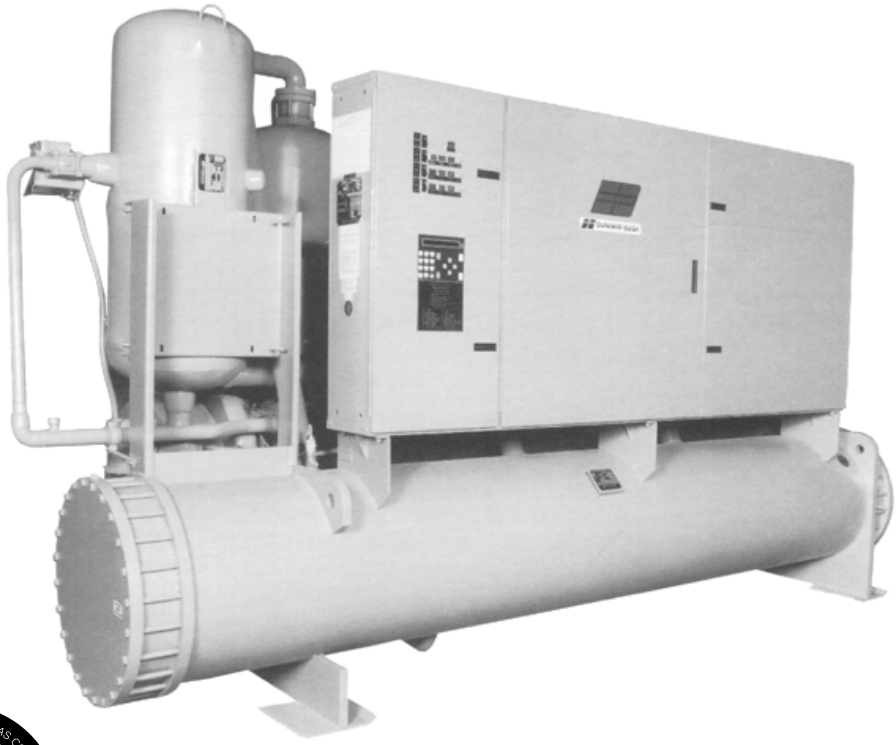
WCFX-B

Water-Cooled Chillers

with rotary screw compressors
100 to 540 tons



MANUFACTURER CERTIFIED TO ARI AS COMPLYING WITH CERTIFICATION SECTIONS OF ARI STANDARD 550/590 FOR WATER-CHILLING PACKAGES USING THE VAPOR COMPRESSION CYCLE

ETL LISTED

Features

- Rotary screw compressors for reliable operation
- Outstanding part-load performance
- Compact footprint
- Operation with HCFC-22 or HFC refrigerants
- Microcomputer control

DUNHAM-BUSH®

Form No. 6088B

INTRODUCTION

The Dunham-Bush WCFX Water-Cooled Rotary Screw Water Chillers are available from 100 to 540 tons. Their performance has been certified by the Air Conditioning and Refrigeration Institute (ARI). These units are supplied with rotary screw compressors that are backed by 35 years of experience. A **two year parts warranty** is provided on the **entire unit** at no extra cost.

The side by side evaporator/condenser arrangement makes a split design optional for ease of movement through any standard commercial doorway.

All units are factory run tested before shipment.

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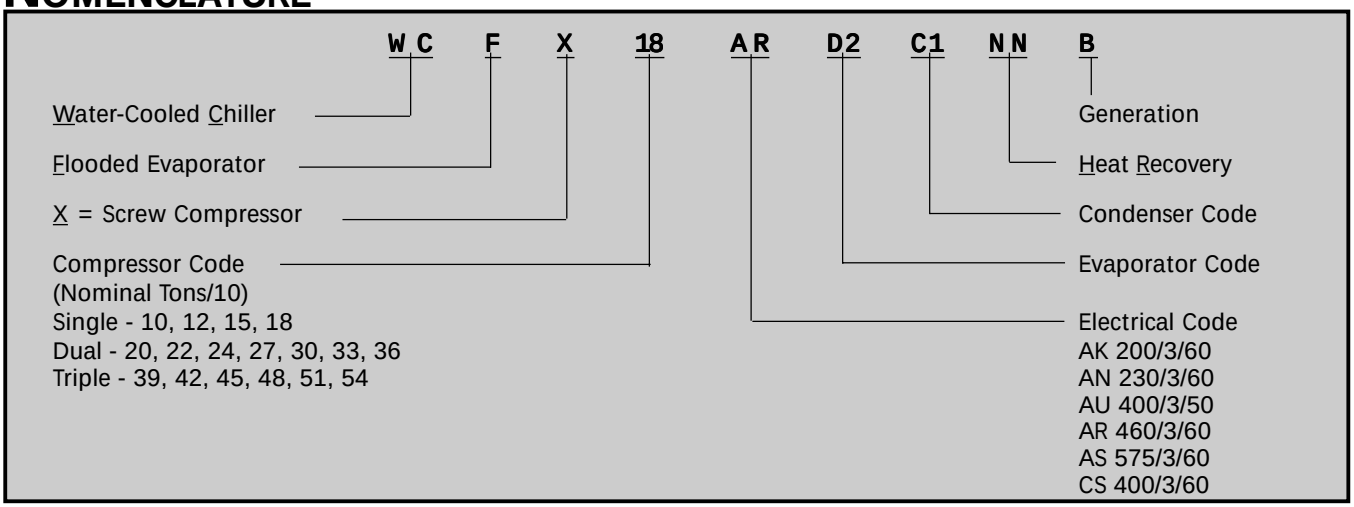
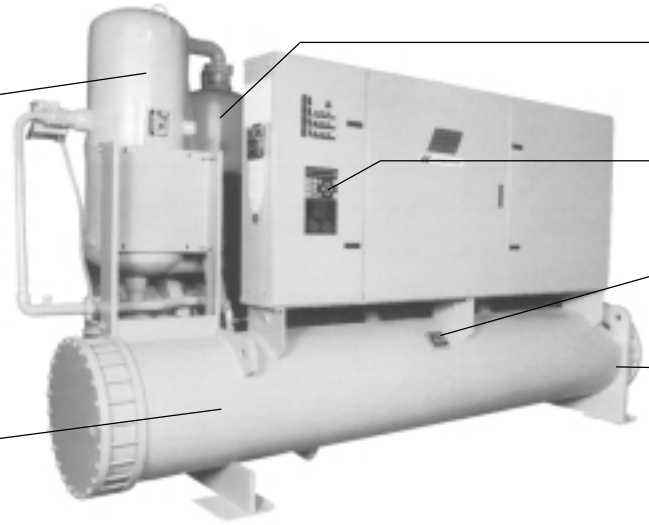
NOMENCLATURE



COMPONENTS



STANDARD FEATURES

Size Range

- 17 Models from 100 to 540 tons at ARI standard conditions with certified performance
- Multiple compressor units provide redundancy, and favorable partload efficiency
- **Two year compressor and parts warranty at no extra cost**

Compressor

- Quiet, reliable MSC Rotary Screw Compressors
- Multiple rotary screw compressor design for fail-safe reliability and redundancy
- Hermetic Design eliminates problematic shaft seals, inspections, expensive teardowns, time consuming alignments, etc.
- Consistent unloading with dependable slide valve mechanism

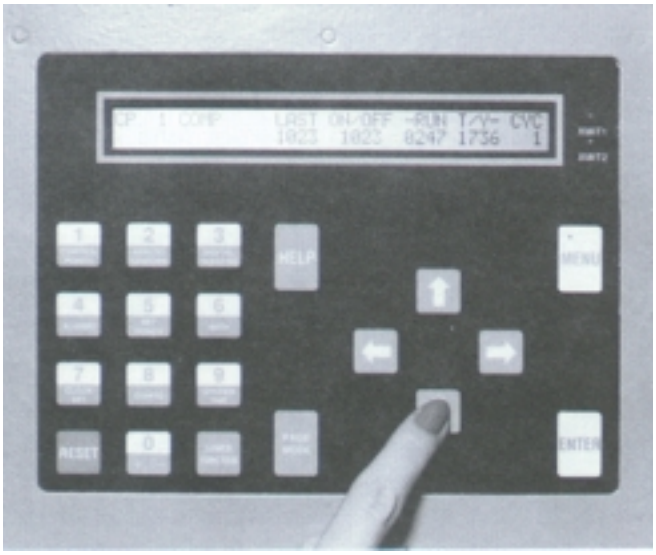
Evaporator/Condenser

- Cleanable and Removable Integral Fin Copper Tubes for easy serviceability
- One, Two or Three Water Passes Available for a wide variety of applications
- Removable Water Heads for service
- Victaulic Groove Water Connections for quick installation and/or service
- ASME Coded Refrigerant Side
- Relief Valves(s) standard - 3/4" FPT
- Full Pump Down Capacity in Condenser, therefore, pump out unit not required

Microcomputer/Electrical

- Proactive Microcomputer 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, High Motor Temperature, Micro Alarm, Control Power, Compressor Control Circuit

UNIT FEATURES: MICROCOMPUTER CONTROL



Advanced Microcomputer Control is a standard feature on all Dunham-Bush Rotary Screw Water Cooled Chillers monitoring analog and digital inputs to achieve precise control of the major operational and protective functions of the unit.

Direct digital control (DDC) allows finger-tip user interaction. Its simple-to-use push button keyboard and menu-driven software provide access to operating conditions, control setpoints and alarm history clearly displayed on a prominent multi-line 80 character alphanumeric display.

An easy-to-install, inexpensive modem option allows remote reading of operating parameter updates. The Dunham-Bush microcomputer insures its owner state-of-the-art efficiency and reliability.

Display Information

The 80 character alphanumeric liquid crystal display utilizes easy-to-understand menu-driven software. Inexperienced operators can quickly work through these menus to obtain the information they require or to modify control parameters. More experienced operators can bypass the menu systems, if desired, and move directly to their requested control function. At all times, assistance is available to the operator by simply pressing the help key. Easily accessible measurements include:

- Leaving chilled water temperature
- Evaporator pressure
- Condenser pressure
- System voltage
- Compressor amp draw, each compressor
- Compressor elapsed run time, each compressor
- Number of compressor starts
- Compressor contactor status
- Optical oil float switch status
- Water temperature reset value
- Water flow switch status
- External start/stop command status

Optional entering chilled water temperature, entering condenser water temperature and leaving condenser water temperature inputs are available. With this option the operator can quickly and accurately read the significant water temperatures and eliminate the need for often inaccurate thermometers.

Capacity Control

Leaving chilled water temperature control is accomplished by entering the water temperature setpoint and placing the microcomputer 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 microcomputer through either the RS485 long distance differential communication port, via terminal or modem connected to the RS232 communication port, or from an external Building Automation System supplying a simple 0 to 5 VDC signal. Optional 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 microcomputer may be programmed with a seven-day operating cycle or other Dunham-Bush control packages may start and stop the system through inter-connecting wiring.

UNIT FEATURES: MICROCOMPUTER CONTROL (CONT.)

System Protection

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

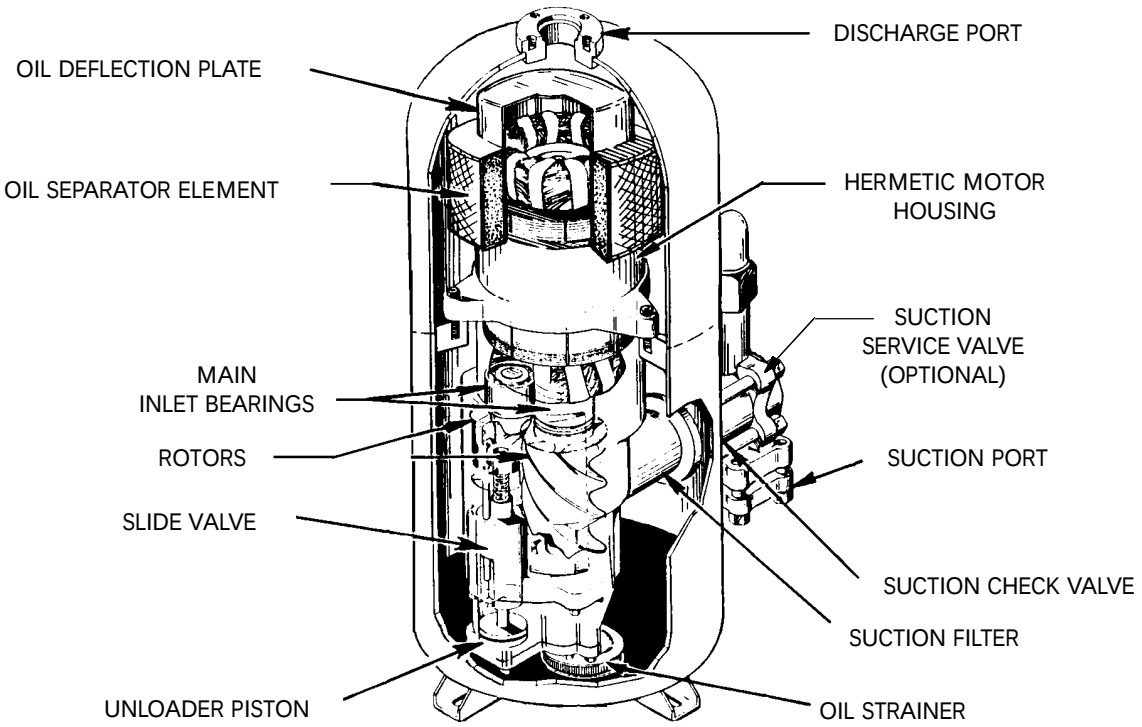
- Low suction pressure
- High discharge pressure
- High motor temperature/overcurrent
- Freeze protection
- High motor temperature
- Low differential pressure
- Low oil level
- Compressor run error
- Power loss
- Chilled water flow loss
- Sensor error
- Compressor overcurrent
- Anti-recycle

The microcomputer will retain the latest eight alarm conditions complete with time of failure in an alarm history. This tool will aid service technicians in troubleshooting tasks enabling downtime and nuisance trip-outs to be minimized.

Remote Monitoring

The microcomputer is complete with an RS232 communications port and all hardware and software necessary to be remotely monitored and controlled from a simple terminal and optional phone modem. This valuable enhancement to the refrigeration system allows the ultimate in serviceability. The microcomputer as standard is additionally equipped with history files which may be used to take logs which may be retrieved via the phone modem periodically. Now owners of multiple buildings have a simple and inexpensive method of investigating potential problems quickly and in a highly cost effective manner. Dunham-Bush has open Protocol on its microcomputer to allow direct interface with Building Management Systems.

UNIT FEATURES: COMPRESSOR



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 differential 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 10% 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 an integral oil separator located adjacent to 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.

Main Bearings

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

Rotors

The latest asymmetrical rotor profiles of patented Dunham-Bush design assure operation at highest efficiencies. Rotors are precision machined from AISI 1141 bar stock and case hardened.

Castings

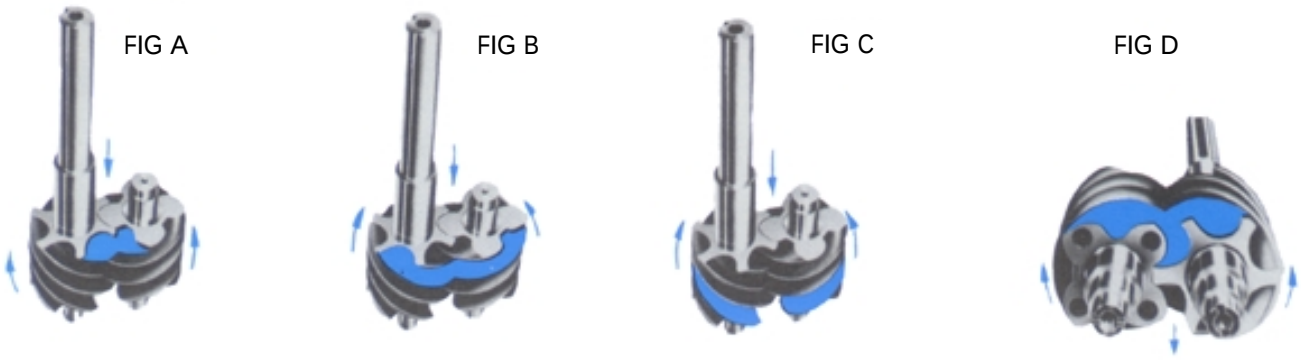
All housings are manufactured of high grade, low porosity, cast iron.

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.

Warranty

The entire compressor(s) is covered by a **two-year** parts warranty as standard when started up and maintained by Dunham-Bush service.



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.

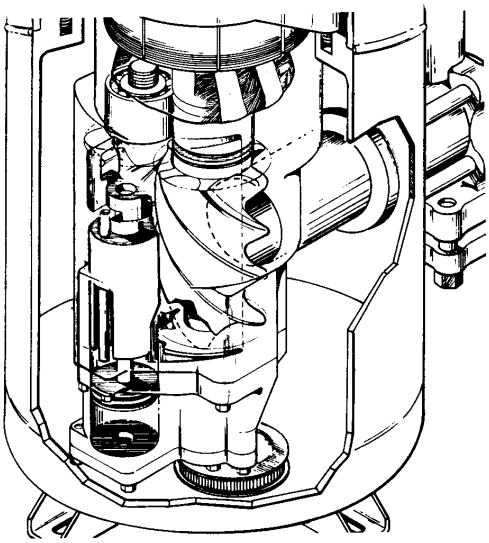
Compression Phase

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.

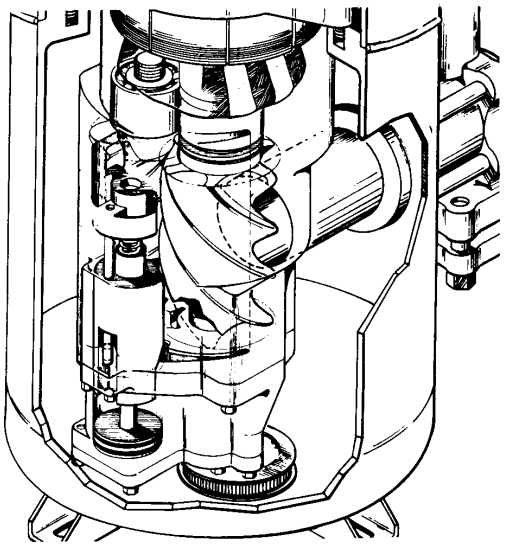
Discharge Phase

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 Loaded



Compressor Fully Unloaded



Slide Valve Control

Movement of the slide valve is programmed by an exclusive Dunham-Bush electrically 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 form 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: REFRIGERATION CYCLE

Dunham-Bush Rotary Screw Water-Cooled 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.

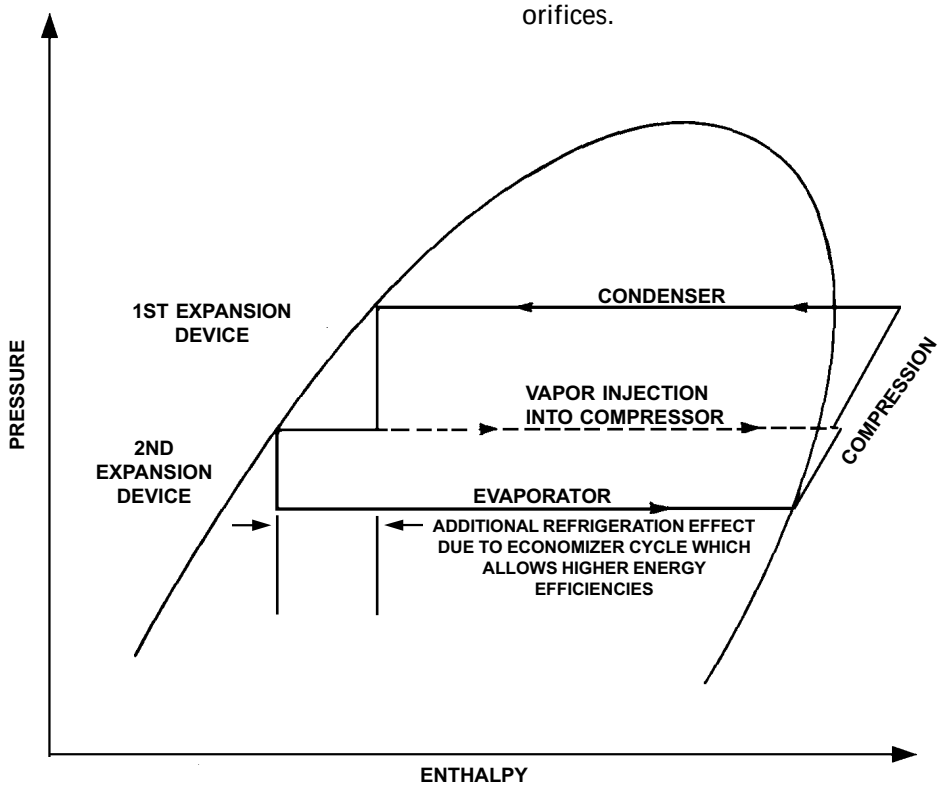
This partially compressed gas is then joined by additional gas from the flash economizer as the rotors rotate past the vapor injection port at an intermediate pressure. Compressed gaseous refrigerant is then discharged into the integral oil separator where oil, which is contained in the refrigerant vapor, is removed and returned 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. Liquid refrigerant then passes through the first expansion device and into the flash economizer where flash gas and liquid refrigerant are separated.

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.

By removing the flash gas from the flash economizer at an intermediate pressure, the enthalpy of the refrigerant flowing into the evaporator is reduced which increases the refrigeration effect and improves the efficiency of the refrigeration cycle.

Refrigerant flow into and out of the flash economizer is controlled by modulating valves which eliminate the energy wasting hot gas bypass effect inherent with fixed orifices.



UNIT FEATURES: PART-LOAD PERFORFMANCE

Through the use of flash economizer modulating flow control and multiple compressors, Dunham-Bush Rotary Screw Water-Cooled Chillers possess superior part-load performance characteristics.

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 com-bine the efficient operation of multiple rotary screw compressors with an economizer cycle and microprocessor 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 character-istics 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 (ARI) has established a system, in ARI Standard 550/590-98, 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:

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

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

Non-Standard Part-Load Values (NPLV) also give a single number estimate for the part-load perfor-mance of a chiller but at Selected Application Rating Conditions, using the same equation as for IPLV.

Integrated Part-Load Values and Non-Standard Part-Load Values are available from your Dunham-Bush Representative and will be calculated for your specific conditions. These points as well as the full load selection point are all covered under the ARI Certification Program for Centrifugal and Rotary Screw Water-Chilling Packages.

OPERATING BENEFITS: EFFICIENCY & RELIABILITY

Compressor Experience

- 35 years of rotary screw experience and dedicated technological advancements.
- Simply designed for high reliability with only two rotating parts. No gears to fail.
- Two year warranty on compressor at no extra costs.
- 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 cycle and microcomputer-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 microprocessor retention of monitored functions.
- Factory run tested.

Safety Code Compliance:

- ASME Boiler and Pressure Vessel Code, Section VIII Division 1 "Unfired Pressure Vessels"
- ASME Standard B31.5 Refrigeration Piping
- ASHRAE Standard 15 Safety Code for Mechanical Refrigeration
- National Electric Code
- cETL unit approval
- ARI Standard 550/590-98 "Centrifugal or Rotary Screw Liquid Chilling Packages"

Refrigerant Compatibility

- Designed to operate with environmentally safe and economically smart HCFC-22 with proven efficiency and reliability.
- Consult factory for use with new alternate HFC refrigerants.

Control Flexibility

- Microcomputer-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 microcomputer 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, low cost, phone modem option.
- Proactive control by microcomputer that anticipates problems and takes corrective action before they occur. Controls will unload compressor(s) if head or suction pressure approaches limits. This will enable unit to stay on the line while warning operator of potential problems.

TYPICAL SEQUENCE OF OPERATION

The Dunham-Bush Rotary Screw Water-Cooled Water Chiller depends mainly on its on-board microcomputer 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
- Unit circuit breakers in the "on" position
- Control power switch on for at least 15 minutes. Compressor switches on.
- Reset pressed on microcomputer 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 microcomputer will call for the lead compressor and the condenser water pump to start. After a one-minute delay, the first contactor (e.g. 1M-1) is energized followed by the second contactor (e.g. 1M-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 microcomputer 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, yielding 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 dead-band, 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.

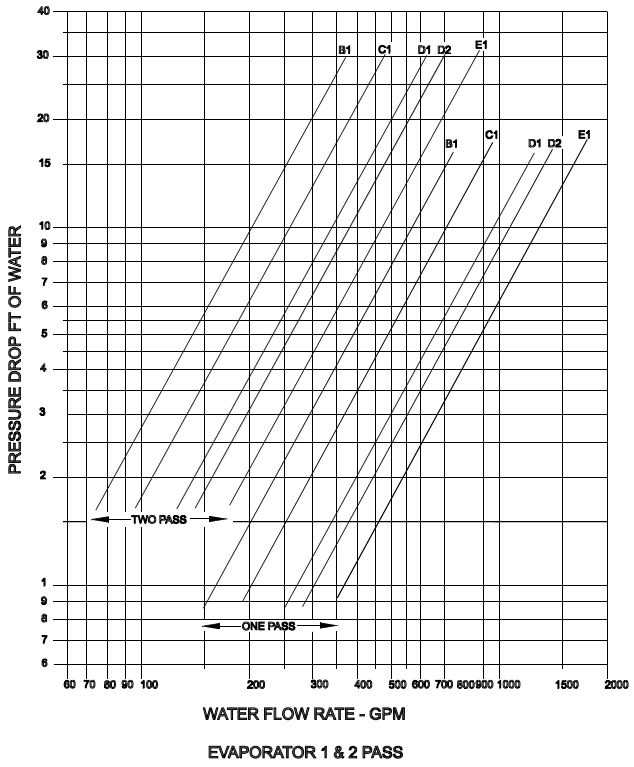
If the applied load is greater than one compressor can handle, it will load fully and then the microcomputer will call for a second compressor. After one minute, the second compressor will start in the same manner as the first. Then both compressors will be commanded to adjust load to 50%. They are gradually 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 80%. If applied load decreases further, the remaining compressor unloads proportionately. 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 temperature rises to 2°F above setpoint and both 15 minute anti-recycle and one minute start delay timers are satisfied.

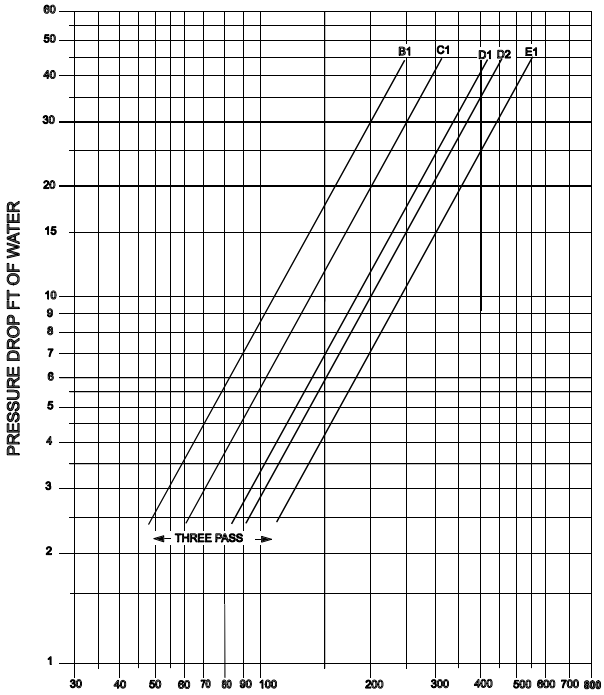
During operation, the computer monitors the difference between condenser and evaporator pressures to insure that a minimum of 30 psi differential is available for compressor lubrication. If the difference falls below a minimum of 30 psi, the computer closes refrigerant flow control valves, starving the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

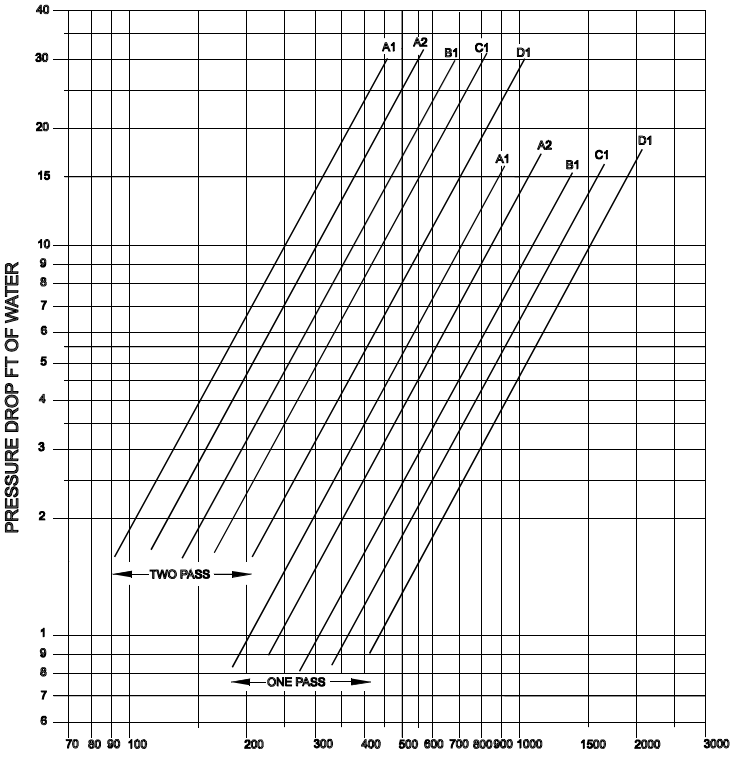
PRESSURE DROPS: WCFX-B 10-18



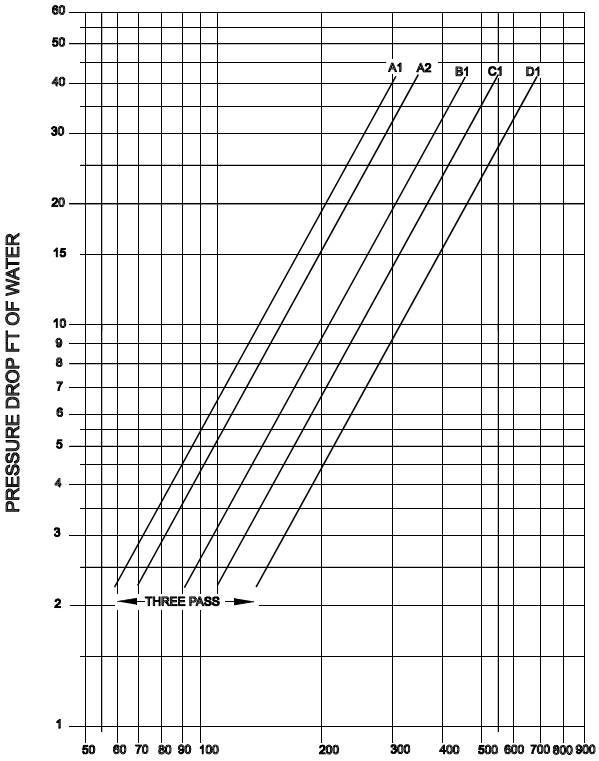
EVAPORATOR 1 & 2 PASS



EVAPORATOR 3 PASS

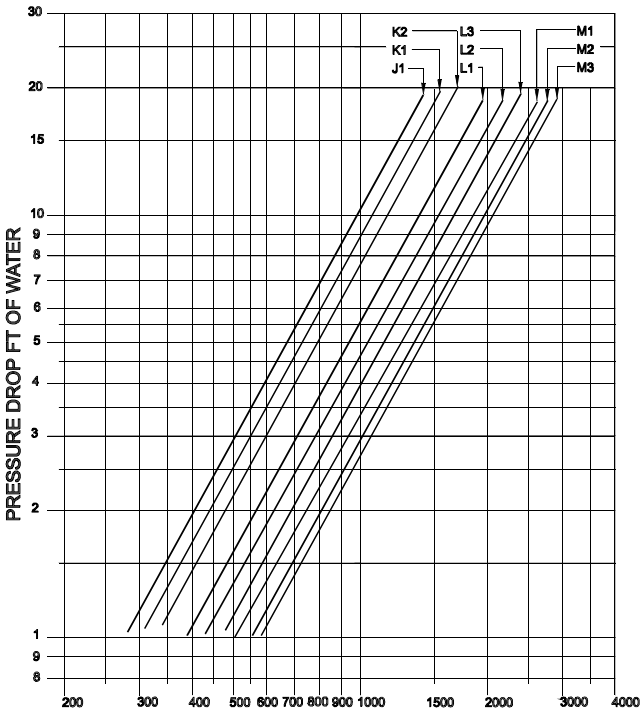


CONDENSER 1 & 2 PASS

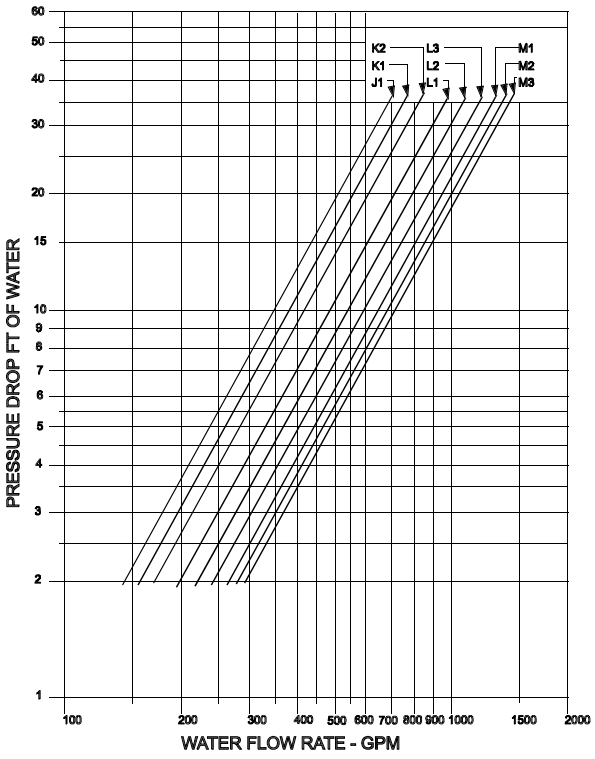


CONDENSER 3 PASS

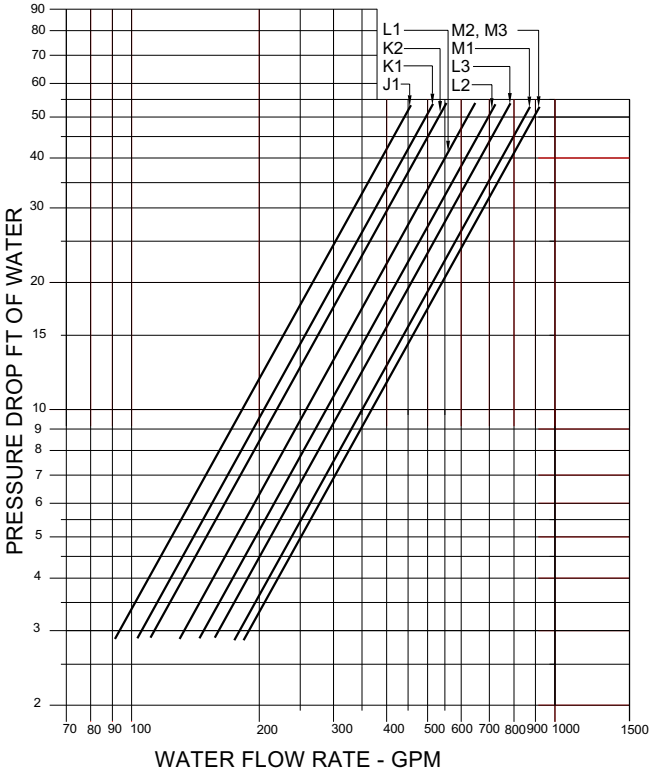
PRESSURE DROPS: WCFX-B 20-36



EVAPORATOR 1 PASS



EVAPORATOR 2 PASS



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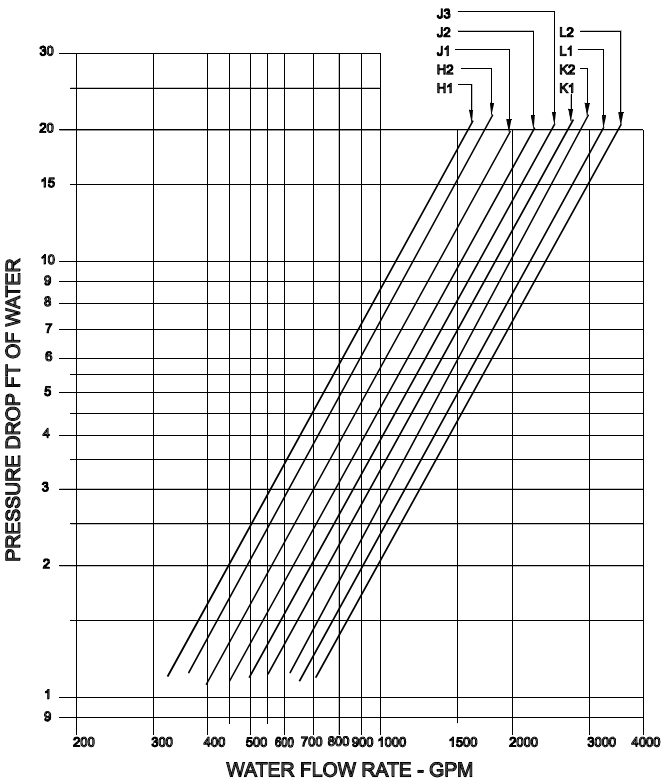
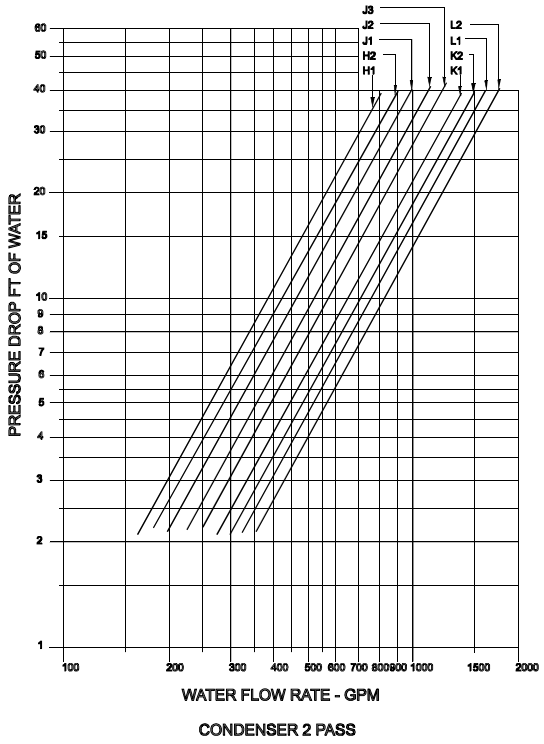


CONDENSER 1 PASS

Pressure Drops: WCFX-B 20-36



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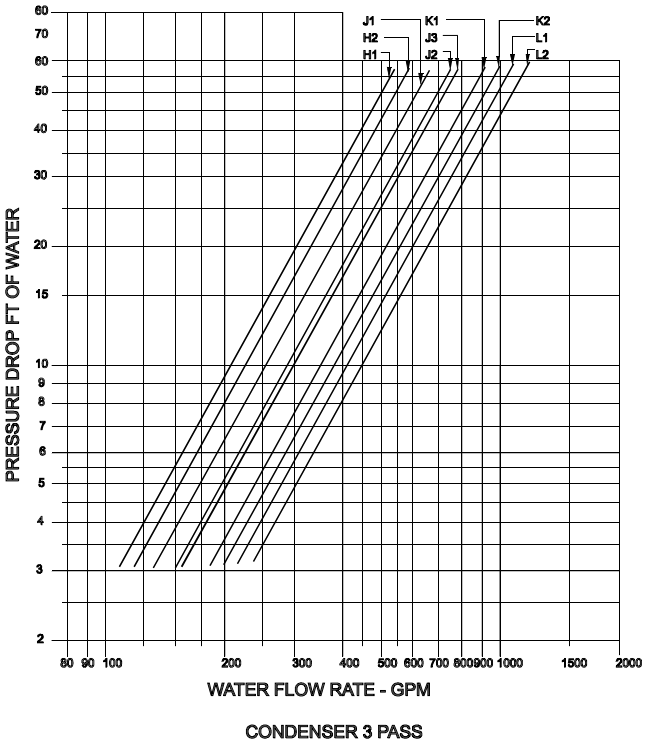

CONDENSER 3 PASS

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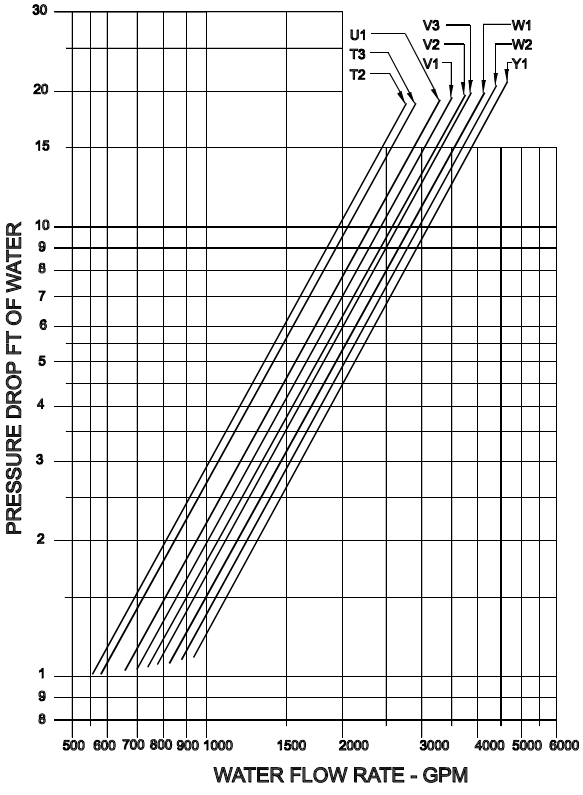
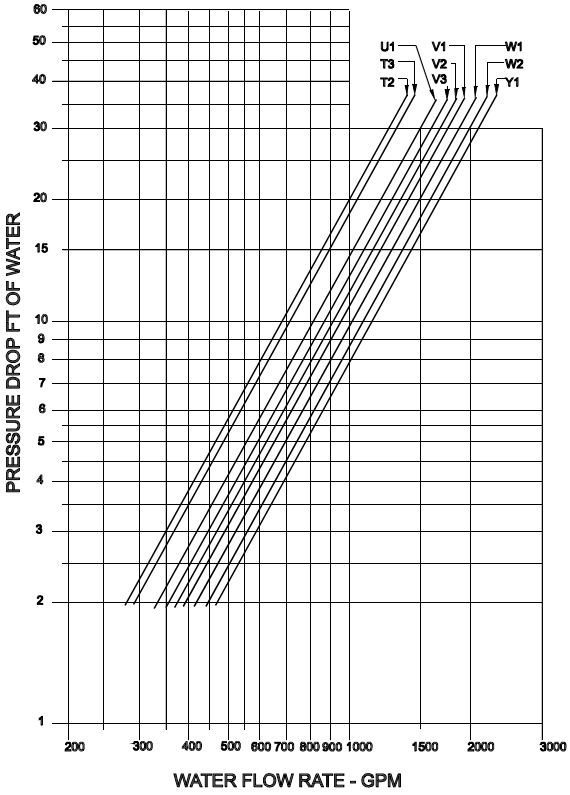
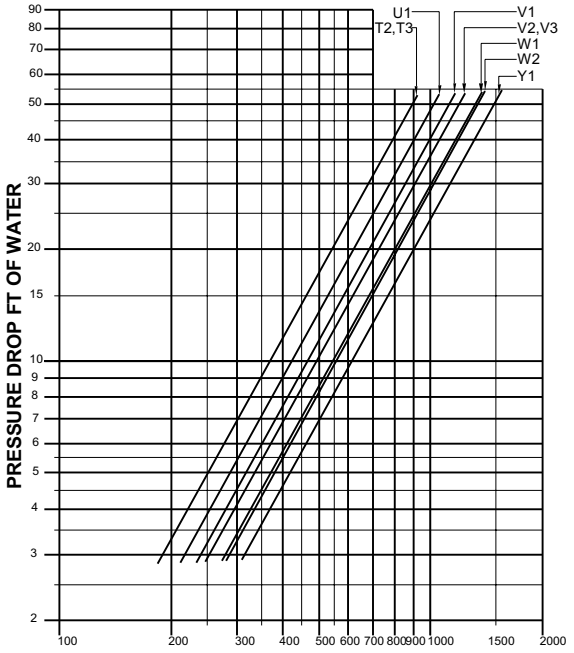


EVAPORATOR 1 PASS

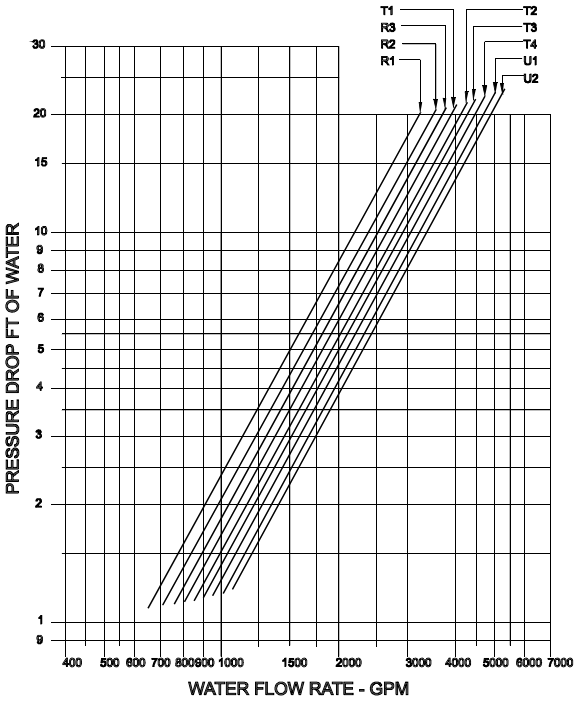


EVAPORATOR 2 PASS

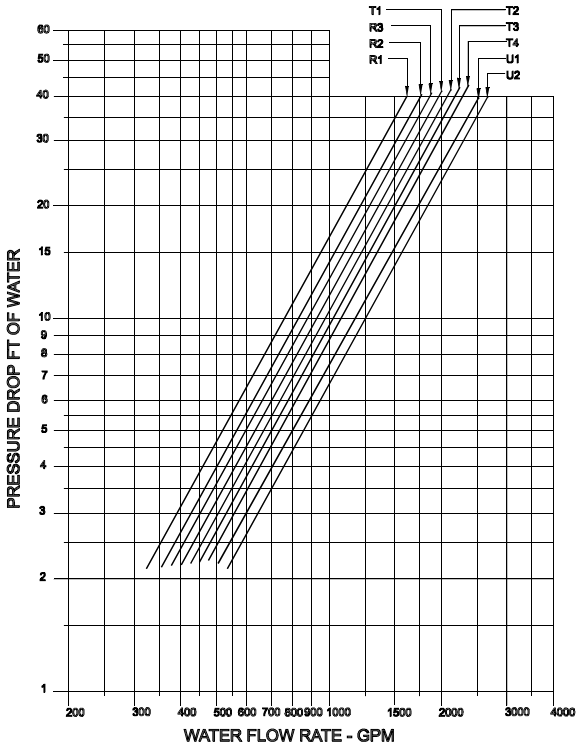
PRESSURE DROPS: WCFX-B 39-54



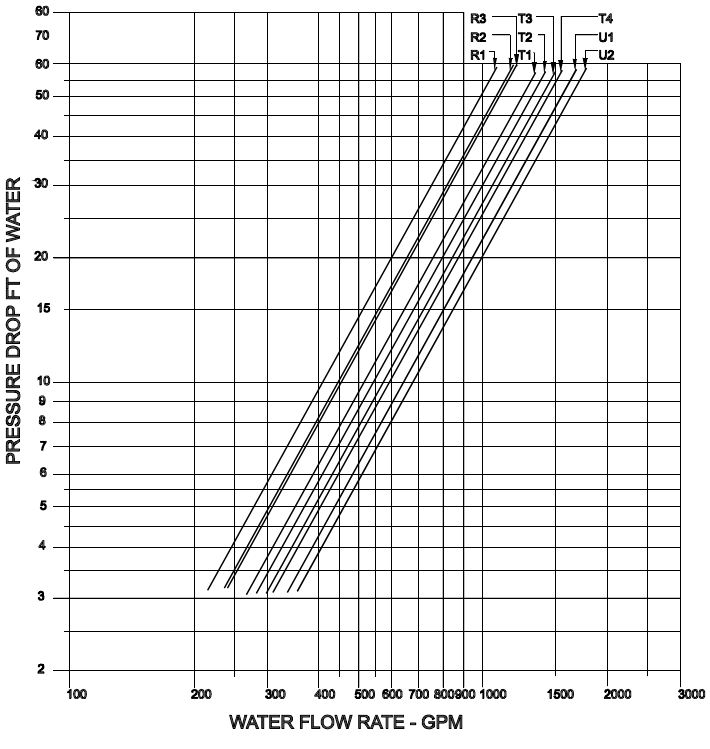
EVAPORATOR 3 PASS



CONDENSER 1 PASS

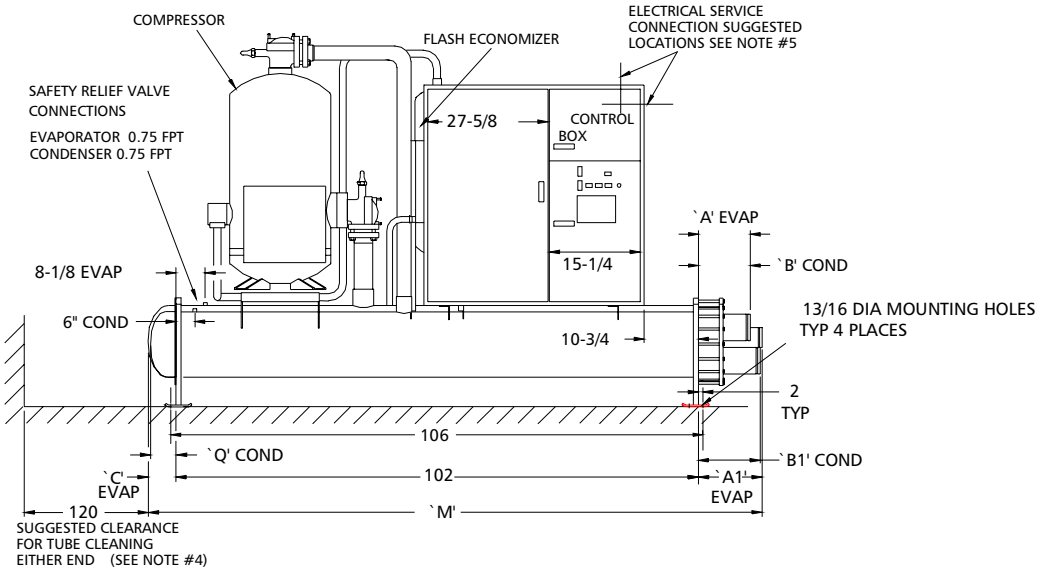


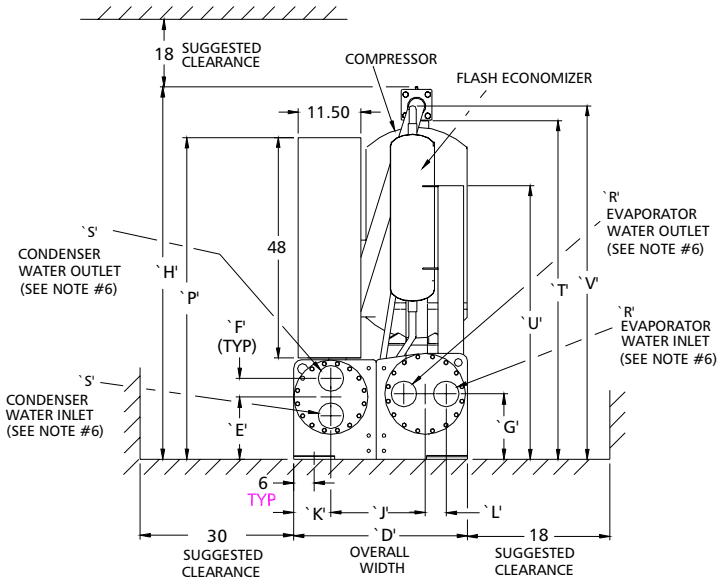
CONDENSER 2 PASS



CONDENSER 3 PASS

DIMENSIONAL DATA: ONE COMPRESSOR MODELS





MODEL MATCHES			EVAPORATOR			CONDENSER																
COMP CODE	EVAP	COND	2 PASS			2 PASS			C	D	E	F	G	H	J	K	L	M	P	Q	T	U	V
			A	A1	R	B	B1	S															
10	B1	A1	11-3/8	16-1/2	5	10-3/8	10-3/8	4	5-1/2	37	13-1/8	4-5/8	13-3/4	72	18-1/8	7-7/8	4	124	71-7/8	5-1/4	65-7/8	54-1/8	68-3/8
12	C1	A2	11-3/8	16-1/2	5	10-3/8	10-3/8	4	6	38	13-1/8	4-5/8	14-3/4	74-1/4	18-1/8	7-7/8	5-1/8	124-1/2	71-7/8	5-1/4	68-1/8	56-1/8	70-3/8
15	D1	B1	11-7/8	11-7/8	6	11-3/8	16-1/2	5	6-1/2	42-3/8	13-1/4	4	15-1/4	80-5/8	20-7/8	8-1/2	5-5/8	124	73	5-1/2	73-1/2	57-5/8	71-7/8
18	D2	C1	11-7/8	11-7/8	6	11-3/8	16-1/2	5	6-1/2	44-3/8	14-1/4	5-1/8	15-1/4	80-5/8	21-7/8	9-1/2	5-5/8	124-1/2	75	6	73-1/2	57-5/8	71-7/8

NOTES:

1 - WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT

2 - ALL DIMENSIONS ARE IN INCHES

3 - VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER

4 - SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS

5 - 36" OF FLEXIBLE CONDUIT SHOULD BE USED

6 - WHEN LOOKING AT (2) PASS EVAPORATOR HEAD CONNECTIONS, WATER OUTLET IS LEFT CONNECTION, WATER INLET IS 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.

7 - DWG SHOWS 2 PASS RIGHT HAND ARRANGEMENT ON BOTH COND. AND EVAP.

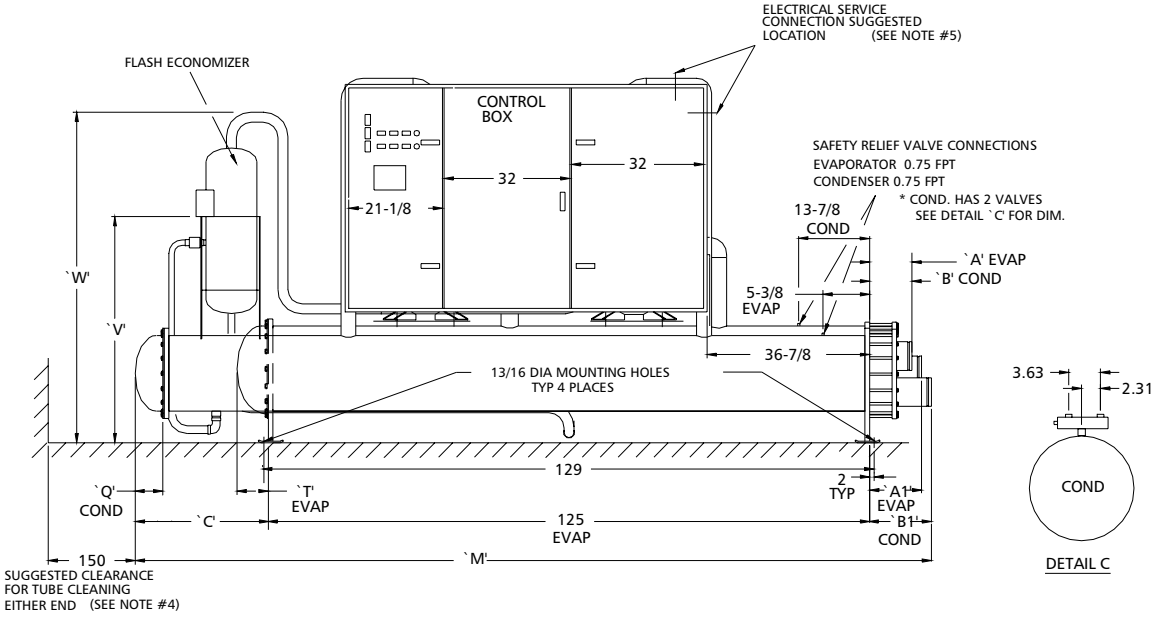
Optional Vessel Sets: One Compressor Models

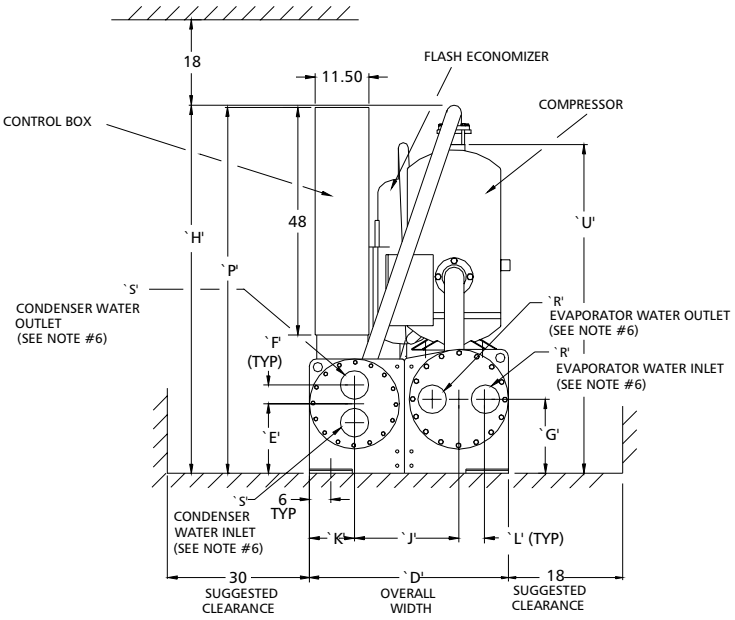
			Evaporator							Condenser								
Model Match			1 Pass		2 Pass			3 Pass		1 Pass		2 Pass			3 Pass			
WCFX Model No.	Evap	Cond	A	R	A	A1	R	A	R	B	S	B	B1	S	B	S	C	D
10	B1	A2	10-1/2	6	11-3/8	16-1/2	5	9-7/8	4	10-1/4	6	10-3/8	10-3/8	4	9-1/2	4	5-1/2	37
	C1	A1-A2	11	6	11-3/8	16-1/2	5	9-7/8	4	10-1/4	6	10-3/8	10-3/8	4	9-1/2	4	6	38
12	B1	A1-A2	10-1/2	6	11-3/8	16-1/2	5	9-7/8	4	10-1/4	6	10-3/8	10-3/8	4	9-1/2	4	5-1/2	37
	C1	A1	11	6	11-3/8	16-1/2	5	9-7/8	4	10-1/4	6	10-3/8	10-3/8	4	9-1/2	4	6	38
	D1-D2	B1	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	10-1/2	8	11-3/8	16-1/2	5	9-7/8	5	6-1/2	42-3/8
15	D1-D2	C1	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	11	8	11-3/8	16-1/2	5	9-7/8	5	6-1/2	44-3/8
	D2	B1	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	10-1/2	8	11-3/8	16-1/2	5	9-7/8	5	6-1/2	42-3/8
	E1	D1	12	8	12-1/4	12-1/4	6	10-1/2	5	11-1/2	8	11-7/8	11-7/8	6	9-7/8	6	7	48-5/8
18	D1-D2	B1	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	10-1/2	8	11-3/8	16-1/2	5	9-7/8	5	6-1/2	42-3/8
	D1	C1	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	11	8	11-3/8	16-1/2	5	9-7/8	5	6-1/2	44-3/8
	E1	D1	12	8	12-1/4	12-1/4	6	10-1/2	5	11-1/2	8	11-7/8	11-7/8	6	9-7/8	6	7	48-5/8

Model Match														
WCFX Model No.	Evap	Cond	E	F	G	H	J	K	L	P	Q	T	U	V
10	B1	A2	13-1/8	4-5/8	13-3/4	72	18-1/8	7-7/8	4	71-7/8	5-1/4	65-7/8	54-1/8	68-3/8
	C1	A1-A2	13-1/8	4-5/8	14-3/4	74-1/4	18-1/8	7-7/8	5-1/8	71-7/8	5-1/4	68-1/8	56-1/8	70-3/8
12	B1	A1-A2	13-1/8	4-5/8	13-3/4	72	18-1/8	7-7/8	4	71-7/8	5-1/4	65-7/8	54-1/8	68-3/8
	C1	A1	13-1/8	4-5/8	14-3/4	74-1/4	18-1/8	7-7/8	5-1/8	71-7/8	5-1/4	68-1/8	56-1/8	70-3/8
	D1-D2	B1	13-1/4	4	15-1/4	75-3/4	20-7/8	8-1/2	5-5/8	73	5-1/2	69-5/8	57-5/8	71-7/8
15	D1-D2	C1	14-1/4	5-1/8	15-1/4	80-5/8	21-7/8	9-1/2	5-5/8	75	6	73-1/2	57-5/8	71-7/8
	D2	B1	13-1/4	4	15-1/4	80-5/8	20-7/8	8-1/2	5-5/8	73	5-1/2	73-1/2	57-5/8	71-7/8
	E1	D1	15-1/4	5-5/8	16-1/4	82-5/8	23-3/4	10-5/8	5-5/8	77	6-1/2	75-1/2	59-5/8	73-7/8
18	D1-D2	B1	13-1/4	4	15-1/4	80-5/8	20-7/8	8-1/2	5-5/8	73	5-1/2	73-1/2	57-5/8	71-7/8
	D1	C1	14-1/4	5-1/8	15-1/4	80-5/8	21-7/8	9-1/2	5-5/8	75	6	73-1/2	57-5/8	71-7/8
	E1	D1	15-1/4	5-5/8	16-1/4	82-5/8	23-3/4	10-5/8	5-5/8	77	6-1/2	75-1/2	59-5/8	73-7/8

Overall Length (OAL):				
Evap. Conn.	Cond. Conn	Vessel Code (Evap/Cond)		
		D/B	D/C	E/D
2 Pass Left Hand	2 Pass Left Hand	124	124-1/2	121-1/4
2 Pass Left Hand	2 Pass Right Hand	130-3/8	130-3/8	124-1/8
2 Pass Right Hand	2 Pass Right Hand	124	124-1/2	121-1/4
2 Pass Right Hand	2 Pass Left	130-3/8	130-3/8	126-1/8
2 Pass Left Hand	1 Pass	124-3/8	124-7/8	125-3/4
2 Pass Right Hand	1 Pass	124-3/8	124-7/8	125-3/4
2 Pass Left Hand	3 Pass	123-3/4	123-3/4	124-1/8
2 Pass Right Hand	3 Pass	123-3/4	123-3/4	124-1/8
1 Pass	2 Pass Left Hand	130	130	128
1 Pass	2 Pass Right Hand	130	130	128
3 Pass	2 Pass Left Hand	128-3/8	128-3/8	124-3/8
3 Pass	2 Pass Right Hand	128-3/8	128-3/8	124-3/8
1 Pass	1 Pass	125	125	126
3 Pass	3 Pass	121-3/4	121-3/4	123

DIMENSIONAL DATA: TWO COMPRESSOR MODELS





MODEL MATCHES			EVAPORATOR			CONDENSER																		
COMP CODE	EVAP	COND	2 PASS			2 PASS			C	D	E	F	G	H	J	K	L	M	P	Q	T	U	V	W
			A	A1	R	B	B1	S																
20	J1	H1	11-7/8	11-7/8	6	11-7/8	17-1/8	6	28	43-3/8	14-1/4	4-1/2	16-1/4	79-3/4	21-7/8	9-1/2	5-5/8	175-1/8	76-3/4	6	6-1/2	70-3/8	53-3/4	74-1/4
22	K1	H2	12-1/4	12-1/4			17-1/8		28	45-5/8	14-1/4	4-1/2		80-3/4	22-7/8	9-1/2		175-1/8	76-3/4	6	7	71-3/8	53-3/4	74-1/4
24	K2	J1	12-1/4	12-1/4			11-7/8		28-1/2	47-5/8	15-1/4	5-5/8		80-3/4	23-7/8	10-1/2		170-3/4	78-3/4	6-1/2	7	71-3/8	55-3/4	76-1/4
27	L1	J2	12-3/8	18-3/8	8					49-5/8			17-1/4	88-1/8	24-7/8		6-7/8	176-7/8			7-1/2	77-1/4		76-1/4
30	L2	J3								49-5/8					24-7/8			176-7/8						76-7/8
33	L3	K1				12-3/8	18-3/8	8	29	51-7/8	16-1/4	6-1/8			25-7/8	11-3/4		177-3/8	80-3/4	7			57-3/4	78-7/8
36	M1	K2		12-3/8		12-3/8	18-3/8	8	29	54-1/8	16-1/4	6-1/8	18-1/4	90-1/8	26-7/8	11-3/4		177-3/8	80-3/4	7	8	79-1/4	57-3/4	78-7/8

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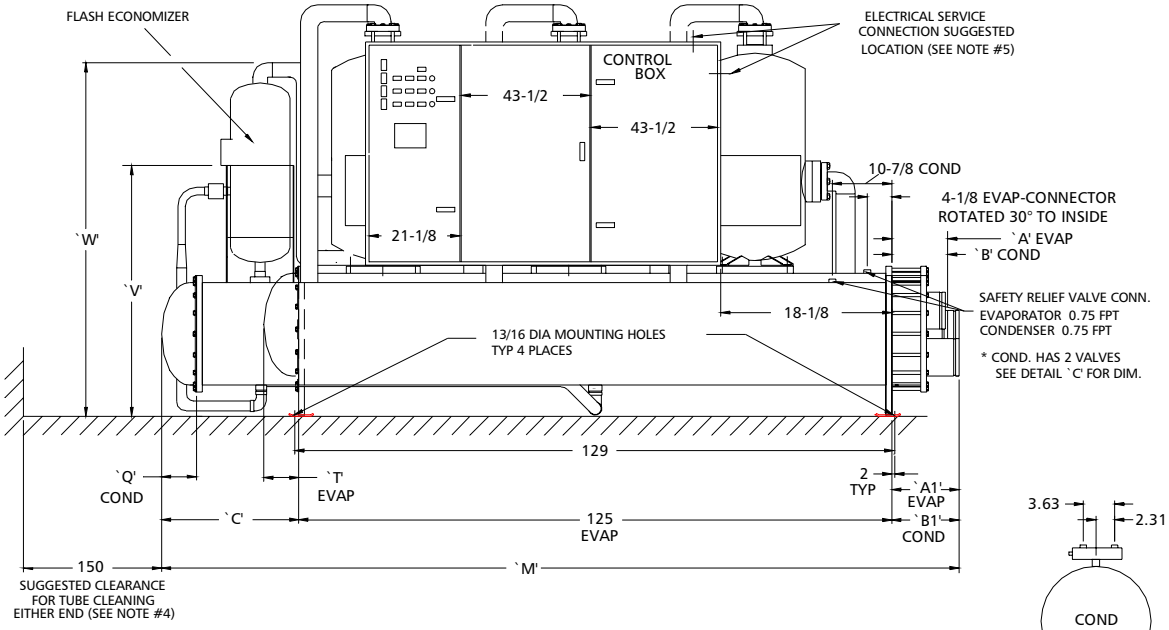
7 - DWG. SHOWS 2 PASS RIGHT HAND ARRANGEMENT ON BOTH COND. AND EVAP.

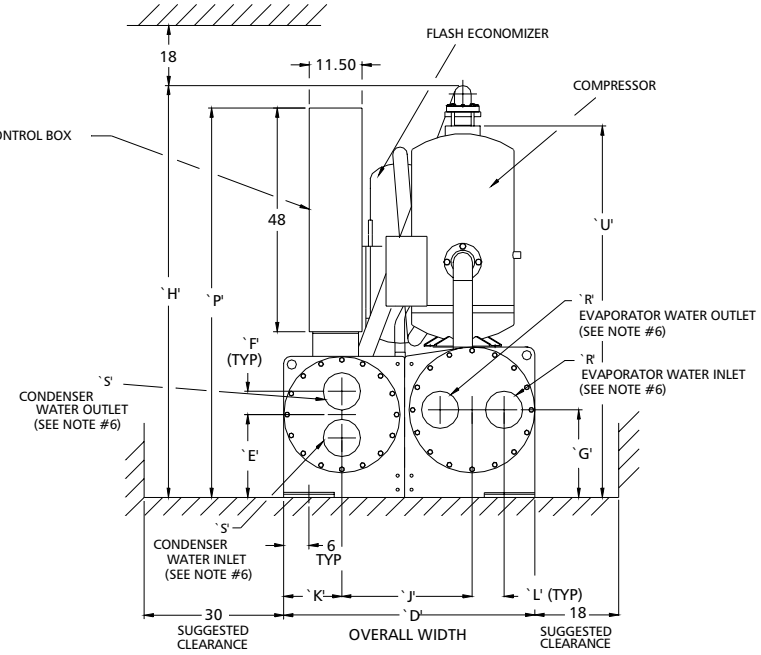
Optional Vessel Sets: Two Compressor Models

Model Match			Evaporator							Condenser								
			1 Pass		2 Pass			3 Pass		1 Pass		2 Pass			3 Pass			
WCFX Model No.	Evap	Cond	A	R	A	A1	R	A	R	B	S	B	B1	S	B	S	C	D
20	J1	H2	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	11	8	11-7/8	17-1/8	6	9-7/8	5	28	43-3/8
	K1-K2	H1-H2	12	8	12-1/4	12-1/4	6	10-1/2	5	11	8	11-7/8	17-1/8	6	9-7/8	5	28	45-5/8
	K1-K2	J1	12	8	12-1/4	12-1/4	6	10-1/2	5	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	47-5/8
22	J1	H1-H2	11-1/2	8	11-7/8	11-7/8	6	9-7/8	5	11	8	11-7/8	17-1/8	6	9-7/8	5	28	43-3/8
	K1-K2	H1	12	8	12-1/4	12-1/4	6	10-1/2	5	11	8	11-7/8	17-1/8	6	9-7/8	5	28	45-5/8
	K1-K2	J1-J2	12	8	12-1/4	12-1/4	6	10-1/2	5	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	47-5/8
	L1	J1-J2	12	10	12-3/8	18-3/8	8	10-3/8	6	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	49-5/8
24	K1-K2	H2	12	8	12-1/4	12-1/4	6	10-1/2	5	11	8	11-7/8	17-1/8	6	9-7/8	5	28	45-5/8
	K1-K2	J1-J2-J3	12	8	12-1/4	12-1/4	6	10-1/2	5	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	47-5/8
	L1-L2	J1-J2-J3	12	10	12-3/8	18-3/8	8	10-3/8	6	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	49-5/8
27	L1-L2-L3	J1-J2-J3	12	10	12-3/8	18-3/8	8	10-3/8	6	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	49-5/8
	L3	K1	12	10	12-3/8	18-3/8	8	10-3/8	6	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	51-7/8
30	L1-L2-L3	J2-J3	12	10	12-3/8	18-3/8	8	10-3/8	6	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	49-5/8
	L2-L3	K1-K2	12	10	12-3/8	18-3/8	8	10-3/8	6	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	51-7/8
	M1	K1-K2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	54-1/8
	M2	L1	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	12	10	12-3/8	18-3/8	8	10-3/8	6	29-1/2	56-1/8
33	L2-L3	J3	12	10	12-3/8	18-3/8	8	10-3/8	6	11	10	11-7/8	11-7/8	6	9-7/8	6	28-1/2	49-5/8
	L2-L3	K1-K2	12	10	12-3/8	18-3/8	8	10-3/8	6	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	51-7/8
	M1-M2	K1-K2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	54-1/8
	M1-M2-M3	L1-L2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	12	10	12-3/8	18-3/8	8	10-3/8	6	29-1/2	56-1/8
36	L3	K1-K2	12	10	12-3/8	18-3/8	8	10-3/8	6	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	51-7/8
	M1-M2	K1-K2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	11-1/2	10	12-3/8	18-3/8	8	10-1/2	6	29	54-1/8
	M1-M2-M3	L1-L2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	12	10	12-3/8	18-3/8	8	10-3/8	6	29-1/2	56-1/8

Model Match															
WCFX Model No.	Evap	Cond	E	F	G	H	J	K	L	P	Q	T	U	V	W
20	J1	H2	14-1/4	4-1/2	16-1/4	79-3/4	21-7/8	9-1/2	5-5/8	76-3/4	6	6-1/2	70-3/8	53-3/4	74-1/4
	K1-K2	H1-H2	14-1/4	4-1/2	16-1/4	80-3/4	22-7/8	9-1/2	5-5/8	76-3/4	6	7	71-3/8	53-3/4	74-1/4
	K1-K2	J1	15-1/4	5-5/8	16-1/4	80-3/4	23-7/8	10-1/2	5-5/8	78-3/4	6-1/2	7	71-3/8	55-3/4	76-1/4
22	J1	H1-H2	14-1/4	4-1/2	16-1/4	79-3/4	21-7/8	9-1/2	5-5/8	76-3/4	6	6-1/2	70-3/8	53-3/4	74-1/4
	K1-K2	H1	14-1/4	4-1/2	16-1/4	80-3/4	22-7/8	9-1/2	5-5/8	76-3/4	6	7	71-3/8	53-3/4	74-1/4
	K1-K2	J1-J2	15-1/4	5-5/8	16-1/4	80-3/4	23-7/8	10-1/2	5-5/8	78-3/4	6-1/2	7	71-3/8	55-3/4	76-1/4
	L1	J1-J2	15-1/4	5-5/8	17-1/4	82-3/4	24-7/8	10-1/2	6-7/8	78-3/4	6-1/2	7-1/2	73-3/8	55-3/4	76-1/4
24	K1-K2	H2	14-1/4	4-1/2	16-1/4	80-3/4	22-7/8	9-1/2	5-5/8	76-3/4	6	7	71-3/8	53-3/4	74-1/4
	K1-K2	J1-J2-J3	15-1/4	5-5/8	16-1/4	80-3/4	23-7/8	10-1/2	5-5/8	78-3/4	6-1/2	7	71-3/8	55-3/4	76-1/4
	L1-L2	J1-J2-J3	15-1/4	5-5/8	17-1/4	82-3/4	24-7/8	10-1/2	6-7/8	78-3/4	6-1/2	7-1/2	73-3/8	55-3/4	76-1/4
27	L1-L2-L3	J1-J2-J3	15-1/4	5-5/8	17-1/4	88-1/8	24-7/8	10-1/2	6-7/8	78-3/4	6-1/2	7-1/2	77-1/4	55-3/4	76-1/4
	L3	K1	16-1/4	6-1/8	17-1/4	88-1/8	25-7/8	11-3/4	6-7/8	80-3/4	7	7-1/2	77-1/4	57-3/4	78-1/4
30	L1-L2-L3	J2-J3	15-1/4	5-5/8	17-1/4	88-1/8	24-7/8	10-1/2	6-7/8	78-3/4	6-1/2	7-1/2	77-1/4	55-3/4	76-7/8
	L2-L3	K1-K2	16-1/4	6-1/8	17-1/4	88-1/8	25-7/8	11-3/4	6-7/8	80-3/4	7	7-1/2	77-1/4	57-3/4	78-7/8
	M1	K1-K2	16-1/4	6-1/8	18-1/4	90-1/8	26-7/8	11-3/4	6-7/8	80-3/4	7	8	79-1/4	57-3/4	78-7/8
	M2	L1	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	80-7/8
33	L2-L3	J3	15-1/4	5-5/8	17-1/4	88-1/8	24-7/8	10-1/2	6-7/8	78-3/4	6-1/2	7-1/2	77-1/4	55-3/4	76-7/8
	L2-L3	K1-K2	16-1/4	6-1/8	17-1/4	88-1/8	25-7/8	11-3/4	6-7/8	80-3/4	7	7-1/2	77-1/4	57-3/4	78-7/8
	M1-M2	K1-K2	16-1/4	6-1/8	18-1/4	90-1/8	26-7/8	11-3/4	6-7/8	80-3/4	7	8	79-1/4	57-3/4	78-7/8
	M1-M2-M3	L1-L2	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	80-7/8
36	L3	K1-K2	16-1/4	6-1/8	17-1/4	88-1/8	25-7/8	11-3/4	6-7/8	80-3/4	7	7-1/2	77-1/4	57-3/4	78-7/8
	M1-M2	K1-K2	16-1/4	6-1/8	18-1/4	90-1/8	26-7/8	11-3/4	6-7/8	80-3/4	7	8	79-1/4	57-3/4	78-7/8
	M1-M2-M3	L1-L2	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	80-7/8

DIMENSIONAL DATA: THREE COMPRESSOR MODELS





MODEL MATCHES			EVAPORATOR			CONDENSER																				
COMP CODE	EVAP	CDS	2 PASS			2 PASS			C	D	E	F	G	H	J	K	L	M	P	Q	T	U	V	W		
			A	A1	R	B	B1	S																		
39	T2	R1	12-3/8	12-3/8	8	12-3/8	18-3/8	8	29-1/2	56-1/8	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	178-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	84-3/4		
42	T3	R2	12-3/8	12-3/8	8	↓	↓	↓	↓	↓	↓	↓	18-1/4	90-1/8	27-7/8	↓	6-7/8	↓	↓	↓	8	79-1/4	↓	↓		
45	U1	R3	11-3/8	11-3/8	10	↓	↓	↓	↓	↓	↓	↓	19-1/4	92-1/8	28-7/8	↓	7-3/8	↓	↓	↓	6-3/8	81-1/4	↓	↓		
48	V1	T1	14-1/2	14-1/2	↓	↓	12-3/8	↓	30	62-3/8	18-1/4	↓	20-1/4	94-1/8	30-7/8	14	8-1/8	175-1/2	84-3/4	8	9	83-1/4	61-3/4	87-5/8		
51	V2	T2	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	61-3/4	87-5/8		
54	V3	T3	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	67	92-7/8		

NOTES:

1 - WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT

2 - ALL DIMENSIONS ARE IN INCHES

3 - VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER

4 - SUFFICIENT ROOM MUST BE ALLOWED FOR EVAPORATOR AND CONDENSER WATER CONNECTIONS

5 - 36" OF FLEXIBLE CONDUIT SHOULD BE USED

6 - WHEN LOOKING AT (2) PASS EVAPORATOR HEAD CONNECTIONS, WATER OUTLET IS LEFT CONNECTION, WATER INLET IS 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.

7 - DWG SHOWS 2 PASS RIGHT HAND ARRANGEMENT ON BOTH COND. AND EVAP.

Optional Vessel Sets: Three Compressor Models

			Evaporator							Condenser								
Model Match			1 Pass		2 Pass			3 Pass		1 Pass		2 Pass			3 Pass			
WCFX Model No.	Evap	Cond	A	R	A	A1	R	A	R	B	S	B	B1	S	B	S	C	D
39	T2-T3	R1-R2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	56-1/8
	U1	R1-R2-R3	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	58-1/8
	U1	T1	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	60-3/8
	V1	T1	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
42	T2-T3	R1-R2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	56-1/8
	U1	R1-R2-R3	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	58-1/8
	U1	T1-T2	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	60-3/8
	V1-V2	T1-T2	13-1/2	12	14-1/2	14-1/2	8	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
45	T3	R2	12-1/2	12	12-3/8	12-3/8	8	10-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	56-1/8
	U1	R2	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	58-1/8
	U1	T1-T2	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	60-3/8
	V1-V2-V3	T1-T2	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
	V2-V3	T3	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
48	U1	R3	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12	12	12-3/8	18-3/8	8	9-7/8	5	29-1/2	58-1/8
	U1	T1-T2	11-1/4	12	11-3/8	11-3/8	10	11-3/8	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	60-3/8
	V1-V2-V3	T1-T2	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
	V2-V3	T3-T4	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
51	V1-V2-V3	T1-T2	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
	V2-V3	T3-T4	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
	V3	U1	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	11-1/4	12	11-3/8	11-3/8	10	10-1/2	5	28-3/8	63-1/2
	W1-W2	U1	12	12	11-7/8	11-7/8	10	11-5/8	8	11-1/4	12	11-3/8	11-3/8	10	10-1/2	5	28-3/8	64-7/8
54	V2-V3	T3-T4	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	12-1/2	12	12-3/8	12-3/8	8	9-7/8	6	30	62-3/8
	V3	U1	13-1/2	12	14-1/2	14-1/2	10	11-1/4	8	11-1/4	12	11-3/8	11-3/8	10	10-1/2	5	28-3/8	63-1/2
	W1-W2	U1-U2	12	12	11-7/8	11-7/8	10	11-5/8	8	11-1/4	12	11-3/8	11-3/8	10	11-1/2	5	28-3/8	64-7/8
	W2	U1	12	12	11-7/8	11-7/8	10	11-5/8	8	11-1/4	12	11-3/8	11-3/8	10	11-1/2	5	28-3/8	64-7/8
	Y1	U1-U2	11-7/8	12	11-7/8	11-7/8	10	11-5/8	8	11-1/4	12	11-3/8	11-3/8	10	11-1/2	5	28-3/8	68

Model Match															
WCFX Model No.	Evap	Cond	E	F	G	H	J	K	L	P	Q	T	U	V	W
39	T2-T3	R1-R2	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	84-3/4
	U1	R1-R2-R3	17-1/4	6-7/8	19-1/4	92-1/8	28-7/8	12-3/4	7-3/8	82-3/4	7-1/2	6-3/8	81-1/4	59-3/4	84-3/4
	U1	T1	18-1/4	6-7/8	19-1/4	92-1/8	29-7/8	14	7-3/8	84-3/4	8	6-3/8	81-1/4	61-3/4	86-3/4
	V1	T1	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	61-3/4	86-3/4
42	T2-T3	R1-R2	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	84-3/4
	U1	R1-R2-R3	17-1/4	6-7/8	19-1/4	92-1/8	28-7/8	12-3/4	7-3/8	82-3/4	7-1/2	6-3/8	81-1/4	59-3/4	84-3/4
	U1	T1-T2	18-1/4	6-7/8	19-1/4	92-1/8	29-7/8	14	7-3/8	84-3/4	8	6-3/8	81-1/4	61-3/4	86-3/4
	V1-V2	T1-T2	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	61-3/4	86-3/4
45	T3	R2	17-1/4	6-7/8	18-1/4	90-1/8	27-7/8	12-3/4	6-7/8	82-3/4	7-1/2	8	79-1/4	59-3/4	84-3/4
	U1	R2	17-1/4	6-7/8	19-1/4	92-1/8	28-7/8	12-3/4	7-3/8	82-3/4	7-1/2	6-3/8	81-1/4	59-3/4	84-3/4
	U1	T1-T2	18-1/4	6-7/8	19-1/4	92-1/8	29-7/8	14	7-3/8	84-3/4	8	6-3/8	81-1/4	61-3/4	86-3/4
	V1-V2-V3	T1-T2	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	61-3/4	86-3/4
	V2-V3	T3	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	67	92
48	U1	R3	17-1/4	6-7/8	19-1/4	92-1/8	28-7/8	12-3/4	7-3/8	82-3/4	7-1/2	6-3/8	81-1/4	59-3/4	85-5/8
	U1	T1-T2	18-1/4	6-7/8	19-1/4	92-1/8	29-7/8	14	7-3/8	84-3/4	8	6-3/8	81-1/4	61-3/4	87-5/8
	V1-V2-V3	T1-T2	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	61-3/4	87-5/8
	V2-V3	T3-T4	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	67	92-7/8
51	V1-V2-V3	T1-T2	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	61-3/4	87-5/8
	V2-V3	T3-T4	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	67	92-7/8
	V3	U1	19-1/4	7-3/8	20-1/4	94-1/8	31-7/8	14-1/8	8-1/8	86-3/4	6-3/8	9	83-1/4	67	92-7/8
	W1-W2	U1	19-1/4	7-3/8	21-1/4	96-1/8	32-7/8	14-1/8	8-5/8	86-3/4	6-3/8	6-7/8	85-1/4	67	92-7/8
54	V2-V3	T3-T4	18-1/4	6-7/8	20-1/4	94-1/8	30-7/8	14	8-1/8	84-3/4	8	9	83-1/4	67	92-7/8
	V3	U1	19-1/4	7-3/8	20-1/4	94-1/8	31-7/8	14-1/8	8-1/8	86-3/4	6-3/8	9	83-1/4	67	92-7/8
	W1-W2	U1-U2	19-1/4	7-3/8	21-1/4	96-1/8	32-7/8	14-1/8	8-5/8	86-3/4	6-3/8	6-7/8	85-1/4	67	92-7/8
	W2	U1	19-1/4	7-3/8	21-1/4	96-1/8	32-7/8	14-1/8	8-5/8	86-3/4	6-3/8	6-7/8	86-1/4	67	92-7/8
	Y1	U1-U2	19-1/4	7-3/8	22-1/4	98-1/8	34	14-1/8	8-5/8	86-3/4	6-3/8	6-7/8	87-1/4	67	92-7/8

PHYSICAL SPECIFICATIONS: ONE COMPRESSOR MODELS

WCFX 10, 12, 15, 18

Unit Model	10ARB1A1	12ARC1A2	15ARD1B1	18ARD2C1
Nominal Tons	100	120	150	180
Compressor	1210	1212	1215	1218
RPM	3500	3500	3500	3500
Electrical Information	AR - 460V	AR - 460V	AR - 460V	AR - 460V
Compressor: RLA, each	98	125	155	186
1st Step Inrush, each	252	310	398	446
LRA, each	652	780	1030	1248
Unit: MCA (Min. Circuit Ampacity)	123	157	194	233
MFS (Max. Allowable Fuse Size)	200	250	300	400
Evaporator Model	B1	C1	D1	D2
Design Press. Water Side (PSIG)	150	150	150	150
Design Press. Refrig. Side (PSIG)	300	300	300	300
Water Volume, Gallons	17	23	31	33
Min. GPM (1 Pass)	149	192	250	282
Min. GPM (2 Pass)	74	96	125	141
Min. GPM (3 Pass)	50	64	83	94
Max. GPM (1 Pass)	743	958	1252	1408
Max. GPM (2 Pass)	372	479	626	704
Max. GPM (3 Pass)	248	319	417	469
Condenser Model	A1	A2	B1	C1
Design Press. Water Side (PSIG)	150	150	150	150
Design Press. Refrig. Side (PSIG)	300	300	300	300
Water Volume, Gallons	19	22	27	34
Min. GPM (1 Pass)	183	227	273	330
Min. GPM (2 Pass)	92	114	137	165
Min. GPM (3 Pass)	61	76	91	110
Max. GPM (1 Pass)	900	900	1366	1500
Max. GPM (2 Pass)	459	569	683	825
Max. GPM (3 Pass)	306	325	455	550
General Information				
Shipping Wt. Lb.	3272	3781	4598	5186
Operating Wt. Lb.	3571	4157	5078	5745
Approx. Refrig. Charge, Lb. R-22	160	192	240	288

NOTES: (1) See page 29 for 200V, 230V and 575V/3PH/60Hz electrical data
(2) For 400V/3PH/50Hz use 460V/3PH/60Hz electrical data

PHYSICAL SPECIFICATIONS: TWO COMPRESSOR MODELS

WCFX 20 - 36

Unit Model	20ARJ1H1	22ARK1H2	24ARK2J1	27ARL1J2	30ARL2J3	33ARL3K1	36ARM1K2
Nominal Tons	200	220	240	270	300	330	360
Compressors (Qty)	(2) 1210	1210/1212	(2) 1212	1212/1215	(2) 1215	1215/1218	(2) 1218
RPM	3500	3500	3500	3500	3500	3500	3500
Electrical Information	AR-460V	AR-460V	AR-460V	AR-460V	AR-460V	AR-460V	AR-460V
Compressor: RLA, each	96	96/122	122	122/151	151	151/182	182
1st Step Inrush, each	252	252/310	310	310/398	398	398/448	448
LRA, each	652	652/780	780	780/1030	1030	995/1248	1248
Unit: MCA (Min. Circ. Amps)	216	249	275	311	340	379	410
MFS (Max. Allow. Fuse)	300	350	350	450	450	500	600
Evaporator Model	J1	K1	K2	L1	L2	L3	M1
Design Press. Water Side (PSIG)	150	150	150	150	150	150	150
Design Press. Refrig. Side (PSIG)	300	300	300	300	300	300	300
Water Volume, Gallons	38	44	47	57	60	64	75
Min. GPM (1 Pass)	282	309	340	391	434	479	524
Min. GPM (2 Pass)	141	155	170	196	217	240	262
Min. GPM (3 Pass)	94	103	113	130	145	160	175
Max. GPM (1 Pass)	1408	1545	1701	1956	2171	2396	2620
Max. GPM (2 Pass)	704	773	851	978	1086	1198	1310
Max. GPM (3 Pass)	469	515	567	652	724	799	873
Condenser Model	H1	H2	J1	J2	J3	K1	K2
Design Press. Water Side (PSIG)	150	150	150	150	150	150	150
Design Press. Refrig. Side (PSIG)	300	300	300	300	300	300	300
Water Volume, Gallons	44	48	56	61	67	77	82
Min. GPM (1 Pass)	325	361	396	449	504	550	598
Min. GPM (2 Pass)	163	181	198	225	252	275	299
Min. GPM (3 Pass)	108	120	132	150	168	183	199
Max. GPM (1 Pass)	1500	1560	1981	2247	2494	2751	2889
Max. GPM (2 Pass)	812	903	870	960	1080	1376	1495
Max. GPM (3 Pass)	541	602	660	749	779	917	996
General Information							
Shipping Wt. Lb.	6741	6822	7208	8284	9519	9778	10343
Operating Wt. Lb.	7420	7576	8060	9265	10021	10311	10962
Approx. Refrig. Charge, Lb. R-22	320	352	384	432	480	528	576

NOTES: (1) See page 29 for 200V, 230V and 575V/3PH/60Hz electrical data
(2) For 400V/3PH/50Hz use 460V/3PH/60Hz electrical data

PHYSICAL SPECIFICATIONS: THREE COMPRESSOR MODELS

WCFX 39 - 54

Unit Model	39ART2R1	42ART3R2	45ARU1R3	48ARV1T1	51ARV2T2	54ARV3T3
Nominal Tons	390	420	450	480	510	540
Compressors	(2) 1212/1215	1212/(2) 1215	(3) 1215	(2) 1215/1218	1215/(2) 1218	(3) 1218
RPM	3500	3500	3500	3500	3500	3500
Electrical Information	AR-460V	AR-460V	AR-460V	AR-460V	AR-460V	AR-460V
Compressor: RLA, each	122/151	122/151	151	151/182	151/182	182
1st Step Inrush, each	310/398	310/398	398	398/446	398/446	446
LRA, each	780/1030	780/1030	1030	1030/1233	1030/1248	1248
Unit: MCA (Min. Circuit Ampacity)	433	462	491	530	561	592
MFS (Max. Allow. Fuse Size)	500	600	600	700	700	700
Evaporator Model	T2	T3	U1	V1	V2	V3
Design Press. Water Side (PSIG)	150	150	150	150	150	150
Design Press. Refrig. Side (PSIG)	300	300	300	300	300	300
Water Volume, Gallons	77	81	94	106	109	112
Min. GPM (1 Pass)	556	598	657	700	739	773
Min. GPM (2 Pass)	278	299	329	350	370	387
Min. GPM (3 Pass)	185	199	219	233	246	258
Max. GPM (1 Pass)	2777	2914	3285	3500	3696	3863
Max. GPM (2 Pass)	1389	1496	1643	1750	1848	1931
Max. GPM (3 Pass)	926	997	1095	1167	1232	1287
Condenser Model	R1	R2	R3	T1	T2	T3
Design Press. Water Side (PSIG)	150	150	150	150	150	150
Design Press. Refrig. Side (PSIG)	300	300	300	300	300	300
Water Volume, Gallons	92	99	104	116	120	126
Min. GPM (1 Pass)	647	710	756	803	851	899
Min. GPM (2 Pass)	324	355	378	402	426	450
Min. GPM (3 Pass)	216	237	252	268	284	300
Max. GPM (1 Pass)	3237	3548	3777	4016	4254	4493
Max. GPM (2 Pass)	1618	1724	1889	2008	2127	2246
Max. GPM (3 Pass)	1079	1183	1207	1339	1418	1498
General Information						
Shipping Wt. Lb.	11845	12598	13698	14517	14909	15288
Operating Wt. Lb.	12487	13270	14474	15396	15815	16217
Approx. Refrig. Charge, Lb. R-22	624	672	720	768	816	864

NOTES: (1) See page 29 for 200V, 230V and 575V/3PH/60Hz electrical data
(2) For 400V/3PH/50Hz use 460V/3PH/60Hz electrical data

ARI CERTIFICATION

ARI Certification Program

The performance of Dunham-Bush Water-Cooled Rotary Screw Water Chillers has been certified by the Air Conditioning and Refrigeration Institute (ARI).

Full load ratings, part load ratings, and water pressure drop data are regularly tested @ 60 Hz under this program and are certified in accordance with ARI Standard 550/590-98. This provides an independent, third party verification of water chiller performance with a laboratory-grade performance test utilizing instrumentation which has calibration traced to the U.S. National Bureau of Standards.

The ARI Seal of Certification on each and every Dunham-Bush WCFX chiller shows our commitment to quality and to our customer's peace of mind. You know you'll get the industry's standard for efficiency and reliability...and more, when you purchase a Dunham-Bush water chiller.

Computer Performance Ratings

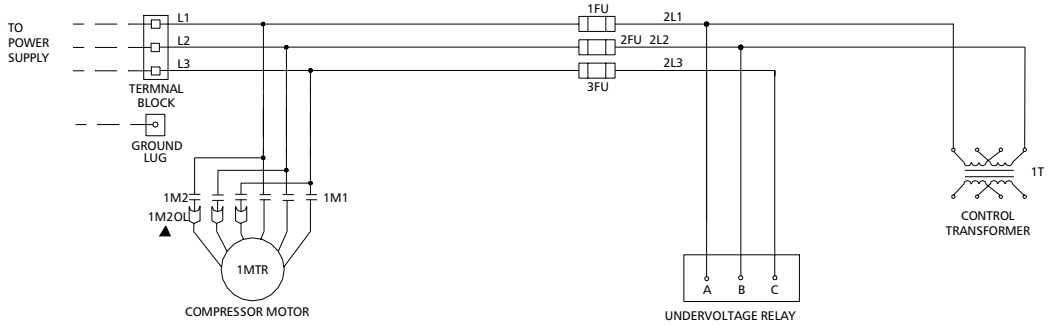
Dunham-Bush WCFX Water-Cooled Rotary Screw Water Chillers are available from 100 to 540 tons. The vast number of combinations of heat exchangers, compressors and motors make it impractical to publish tabular ratings for each combination. A chiller may be custom matched to certain building requirements by your Dunham-Bush Sales Representatives utilizing the **WCFX Computer Selection Program** which has ratings which are certified in accordance with ARI Standard 550/590-98. Data which can be provided to you will include:

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

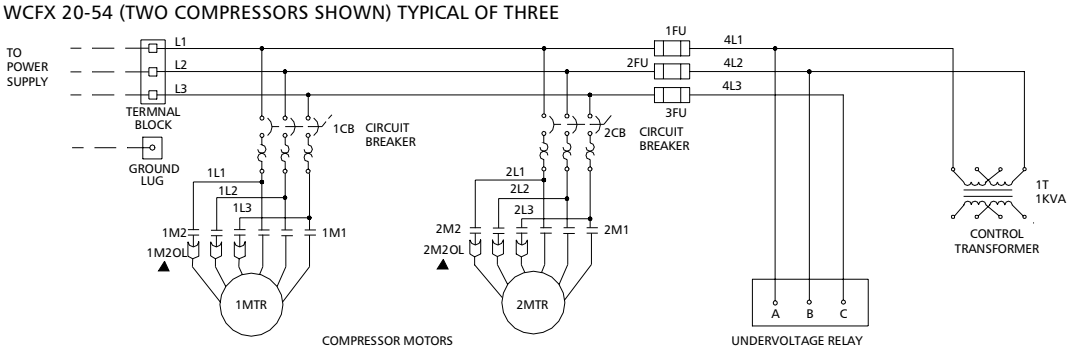
Contact our local Dunham-Bush Sales Representative to discuss what Custom Solutions Dunham-Bush can offer to solve your chiller selection questions.

STANDARD POWER WIRING

WCFX 10-18

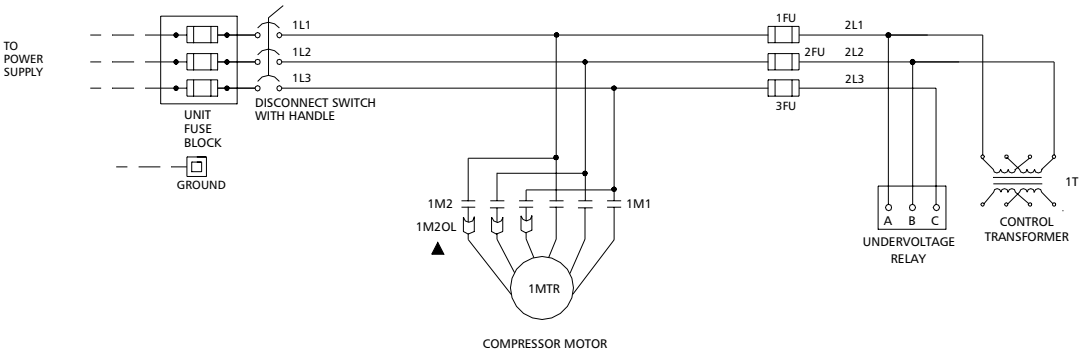


WCFX 20-54 (TWO COMPRESSORS SHOWN) TYPICAL OF THREE

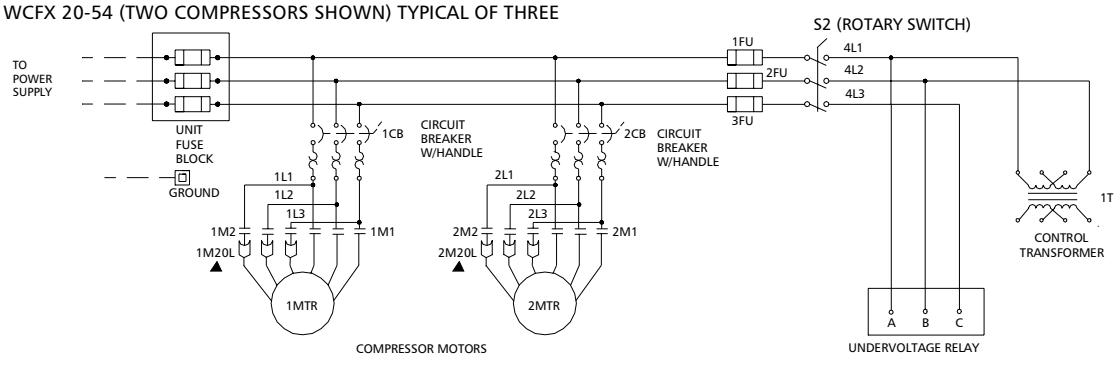


FUSED DISCONNECT OPTION POWER WIRING

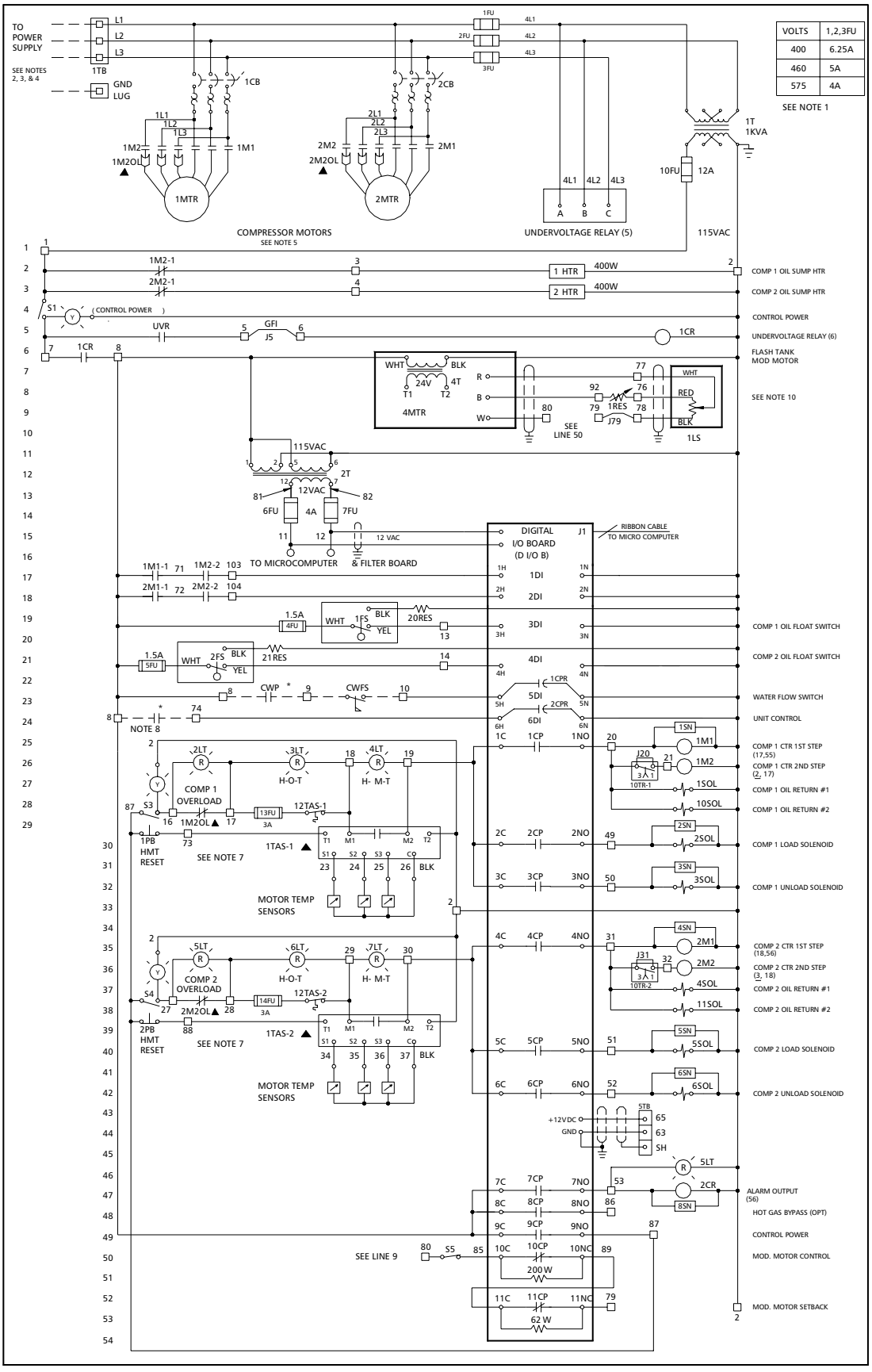
WCFX 10-18



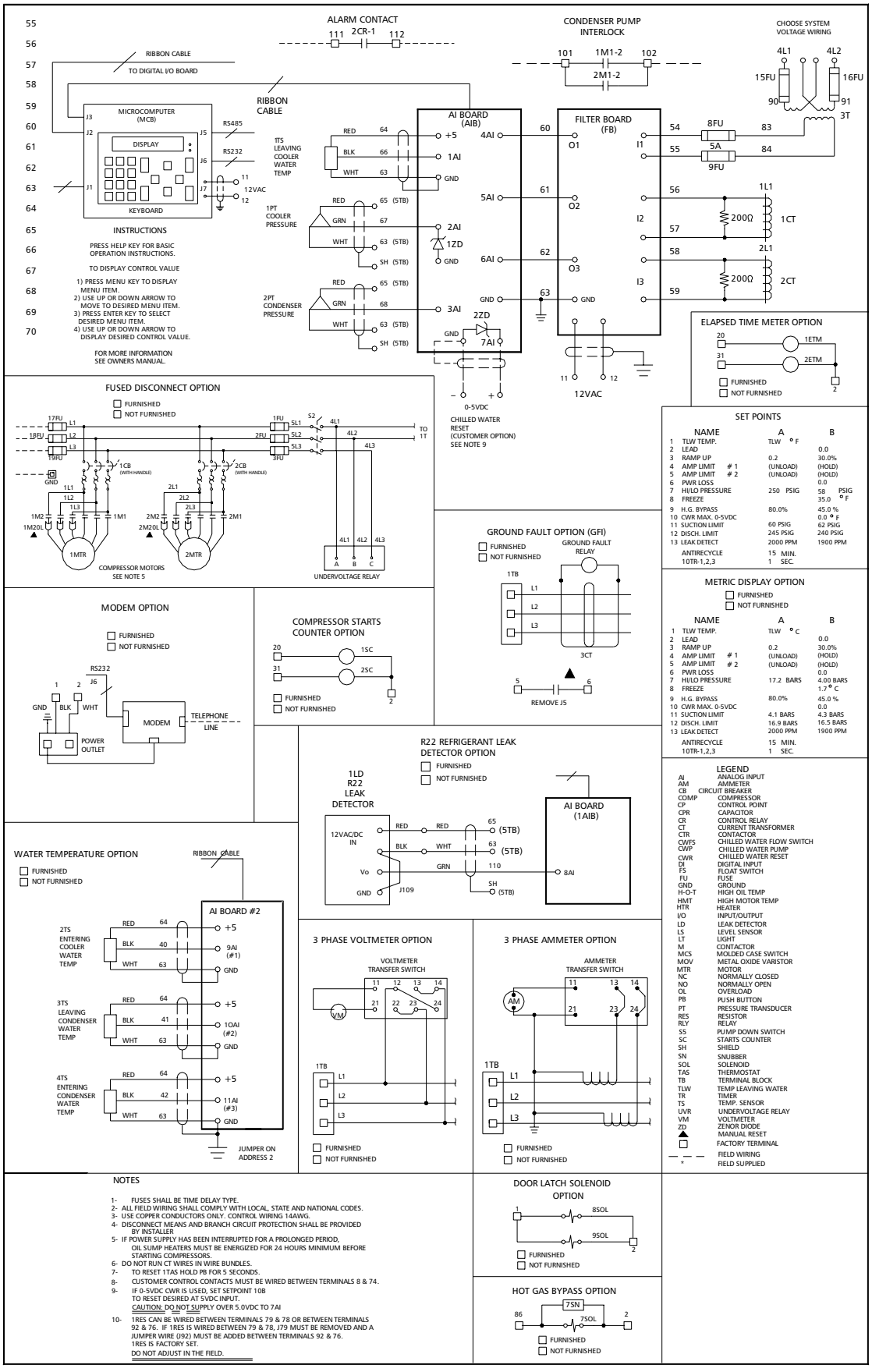
WCFX 20-54 (TWO COMPRESSORS SHOWN) TYPICAL OF THREE



CONTROL POWER WIRING



CONTROL POWER WIRING



ELECTRICAL DATA (60 HZ/3 PH)

Unit Model		Nom. Volts	Unit		Each Compressor		
			MCA	MFS	RLA	INR	LRA
WCFX10	AK	200	283	500	226	580	1420
	AN	230	245	400	196	504	1304
	AS	575	99	175	79	202	480
WCFX12	AK	200	360	600	288	713	1796
	AN	230	313	500	250	620	1562
	AS	575	125	225	100	248	624
WCFX15	AK	200	447	800	357	863	2369
	AN	230	388	600	310	750	2060
	AS	575	155	250	124	300	824
WCFX18	AK	200	535	800	428	1070	2870
	AN	230	465	800	372	930	2495
	AS	575	187	300	149	372	998
WCFX20	AK	200	498	700	221	580	1420
	AN	230	432	600	192	504	1304
	AS	575	174	250	77	202	480
WCFX22	AK	200	573	800	221/281	580/713	1420/1796
	AN	230	497	700	192/244	504/620	1304/1562
	AS	575	200	250	77/98	202/248	480/624
WCFX24	AK	200	633	800	281	713	1796
	AN	230	549	700	244	620	1562
	AS	575	221	300	98	248	624
WCFX27	AK	200	716	1000	281/348	713/863	1796/2369
	AN	230	622	800	244/302	620/750	1562/2000
	AS	575	250	350	98/121	248/300	624/824
WCFX30	AK	200	783	1000	348	863	2369
	AN	230	680	800	302	750	2060
	AS	575	273	350	121	300	824
WCFX33	AK	200	872	1200	348/419	863/1070	2369/2870
	AN	230	757	1000	302/364	750/930	2060/2495
	AS	575	304	400	121/146	300/372	824/998
WCFX36	AK	200	943	1200	419	1070	2870
	AN	230	819	1000	364	930	2495
	AS	575	329	450	146	372	998
WCFX39	AK	200	997	1200	(2)281/348	(2)713/863	(2)1796/2369
	AN	230	866	1000	(2)244/302	(2)620/750	(2)1562/2060
	AS	575	348	450	(2)98/121	(2)248/300	(2)624/824
WCFX42	AK	200	1064	1200	281/348(2)	713/863	1796/2369(2)
	AN	230	924	1200	244/302(2)	620/750(2)	1562/2060(2)
	AS	575	371	450	98/121(2)	248/300(2)	624/824(2)
WCFX45	AK	200	1131	1200	348(3)	863(3)	2369(3)
	AN	230	982	1200	302(3)	750(3)	2060(3)
	AS	575	394	500	121(3)	300(3)	824(3)
WCFX48	AK	200	1220	1600	(2)348/419	(2)863/1070	(2)2369/2870
	AN	230	1059	1200	(2)302/364	(2)750/930	(2)2060/2495
	AS	575	425	500	(2)121/146	(2)300/372	(2) 824/998
WCFX51	AK	200	1291	1600	348/419(2)	863/1070(2)	2369/2870(2)
	AN	230	1121	1200	302/364(2)	750/ 930(2)	2060/2495(2)
	AS	575	450	500	121/146(2)	300/ 372(2)	824/998(2)
WCFX54	AK	200	1362	1600	419(3)	(3)1070	(3)2870
	AN	230	1183	1200	364(3)	(3)930	(3)2495
	AS	575	475	600	146(3)	(3)372	(3)998

NOTES:
- MCA - Minimum Circuit Ampacity
- MFS - Maximum Fuse Size
- RCA - Rated Load Amps at ARI COS
- INR - First Step Inrush Amps
- LRA - Locked Rotor Amps

APPLICATION DATA: HEAT RECOVERY

The Dunham-Bush Rotary Screw Water-Cooled 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 Rotary Screw Water-Cooled 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 must be selected very carefully in order to accomplish a successful installation. They are very susceptible to surge and stall conditions during part-load operation and must be selected to operate in a narrow operating envelope. The heat recovery Dunham-Bush Rotary Screw Water-Cooled Chiller, on the other hand, utilizes a positive displacement compressor which cannot 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 head condition can even be modified in the future without any of the added costs to change gears or impellers that would be required with a centrifugal chiller.

Lower Energy Consumption

The efficient unloading characteristics of the Dunham-Bush Rotary Screw Water-Cooled 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. In addition, no penalty will be paid when operating the Dunham-Bush heat recovery chiller in the cooling mode, unlike a centrifugal which, when selected for the higher heat recovery temperatures will not perform as well at the lower cooling only temperatures.

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 cooler entering condensing water temper-atures 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.

HEAT RECOVERY IS NOT WITHIN THE SCOPE OF THE ARI CERTIFICATION PROGRAM.

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.

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 microcomputer 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.

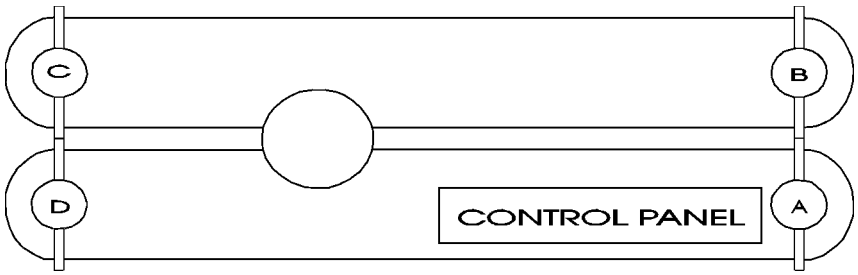
Ice Storage

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 microcomputer. No matter what your ice storage needs, the Dunham-Bush Rotary Screw Water-Cooled Chiller can handle it better than any other chiller. The use of multiple compressors minimizes the amount of horse power 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 water side. 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 microcomputer can control up to three chillers. This eliminates the need for external control interface which often becomes difficult. If more than three chillers need to be controlled, an Equipment Management Center can be supplied for controlling/monitoring up to ten units.

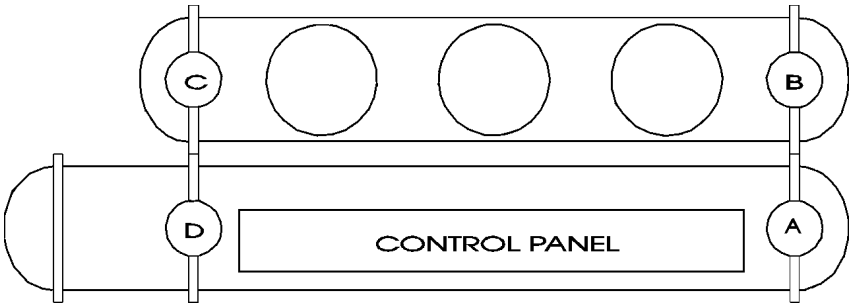
APPLICATION DATA: POINT LOADING



FLOOR LOADING DIAGRAM
WCFX10-18

Point Loading, Lbs. (standard vessels only)*

Unit Model	A	B	C	D
WCFX10ARB1A1	857	260	1525	930
WCFX12ARC1A2	1000	386	1700	1072
WCFX15ARD1B1	1229	338	2191	1322
WCFX18ARD2C1	1404	431	2412	1499



FLOOR LOADING DIAGRAM
WCFX20-54

Point Loading, Lbs. (standard vessels only)*

Unit Model	A	B	C	D
WCFX20ARJ1H1	1380	2149	2497	1393
WCFX22ARK1H2	1491	2116	2479	1505
WCFX24ARK2J1	1603	2205	2634	1618
WCFX27ARL1J2	1864	2581	2944	1876
WCFX30ARL2J3	2011	2717	3263	2030
WCFX33A4L3K1	2015	2868	3397	2032
WCFX36ARM1K2	2201	2974	3567	2220
WCFX39ART2R1	2520	3446	3985	2537
WCFX42ART3R2	2676	3644	4256	2695
WCFX45ARU1R3	2922	3841	4763	2948
WCFX48ARV1T1	3212	4000	4944	3239
WCFX51ARV2T2	3312	4091	5073	3339
WCFX54ARV3T3	3408	4147	5223	3438

NOTE: Refer to dimensional drawings for location of mounting points.

*Weights include a 15% allowance (weight increase) over calculated weight.

STANDARD EQUIPMENT

Dunham-Bush Rotary Screw Water-Cooled 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:

- Two year warranty on compressor(s) and parts.
- Unit mounted and wired reduced inrush starting system
- Factory mounted and wired control power transformer
- Single point electrical power connection
- Undervoltage phase failure relay
- Microprocessor monitoring of cooler leaving water temperature
- Microprocessor monitoring of suction & discharge pressures
- Microprocessor monitoring of power supply volts
- Microprocessor monitoring of single phase amps for each compressor
- Microprocessor 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, high motor 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. Single compressor units have a discharge service valve in lieu of a check valve.

OPTIONS

Dunham-Bush offers many Factory Installed and Tested Options for "custom solutions" to everyday owner and operator special requirements:

Flanged Water Connections (FWC)—for the cooler and condenser inlet and outlet.

Systems International Display (SID)—provides microcomputer controller information displayed in SI Units. The microcomputer controller display defaults to English Units unless the computer is set up for SI units.

Un-Charged Unit (UNC)—for shipping units without the refrigerant charge. The chiller will be built and tested and the refrigerant removed after testing.

Electric Panel Door Latch Solenoid (CPS)—to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The *control panel* can be accessed with a key-lock override actuated switch.

Cooler Insulation Single Layer (CISL) or (CIR)—for factory installed single layer of 3/4 inch closed cell insulation.

Cooler Insulation Double Layer (CIDL) or (CIR Dbl. Layer)—for factory installed double layer of 3/4 inch closed cell insulation.

Ground Fault Interrupt Relay (GFI)—that takes the unit off the line if a ground fault is detected.

Hot Gas Bypass (HGB)—for very low load situations when the load is less than the minimum capacity of the chiller.

Isolation Valves (ISO)—for suction and Vapor Injection port only.

Volt Meter (VM3)—provides volt meter mounted in the control box door with selector switches to allow readings of each power phase.

Amp Meter (AM3)—provides amp meter mounted in the control box door with selector switches to allow readings of each power phase.

Remote Monitoring Modem (MOD)—for long distance communication, allows the system to be monitored, retrieve logs, and assist with investigating potential problems quickly and in a cost effective manner from a remote source.

OPTIONS (CONT.)

Cooler Return Water plus Condenser Entering and Leaving Temperature Monitoring (4TS)—microcomputer monitoring of three **extra** temperature sensors, mounted and wired, for monitoring of all water temperatures.

Sound Blanket (SBL)—for Compressor ONLY.

Unit Fusing with Individual Disconnects for each Compressor and Control Circuit (FDS)—for 460/3/60, 575/3/60 and 400/3/50 voltage units disconnect handles through the door of the control box.

Semi-Hermetic Flanged Compressor (FLG)—provides some serviceability plus sound reduction.

R22 Refrigerant Sensor (REFS)—is an R22 sensor that senses R22 in the equipment room between the chiller vessels and reports this information to the unit microcomputer controller.

SPECIAL NON-STANDARD OPTIONS

Mounted and wired at the factory:

Under and Over Voltage and Phase Protection Relay (UVR2)—protects against high and low incoming voltage conditions sa well as single phasing, phase reversal and phase imbalance by opening the control circuit. The UVR2 is an automatic reset device, but the unit microcomputer controller can be set up for manual reset to prevent unwanted restarts.

Alarm Bell (BEL2)—mounted and wired to indicate a common alarm fault.

Chiller*LINK* (CHLK)—for communication with (BMS) building management systems through BacNet or Modbus. See Chiller*LINK* Data Acquisition Form SD202-22203.

Condenser Water Control (CWC)—provides an analog output that can be used to control condenser water flow. The 0-5VDC or 0-10VDC signal increases as discharge presure rises above a setpoint (TYP > 160 psig). This should produce an increase in condenser water flow.

Shipping and Handling Skid (SKID)—for special handling arrangements where rigging is not available.

Dual Mode (DMOD)—for operating the chiller with thermal storage Ice-Cel plus Air Conditioning Duty Modes.

ACCESSORIES

Accessories ship loose for field installation:

Water Flow Switch (WFS)—field mounted and wired paddle type, field adjustable, flow switch available for use in the cooler or condenser fluid piping circuit. /The water flow switch is a safety to help prevent cooler freeze ups and needs to be tied into the unit safety circuit to provide fluid flow before the unit can operate.

Neoprene Pads (ISP)—to be used under the unit for sound isolation from the mounting.

Spring Vibration Isolators (SPG)—designed for 1" deflection, with a neoprene friction pad on the bottom to help prevent sound passing into the unit mounting structure. Spring vibration isolators are more suitable on critical sound sensitive applications than Rubber-in-Shear (RIS) Isolators.

Alarm Bell (BEL1)—is a shipped loose bell to be mounted remote of the unit and wired to the unit ALC common alarm contacts in the unit, by the contractor.

Remote Monitor Display Terminal (RMDT)—provides remote monitoring and enable/disabling of the unit control plus reading of all microcomputer screens.

GUIDE SPECIFICATIONS

Part 1: General

1.01 Work Included

A. Provide a complete Water Cooled Packaged Chiller utilizing rotary screw compressors suitable for indoor installation and be controlled by a Full Function Microcomputer Controller. Contractor shall furnish and install chillers as shown and scheduled on the drawings. Units shall be installed in accordance with this specification.

B. Chillers shall be selected for use with water / (___% ethylene or propylene glycol).

1.02 Quality Assurance

A. Unit construction shall be designed to conform to ANSI / ASHRAE 15 latest version safety standards, NEC (USA), and ASME Section VIII Division I (USA) applicable codes.

B. Unit shall have ETL (USA) and cETL (Canadian) approval (60Hz)

C. The unit shall comply with all local codes.

D. The unit shall be rated in accordance with ARI Standard 550/590 latest version.

E. The unit shall be fully tested at the factory with all options mounted and wired on low voltage units.

1.03 Design Base

A. The construction drawings indicate a system based on a selected manufacturer of equipment and the design data available to the Engineer during construction document preparation. Electrical services, size, configuration and space allocations are consistent with that manufacturer's recommendations and requirements.

B. Other listed or approved manufacturers are encouraged to provide equipment on this project; however, it shall be the Contractor and/or Supplier's responsibility to assure the equipment is consistent with the design base. No compensation will be approved for revisions required by the design base or other manufacturers for any different services, space, clearances, etc.

1.04 Related Work Specified Elsewhere

A. General Provisions: Section 15XXX

B. General Completion and Startup: Section 15XXX

C. Equipment & Pipe Identification: Section 15XXX

D. Tests: Section 15XXX

E. Vibration Isolation: Section 15XXX

F. Chilled Water System: Section 15XXX

1.05 Submittals

A. Submit shop drawings on each piece of equipment specified in accordance with Specifications Section 15010, General Provisions.

B. Furnish three (3) sets of Operations and Maintenance Data.

C. Furnish one (1) copy of submittal for each chiller unit to the Temperature Control Contractor.

1.06 Delivery and Handling

A. The unit shall be delivered to the job site completely assembled and charged with refrigerant and oil by the manufacturer.

B. Delivery and handling shall comply with the manufacturer's instruction for rigging and handling.

C. The unit controls shall be capable of withstanding 130°F (54.4C) storage temperature in the control panel for an indefinite period of time.

1.07 Start-Up

A. The contractor shall provide labor to accomplish the check, test and start-up procedure as recommended by the unit manufacturer.

B. The start-up serviceman shall provide and complete the manufacturers check, test and start forms. One copy shall be sent to the engineer and one copy to the manufacturer's factory.

C. The unit manufacturer shall provide a factory-trained serviceman to supervise the original start-up of the units for final operation.

1.08 Warranty

A. The equipment supplier shall provide a warranty on the entire refrigeration system, **exclusive of refrigerant**, for a period of two (2) years from date of start-up or 30 months from date of shipment, whichever occurs first. **The compressors shall have a two (2) year limited warranty** from date of start-up or 30 months from date of shipment, whichever occurs first.

B. (Provide an optional extended three-(3) year warranty on the compressors only, 5 years total).

C. The start-up date shall be certified by the Mechanical Contractor, and provided to the Manufacturer, Engineer and Owner.

D. (During the warranty period, the equipment supplier shall furnish the services of an authorized service agency for all labor associated with parts replacement or repair, and start-up of the refrigeration equipment at the beginning of each cooling season. The equipment supplier shall also furnish the services of an authorized service agent for one maintenance visit during winter months of operation; the Owner shall designate such time.)

1.09 Maintenance

Maintenance of the chillers shall be the responsibility of the owner and performed in accordance with the manufacturer's instructions.

Part 2: Products

2.01 Water Cooled Rotary Screw Water Chillers

2.02 Acceptable Manufacturers

A. Dunham-Bush, Inc.
B. (Approved equal)

2.03 General

A. Furnish and install as shown on the plans and specifications, a Dunham-Bush Inc. water-cooled packaged chiller, Model WCFX____ B. The unit is to be a completely assembled package consisting of positive displacement, hermetic, helical-axial, twin rotor, direct-drive screw compressors, cooler, condenser, external oil separator on R-134a units, internal separator on R-22 units. Unit starter mounted and wired to the microcomputer control center. .
B. The packaged chiller shall be factory assembled, and charged with a full charge of R____ and oil. The unit shall be given a factory functional test run and shipped with the full operating charge of refrigerant and oil.
C. The units shall be built in accordance with all applicable national and local codes including the ANSI safety code; the National Electrical Code and applicable ASME Code for Unfired Pressure Vessels.

2.04 Performance

The unit capacity shall not be less than shown on the capacity schedules and drawings. Unit performance shall be rated in accordance with ARI Standard 550/590, latest revision.

2.05 Construction

The unit construction shall be of a "Structural Vessel Design" where the shells form a structural base permitting rigging, handling and installation without additional structural steel. The compressors, oil, piping, and electrical control center shall all be mounted on the structural vessel base. The unit base foot mounts will be welded to the vessel tube sheets. The compressor base will be welded to the structural vessel base. The unit control center, shall be constructed of 16 gauge enclosure with 14 gauge galvanized steel doors. The entire assembly shall be painted to resist corrosion. Electrical enclosures shall be finished with a baked powder high grade outdoor quality coating system which exceeds 500 hour salt spray requirements when tested in accordance with the ASTM-B-117 specifications.

Cooler

The cooler shall be flooded type, with refrigerant in the shell and fluid in the tubes, cleanable shell and tube type vessel. The shell and tubesheets shall be fabricated and machined from carbon steel. Removable heads shall be supplied for cleaning and servicing of cooler tubes. Vent and drain plugs shall be provided in each head. Tubes shall be enhanced inner and outer surface seamless copper, mechanically expanded into the heavy carbon steel tubesheets. Base performance on fluid velocity not less than 3 feet per second (fps) (0.9144 m/s) nor more than 12 fps (3.658 m/s), and a fouling factor of 0.0001 hr•ft²°F/BTU (0.018 M²•°C/kW). The flooded cooler 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. The cooler shall be fitted with an oil recovery system. The oil recovery system will ensure the cooler operates at peak efficiency at all times and shall provide optimal energy efficiency during extended periods of part load operation. The coolers shall be available in one, two or three pass design as indicated on the drawings with Victaulic (or optional flanged connections) fluid connections. Stub-out connections will not be acceptable. The shell side of the cooler is to be equipped with a single pressure relief device. Coolers shall be designed, constructed, stamped and inspected to comply with latest edition ASME code for unfired pressure vessels. Refrigerant shell side design working pressure shall be minimum 300 psig (2069 kPa). The tube side fluid design working pressure shall be minimum 150 psig (1034 kPa).

(The cooler shall be insulated with a single or double layer (Cooler Double Layer Insulation) of ¾" thick closed-cell urethane insulation with a .28 K factor at 75°F mean temperature.)

2.07 Oil System

The compressors shall be lubricated by means of differential pressure with an oil recovery system. An oil filter with replaceable core filter shall be provided to filter 100% of the oil supplied to the compressors. The flooded cooler is to be supplied with an oil recovery and equalization system on multiple compressor models that will ensure the cooler will operate at peak efficiency at all times, including extended periods of part load operation.

2.08 Condenser

The condenser shell shall be fabricated from carbon steel with welded tubesheets, machined from heavy carbon steel. Tubes shall be enhanced inner and outer surface seamless copper, mechanically expanded into the heavy carbon steel tubesheets. Removable heads shall be supplied for cleaning and servicing of condenser tubes. Vent and drain plugs shall be provided in each head. They shall be available in two or three pass configuration as required on the schedule or drawings with victaulic (or optional flanged connections) fluid connections. Base performance on fluid velocity shall not be less than 3 feet per second (fps) (0.9144 m/s) nor more than 12 fps (3.658 m/s) and a fouling factor of 0.00025 hr•ft2•°F/BTU (0.044 M2•°C/kW). The chiller shall be selected to operate satisfactorily at entering condenser fluid temperature down to 60°F (15.6°C) providing head pressure control is maintained, by modulating the condenser water flow. The contractor shall pipe the connections with mechanically grooved elbows that enable the head and elbow to be removed, for service and rodding of the condenser tubes, without disturbing any piping. The shell side of the condenser shall have dual relief valves with by-pass valve and provision for refrigerant recovery on multiple compressor models with single relief valves on single compressor models. The condenser shall be sized for full pump-down capacity. If the condenser cannot store the entire refrigerant charge, the contractor shall furnish an approved refrigerant recovery unit and an adequate quantity of DOT approved cylinders to store the entire charge.

Condensers shall be designed, constructed, stamped and inspected to comply with latest edition ASME code for unfired pressure vessels. Refrigerant shell side design working pressure shall be minimum 300 PSIG (2069 kPa) and fluid tube side design working pressure shall be minimum 150 PSIG (1034 kPa).

2.09 Compressor

A. Provide single or multiple single-stage direct connected positive displacement rotary screw compressors as required, driven by a 3500-RPM motor. Each compressor shall include an integral oil separation system (with external separation on R-134a) and oil sump. The oil temperature shall be controlled during operation to maintain proper oil temperatures throughout the lubrication system. An electric oil heater shall be supplied with each compressor to maintain oil temperatures during shutdown period. Each multiple compressor model shall have a suction check valve, suction filter and a discharge check valve. Single compressor models shall have a discharge service and suction service valve, suction check valve and suction filter. (In addition, each multiple compressor model shall be furnished with suction service valves and vapor injection service valves permitting isolation of the complete refrigeration charge in either the cooler or condenser.) Compressor capacity control shall be obtained by an electrically initiated, hydraulically actuated slide valve within each compressor housing.

B. The compressor shall have a standard **TWO YEAR LIMITED WARRANTY**.

2.10 Capacity Control

A. An infinitely variable capacity control system that is capable of matching the demand requirement of the system.

B. A microcomputer-based controller shall modulate a compressor slide valve, in response to supply water temperature and its rate of change to maintain water temperature within ½°F of set point. This system is to provide precise and stable control of supply water temperature over the complete range of operating conditions. It shall be capable of a system capacity control range of 100% to 15% at specified conditions, on multiple compressor units, 25% on single compressor units. (Provide hot gas bypass to provide capacity control to 10% of the unit capability).

2.11 Refrigerant Control System

The packaged chiller shall use a positive pressure refrigerant that will not require a purge system.

The refrigerant control system, by means of a liquid level float assembly, shall measure the level of liquid refrigerant in the flooded cooler and restrict refrigerant flow entering the cooler upon a rise in the level, helping to prevent liquid carry over and possible compressor liquid slugging. **Fixed orifice control systems are not acceptable.**

2.12 Control Center

A. Control Center shall be NEMA 1 fully enclosed, control panel with hinged access doors. Dual compartments, separating the safety and operating controls from the power controls, are to be provided. Controls shall include:

1. Compressor solid state, thermal sensing overloads, manual reset
2. Low water temperature freeze protection manual reset

3. Phase failure, low voltage and phase reversal protection
4. Power terminal block
5. Control transformer
6. Compressor contactors
7. Circuit breakers on each compressor circuit on multiple compressor units.
8. Microprocessor based controller and factory installed sensor
9. Anti-cycle protection
10. Complete labeling of all control components
11. Numbered wiring and terminal strips for wire tracing

B. The control center's microcomputer shall provide compressor staging based on leaving water temperature, and maintain equal loading of the compressors throughout the full range of operation.
It shall have a two line 80 character display and input shall be through a 20-character touch pad Keyboard through menu-driven prompts. It shall be proactive in control and accommodate system anomalies such as high condenser water temperature and temperature inversions by altering loading and refrigerant flow to keep the unit on line but at reduced capacity until the fault is fixed.

C. Reduced inrush incremental starting system for each compressor.

D. Operating and safety lights visible from the unit exterior including:
Power on
High motor temperature
Compressor high oil temperature
Compressor motor overload
High/low pressure, low oil and freeze safeties

E. Fifteen (15) minute anticycle timer

F. (Ground fault interrupter)

G. Microcomputer: Individual chiller controller shall provide for:

1. Unit control:
   a. Loading and unloading of the compressor based on leaving water temperature
   b. Seven-day time clock with schedules for machine control
   c. Proactive control to unload the compressors based on high pressure, low pressure, and high amp draw to reduce nuisance trips
   d. Compressor staging and balancing
   e. (Control of hot gas bypass circuit)
   f. Dry contact for condenser pump interlocks
   g. Terminals for customer enable/disable of unit
   h. Lead\lag compressor status
   i. Dry contact for unit alarm

2. Unit Protection:
   a. Low refrigerant suction pressure
   b. High refrigerant discharge pressure
   c. Automatic restart from power outage
   d. Cooler freeze protection
   e. Compressor current limiting
   f. Anti-recycling protection
   g. Sensor error
   h. Condenser water flow loss
   i. High motor temperature protection
   j. Low oil level
   k. Over current protection
   l. Undervoltage, phase loss and phase reversal relay (over voltage)
   m. Ramp control for timed unit loading when the return water temperature is 5°F above leaving water set point
   n. Over current protection
   o. Overload protection

3. Microcomputer - Readouts shall provide the following:
   a. Compressor run time and cycles
   b. Leaving liquid temperature
   c. Compressor motor ampere draw
   d. Suction pressure
   e. Discharge pressure
   f. Unit control contacts

g. Chilled water flow switch
h. Chilled water reset
i. Digital Outputs
j. Compressor control status
k. Unloader control status
l. Alarm control status
m. Control power status
n. (Condenser water flow indication)
o. Utility demand limit

4. Microcomputer - Set-points shall provide the following:
a. High discharge pressure
b. Low suction pressure
c. Freeze protection temperature
d. Leaving cooler fluid temperature
e. Low suction unload
f. High discharge unload
g. High compressor motor amperes
h. Chilled water reset
i. Demand limit reset

5. Microcomputer - Alarm History shall provide the following:
a. The 8 most recent alarms can be displayed
b. Low suction pressure
c. High discharge pressure
d. Freeze protection cutout
e. No run
f. Loss of cooler fluid flow
g. Power failure
h. Temperature sensor error
i. Low oil level
j. (Refrigerant leak detector)
k. Pressure sensor error
l. Compressor start fault
m. Compressor slide valve error

6. Microcomputer Remote Monitoring Capabilities:

a. Telephone Modem (option):
The microcomputer is complete with an RS232 communications port and all hardware and software necessary to remotely monitor and control the packaged chiller through the optional phone modem. A dedicated phone line is required.

b. Remote Monitor Display Terminal (option):
The Remote Monitor Display Terminal is supplied with a 14" monitor, two (2) RS232 serial ports, 6 foot 115 volt power cord and an enhanced PC keyboard. The RMDT can be hard wired up to 50 feet away from the chiller for remote monitoring and operating of the one or multiple units.
This option allows remote start-stop, chilled water set-point changes, and reading of all microcomputer screens including operating condition, faults, and fault history.

c. BMS - Building Management System Terminal:
A BMS (Building Management System) may interface with the chiller microcomputer and provide the same level of monitoring and operating control as above, when the BMS company has implemented the communications protocol. Dunham-Bush has an open communications protocol policy with most BMS companies.

d. (Chiller*LINK* {CHLK option}):
The Chiller*LINK* shall be supplied for communication from the Chiller to the BMS System through BACnet or MODBUS communicating protocol)

2.13 Additional Equipment

A. (Alarm Bell mounted and wired to indicate a common alarm fault).
(Electric Panel Door Latch Solenoid to provide the safety and security required by local codes. Main power must be disconnected to gain entry to the power and control electrical panels. The control panel can be accessed with a key-lock actuated override switch).

B. (ChillerLINK Communication Module for communication with (BMS) building management systems through BacNet or Modbus communication protocol).

C. (Systems International Display provides microcomputer controller information displayed in SI units, temperature in °C and pressure in BARS).
D. (Refrigerant Sensor, mounted on the unit between the cooler and condenser, senses leak in the equipment room and reports this information to the unit microcomputer controller).
E. (Water Temperature Monitoring for entering and leaving water temperatures for both the cooler and condenser fluids).
F. (Condenser Water Control provides analog output that can be used to control condenser water flow. The 0-5VDC or 0-10VDC signal increases as discharge pressure rises above a setpoint (TYP 160 psig). This should produce an increase in the condenser water flow.)
G. (Hot gas bypass valve to permit operation down to 10% of unit capability).
H. (Shipping Less Refrigerant to enable shipping by means that do not allow shipping with refrigerant charges installed in the unit. The chiller must be built and tested and the refrigerant removed after testing.)
I. (Cooler Single Layer Insulation for factory installed ¾ inch layer of closed cell cooler insulation).
J. (Cooler Double Layer Insulation for factory installed two ¾ inch layers of closed cell cooler insulation).
K. (Flow Switch shipped loose for field mounting and wiring).
L. (Vibration Isolators shipped loose: spring or rubber-in-shear).
M. (Alarm Bell shipped loose to be mounted remote of the chiller and wired to the common alarm contacts by the contractor).
N. (Remote Monitor Display Terminal to provide remote monitoring and enabling/disabling of the unit control plus reading of all microcomputer screens).

Part 3: Execution

3.01 Installation Work By Mechanical Contractor

A. Install on a flat surface level within 1/16 inch per foot and of sufficient strength to support concentrated loading. Place vibration isolators under the unit.
B. Assemble and install all components furnished loose by manufacturer as recommended by the manufacturer's literature.
C. Complete all water and electrical connections so units water circuits and electrical circuits are serviceable.
D. Provide and install valves in water piping upstream and downstream of the cooler water connections to provide means of isolating cooler and condenser for maintenance and to balance and trim system.
E. Provide soft sound and vibration eliminator connections to the cooler and condenser water inlet and outlet as well as electrical connections to the unit.
F. Interlock chillers through a flow switch in the chilled water line to the chilled water pump to ensure the unit can operate only when water flow is established.
G. Furnish and install taps for thermometers and pressure gauges in water piping adjacent to inlet and outlet connections of the cooler and condenser.
H. Provide and install drain valves with capped hose ends to each cooler and condenser head drain fitting.
I. Install vent cocks to each cooler and condenser head vent fitting.

3.02 Work By Temperature Control Contractor

A. Furnish interlock wiring per manufacturer's recommendations and install loose control components furnished by chiller manufacturer.

3.03 Work By Electrical Contractor

A. Furnish power wiring to chiller control panel and obtain required code approval.
B. Furnish and install approved disconnect switch.

End of Section

DUNHAM-BUSH®
101 Burgess Road, Harrisonburg, VA 22801
Phone: 540-434-0711 FAX: 540-432-6690
www.dunham-bush.com