressor, the Dunham-Bush water chiller can easily cool low temperature glycol down to 22°F with entering condenser water of 85°F. The same chiller can also produce warmer (40° to 45°F) leaving glycol for those building systems designed for only peak shaving. This can be accomplished by an external signal to the unit controller. No matter what your ice storage needs, the Dunham-Bush Water Cooled Screw Flooded Chiller can handle it better than any other chiller. The use of multiple compressors minimizes the amount of horsepower used at any condition high temperature glycol for direct cooling in coils or low temperature glycol for producing ice at off-peak power rate times.

Multiple Unit Control

One of the most perplexing problems to system designers is control of multiple chillers on the same water loop. The first decision is whether to put the chillers in parallel or series on the chilled waterside. If lower pumping cost is paramount, then putting chillers in series is often preferable. If primary/secondary pumping is utilized with normal 10°F range, then putting chillers in parallel is normally used. In either case, the Dunham-Bush controller can control up to five chillers. This eliminates the need for external control interface which often becomes difficult. If more than five chillers need to be controlled, an Equipment Management Center can be supplied for controlling/ monitoring up to ten units.

EQUIPMENT

Standard Equipment And Factory Installed Options

Dunham-Bush Water Cooled Screw Flooded Chillers, like many other Dunham-Bush products, distinguish themselves by offering as standard many features that other manufacturers provide only as costly options.

Some of the Standard Features of these chillers which provide for efficiency and reliability are:

- Addition of service valve in suction and vapor injection lines on each compressor allow replacement of one compressor while others are running and also allow refrigerant storage in the evaporator via a service compressor.
- Unit mounted and wired reduced inrush starting system.
- Factory mounted and wired control power transformer.
- Single point electrical power connection.
- Undervoltage phase failure relay.
- Controller monitoring of evaporator leaving water temperature.
- Controller monitoring of suction & discharge pressures.
- Controller monitoring of power supply volts.
- Controller monitoring of single phase amps for each compressor.
- Controller monitoring of each compressor, number of starts (cycles) and elapsed time for both a by hour period or total time and cycles.
- Units shipped completely factory tested, charged and adjusted for ease of installation and minimal field start-up adjustments.
- Chilled water reset from control panel or external building automation system.
- High oil temp, low oil level, freeze, low suction pressure, high discharge pressure, and solid state overload protection are all featured.
- Unit mounted circuit breaker for each compressor on two and three compressor units.
- Discharge check valves on multiple compressor units allow refrigerant charge to be stored in the condenser for service to compressor or evaporator.

Additional Features offered by Dunham-Bush as Factory Installed Options include:

- Insulation of all low temperature surfaces.
- Hot gas bypass for very low load situations.
- Controller monitoring of return chilled water and entering and leaving condenser water in addition to the standard leaving chilled water temperature.
- Personal computer with communication software installed to enable the remote monitoring of all functions and inputs to the controller.
- Dual bundle heat reclaim condensers are available for special applications.
- Control of up to five packages via a master slave arrangement requiring only two shielded cables between units. Up to ten packages can be controlled via an Equipment Management Center.
- Unit mounted disconnect switch 400 to 575 volts applications.
- Flanged semi-hermetic compressor.
- Discharge service valve for MSC 226 series compressor.

GUIDE SPECIFICATIONS

1. The contractor shall in accordance with the plans, furnish and install _____________ Dunham-Bush _______________ packaged liquid chiller(s). The unit(s) shall be completely factory packaged including rotary screw compressor(s), evaporator, condenser, and control panel. The packaged chiller shall be factory assembled, charged and tested with a full operating refrigerant and oil charge. The refrigerant type shall be R134a.

2. Capacity of each chiller shall be not less than _________________ refrigerant tons (kW output) cooling at _____________ GPM (liters/min.) of water from __________ °F(°C) to _________ °F(°C). Power input requirements for the unit(s), incorporating all appurtenances necessary for unit operation, including but not limited to the control accessories and pumps, if required, shall not exceed ___________kW input at design conditions. The unit shall be able to unload to _______% of cooling (refrigeration) capacity when operating with leaving chilled water and entering condenser water at design temperatures. The unit shall be capable of continuous operation at this point, with stable compressor operation, without the use of hot gas bypass.

3. Heat transfer surfaces shall be selected to reflect the incorporation of a fouling factor of .00025 hr.sq.ft. °F/BTU (0.000044m²·°C/W) for the water condenser and 0.0001 for evaporator. Water pressure drop at design conditions shall not exceed ___________ feet of water through the condenser, and ____________ feet of water through the evaporator.

4. The packaged chiller shall be furnished with single-stage direct connected positive displacement rotary screw compressor(s) as required, driven by a 2900 RPM (3500 RPM-60Hz) motor. Each compressor shall include integral oil separation system, oil sump and oil filter. The oil differential pressure shall be controlled during operation to maintain proper oil lubrication throughout the lubrication system. An electric oil heater shall be supplied with each compressor to maintain oil temperature during shutdown period. Each compressor shall have a suction check valve, suction filter, (suction service valve) (and a discharge check valve). Compressor capacity control shall be obtained by an electrically initiated, hydraulically actuated slide valve within each compressor. (Provide isolation valves on all connections to compressor to allow condenser to be used as a pump down receiver).

GUIDE SPECIFICATIONS

5. Evaporator and condenser vessels shall all be cleanable shell and tube type with integral finned copper water tubes mechanically expanded into heavy fixed steel tube sheets. They are to be available in one, two or three pass design as required on the drawings with Victaulic connections. The shell side of the evaporator and condensers shall have pressure relief valve with provision for refrigerant venting. Evaporators and condensers shall be designed, constructed in accordance with the ASME Code for Unfired Pressure Vessels. The condenser shall be sized for full pump down capacity. The flooded evaporator shall have a built in distributor for feeding refrigerant evenly under the tube bundle to produce a uniform boiling action and baffle plates shall be provided to ensure vapor separation. Water heads are to be removable for tube cleaning. Vent and drain plugs are to be provided in each head. (All low temperature surfaces shall be factory insulated.) (Provide a dual bundle on condenser for heat reclaim.)
6. The flooded evaporator shall be fitted with an oil recovery system. The oil recovery system will insure that the evaporator is operating at peak efficiency at all times and provide optimal energy efficiency during extended periods of part load. Units without oil recovery systems mounted on the evaporator will not be acceptable.
7. To maximize energy efficiency, the packaged chiller shall be equipped with a economizer and modulating refrigerant expansion devices. Refrigerant vapor from the economizer shall be fed back into an intermediate compressor stage, reducing the enthalpy of the refrigerant and increasing the net refrigeration effect of the evaporator.
8. The packaged chiller shall be furnished with a modulating refrigerant control system to optimize efficiency and compressor protection. This refrigerant control system will reduce the flow of efficiency robbing refrigerant vapor in the condenser from entering the evaporator at reduced load by directly modulating a motorized refrigerant valve in the liquid line entering the evaporator. In addition, the refrigerant control system shall measure the level of liquid refrigerant in the flooded evaporator and restrict refrigerant flow entering the evaporator upon a rise in the level, protecting the compressor from slugging liquid refrigerant. Fixed orifice control systems will not be acceptable. (Hot gas bypass shall be factory installed for operation down to approximately 10% of full load.)
9. The packaged chiller shall be equipped with controller control. The control shall provide for compressor loading based on leaving chilled water temperature. It shall provide for high and low refrigerant pressure protection, low oil level protection, evaporator water freeze protection, sensor error protection, and motor load control (demand limiter) based on amp draw. Anti-recycle protection shall also be provided. The computer shall have a simple keyboard accessed input system and be complete with 320x240 pixel, 256 color display. Input shall be accomplished through simple menu driven display screens, with on-line help available by pressing a help button at anytime during operation. The controller shall continuously monitor evaporator leaving water temperature; evaporator and condenser pressure; compressor amp draw; and refrigerant. The computer shall be complete with all hardware and software necessary to enable remote monitoring of all data through the addition of only a simple, phone modem and terminal. The controller shall be completed with an RS232 "local" communications port and an RS485 long distance differential communications port. The controller shall also accept a remote start and stop signal, 0 to 5VDC chilled water temperature reset signal and (0 to 5VDC compressor current limit reset signal). Terminal or PC with communication software installed to enable remote monitoring.
10. The electrical control panel shall be wired to permit fully automatic operation during - initial start-up, normal operation, and shutdown conditions. The control system shall contain the following control and safety devices:

    MANUAL CONTROLS
    - Control circuit stop and start switches
    - Compressor enable switch

    SAFETY CONTROLS
    - Solid state compressor motor starter overloads (3 phase)
    - Low oil level optical sensor
    - High condenser pressure
    - Low evaporator pressure
    - Freeze protection
    - Chilled water flow loss
    - Under voltage phase failure relay

    AUTOMATIC CONTROLS
    - Compressor motor increment contactors
    - Increment start timer
    - Anti-recycle timer
    - Oil sump heater interlock relays

    REFRIGERANT CONTROLS
    - Motorized refrigerant flow control
    - Liquid refrigerant level sensor for evaporator
    - Compressor load and unload solenoid valves

    INDICATOR LIGHTS
    - Power on
    - Compressor high oil temperature
    - Compressor motor overload
    - System common alarm
11. The control system shall be provided with an anti-recycle device. The control shall limit compressor starting to a minimum of 15 minutes between starts.
12. The packaged chiller shall be furnished with unit mounted reduced inrush starting system for each compressor. The starters shall be factory mounted and wired, with individual circuit breakers on multiple compressor units. The unit shall be wired so that the only field electrical connection to the packaged chiller shall be to a single three-phase power terminal.

Optional items in (   )

Americas

United States of America

175 South Street,
West Hartford,
CT 06110, USA

Tel: 1-860-249 8671
Fax: 1-860-953 3300

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United Kingdom

8 Downley Road,
Havant, Hampshire,
England PO9 2JD

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Fax: 44-23-9245 0396

Africa

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Route 21 Corporate Park
Irene, Pretoria
South Africa

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Fax: 27-12-345 4203

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China 264003

Tel: 86-535-658 8999
Fax: 86-535-658 1999

Asia

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United Arab Emirates

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Fax: 7-499-255 6953

Malaysia

Lot 5755-6, Kidamai Industrial Park,
Bukit Angkat,
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Selangor Darul Ehsan,
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Fax: 603-8739 5020

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