Form No: MM04100A-0914

DUNHAM-BUSH

Products that perform...By people who care

INSTALLATION, OPERATION & MAINTENANCE MANUAL

VARIABLE SPEED WATER COOLED ROTARY SCREW CHILLERS

MODEL:

WCFX-V Series

50Hz 60Hz

R134a

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

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INTRODUCTION

This manual is designed to provide essential information for installation, operation and maintenance of Dunham-Bush medium screw compressor flooded water cooled package chiller(s).

Dunham-Bush equipments are manufactured under careful quality control and performance pretested at specific filed operating conditions to ensure reliability and performance.

When Installed, operated and maintained with care and attention, your investment will give many years of satisfactory service. It is assumed that the user(s) of this manual is(are) experienced and qualified air conditioning equipment personnel and have read this manual and fully understood the contents before commencing with installation / operating or maintenance work on the equipment.

SAFETY CONSIDERATION & PERSONAL PROTECTIVE EQUIPMENT (PPE)

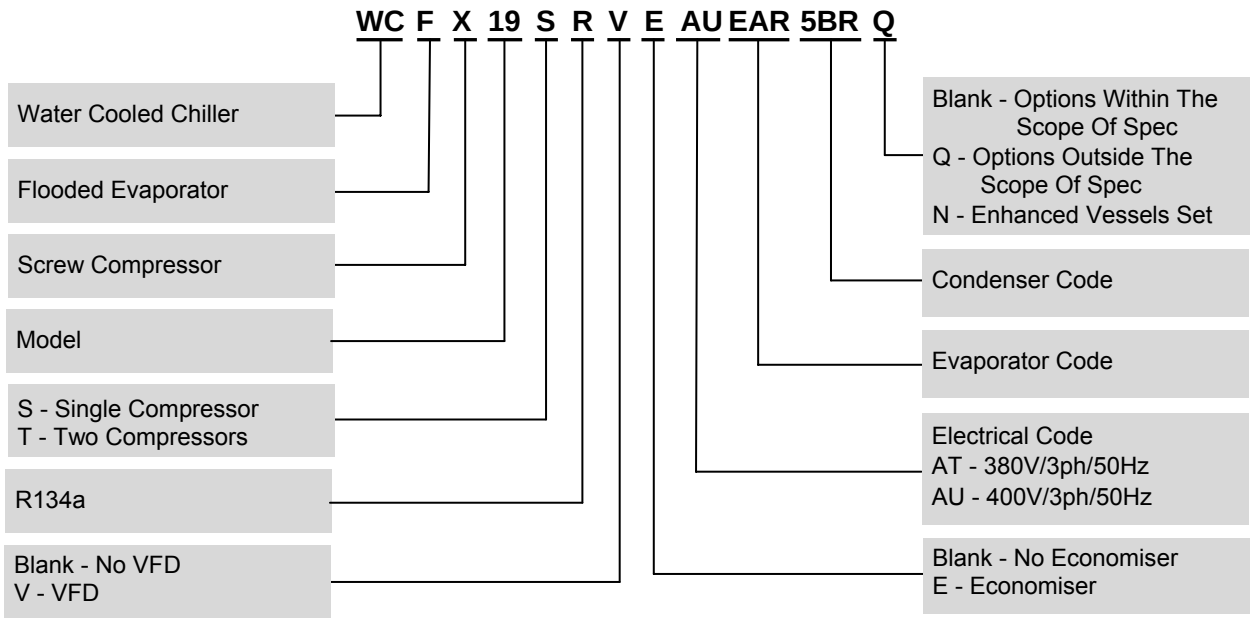
When working with chiller(s) there is always a risk of exposure to electrical / mechanical or chemical hazards during installation and service work.

The right Personal Protective Equipment (PPE) should always be used during installation, repair or service work. Reference should be made to appropriate *Material Safety Data Sheets* (MSDS) and *Occupational Safety and Health* Administration *(*OSHA) guidelines for PPE.

Refrigerant are classified as hazardous chemical, reference should be made to MSDS and OSHA guidelines for proper PPE when handling refrigerant. Refrigerant should be handle, reclaimed, recovered and recycled in accordance to *The Federal Clean Air Act*.

Personal safety and the safety of others should never be compromised. Failure to follow recommendations could result in death or serious injuries.

NOMENCLATURE



INTRODUCTION

PHYSICAL SPECIFICATIONS

Model WCFX-V	19S	20S	23S	24S	27S	30S	36S	38T	40T	41S
Nominal Capacity TR [kW]	132.8 [467.1]	163.9 [576.4]	186.3 [655.2]	201.7 [709.4]	220.4 [775.1]	248.5 [874.0]	292.2 [1027.7]	270.3 [950.6]	329.9 [1160.3]	332.1 [1168.0]
Nominal Power Input kW	79.6	97.1	107.9	118.9	127.5	147.4	168.0	155.7	191.5	190.2
Energy efficiency kW/TR	0.599	0.592	0.579	0.589	0.578	0.593	0.575	0.576	0.580	0.573
COP	5.87	5.94	6.07	5.97	6.08	5.93	6.12	6.11	6.06	6.14
Voltage V/PH/Hz	380-415/3/50 or 460/3/60									
Compressor										
Model (Qty)	1220(1)	1222(1)	1222(1)	1227(1)	1227(1)	1230(1)	2233(1)	1220(2)	1222(2)	2236 (1)
Evaporator										
Model	FAR	EAR	JAR	JBR	6DR	6ER	7CR	6CR	8BR	7BR
Water Connection Inch [mm]	8 [203.2]	6 [152.4]	8 [203.2]	8 [203.2]	8 [203.2]	8 [203.2]	8 [203.2]	8 [203.2]	10 [254.0]	10 [254.0]
Design Press. Water Side psig [kPa]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]
Flowrate USgpm [m^3/h]	317.0 [72.0]	391.0 [88.8]	443.3 [100.6]	482.4 [109.5]	525.7 [119.3]	591.5 [134.3]	697.5 [158.3]	644.2 [146.2]	787.1 [178.7]	791.4 [179.6]
Pressure Drop psig [kPa]	1.8 [12.4]	4.0 [27.6]	4.1 [28.3]	4.2 [29.0]	3.6 [24.8]	4.1 [28.3]	4.3 [29.6]	4.7 [32.4]	4.3 [29.6]	4.4 [30.3]
Condenser										
Model	D2R	5BR	5BR	5CR	6CR	1KR	RAR	K5R	M3R	M1R
Water Connection Inch [mm]	6 [152.4]	6 [152.4]	6 [152.4]	6 [152.4]	6 [152.4]	8 [203.2]	8 [203.2]	8 [203.2]	10 [254.0]	10 [254.0]
Design Press. Water Side psig [kPa]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]
Flow Rate USgpm [m^3/h]	373.5 [84.8]	460.2 [104.5]	521.4 [118.4]	565.9 [128.5]	616.6 [140.0]	697.7 [158.4]	816.9 [185.4]	755.8 [171.6]	923.6 [209.7]	927.9 [210.6]
Pressure Drop psig [kPa]	3.0 [20.7]	4.1 [28.3]	5.0 [34.5]	4.4 [30.3]	4.7 [32.4]	4.5 [31.0]	4.8 [33.1]	5.8 [40.0]	5.4 [37.2]	4.6 [31.7]
General										
Unit Length Inch [mm]	132 3/16 [3358]	164 3/16 [4171]	164 3/16 [4171]	164 3/16 [4171]	164 3/16 [4171]	164 3/16 [4171]	174 3/16 [4425]	196 12/16 [4997]	196 12/16 [4997]	174 3/16 [4425]
Unit Width Inch [mm]	70 [1778]	70 [1778]	70 [1778]	70 [1778]	70 [1778]	70 [1778]	70 [1778]	75 [1905]	80 [2032]	70 [1778]
Unit Height Inch [mm]	73 [1854]	72 [1829]	73 [1854]	73 [1854]	75 [1905]	79 15/16 [2031]	92 [2337]	82 [2083]	87 15/16 [2234]	94 [2388]
Unit Shipping Weight lbs [kg]	8576 [3894]	10497 [4766]	10915 [4955]	11326 [5142]	11962 [5431]	13075 [5936]	15205 [6903]	14103 [6403]	17414 [7906]	16180 [7346]
Unit Operating Weight lbs [kg]	9370 [4254]	11173 [5073]	11631 [5280]	12118 [5502]	12833 [5826]	14052 [6380]	16473 [7479]	15393 [6988]	18673 [8478]	17633 [8005]
R134a Charge (Approx)lbs [kg]	419 [190]	529 [240]	558 [253]	584 [265]	705 [320]	750 [341]	981 [445]	882 [400]	1014 [460]	1102 [500]

Model WCFX-V	46S	46T	50T	54T	57T	60T	73T	75T	81T	90T
Nominal Capacity TR [kW]	375.8 [1321.7]	375.1 [1319.2]	409.4 [1439.9]	444.2 [1562.3]	474.1 [1667.4]	503.7 [1771.5]	582.1 [2047.2]	621.8 [2186.9]	665.0 [2338.8]	747.0 [2627.2]
Nominal Power Input kW	212.2	213.4	232.7	252.5	270.7	288.8	337.8	359.7	381.3	430.2
Energy efficiency kW/TR	0.565	0.569	0.568	0.568	0.571	0.573	0.580	0.578	0.573	0.576
COP	6.23	6.18	6.19	6.19	6.16	6.13	6.06	6.08	6.13	6.11
Voltage V/PH/Hz	380-415/3/50 or 460/3/60									
Compressor										
Model (Qty)	2246 (1)	1222 (2)	1222 (1) 1227 (1)	1227 (2)	1227 (1) 1230 (1)	1230 (2)	2233 (2)	2233 (1) 2236 (1)	2236 (2)	2246 (2)
Evaporator										
Model	8DR	8DR	KBR	YAR	YBR	YCR	MAR	MBR	NAR	PAR
Water Connection Inch [mm]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]	12 [304.8]	12 [304.8]	12 [304.8]	12 [304.8]
Design Press. Water Side psig [kPa]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]
Flow rate USgpm [m^3/h]	897.2 [203.7]	892.8 [202.7]	976.1 [221.6]	1056.6 [239.8]	1135.0 [257.6]	1199.8 [272.4]	1385.1 [314.4]	1476.8 [335.2]	1588.4 [360.6]	1782.7 [404.7]
Pressure Drop psig [kPa]	5.8 [40.0]	4.8 [33.1]	4.7 [32.4]	4.7 [32.4]	4.9 [33.8]	5.0 [34.5]	5.3 [36.5]	5.4 [37.2]	4.9 [33.8]	6.5 [44.8]
Condenser										
Model	M5R	M5R	T5R	YAR	YBR	YCR	JAR	JBR	KAR	8AR
Water Connection Inch [mm]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]	10 [254.0]	12 [304.8]	12 [304.8]	12 [304.8]	12 [304.8]
Design Press. Water Side psig [kPa]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]	150 [1034]
Flow Rate USgpm [m^3/h]	1047.9 [237.9]	1047.1 [237.7]	1142.7 [259.4]	1240.0 [281.5]	1324.2 [300.6]	1407.6 [319.5]	1629.5 [369.9]	1740.0 [395.0]	1858.6 [421.9]	2088.8 [474.2]
Pressure Drop psig [kPa]	5.1 [35.2]	4.6 [31.7]	4.9 [33.8]	4.7 [32.4]	4.9 [33.8]	5.0 [34.5]	5.7 [39.3]	5.2 [35.9]	4.8 [33.1]	6.0 [41.4]
General										
Unit Length Inch [mm]	174 3/16 [4425]	196 12/16 [4997]	196 12/16 [4997]	196 12/16 [4997]	196 12/16 [4997]	196 12/16 [4997]	206 12/16 [5251]	206 12/16 [5251]	206 12/16 [5251]	213 12/16 [5429]
Unit Width Inch [mm]	75 [1905]	80 [2032]	80 [2032]	80 [2032]	80 [2032]	80 [2032]	88 [2235]	88 [2235]	88 [2235]	90 [2286]
Unit Height Inch [mm]	97 [2464]	87 [2210]	92 [2337]	97 [2464]	97 [2464]	97 [2464]	93 [2362]	93 [2362]	95 [2413]	99 [2515]
Unit Shipping Weight lbs [kg]	17505 [7947]	18211 [8268]	19928 [9047]	21645 [9827]	22456 [10195]	23071 [10474]	26820 [12176]	27597 [12529]	29952 [13598]	32915 [14943]
Unit Operating Weight lbs [kg]	19255 [8742]	19863 [9018]	21688 [9846]	23588 [10709]	24486 [11117]	25208 [11444]	29144 [13231]	30111 [13670]	32773 [14879]	36206 [16438]
R134a Charge (Approx)lbs [kg]	1113 [505]	1113 [505]	1312 [596]	1356 [616]	1422 [646]	1477 [671]	1455 [661]	1543 [701]	1808 [821]	2701 [1226]

Notes: 1. This physical specifications table is based on Superior vessel models with the following operation condition: inlet/outlet cooled water temperature 54/44°F, inlet/outlet cooling water temperature 85/95°F, Fouling factor of evaporator 0.0001hr.ft^2.°F/Btu, Fouling factor of condenser 0.00025hr.ft^2.°F/Btu, 2 pass vessels

2. Actual capacity will depend on the specified conditions. To consult nearest Dunham-bush sales office for computer selections.

3. Non-standard chillers can be designed according to different requirements.

1.0 GENERAL INFORMATION

1.1 RECEIVING AND INSPECTION

The unit should be inspected immediately, in the presence of the carrier's representative, for any evidence of damage during shipping. Any damage should be noted on the carrier's delivery receipt before it is signed. A damage claim should then be filed by the purchaser against the delivering carrier as all shipments are made at the purchaser's risk. The receiving inspection instructions, sent with the installation instructions, should also be filled at this time and forwarded to the Dunham-Bush Industries, M & E Service Department.

1.2 APPLICATION PRECAUTIONS

The following instructions are intended to help assure proper and successful application of your water chilling machines.

1.2.1 WATER CONDITIONS

Dunham-Bush's WCFX-V Variable Speed Water Cooled Rotary Screw Flooded Chillers are engineered and designed with liquid heads together with steel shell and copper tube type heat ex-changes for extended heat transfer surface as well as straight forward cleaning advantages (shell and tube evaporator and condenser).

The materials used in fabrication are generally suitable for clean fresh water found in most localities. However, minerals and other contaminants found in some water systems may promote aggressive attack on the tubes or tube sheets, resulting in failure with serious consequences for the entire package chiller.

Since Dunham-Bush has no control over the condition of the water used in these machines, Dunham-Bush is not liable for failure of tubes or tube sheets due to water corrosion or erosion. It is recommended that the end user/owner obtain the services of local water treatment specialists to prescribe the correct water treatment.

1.2.2 CHILLED WATER FLOW

Dunham-Bush WCFX-V Variable Speed Water Cooled Rotary Screw Flooded Chillers are designed for a constant chilled water flow rate, even when the cooling load is varying. The machine will generally perform satisfactorily with steady flow rates deviating from design by as much as +10% / -50%. However, varying water flow rates will cause control instability, which will result in undesirable system effects, particularly poor control of leaving chilled water temperature. If two-way valves are used to control flow through cooling coils, some means of control (for example automatic modulating valve) should be installed in the system to maintain steady flow through the evaporator.

If either the chilled water flow rate or/and load varies, the variation must be controlled so that return water temperature does not vary at a rate exceeding 2°F [1.1°C] per minute.

If the chilled water system is designed for the dual purpose of cooling and heating, the evaporator must incorporate valves to prevent the flow of hot water through it. This can be done with either manual or automatic shutoff valves, but water temperature entering the evaporator must never exceed 90°F [32°C].

1.2.3 WATER COOLED CONDENSERS

The water cooled condenser is also designed for constant water flow rate, and should be supplied with the design flow rate ±10%. The condenser must be protected from rapid changes in temperature as well. The maximum allowable rate of change in condenser entering water is 1°F [0.6°C] per minute.

Fluctuating flow rate or temperature will cause unstable control of the machine, resulting in poor control of leaving chilled water temperature. If a cooling tower is used to reject heat from the condensing water loop, it must be controlled to provide an entering condensing water temperature which does not change more rapidly than 1°F [0.6°C] per minute and does not go below 60°F [15.6°C]. One or more of the following methods may be used to control the tower:

1.2.3.1 A modulating three-way valve which bypasses tower sprays at low load and low ambient temperature.

1.2.3.2 Tower fan staging in response to a thermostat in the tower sump. Fan thermostat should have a differential of at least 20°F [11.1°C] to avoid short cycling.

1.2.3.3 A modulating three-way valve which bypasses the cooling tower to blend warm leaving condenser water with cold tower water.

1.2.4 CONDENSING WATER TREATMENT

Condensing water tends to leave silt, algae and mineral deposits in the condenser tubes. This fouling gradually decreases unit efficiency. For this reason, a program of water treatment should be employed. Also, at regular intervals depending on water quality, the unit should be shut down, condenser heads removed and tubes cleaned. See Section 5.4.

1.0 GENERAL INFORMATION

1.3 RIGGING AND MOVING

Each unit is carefully designed and built in the factory; every precaution has been taken into consideration to assure that the unit reaches you in perfect condition. It is very important that the riggers and movers use the same care and precaution when moving the equipment into place. Make sure that chains, cables or other moving equipment are placed or position correctly to avoid damage to the unit or piping. The refrigerant piping must not be used as a ladder or as a hand hold. Do not attach a chain hoist sling to the piping or equipment. Move the unit in an upright position and let it down gently from trucks or rollers.

Unit(s) mounted on skids may be moved with a forklift, but care must be taken so that the fork of the forklift does not to damage the unit. The skids should not be removed until the unit is at its final location.

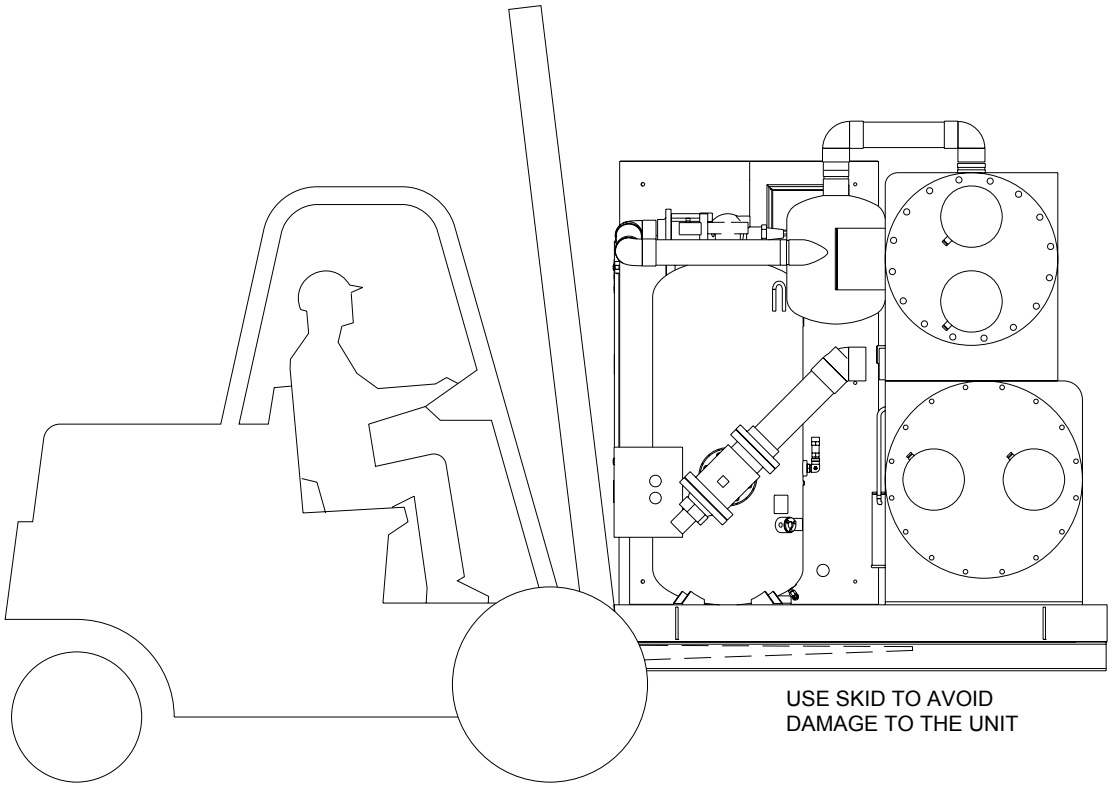
The WCFX model is to be rigged through the provided rigging holes. It is highly recommended that spreader bars be used between rigging lines to prevent damage to the unit. The unit must be lifted using all rigging points. It can also be moved on skids placed under the tube sheets. Refer to Figure 1.3.1 and 1.3.2 for rigging instructions.

1.4 SPACE REQUIREMENTS AND CLEARANCE

The dimensional data and clearances that follow are useful for determining space requirements. The unit should be placed to make the clearance noted available for servicing properly. Failure to allow these clearances will cause serious trouble and result in higher costs for operation, maintenance and repair.

The dimensional data and space requirement are shown in Figure 1.4.

FIGURE 1.3.1 MOVING UNIT WITH FORK LIFT



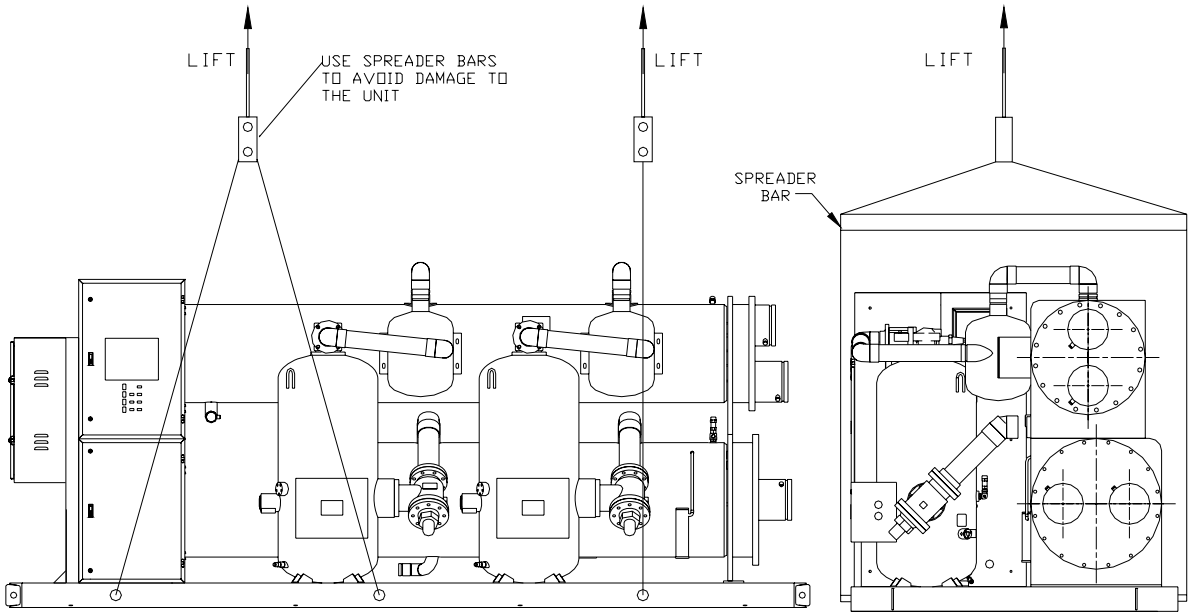
Note: Skid supplied by others. Please contact Dunham-Bush if further information about skid is required.

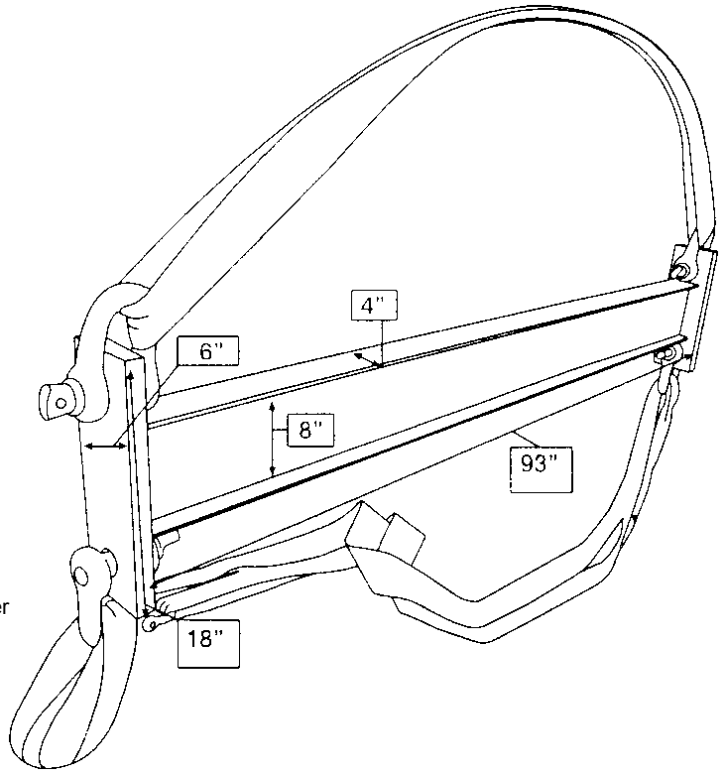
1.0 GENERAL INFORMATION

FIGURE 1.3.2 RIGGING DIAGRAM

Rigging should be done in a manner so that no strain is placed on unit components other than at cable connection points

Sample



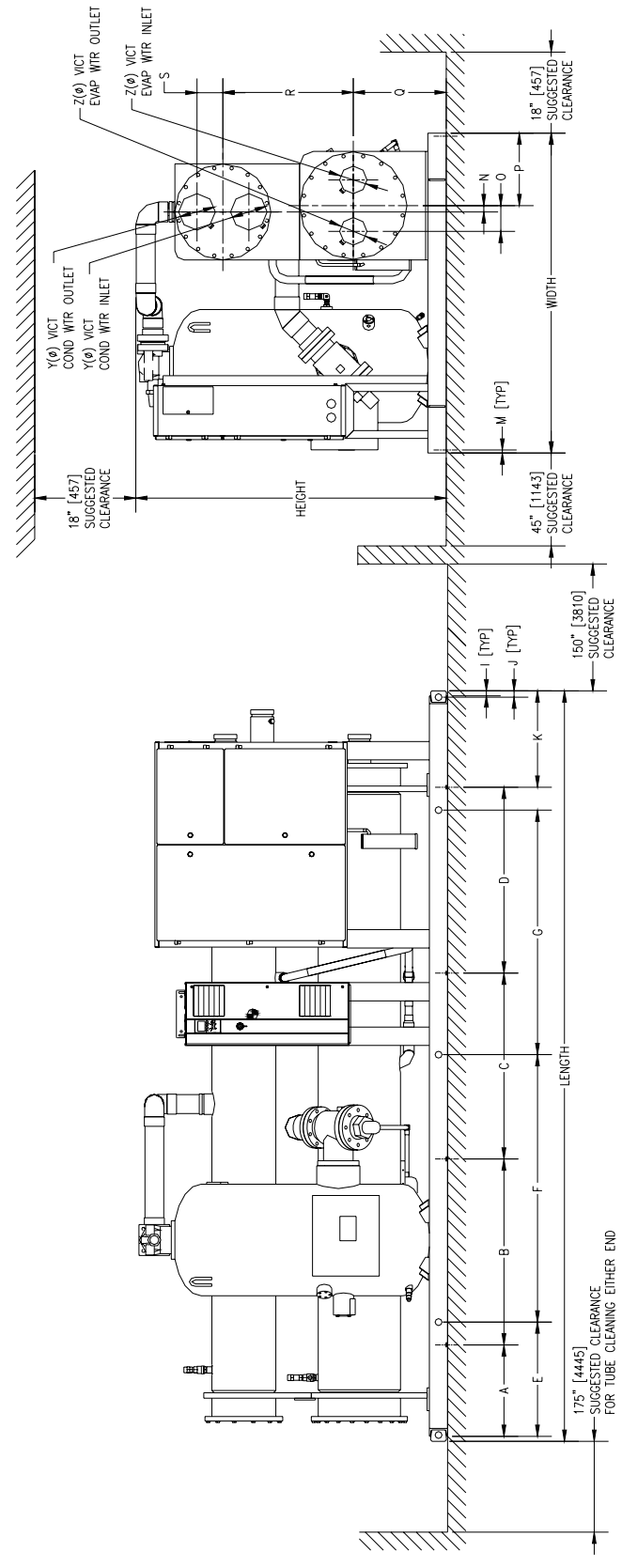


Note: Spreader bar supplied by others.
Please contact Dunham-Bush if further information about the spreader bar is required.

1.0 GENERAL INFORMATION

FIGURE 1.4 DIMENSIONAL DATA

WCFX-V 19S, 20S, 23S, 24S, 27S, 30S, 36S, 41S, 46S

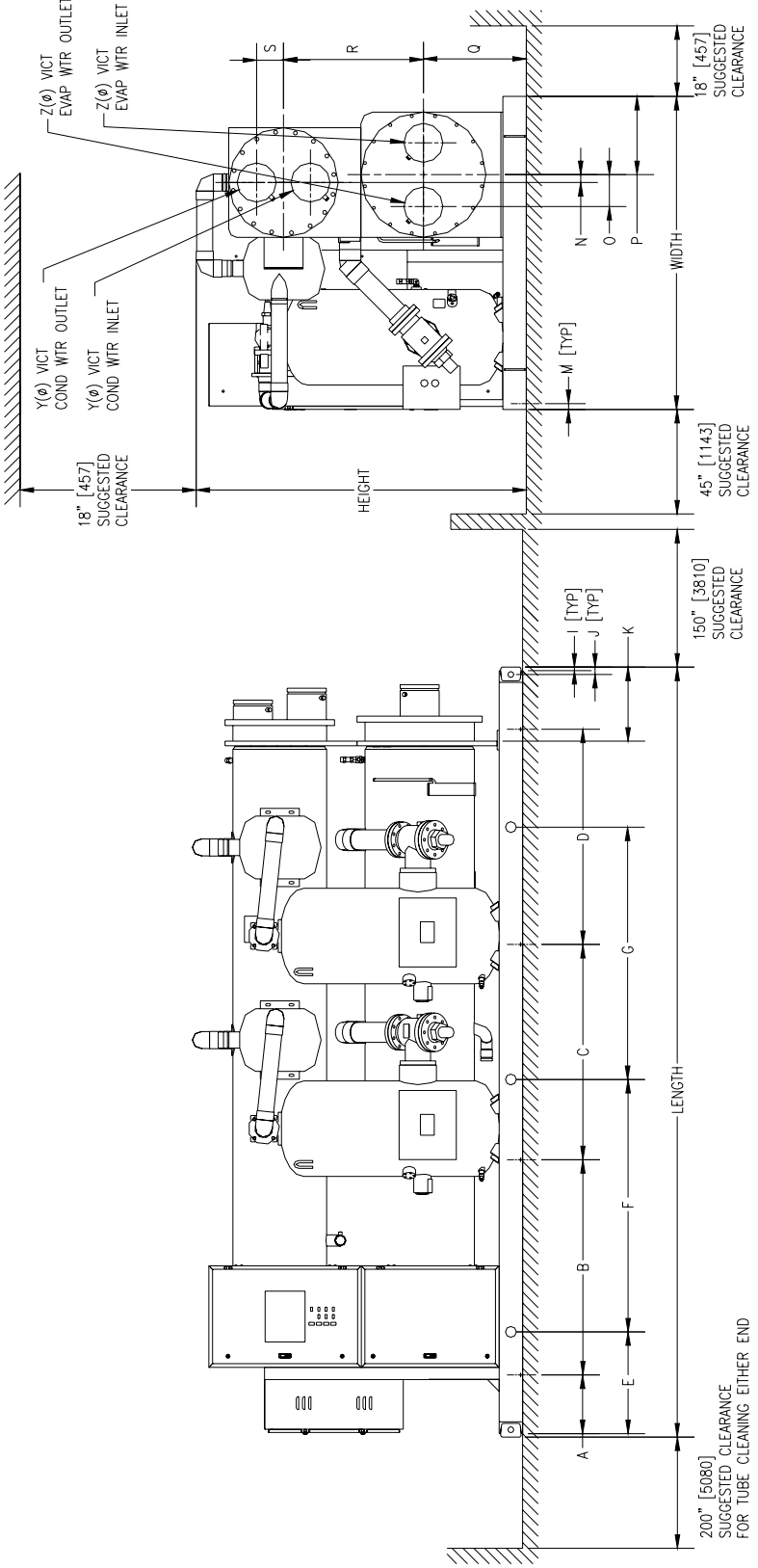


Model WCFX-V	A	B	C	D	E	F	G	HEIGHT	I	J	K	LENGTH	M	N	O	P	Q	R	S	WIDTH	Y (Ø)	Z (Ø)
19S	15 [381]	33 3/16 [843]	33 3/16 [843]	33 3/16 [843]	17 8/16 [445]	37 13/16 [960]	51 3/16 [1300]	73 [1854]	1 2/16 [29]	1 6/16 [35]	20 14/16 [530]	132 3/16 [3358]	11/16 [17]	2 8/16 [64]	6 14/16 [175]	15 14/16 [403]	21 5/16 [541]	29 12/16 [756]	5 10/16 [143]	70 [1778]	6 [152]	8 [203]
20S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1486]	53 8/16 [1359]	72 [1829]	1 2/16 [28]	1 6/16 [35]	20 14/16 [530]	164 3/16 [4171]	11/16 [17]	1 4/16 [32]	5 10/16 [143]	15 14/16 [403]	20 5/16 [516]	28 9/16 [725]	5 10/16 [143]	70 [1778]	6 [152]	6 [152]
23S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1486]	53 8/16 [1359]	73 [1854]	1 2/16 [28]	1 6/16 [35]	20 14/16 [530]	164 3/16 [4171]	11/16 [17]	2 8/16 [64]	6 14/16 [175]	15 14/16 [403]	21 5/16 [542]	29 12/16 [756]	5 10/16 [143]	70 [1778]	6 [152]	8 [203]
24S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1486]	53 8/16 [1359]	73 [1854]	1 2/16 [28]	1 6/16 [35]	20 14/16 [530]	164 3/16 [4171]	11/16 [17]	2 8/16 [64]	6 14/16 [175]	15 14/16 [403]	21 5/16 [542]	29 12/16 [756]	5 10/16 [143]	70 [1778]	6 [152]	8 [203]
27S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1486]	53 8/16 [1359]	75 [1905]	1 2/16 [28]	1 6/16 [35]	20 14/16 [530]	164 3/16 [4171]	11/16 [17]	3 8/16 [89]	6 14/16 [175]	15 14/16 [403]	22 5/16 [567]	30 13/16 [782]	5 10/16 [143]	70 [1778]	6 [152]	8 [203]
30S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	40 11/16 [1033]	25 [635]	58 8/16 [1486]	53 8/16 [1359]	80 [2032]	1 2/16 [28]	1 6/16 [35]	21 2/16 [536]	164 3/16 [4171]	11/16 [17]	2 2/16 [54]	6 14/16 [175]	15 14/16 [403]	22 5/16 [567]	31 12/16 [807]	6 2/16 [155]	70 [1778]	8 [203]	8 [203]
36S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	50 11/16 [1287]	30 11/16 [780]	60 [1524]	60 [1524]	92 [2337]	1 2/16 [28]	1 6/16 [35]	21 2/16 [536]	174 3/16 [4425]	11/16 [17]	2 [51]	8 2/16 [207]	15 14/16 [403]	24 5/16 [618]	35 4/16 [895]	6 14/16 [175]	70 [1778]	8 [203]	8 [203]
41S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	50 11/16 [1287]	30 11/16 [780]	60 [1524]	60 [1524]	94 [2388]	1 2/16 [28]	1 6/16 [35]	21 2/16 [536]	174 3/16 [4425]	11/16 [17]	1 [25]	7 6/16 [187]	15 14/16 [403]	24 5/16 [618]	36 4/16 [921]	6 14/16 [175]	70 [1778]	10 [254]	10 [254]
46S	20 [508]	40 11/16 [1033]	40 11/16 [1033]	50 11/16 [1287]	30 11/16 [780]	60 [1524]	60 [1524]	97 [2464]	1 2/16 [28]	1 6/16 [35]	21 2/16 [536]	174 3/16 [4425]	11/16 [17]	2 [51]	8 2/16 [206]	20 [508]	26 5/16 [668]	37 5/16 [947]	6 14/16 [175]	75 [1905]	10 [254]	10 [254]

Notes : 1.) All dimensions are in inches[mm].
2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

1.0 GENERAL INFORMATION

WCFX-V 38T, 40T, 46T, 50T, 54T, 57T, 60T

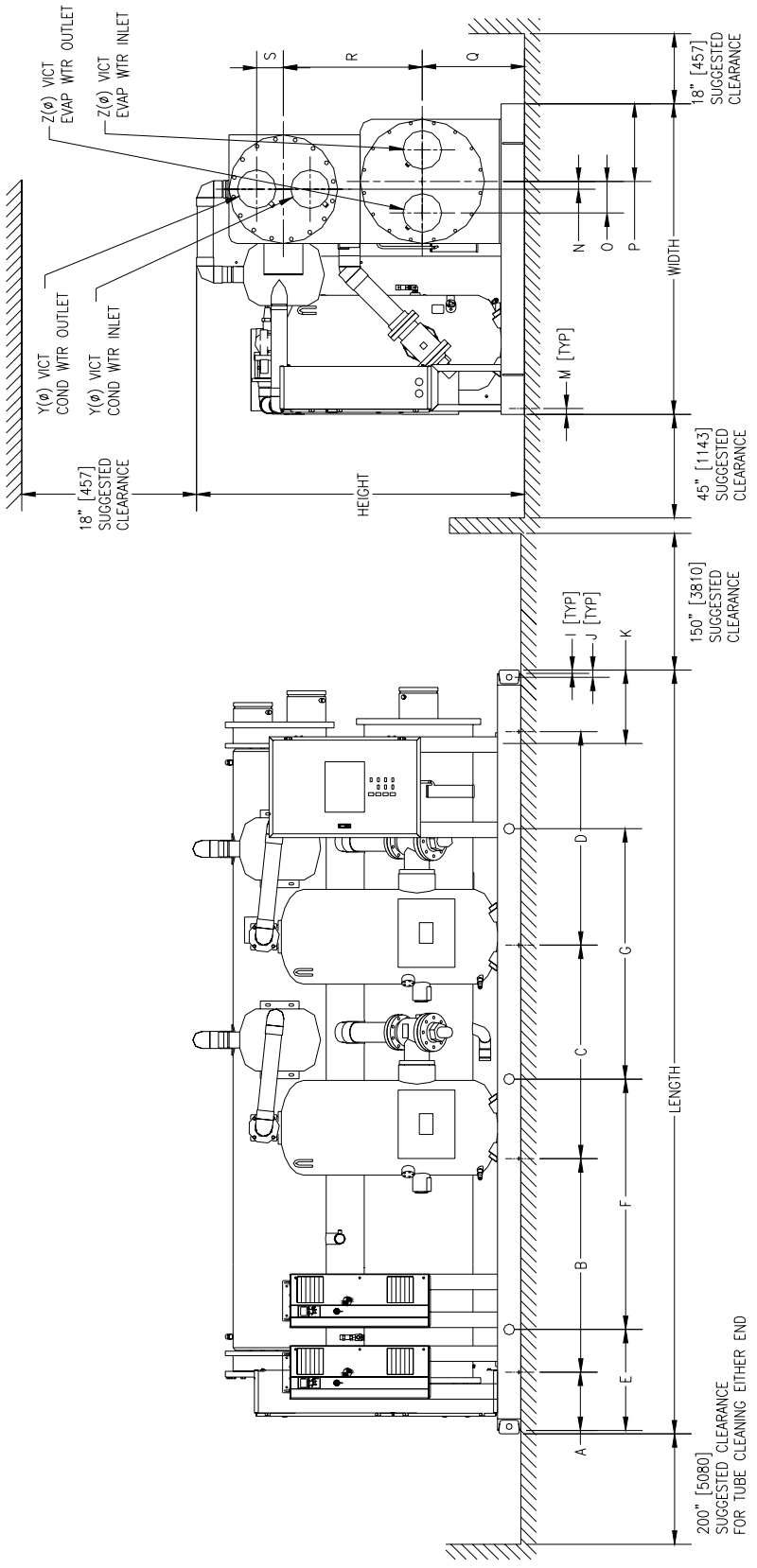


Model WCFX-V	A	B	C	D	E	F	G	HEIGHT	I	J	K	LENGTH	M	N	O	P	Q	R	S	WIDTH	Y (Ø)	Z (Ø)
38T	15 [381]	60 [1524]	60 [1524]	45 [1143]	24 [610]	68 8/16 [1740]	78 8/16 [1994]	82 [2083]	14/16 [22]	1 14/16 [48]	21 2/16 [537]	196 12/16 [4997]	1 8/16 [38]	2 2/16 [54]	6 14/16 [175]	17 8/16 [445]	24 5/16 [618]	31 12/16 [807]	6 2/16 [155]	75 [1905]	8 [203]	8 [203]
40T	15 [381]	60 [1524]	60 [1524]	45 [1143]	24 [610]	68 8/16 [1740]	78 8/16 [1994]	88 [2235]	14/16 [22]	1 14/16 [48]	21 2/16 [537]	196 12/16 [4997]	1 8/16 [38]	2 [51]	8 2/16 [206]	20 [508]	26 5/16 [668]	35 12/16 [908]	6 14/16 [175]	80 [2032]	10 [254]	10 [254]
46T	15 [381]	55 [1397]	55 [1397]	55 [1397]	26 [660]	64 8/16 [1638]	64 8/16 [1638]	87 [2210]	14/16 [22]	1 14/16 [48]	18 14/16 [480]	196 12/16 [4997]	1 8/16 [38]	2 [51]	8 2/16 [207]	20 [508]	26 5/16 [669]	35 13/16 [909]	6 14/16 [175]	80 [2032]	10 [254]	10 [254]
50T	15 [381]	55 [1397]	55 [1397]	55 [1397]	26 [660]	64 8/16 [1638]	64 8/16 [1638]	92 [2337]	14/16 [22]	1 14/16 [48]	18 14/16 [480]	196 12/16 [4997]	1 8/16 [38]	3 [76]	8 2/16 [206]	20 [508]	27 5/16 [694]	36 12/16 [934]	6 14/16 [175]	80 [2032]	10 [254]	10 [254]
54T	15 [381]	55 [1397]	55 [1397]	55 [1397]	26 [660]	64 8/16 [1638]	64 8/16 [1638]	97 [2464]	14/16 [22]	1 14/16 [48]	18 14/16 [480]	196 12/16 [4997]	1 8/16 [38]	3 14/16 [99]	8 14/16 [225]	20 [508]	28 5/16 [719]	39 11/16 [1008]	7 6/16 [187]	80 [2032]	10 [254]	10 [254]
57T	15 [381]	55 [1397]	55 [1397]	55 [1397]	26 [660]	64 8/16 [1638]	64 8/16 [1638]	97 [2464]	14/16 [22]	1 14/16 [48]	18 14/16 [480]	196 12/16 [4997]	1 8/16 [38]	3 14/16 [99]	8 14/16 [225]	20 [508]	28 5/16 [719]	39 11/16 [1008]	7 6/16 [187]	80 [2032]	10 [254]	10 [254]
60T	15 [381]	55 [1397]	55 [1397]	55 [1397]	26 [660]	64 8/16 [1638]	64 8/16 [1638]	97 [2464]	14/16 [22]	1 14/16 [48]	18 14/16 [480]	196 12/16 [4997]	1 8/16 [38]	3 14/16 [99]	8 14/16 [225]	20 [508]	28 5/16 [719]	39 11/16 [1008]	7 6/16 [187]	80 [2032]	10 [254]	10 [254]

Notes : 1.) All dimensions are in inches[mm].
2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

1.0 GENERAL INFORMATION

WCFX-V 73T, 75T, 81T, 90T



Model WCFX-V	A	B	C	D	E	F	G	HEIGHT	I	J	K	LENGTH	M	N	O	P	Q	R	S	WIDTH	Y (Ø)	Z (Ø)
73T	15 [381]	53 11/16 [1363]	60 11/16 [1541]	60 11/16 [1541]	25 [635]	74 [1880]	81 [2057]	93 [2362]	14/16 [22]	1 14/16 [48]	20 10/16 [524]	206 12/16 [5251]	1 8/16 [38]	3 12/16 [95]	10 3/16 [258]	24 8/16 [622]	29 5/16 [745]	40 13/16 [1037]	8 [203]	88 [2235]	12 [305]	12 [305]
75T	15 [381]	53 11/16 [1363]	60 11/16 [1541]	60 11/16 [1541]	25 [635]	74 [1880]	81 [2057]	93 [2362]	14/16 [22]	1 14/16 [48]	20 10/16 [524]	206 12/16 [5251]	1 8/16 [38]	3 4/16 [83]	10 3/16 [258]	24 8/16 [622]	29 5/16 [745]	40 13/16 [1037]	8 [203]	88 [2235]	12 [305]	12 [305]
81T	15 [381]	53 11/16 [1363]	60 11/16 [1541]	60 11/16 [1541]	25 [635]	74 [1880]	81 [2057]	95 [2413]	14/16 [22]	1 14/16 [48]	20 10/16 [524]	206 12/16 [5251]	1 8/16 [38]	3 4/16 [83]	10 3/16 [258]	24 8/16 [622]	30 [762]	44 [1118]	8 2/16 [207]	95 [2413]	12 [305]	12 [305]
90T	15 [381]	60 11/16 [1541]	60 11/16 [1541]	60 11/16 [1541]	25 [635]	90 3/16 [2290]	71 14/16 [1826]	118 [2997]	14/16 [22]	1 14/16 [48]	20 1/16 [509]	213 12/16 [5429]	1 8/16 [38]	3 6/16 [86]	10 3/16 [259]	25 8/16 [648]	32 5/16 [821]	46 [1168]	9 12/16 [248]	90 [2286]	12 [305]	12 [305]

Notes : 1.) All dimensions are in inches[mm].
2.) Above drawing is for Superior model. Consult factory for Standard and Premium model dimension.

2.0 INSTALLATION

2.1 FOUNDATION

A flat, level concrete foundation or floor capable of supporting the weight of the unit must be provided. Weights are given in Table 2.1. The unit must be leveled to within 1/16" per foot [5.2mm per meter] for proper operation.

2.2 VIBRATION ISOLATION

In case of structure-borne vibration may be of concern, it is recommended to install vibration isolators under the base of the Packaged Chiller.

Rubber-in-shear or spring vibration isolators are offered as optional items. When spring isolators are used, flexible connections must be installed in the water piping system and in the refrigerant lines if it is a split system. Note: These flexible connectors must be suitable for the fluid and pressures involved.

All piping which is external to the chiller must be supported by spring mounted hangers and any piping which goes through the wall, ceiling or floor should be properly sheathed to prevent transmission of piping vibration to the structure.

When spring isolators are used, electrical service to the unit must also be connected by means of a 36" [914mm] section of flexible conduit.

The installation of spring isolators shall follow the instructions as below:

1. Place all the spring isolators in place on the foundation, according to the isolator models and locations in the provided GA drawing.
2. **(For spring isolator models DHB only)** Unscrew leveling screw bolt (assembled with spring isolator) by turning counter-clockwise, (CCW) from the spring isolator.
3. Lift up the chiller as per the instructions in Section 1.3.2 Rigging, and position the chiller on top of the upper housing of the spring isolators.

(For spring isolator models DHB only)

4. Align mounting hole of the chiller base with the leveling screw bolt hole of the upper housing of the spring isolators.
5. Pass through leveling screw bolt & turn Clock-Wise (CW) to load spring until desired level (FH & OH) is achieved. Leave the locking nut loose for moment.
6. After completing level adjustment of all spring isolators, lock the locking nut of the spring isolators tight. (CW)
7. Bolt down the spring isolators to the floor.

(For spring isolator models YRS only)

4. Align mounting hole of the chiller base with the tapped hole of the upper housing of the spring isolators.
5. Adjust the leveling screw bolt until desired level (FH & OH) is achieved. Turn clock-wise (CW) to load spring or counter-clockwise (CCW) to unload spring.
6. After completing level adjustment of all spring isolators, lock the tapped bolt tight (CW) to fix the spring isolators to the chiller.
7. Bolt down the spring isolators to the floor.

2.3 UNMOUNTED ACCESSORIES

A chiller water flow switch (option item), which is shipped separately accompanying the unit must be field installed in the external chilled water outlet piping. It must be located in a horizontal section on the pipe where there is at least five (5) pipe diameters on both sides of the flow switch before any other connections, as indicated in Figure 2.3. The flow switch paddle must be adjusted to the size of pipe in which the paddle is installed, and the switch set to trip at approximately -50% of the design flow. **Refer to the unit wiring diagram for the electrical connections to interlock the Chilled Water Flow Switch (CWFS) with the control panel.**

Figure 2.3 Flow Switch

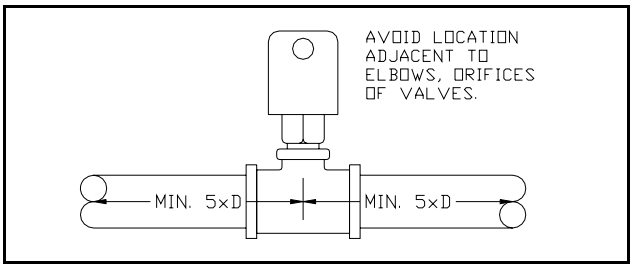
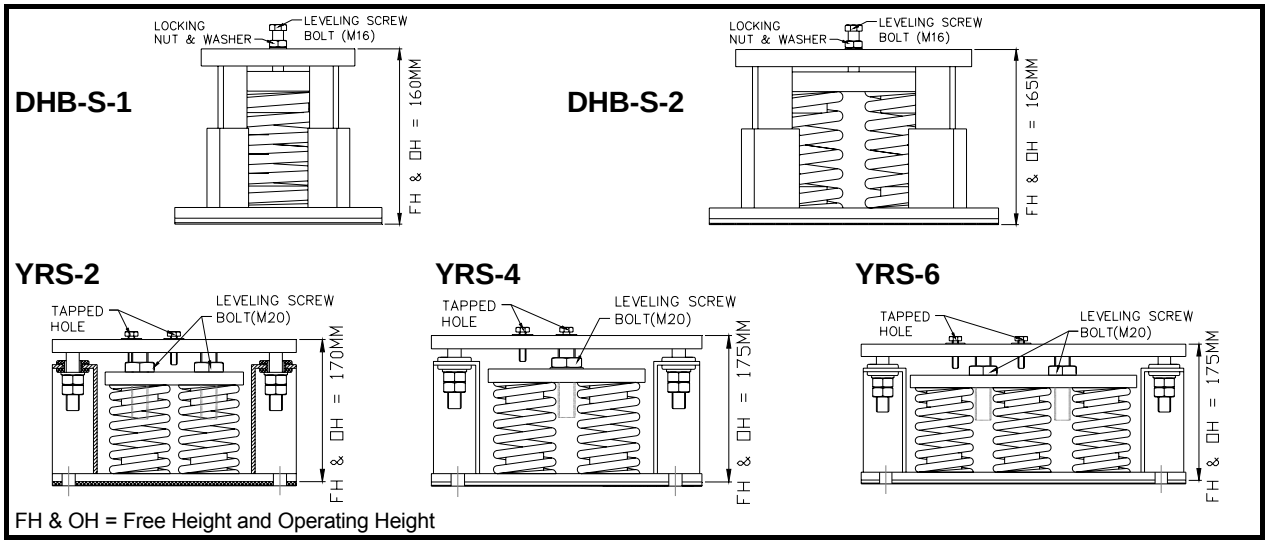


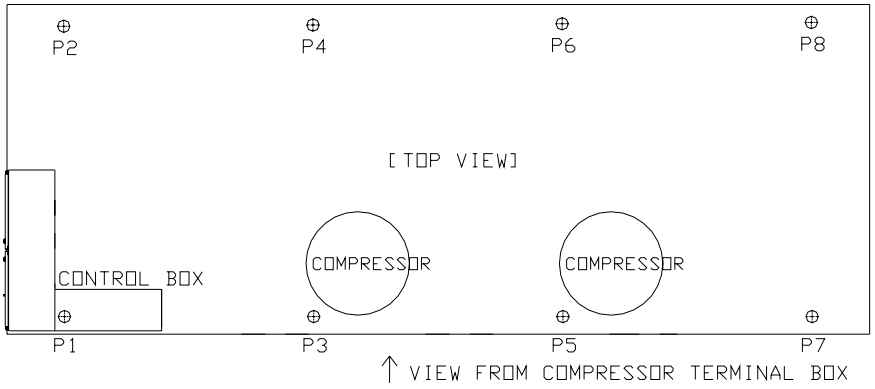
Figure 2.2 Spring Vibration Isolators



FH & OH = Free Height and Operating Height

2.0 INSTALLATION

WCFX-V 19S, 20S, 23S, 24S, 27S, 30S, 36S, 41S, 46S
38T, 40T, 46T, 50T, 54T, 57T, 60T, 73T, 75T, 81T, 90T



POINT LOAD DATA

Model WCFX-V	P1	P2	P3	P4	P5	P6	P7	P8	Operating Weight
	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]	Lbs [kg]
19S	1131 [513]	1545 [701]	1034 [469]	1420 [644]	935 [424]	1296 [588]	838 [380]	1171 [531]	9370 [4250]
20S	1292 [586]	1934 [877]	1173 [532]	1764 [800]	1054 [478]	1595 [724]	935 [424]	1426 [647]	11173 [5068]
23S	1329 [603]	2023 [918]	1210 [549]	1846 [837]	1090 [494]	1670 [757]	970 [440]	1493 [677]	11631 [5276]
24S	1411 [640]	2106 [955]	1273 [578]	1918 [870]	1136 [515]	1731 [785]	999 [453]	1544 [700]	12118 [5497]
27S	1468 [666]	2247 [1019]	1329 [603]	2049 [929]	1190 [540]	1850 [839]	1050 [476]	1651 [749]	12833 [5821]
30S	1621 [735]	2456 [1114]	1463 [664]	2238 [1015]	1305 [592]	2020 [916]	1147 [520]	1802 [817]	14052 [6374]
36S	1709 [775]	2838 [1287]	1608 [729]	2653 [1203]	1507 [684]	2468 [1120]	1406 [638]	2283 [1036]	16473 [7472]
38T	1936 [878]	2357 [1069]	1793 [813]	2202 [999]	1651 [749]	2048 [929]	1510 [685]	1896 [860]	15393 [6982]
40T	2348 [1065]	2859 [1297]	2176 [987]	2672 [1212]	2004 [909]	2485 [1127]	1832 [831]	2297 [1042]	18673 [8470]
41S	1813 [822]	3055 [1386]	1705 [773]	2856 [1296]	1597 [725]	2658 [1205]	1489 [676]	2459 [1115]	17633 [7998]
46S	2026 [919]	2980 [1352]	1954 [886]	2924 [1326]	1883 [854]	2867 [1300]	1811 [821]	2811 [1275]	19255 [8734]
46T	2337 [1060]	3057 [1387]	2233 [1013]	2875 [1304]	2129 [966]	2694 [1222]	2025 [919]	2512 [1140]	19863 [9010]
50T	2521 [1144]	3385 [1536]	2403 [1090]	3181 [1443]	2285 [1036]	2976 [1350]	2166 [983]	2771 [1257]	21688 [9838]
54T	2696 [1223]	3713 [1684]	2579 [1170]	3489 [1583]	2461 [1116]	3265 [1481]	2343 [1063]	3041 [1380]	23588 [10699]
57T	2811 [1275]	3809 [1728]	2698 [1224]	3590 [1628]	2585 [1173]	3371 [1529]	2472 [1121]	3151 [1430]	24486 [11107]
60T	2888 [1310]	3897 [1768]	2786 [1264]	3677 [1668]	2684 [1218]	3456 [1568]	2582 [1171]	3236 [1468]	25208 [11434]
73T	3733 [1694]	4850 [2200]	3255 [1476]	4464 [2025]	2777 [1259]	4077 [1849]	2298 [1042]	3690 [1674]	29144 [13220]
75T	3840 [1742]	5012 [2274]	3354 [1521]	4615 [2094]	2868 [1301]	4219 [1914]	2382 [1080]	3822 [1734]	30111 [13658]
81T	4082 [1852]	5504 [2497]	3582 [1625]	5076 [2302]	3082 [1398]	4647 [2108]	2582 [1171]	4218 [1913]	32773 [14866]
90T	2620 [1188]	2100 [953]	3260 [1479]	4348 [1972]	3900 [1769]	6595 [2991]	4541 [2060]	8842 [4011]	36206 [16423]

Notes: 1.) Refer to dimensional drawings for location of mounting points.
2.) Unit must be lowered onto mounting springs in a level fashion or spring damage may occur.

2.0 INSTALLATION

2.4 WATER PIPING CONNECTIONS

Refer to Figures 1.4. for water piping connection locations. Note that the condenser water inlet must be connected to the bottom (condenser water inlet). If necessary, evaporator or condenser headers can be swapped, from the left to the right end of the vessel or vice versa to suit site water piping conditions. **Leaving chilled water temp sensor must be located at leaving chilled water stream**. After the unit has been leveled and isolators (if any) have been installed and adjusted, evaporator and condenser water piping are connected. Piping must be properly supported to avoid stress on unit water connections. Install air vent valves in all high connections on evaporator and condenser headers. Drain valves should be installed in similar low points to facilitate gravity draining of the system. It is important that water systems should be cleaned before start-up to avoid debris getting trapped in evaporator and condenser. The best solution is to install wye strainers upstream (before the chiller) on both systems of the unit.

After the systems are filled with water, trapped air should be bled from the various vent valves. Check for proper flow rates by measuring water pressure drop across heat exchangers and reading flow rates from charts, Figure 2.4. Compare measured flow rates with values specified on purchase order. Refer and check Table 2.1. to see if evaporator and condenser flow rates fall between min. and max. limits.

CAUTION: WATER QUALITY - WCFX

Evaporators used in these packages are made of steel, copper and brass and are suitable for operation with well-maintained water systems. However, if the water used in evaporator is corrosive, high in mineral content or entrained solids, the water can cause reduced performance and even failure of heat exchangers. Therefore, it may be necessary to obtain the services of a water treatment consultant and to provide and maintain water treatment. This is particularly important with glycol solution systems.

2.5 ELECTRICAL WIRING

In connecting power wiring to the unit, the following precautions should be taken:

- All field wiring shall be in accordance with the National Electric Code and must comply with state and local codes.
- Check unit wiring for damage and all terminal connections for tightness. Unit terminal blocks are connected with copper conductors only, and are sized according to ampacity listed on unit data plate.
- Connections to unit should match the unit name plate in volts, phase and Hertz. Voltage must not vary beyond ±10% of name plate value and voltage imbalance between phases must not exceed 2% at any time during operation of the unit.
- Phase sequence to connections L1, L2, L3 shall be in that order. Check with Amprobe phase sequence adapter PSA-1 or equivalent.

2.6 CONTROLS

2.6.1 CONNECTIONS

Controls, which are to be **field installed**, should be connected in accordance with the appropriate wiring diagram accompanying the unit. The following connections should be made where applicable:

2.6.1.1 Connect a set of **normally open auxiliary contacts** from chilled water pump contactor into unit controls as shown on unit wiring diagram.

2.6.1.2 Install a **chilled water flow switch** (paddle type recommended) in straight length of chilled water piping to avoid turbulence. Connect in same electrical circuit as 2.6.1.1.

2.6.1.3 For control of condensing water pumps, connect contacts supplied in unit in series with condensing water pump starter coil.

2.6.1.4 Connect an enable/disable contact into the unit controls as shown on the wiring diagram. Closure of this contact enables the unit to operate.

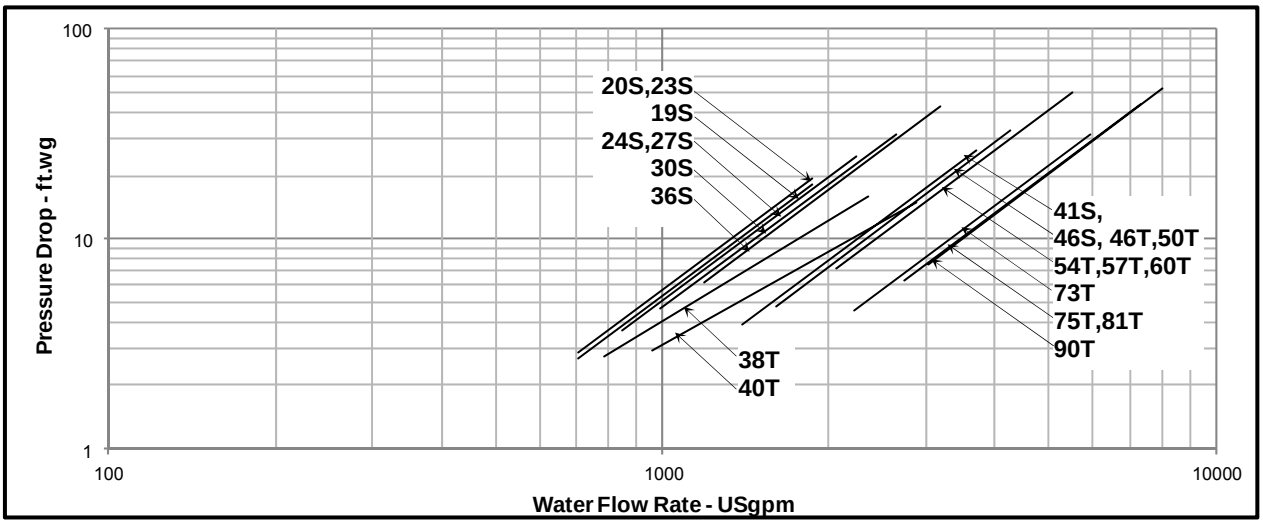
2.6.2 SETTINGS

All controls are factory set however operating control settings are not always applicable under all operating conditions. For recommended control settings, see wiring diagram accompanying unit. Safety controls must be set in accordance with factory recommendations.

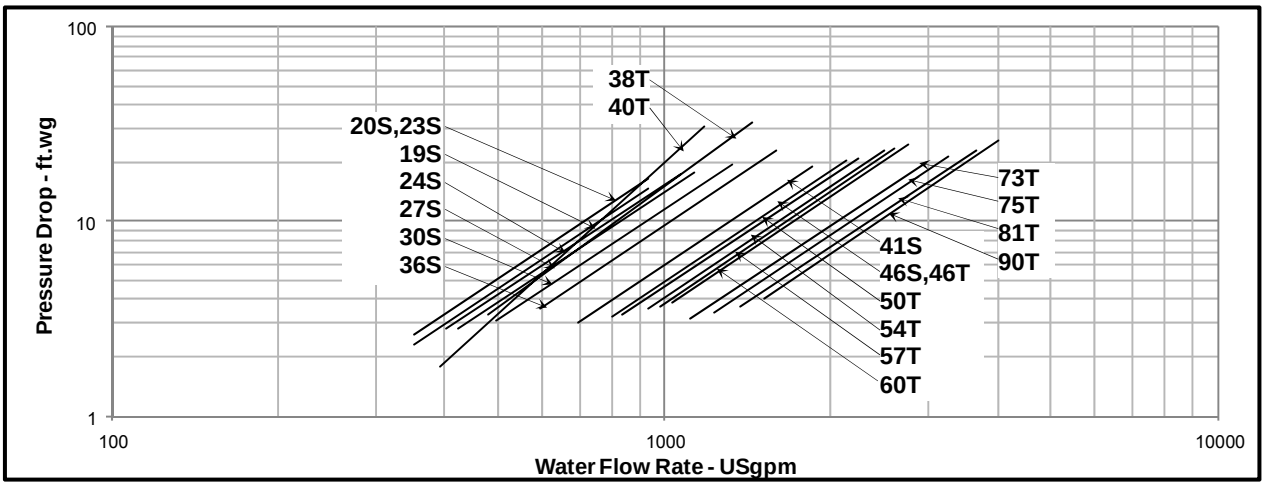
2.0 INSTALLATION

Figure 2.4 Water Pressure Drop
IMPERIAL UNITS

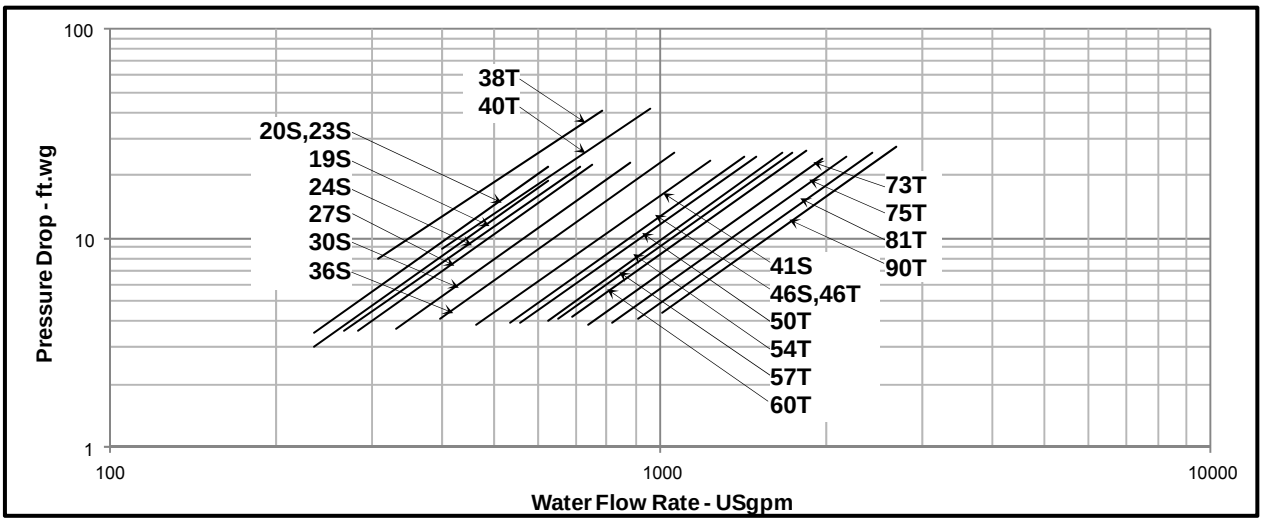
1A.) EVAPORATOR 1 PASS



1B.) EVAPORATOR 2 PASS



1C.) EVAPORATOR 3 PASS

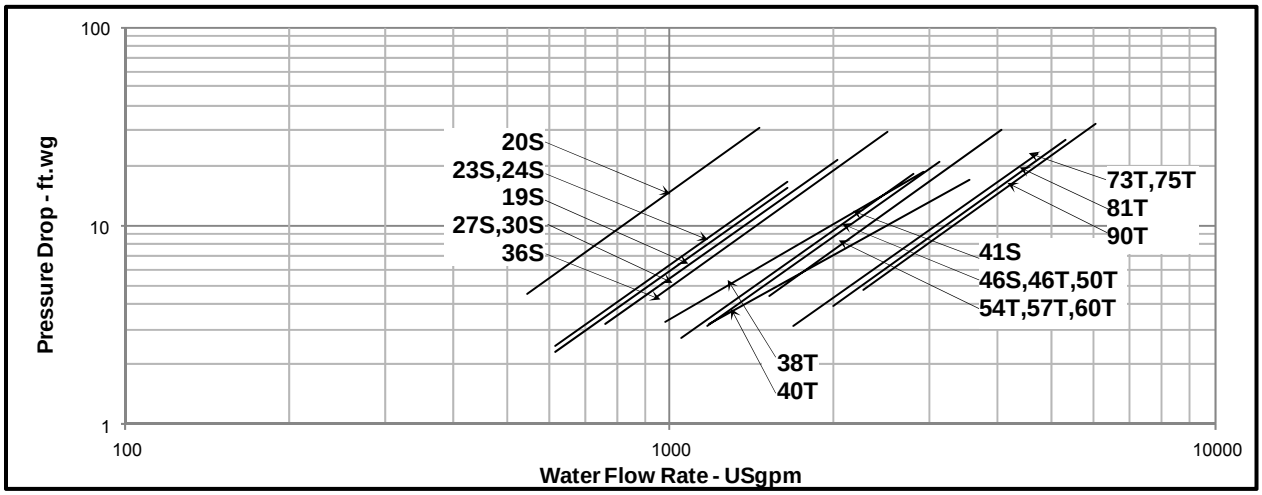


Note : Above water pressure drop is for Superior model. Consult factory for Standard and Premium model.

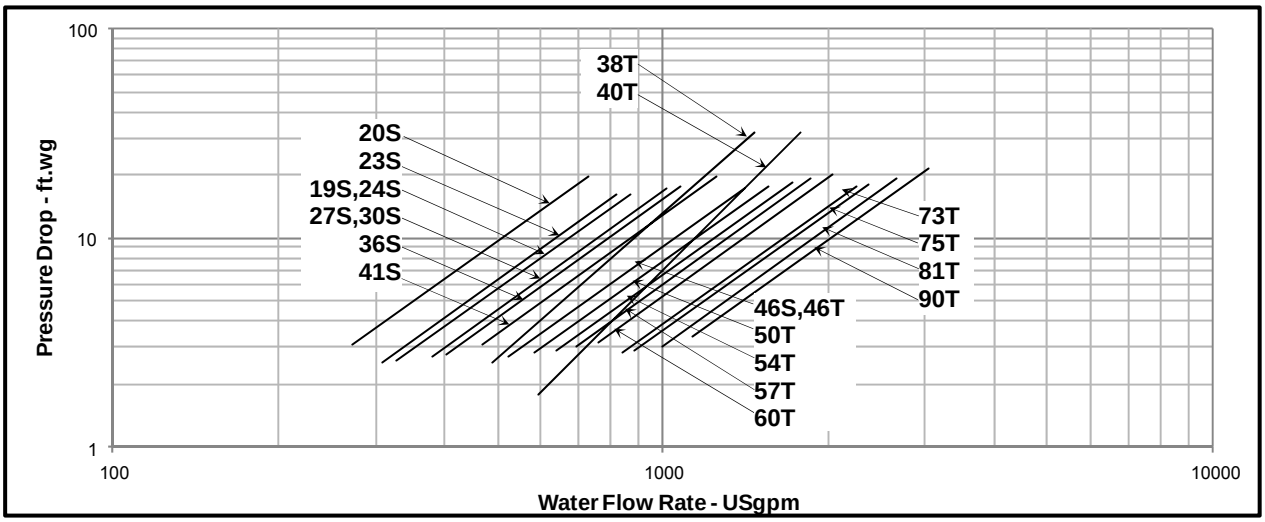
WATER PRESSURE DROP

IMPERIAL UNITS

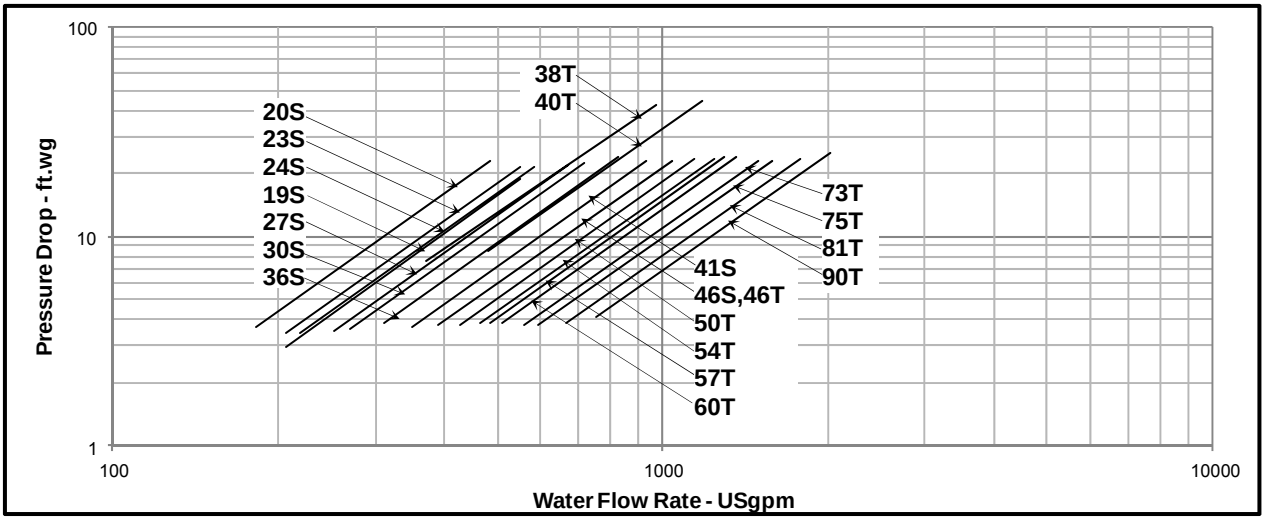
2A.) CONDENSER 1 PASS



2B.) CONDENSER 2 PASS



2C.) CONDENSER 3 PASS

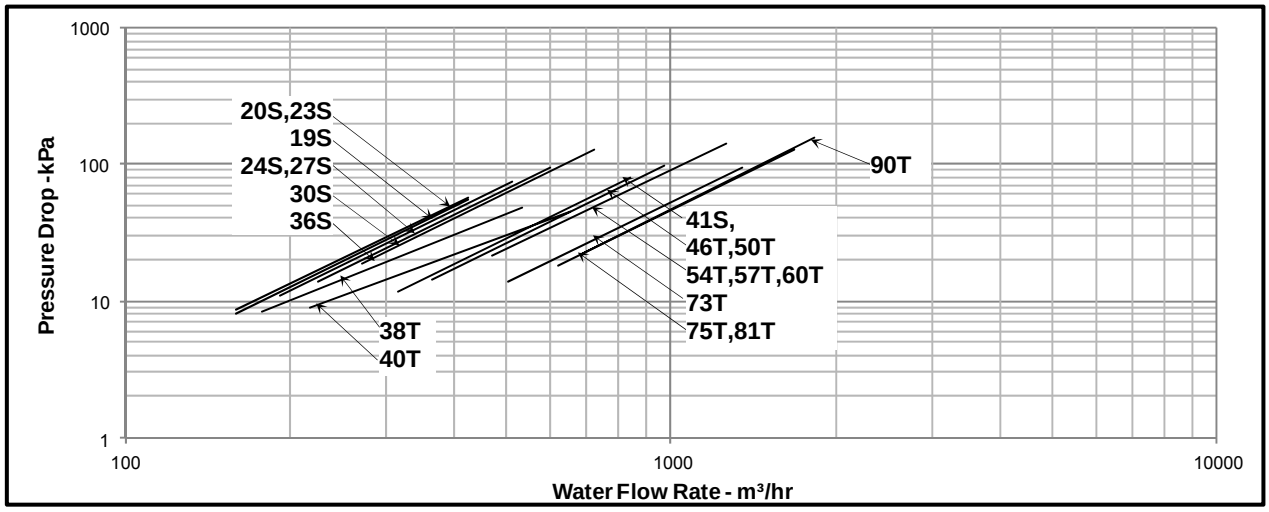


Note : Above water pressure drop is for Superior model. Consult factory for Standard and Premium model.

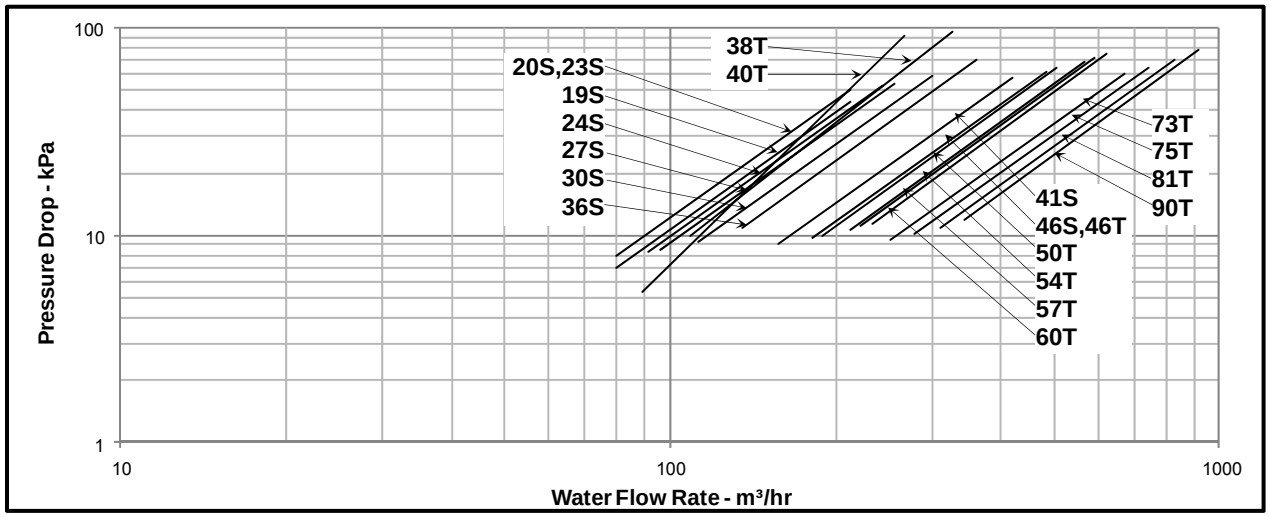
WATER PRESSURE DROP

SI Units

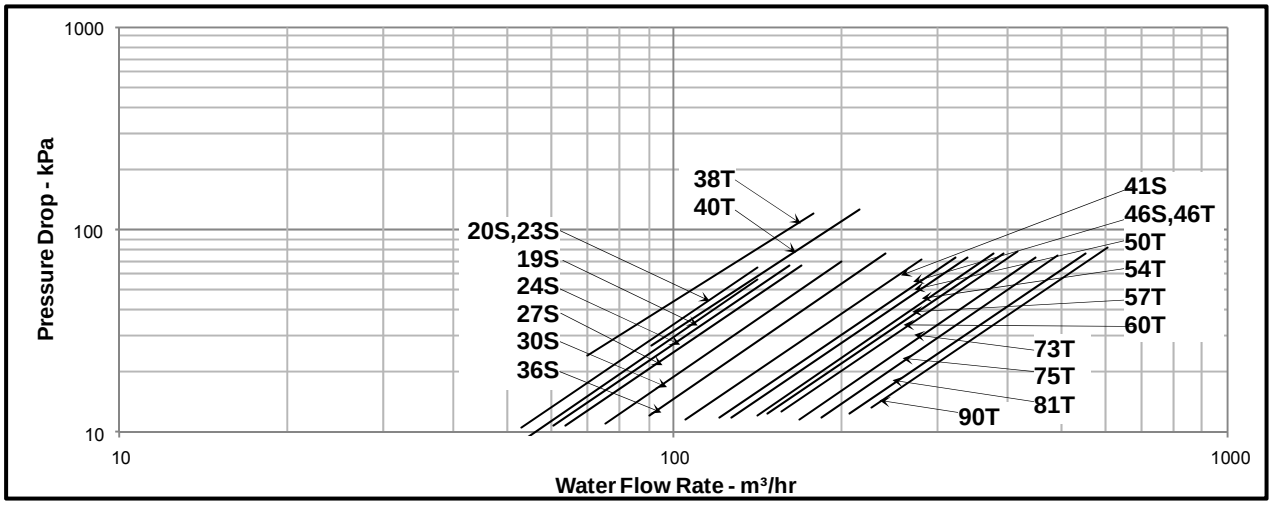
1A.) EVAPORATOR 1 PASS



1B.) EVAPORATOR 2 PASS



1C.) EVAPORATOR - 3 PASS

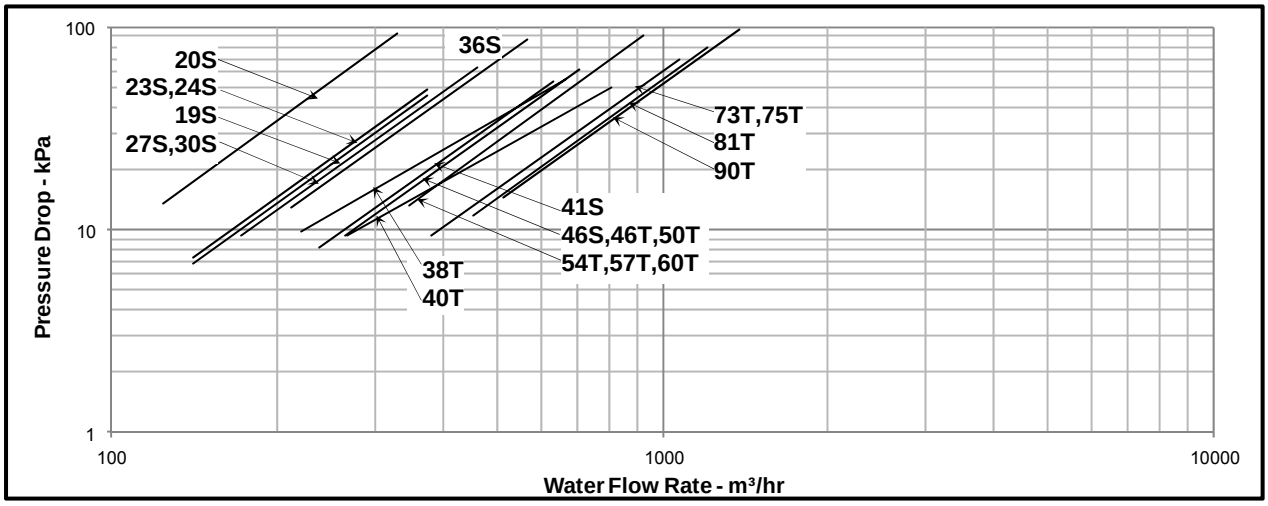


Note : Above water pressure drop is for Superior model. Consult factory for Standard and Premium model.

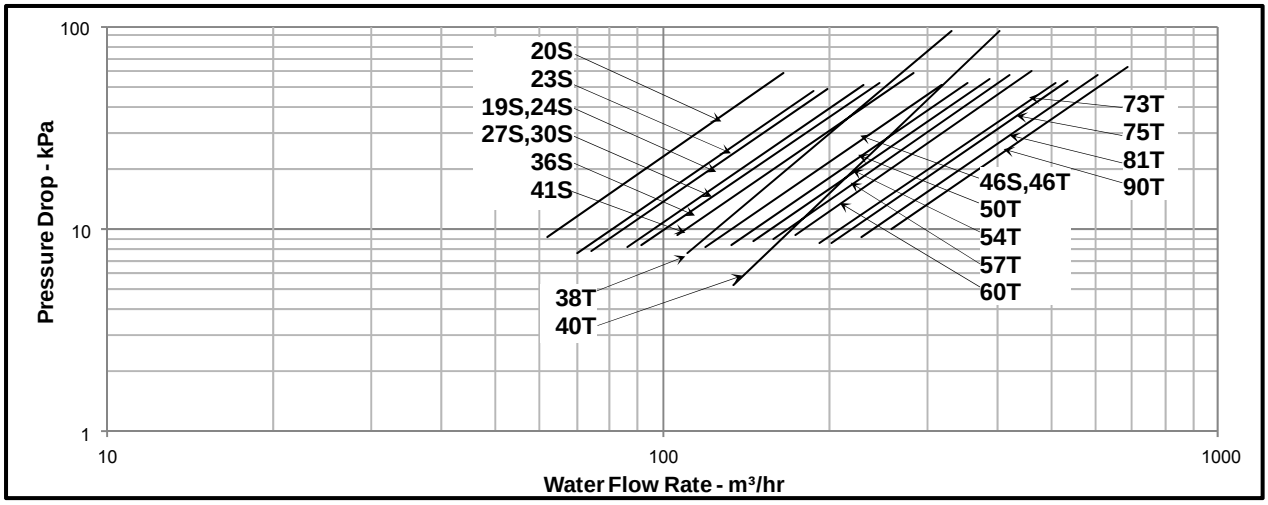
WATER PRESSURE DROP

SI Units

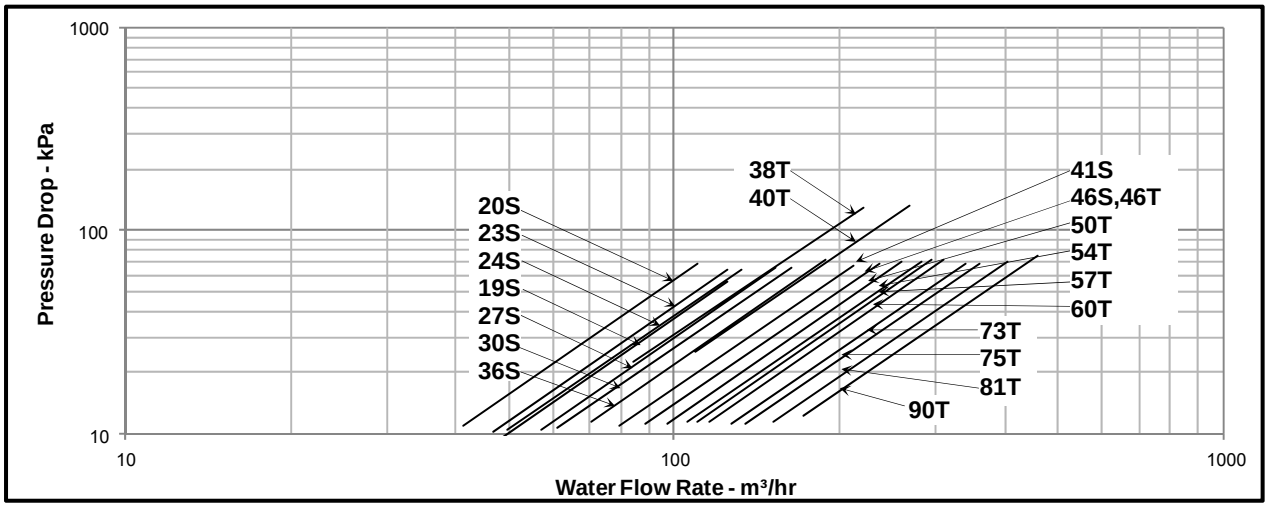
2A.) CONDENSER - 1 PASS



2B.) CONDENSER 2 PASS



2C.) CONDENSER 3 PASS



Note : Above water pressure drop is for Superior model. Consult factory for Standard and Premium model.

2.0 INSTALLATION

2.7 REQUEST FOR START-UP REPRESENTATIVE

After completion of installation and system checking, contact Dunham-Bush Industries Service Department to an engage the services of authorized start-up representative to perform the first (1st) initial start-up of the Dunham-Bush chiller.

Start-up should be performed in the presences of service and operational representative from the end user side, representative are encourage to participate and assist in the work to get acquainted with the new equipment.

Subsequently Dunham-Bush's representative will be sent to the installation site to carry out a final inspection on the installation work to determine if Dunham-Bush Industries requirements are met. Perform an equipment pre-handover start-up; review and check required operation condition and parameters. Provide guidance to the specified customer personnel in its operation and basic maintenance procedure for the length of time indicated in the purchase contract (If any). For extensive equipment training is required please contact Dunham-Bush Sales and Service department for arrangements

NOTE:

Sump oil heaters should be energized for a minimum of 24 hours and the oil sump temperature must be at a minimum of 100°F [38°C] prior to arrival of start-up representative. This will ensure that the oil is warm enough to vaporize any dissolved refrigerant and that the oil is within the normal operating temperature range. Sump oil heaters are energized simply by turning on the control power switch.

WARNING:

Initial compressor(s) start-up should ONLY be carried out under the direct supervision of an Authorized Dunham-Bush Industries Start-Up Representative.

2.8 SOUND

Other consideration to be made when installing the chiller is the location of the chiller. Chiller should not be located near noise sensitive areas. Adequate support / precaution should be put into place to avoid vibration and noise transmission into the building. Sound and Structural consultants should be consulted for critical installations

Table 2.8 Sound Pressure Data

Model WCFX-V	Octave Band (Hz)								Total dB (A)
	63	125	250	500	1000	2000	4000	8000	
19S	68	57	63	68	75	72	72	54	79
20S	68	57	63	68	75	72	72	54	79
23S	68	57	63	68	75	72	72	54	79
24S	69	59	64	68	76	73	74	56	80
27S	69	59	64	68	76	73	74	56	80
30S	70	61	65	69	78	75	74	59	81
36S	70	61	65	69	78	75	74	59	81
38T	71	60	66	71	78	75	75	57	82
40T	70	59	65	70	77	74	74	56	81
41S	70	61	65	69	78	75	74	59	81
46S	73	64	68	72	81	78	77	62	85
46T	70	59	65	70	77	74	74	56	81
50T	71	60	66	70	78	75	75	57	82
54T	71	61	66	70	78	75	76	58	82
57T	71	62	66	70	79	76	76	60	83
60T	72	63	67	71	80	77	76	61	83
73T	72	63	67	71	80	77	76	61	83
75T	72	63	67	71	80	77	76	61	83
81T	72	63	67	71	80	77	76	61	83
90T	75	66	70	74	83	80	79	64	87

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

2.9 WARNING LABEL


Electric shock


Hot surface


Wear ear protective device


Do not step

3.0 OPERATION

3.1 SYSTEM WATER FLOW RATE

The volume of chilled water being circulated can be measured quite accurately (±5%) by determining the water pressure drop through the evaporator and reading flow rates from evaporator pressure drop curve, Figures 2.3. Connect reliable pressure gauges to valves installed in evaporator entering and leaving water vent connections and read pressure difference with chilled water pump in operation. Condenser water flow rate can be measured in the same way. An alternate method of determining flow rates is to measure pressure difference from pump inlet to outlet, and read flow rates from the pump curve.

3.2 SEASONAL SHUT-DOWN PROCEDURE

3.2.1 If the unit is to be shut down for a prolonged period (a month or more), the power supply to the unit may be de-energized to conserve energy.

3.2.2 The cooling tower may be drained to avoid freezing. If the unit is located in an area where the ambient temperature constantly remains above freezing, the condenser need not be drained. It is better to leave the condenser and evaporator filled with water during a shutdown period. If the unit is located where ambient temperature will be below freezing, drain all water thoroughly and remove all vent and drain plugs from both headers of each vessel. Blow out tubes with compressed air.

NOTE: Simply draining is not sufficient. Stagnant water may cause serious corrosion.

3.2.3 It is recommended to that an oil sample is taken from each compressor and submitted for laboratory analysis during the seasonal shut-down to check for moisture level and impurities. Dunham-Bush offers this service in its Oil Kare Program. Oil analysis should be done at the beginning and end of each operating season, or every six months if the unit is used year round.

Important: Discontinue chilled water pump operation when unit is not operational.

3.3 SEASONAL START-UP PROCEDURE

When the unit is to be started up after being shut down for a prolonged period:

3.3.1 Check unit for evidence of rust or corrosion. Clean surfaces and repaint as necessary. Repair insulation if necessary.

3.3.2 Clean waterside heat transfer surface of condenser and evaporator by removing headers and brushing tubes**.**

3.3.3 Check water circuits to see if cooling tower is ready for operation, and both circuits are filled with water remove airlocks (if any). Start pumps and check for flow in both evaporator and condenser.

3.3.4 Energize compressor oil sump heater for at least 24 hours prior to compressor start-up, oil sump temperature must be at a minimum of 100°F [38°C]. Turn on control circuit power switches, turn on compressor switch, and press on computer keyboard. Compressor should start after start-up clock time count down **3.3.5** Have a trained service mechanic check the function of all control setpoints. Check signal lights for proper operation.

3.3.7 Take oil sample from each compressor and submit it for laboratory analysis.

3.4 REFRIGERATION CYCLE

Refer to Figure 3.4 Typical Piping Schematic for:

1 compressor - WCFX 19S, 20S, 23S, 24S, 27S, 30S, 36S, 41S, 46S

2 compressors - WCFX 38T, 40T, 46T, 50T, 54T, 57T, 60T, 73T, 75T, 81T, 90T

Dual condition units have same cycle as standard units.

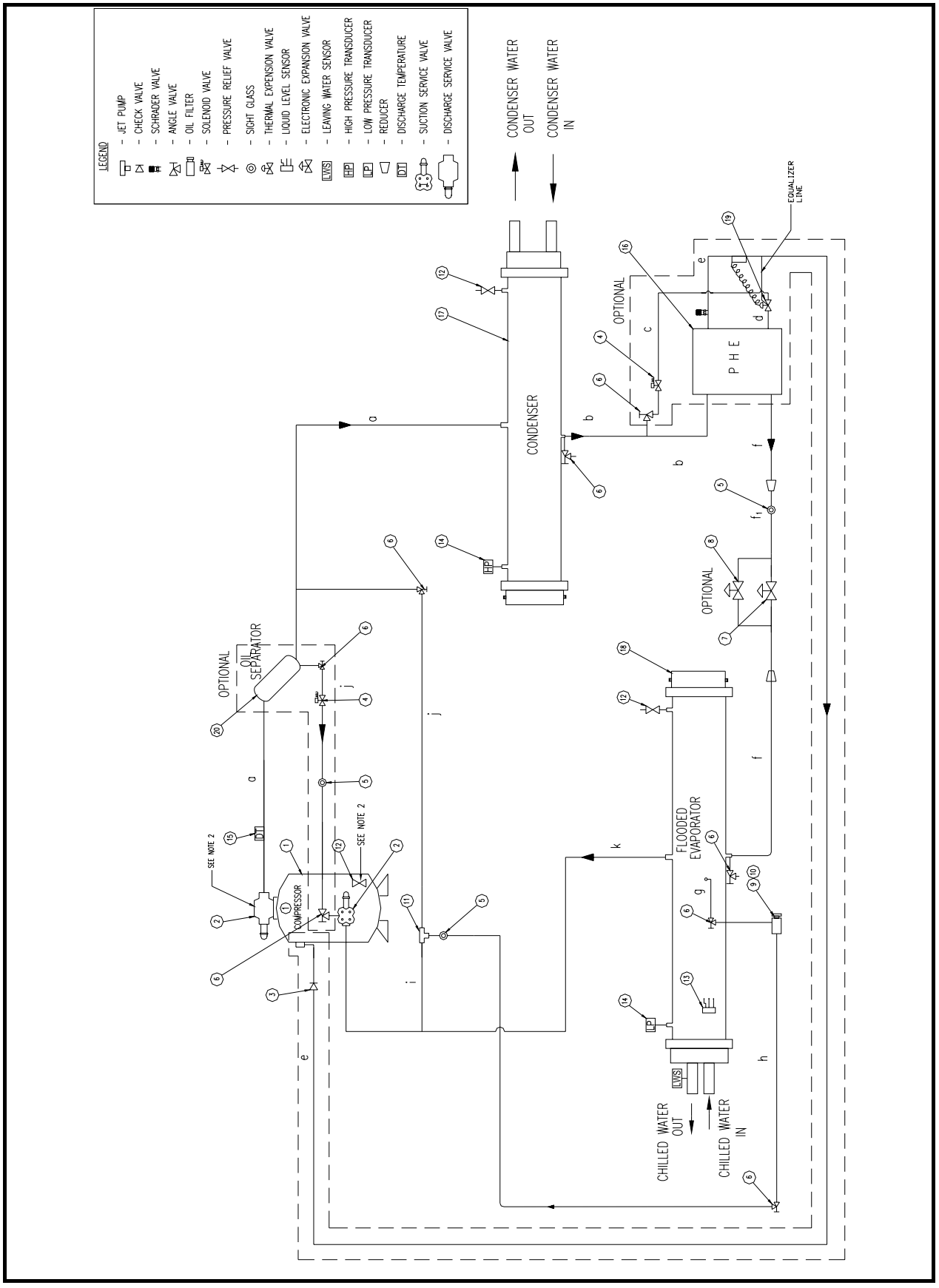
Each vertical screw compressor discharges hot and high pressure gas through a discharge service valve (or check valve in multiple compressor units) into the condenser, where it condenses by rejecting heat to water inside the tubes. The liquid refrigerant drains to the bottom of the condenser and exits from the bottom side, then the liquid line separate to two lines, one line refrigerant feed TXV before economizer, absorb heat from the other line refrigerant inside economizer which is at an intermediate pressure between condenser and evaporator, and turn to gas back to compressor vapor injection port, the other line refrigerant get some subcooling and drain to ball valve before evaporator. Ball valve is actuated by a motor that adjusts flow to maintain an appropriate refrigerant level in the evaporator, which is determined by a liquid level float switch. liquid refrigerant flows into the flooded evaporator, where it boils, by absorbing heat from the water flowing inside evaporator tubes. Vapor from the boiling refrigerant flows up the suction pipes through a shut-off valve (optional), suction check valve and suction filter (inside compressor) into the compressor where it is compressed and starts the cycle again.

Economizer return vapor will feeds it into the compressor part way through the compression process. Check valve prevents backflow at shutdown in multi-compressor units. All compressors operate in parallel on a common evaporator and condenser.

3.0 OPERATION

Figure 3.4 Typical Piping Schematic

1.) 1 Compressor – WCFX-V 19S, 20S, 23S, 24S, 27S, 30S, 36S, 41S, 46S



3.0 OPERATION

2.) 2 Compressors - WCFX 38T, 40T, 46T, 50T, 54T, 57T, 60T, 73T, 75T, 81T, 90T

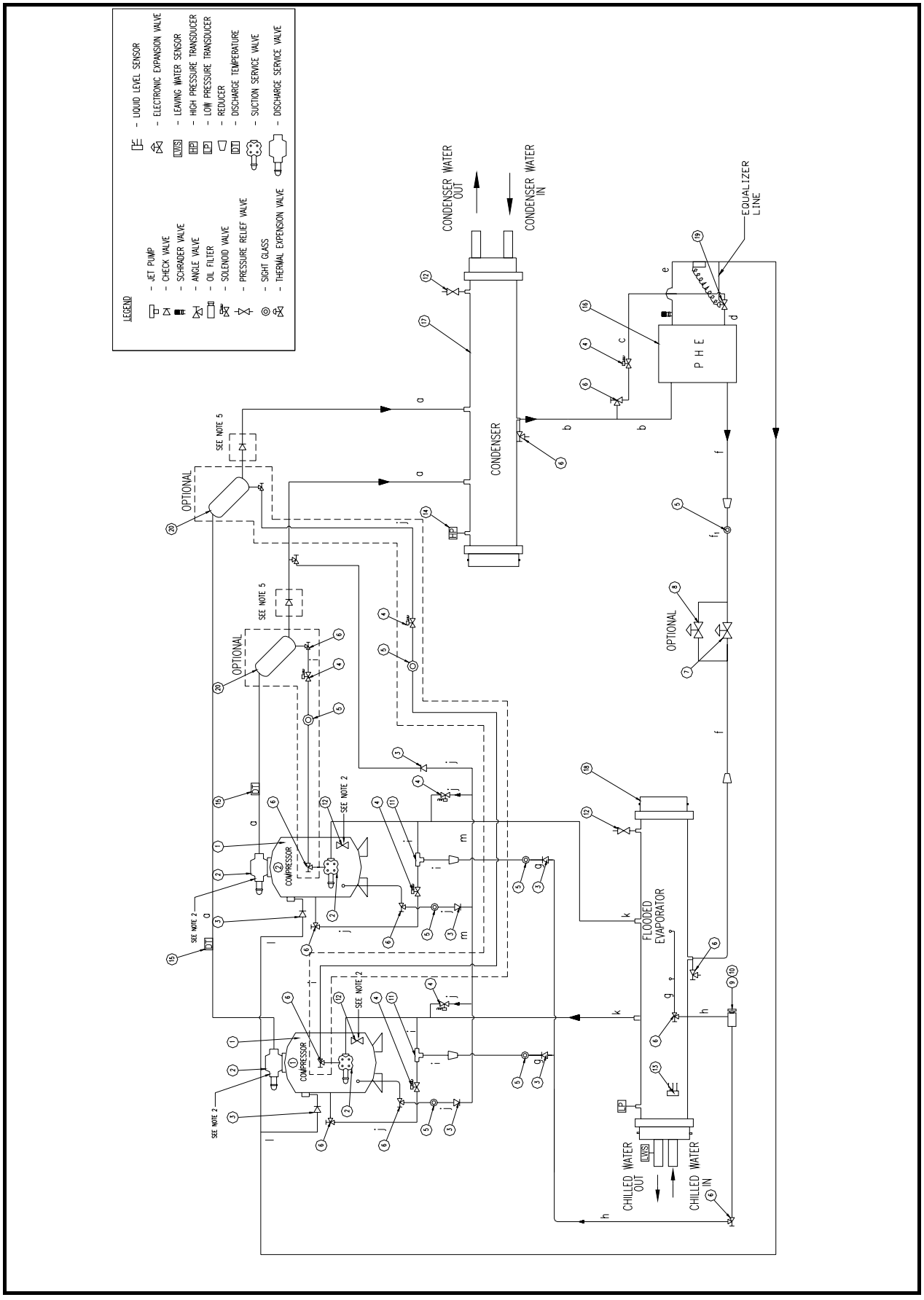


TABLE 1

ITEM	DESCRIPTION	NOTE
1	MSC ROTARY SCREW COMPRESSOR	
2	VALVE, SERVICE	
3	VALVE, CHECK	
4	VALVE, SOLENOID	
5	SIGHT GLASS	
6	VALVE, ANGLE / ROTALOCK	
7	ELECTRONIC EXPANSION VALVE	
8	ELECTRONIC EXPANSION VALVE	OPTIONAL
9	DRIER, SHELL	
10	DRIER, CORE	
11	JETPUMP EJECTOR	
12	VLV, RELF.	
13	SWT - LIQ LEVEL	
14	P. TRANSMITTER 0 - 5V / 0-500 PSI	
15	NTCO30HT TEMP. PROBE 3M	
16	PLATE HEAT EXCHANGER	
17	CONDENSER	
18	EVAPORATOR	
19	THERMAL EXPANSION VALVE	
20	OIL SEPARATOR	
21	VLV, RELF. 450 PSI	OPTIONAL
22	OIL SEPARATOR	OPTIONAL
23	VALVE, ANGLE	OPTIONAL
24	DRIER, FILTER	OPTIONAL
25	VALVE, SOLENOID	OPTIONAL
26	SIGHT GLASS	OPTIONAL

TABLE 2 (A)

PIPING SIZE	
ITEM	LINE SIZE
a	4 1/8, 3 1/8, 3 5/8
b	2 5/8, 1 1/8, 1 3/8, 1 5/8, 2 1/8
c	1 1/8, 5/8, 7/8
d	1 3/8, 1 1/8
e	2 5/8, 1 3/8, 1 5/8
f	2 1/8, 1 1/8, 1 3/8, 1 5/8
f_1	1 1/8, 1 3/8, 2 1/8
g	5/8
h	1 1/8, 7/8
i	7/8
j	3/8
k	5 1/8, 3 5/8, 4 1/8
l	1 5/8
m	1 1/8

TABLE 2 (B)

PIPING SIZE		PIPING MATERIAL		
		THICKNESS		MATERIAL
INCHES	MILLIMETER	INCHES	MILLIMETER	
3/8"	9.5	0.060	1.52	SB75 C12200 SMLS PIPE (050)
5/8"	15.9	0.060	1.52	
7/8"	22.2	0.060	1.52	
1 1/8"	28.6	0.060	1.52	
1 3/8"	34.9	0.060	1.52	
1 5/8"	41.3	0.060	1.52	
2 1/8"	54.0	0.070	1.80	SB75 C12200 SMLS PIPE (H80)
2 5/8"	66.7	0.080	2.00	
3 1/8"	79.0	0.090	2.30	
3 5/8"	92.1	0.100	2.50	
4 1/8"	104.8	0.110	2.80	
5 1/8"	130.2	0.120	3.05	

NOTE:
1. THIS SCHEMATIC PIPING DIAGRAM IS FOR UNIT WITH R134a REFRIGERANT.
2. DISCHARGE SERVICE VALVE IS OPTIONAL. IF DISCHARGE SERVICE VALVE IS NOT INSTALLED, THEN VAL. RELIEF IS OMITTED.
3. CHECK VALVE AT HOT GAS RELIEF LINE MUST BE INSTALLED IN SUCH A WAY THAT THE FLOW IS TOWARDS DISCHARGE LINE. 25LB SPRING MUST BE INSTALLED INTO THE CHECK VALVE.
4. THE DESIGN PRESSURE FOR R134a IS THE MAXIMUM PRESSURE AT DIFFERENT LINES. WORKING PRESSURE WILL BE LESSER THAN THE INDICATED DESIGN & TEST PRESSURE WHICH SHOWN IN TABLE 3.
5. DISCHARGE CHECK VALVE CAN BE LOCATED BEFORE OR AFTER THE OIL SEPARATOR

TABLE 3

	DESIGN PRESSURE	TEST PRESSURE
DISCHARGE LINE	200 PSI	286 PSI
LIQUID LINE		
SUCTION LINE		

TABLE 4

MIN. TEMPERATURE	MAX. TEMPERATURE
35°F	150°F

3.0 OPERATION

3.5 OIL MANAGEMENT SYSTEMS

The compressor is oil lubricated and discharges a small amount of oil mist along with refrigerant. This oil is carried into the evaporator. Oil rich refrigerant is returned from the evaporator through a tap in the shell, oil return valve, filter drier, angle valve, sight glass and into jet pump installed on the suction line. The jet pump is powered by high pressure gas from the compressor discharge line through hot gas feed valve. This forces the oil rich mixture from the evaporator through oil return valve into the suction line where it is carried into the compressor.

The hot gas valve should be opened enough only to allow good oil return when the unit is fully unloaded. (1/8 to 1/2 turn). Excessive oil return will lower discharge superheat un-desirably. The oil return valve should be left wide open. In normal operation, no oil level will be visible in the compressor sight glass.

3.6 SYSTEM START UP

1. Before starting the compressor(s), check all three phases of supply voltage, of all legs of the motor. They must be within ±10% of the nameplate voltage. Check to be sure compressor is not running backwards.
2. Start compressor(s), check the gages and note if the pressures are within the prescribed limits
3. Stage unit down until all compressors are off and check the compressor crankcase sight glass for oil level. It should be 1/2 to 3/4 of the compressor sight glass.
4. The electrical control settings should be checked and if necessary, reset to those settings indicated on the wiring diagram. Safety controls are factory set and must be maintained at settings indicated on the wiring diagram.
5. The temperatures of the chilled water both in and out, should be checked to insure the unit is operating within the desired temperatures.

3.7 SYSTEM STANDSTILL

- The temperatures of the chilled water both in and out, should be checked to insure the unit is operating within the desired temperatures.
- Under steady-state operating conditions, check refrigerant piping or capillary tubes for abnormal vibrations.
- After 2-5 hours of operations under established conditions, check the oil level and add oil if necessary. If oil return continues to perform poorly, further investigation of the piping design is required.
- When necessary, refrigerant can added in the liquid phase, carefully throttling the refrigerant on the low-pressure side and as far as possible from the compressor.

Important: Do not overcharge the system.

Note: Observe any abnormal running noise; ensure the absence of any liquid flood-back to the compressor by measuring the return gas superheat and compressor sump temperature.

3.8 SHUT-DOWN (Overnight or Weekend)

To shut down in the unit with compressors on or off, turn each individual compressor switch. Do not close any valve. The chilled water pump shall then be turned off. Finally, do not open the main unit disconnect. Main power is required to keep the sump heaters.

Important: Discontinue chilled water pump operation when unit is not operational.

Note: For chillers operating in low ambient, if it is possible that the overnight ambient will drop below 45°F [7.2°C], it is preferable to leave the chilled water pump on.

3.9 SAFETY RELIEF VALVES

Each pressure vessel is protected by a safety relief valve as required by ASME Code. Each compressor is protected by a relief valve which is vented to atmosphere. Never install any kind of shut-off valve in a safety relief vent line.

Local codes may require that all safety relief valves be piped to the outdoors.

3.10 PIPING JOINTS

Joints shall be designed so that they will not be damaged due to the freezing of water on the outside. They shall be suitable for the pipe, the piping material and the pressure, temperature and fluid. Coated (e.g. galvanized) pipes shall not be welded, unless all coating has been completely removed from the joint area. Welded joints shall be suitably protected.

The piping material is copper. The joint material is silver alloy (argentum, copper, cadmium and zinc). The welding joint is used at evaporator steel pipe. Not for piping. The welding joint is protected well with epoxy paint.

In general, detachable joints shall only be used where permanent joints for technical reasons are not appropriate. The detachable joints are included Flanged joint, Flared joints, Taper pipe threads and Compression joints.

3.0 OPERATION

3.11 ANTI-FREEZE PROTECTION

3.11.1 DESUPERHEATERS

A hot gas desuperheater can be factory supplied for field installation. Tees in refrigerant lines with shut off valves can be supplied. Consult factory for further details.

3.11.2 WATER CIRCUIT

Constant water flow required with a minimum of 3 gallons per ton (3.3 liters/ kWo) increasing up to 10 gallons (11 lifers) for process, low load applications with small temperature ranges and/or vastly fluctuating load conditions.

3.11.3 GLYCOL FREEZE PROTECTION

If the chiller or fluid piping may be exposed to temperatures below freezing, glycol protection is recommended if the water is not drained. The recommended protection is 10°F [5.6°C] below the minimum ambient temperature in the equipment room and around piping. Use only glycol solutions approved for heat exchanger duty. DO NOT use automotive anti-freezing.

If the equipment is being used to supply chilled fluid 38°F [3.3°C] or below, glycol should be used to prevent freeze damage. The freeze protection level should be 15°F [8.3°C] lower than the leaving brine temperature.

The use of glycol causes a performance derate as shown below which needs to be included in the unit selection procedure.

Ethylene Glycol

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

Propylene Glycol

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

Evaporator Fouling Factor

Fouling Factor		Capacity Correction Factor	kW Correction Factor
hr.ft².°F/BTU	m².°C/kW		
0.00010	0.018	1.000	1.000
0.00025	0.044	0.992	0.998
0.00050	0.088	0.979	0.995
0.00075	0.132	0.967	0.991
0.00100	0.176	0.955	0.987

Condenser Fouling Factor

Fouling Factor		Capacity Correction Factor	kW Correction Factor
hr.ft².°F/BTU	m².°C/kW		
0.00025	0.044	1.000	1.000
0.00050	0.088	0.992	1.018
0.00075	0.132	0.983	1.036
0.00100	0.176	0.973	1.054

IMPORTANT:

- Depending on the climatic conditions, add glycol with an adequate concentration as shown in table for ethylene glycol and table for propylene glycol to protect the chiller or the water piping at the installation site.
- If the system will not be used during the freezing weather conditions and is not protected by an antifreeze solution, draining of the evaporator and outdoor piping is mandatory.
- In cases where it is not possible to apply the recommendations in above paragraph, the circulating pump with immersion heater is another optional item to protect the evaporator against frost.

3.0 OPERATION

3.12 HYDRAULIC CAPACITY CONTROL SYSTEM
(See Figure 3.12.)

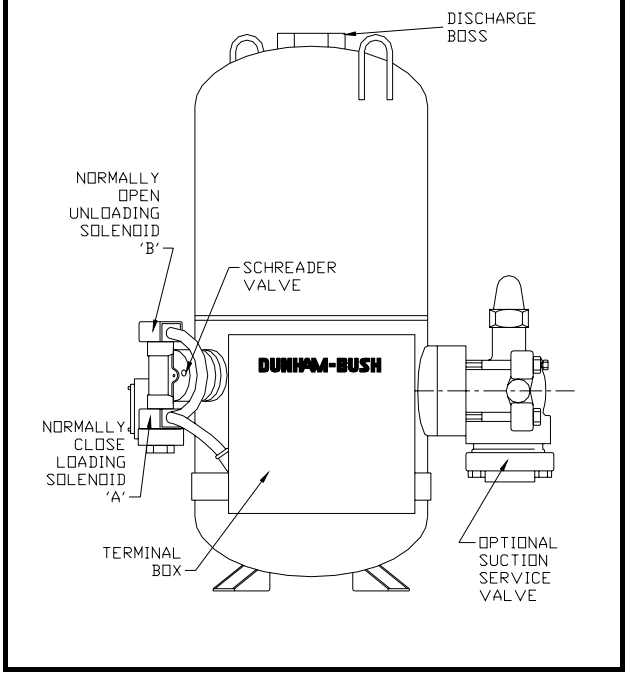
Each compressor has a hydraulic control system to position the capacity control slide valve, in order to regulate compressor capacity. It is composed of a normally closed solenoid valve, a normally open solenoid valve and internal pressure regulating valve.

With valves A and B both energized (A open, B closed) during normal compressor operation, high pressure oil is directed to the slide valve. The pressure acting on the surface of the slide valve piston creates a force which is sufficient to overcome the opposing spring force and to move the valve in the direction of increasing capacity. When the compressor is given a "hold" command, valve A is de-energized (closed) and slide valve movement is halted. The internal pressure regulating valve allows oil to bleed from the slide valve chamber during the hold condition. If valve B is then de-energized (open), the high pressure oil acting on the slide valve will be vented to suction, and the pressure in the slide valve chamber will be reduced. The slide valve spring will now move the piston back toward the minimum capacity position.

Under standard conditions, the compressor will load in 60 seconds and unload in 55 seconds.

Figure 3.12 Hydraulic Control System

	SLIDE VALVE POSITION		
	UNLOADING	**LOADING**	**HOLD**
SOLENOID VALVE A (NORMALLY CLOSED)	CLOSED (DE-ENERGIZED)	OPEN (ENERGIZED)	CLOSED (DE-ENERGIZED)
SOLENOID VALVE B (NORMALLY OPEN)	OPEN (DE-ENERGIZED)	CLOSED (ENERGIZED)	CLOSED (ENERGIZED)



3.13 FREEZE PREVENTION

If water (or brine) is allowed to freeze within the tubes and headers of the evaporator or condenser, severe damage will result; e.g. split and leaking tubes and cracked and leaking headers. Since this damage can be extremely costly and is not covered by warranty, it is important to be mindful of freeze prevention. Three cases deserve particular attention:

3.13.1 STANDBY AT LOW AMBIENT TEMPERATURES

If the unit is to stand idle at ambient temperatures below 32°F [0°C], the water should be drained from evaporator and condenser. A header should be removed from each vessel and the tubes should be blown dry with compressed air. Gravity draining the vessel through drains in headers may not be sufficient. If evaporator or condenser is served with a glycol solution, make sure the freeze temperature of the solution is lower than the expected minimum ambient temperature.

3.13.2 IN OPERATION

Freezing of water in evaporator tubes is a possibility if chilled water flow stops and if the low suction pressure cutout (normally set for 28 psig [1.9BAR], or 32°F [0°C] saturation) and the low water temperature cutout both fail. If the chilled water flow switch and pump interlock are properly applied (See 2.6.1.1 and 2.6.1.2) the unit has four protective devices which must all fail in order to freeze the evaporator in operation. While this is unlikely, it is important to see that all these devices are functional and properly calibrated.

3.13.3 DURING MAINTENANCE

In transferring refrigerant within the unit, or removing refrigerant from the unit for maintenance purposes, it is possible to freeze evaporator or condenser tubes. Remember that whenever the pressure in a vessel is reduced below 28 psig [1.9BAR], if water is not flowing, it is possible to freeze the tubes. For this reason, it is a good precaution to have water flowing in both vessels whenever transferring refrigerant.

4.0 ELECTRICAL

4.1 ELECTRICAL DATA

50Hz

Power Supply	380VAC±10%					400VAC±10%				
Model WCFX-V	Unit		Compressor			Unit		Compressor		
	Max. Fuse Size	Min. Circuit Ampacity	Compressor Model	RLA	LRA	Max. Fuse Size	Min. Circuit Ampacity	Compressor Model	RLA	LRA
19S	300	189	1220(1)	151	741	300	180	1220(1)	144	704
20S	400	233	1222(1)	186	887	400	221	1222(1)	177	843
23S	400	241	1222(1)	193	887	400	241	1222(1)	193	843
24S	400	276	1227(1)	221	1094	400	261	1227(1)	209	1040
27S	500	300	1227(1)	240	1094	500	285	1227(1)	228	1040
30S	600	339	1230(1)	271	1209	500	321	1230(1)	257	1149
36S	700	393	2233(1)	314	1614	600	373	2233(1)	298	1534
41S	800	451	2236(1)	361	2130	700	429	2236(1)	343	2024
38T	400	340	1220(2)	151(2)	741(2)	400	324	1220(2)	144(2)	704(2)
40T	600	419	1222 (2)	186(2)	887(2)	500	398	1222 (2)	177(2)	843(2)
46T	600	434	1222(2)	193(2)	887(2)	600	434	1222(2)	193(2)	843(2)
46S	800	476	2246(1)	381	1752	700	452	2246(1)	362	1664
50T	700	493	1222(1)/ 1227(1)	193/ 240	887/ 1094	700	478	1222(1)/ 1227(1)	193/ 228	843/ 1040
54T	700	540	1227(2)	240(2)	1094(2)	700	513	1227(2)	228(2)	1040(2)
57T	800	579	1227(1)/ 1230(1)	240/ 271	1094/ 1209	800	549	1227(1)/ 1230(1)	228/ 257	1040/ 1149
60T	800	610	1230(2)	271(2)	1209(2)	800	578	1230(2)	257(2)	1149(2)
73T	1000	707	2233(2)	314(2)	1614(2)	800	671	2233(2)	298(2)	1534(2)
75T	1000	765	2233(1)/ 2236(1)	314/ 361	1614/ 2130	1000	727	2233(1)/ 2236(1)	298/ 343	1534/ 2024
81T	1000	812	2236(2)	361(2)	2130(2)	1000	772	2236(2)	343(2)	2024(2)
90T	1000	857	2246(2)	381(2)	1752(2)	1000	815	2246(2)	362(2)	1664(2)

60Hz

Model WCFX-V	Unit			Compressor		
	Power Supply	Max. Fuse Size	Min. Circuit Amp.	Compressor Model	RLA	LRA
19S	460VAC ±10%	300	189	1220(1)	151	741
20S		400	233	1222(1)	186	887
23S		400	241	1222(1)	193	887
24S		400	276	1227(1)	221	1094
27S		500	300	1227(1)	240	1094
30S		600	339	1230(1)	271	1209
36S		700	393	2233(1)	314	1614
41S		800	451	2236(1)	361	2130
38T		400	340	1220(2)	151(2)	741(2)
40T		600	419	1222 (2)	186(2)	887(2)
46T		600	434	1222(2)	193(2)	887(2)
46S		800	476	2246(1)	381	1752
50T		700	493	1222(1)/ 1227(1)	193/ 240	887/ 1094
54T		700	540	1227(2)	240(2)	1094(2)
57T		800	579	1227(1)/ 1230(1)	240/ 271	1094/ 1209
60T		800	610	1230(2)	271(2)	1209(2)
73T		1000	707	2233(2)	314(2)	1614(2)
75T		1000	765	2233(1)/ 2236(1)	314/ 361	1614/ 2130
81T		1000	812	2236(2)	361(2)	2130(2)
90T		1000	857	2246(2)	381(2)	1752(2)

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

4.2 WIRING DIAGRAM

Figure 4.2 shows the typical wiring diagram for 1, 2 & 3 compressors unit. It is best to use the wiring diagram mounted in the package control panel. A copy of that diagram is furnished with the unit owner's manual.

4.3 TYPICAL OPERATION

In order to start a compressor; the following conditions must be met:

- Correct system voltage and phase sequence such that phase control relay (PCR) is in normal state
- Chilled water pump running
- Chilled water flow switch made
- Compressor circuit breakers on
- Customer unit control contact closed
- Control switch and compressor switches on
- Power has been on the microcomputer for 15 minutes
- Reset pressed on microcomputer keypad
- All safety conditions satisfied
- Leaving chilled water temperature 2°F [1.1°C] or more above setpoint

A compressor is started by turn on the VFD. The compressor will ramp from minimum frequency and thus the inrush current is lowered/ eliminated. Anti-recycle time of 15 minutes is initiated within the computer at start.

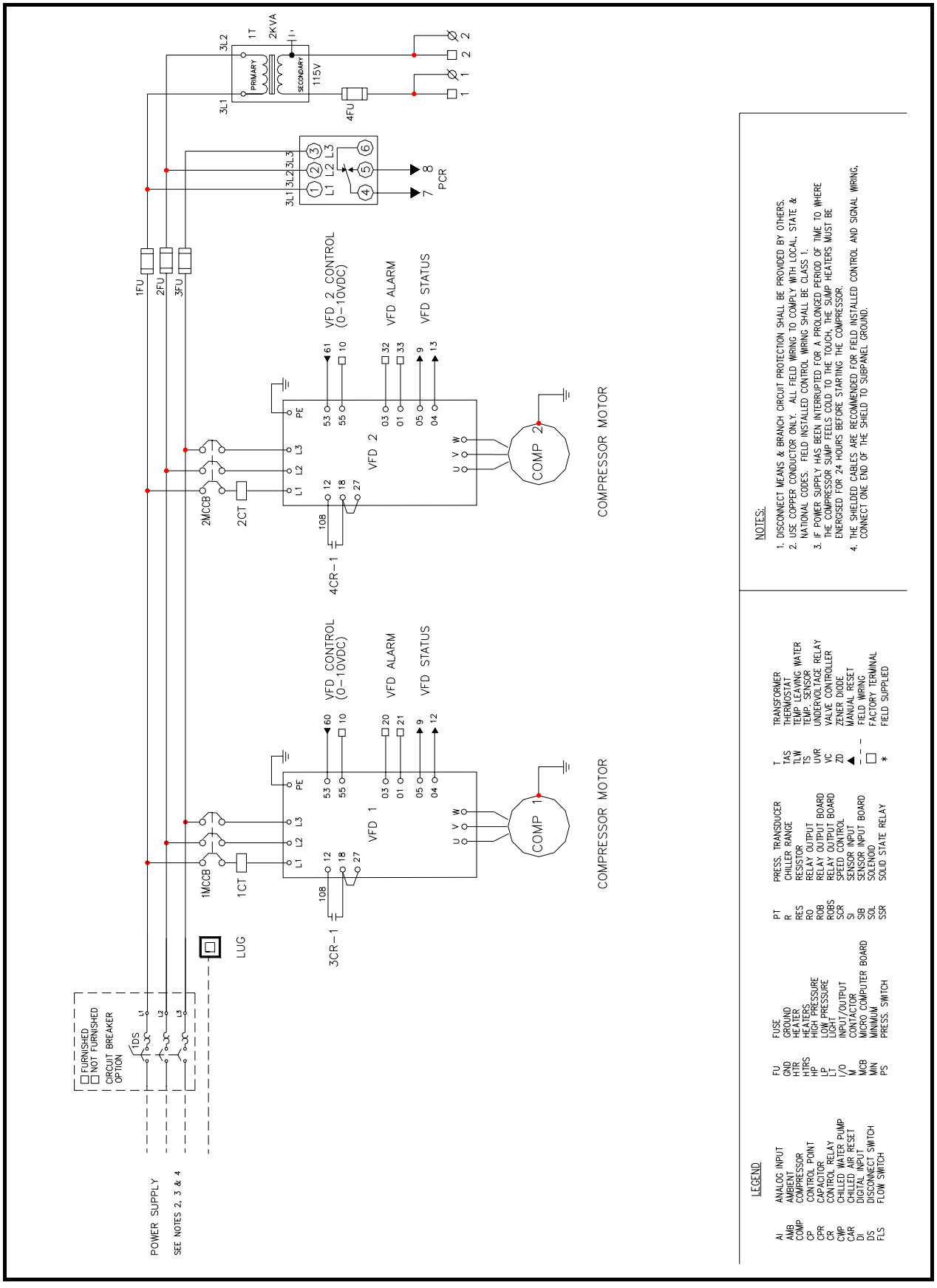
When the compressor starts, the micro-computer monitors amperage by means of 1CT, leaving water temperature using TS, and condensing pressure. These inputs are used to control the loading and staging of the compressor. The compressor's loading is controlled by pulsing signals to the load and unload solenoids.

To shut down the unit automatically, the customer control contacts must be opened. To shut down the unit manually, simply shut off the compressor switches. This will cause a no-run alarm that must be reset to restart the compressor.

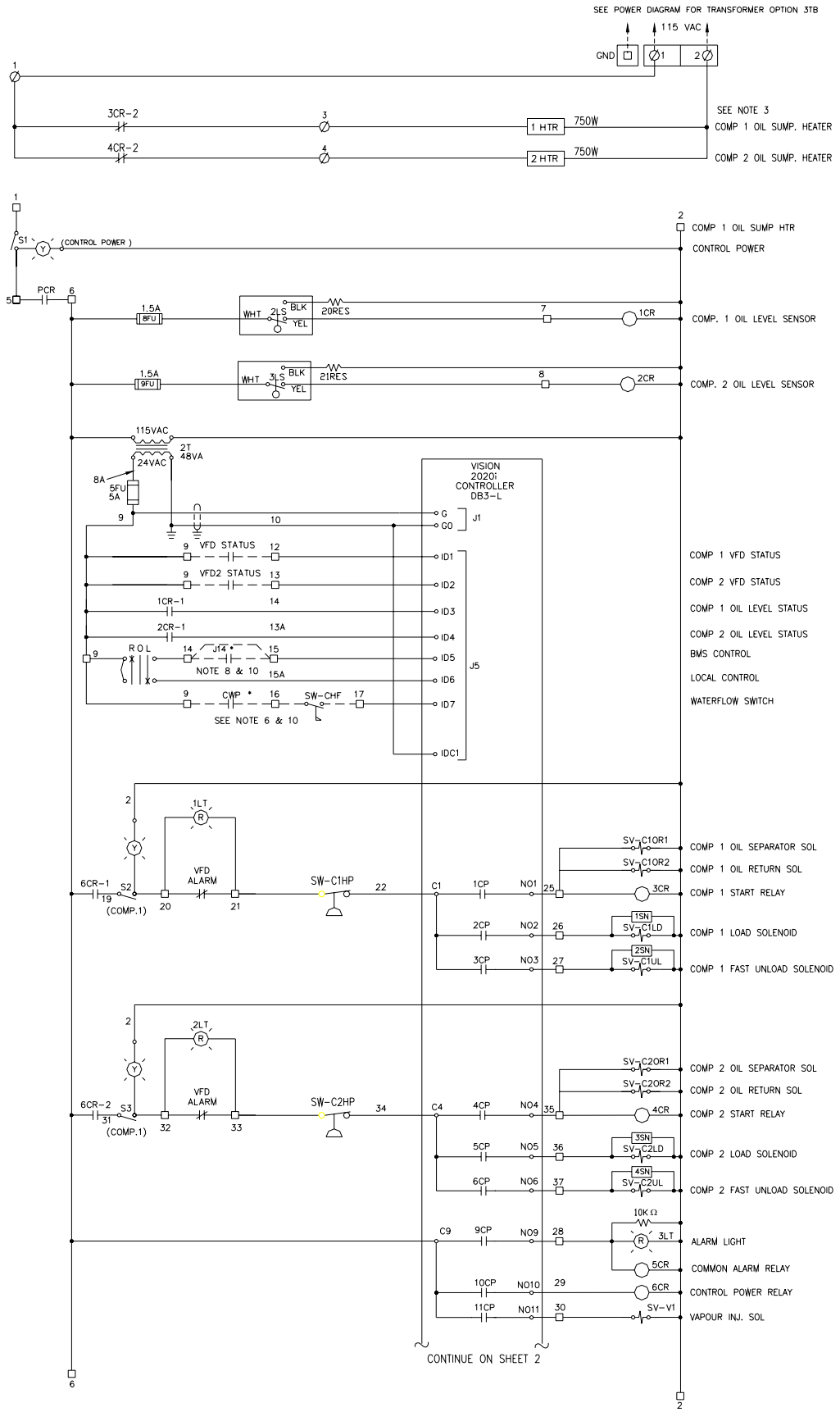
4.0 ELECTRICAL

Figure 4.2 Typical Wiring Schematic

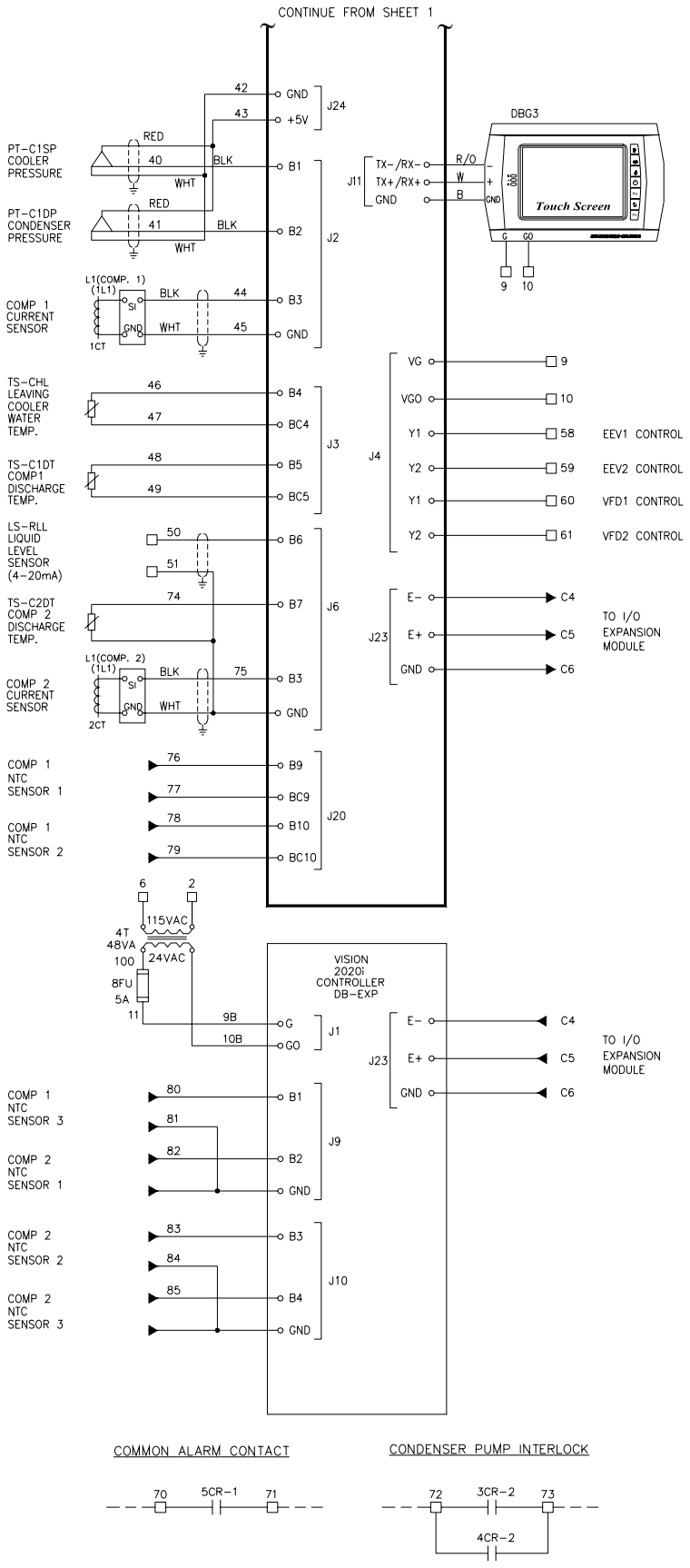
2 Compressors Units (Vision 2020i)



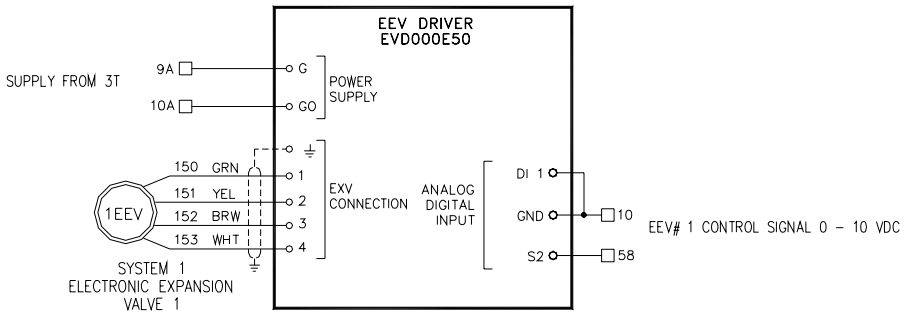
4.0 ELECTRICAL

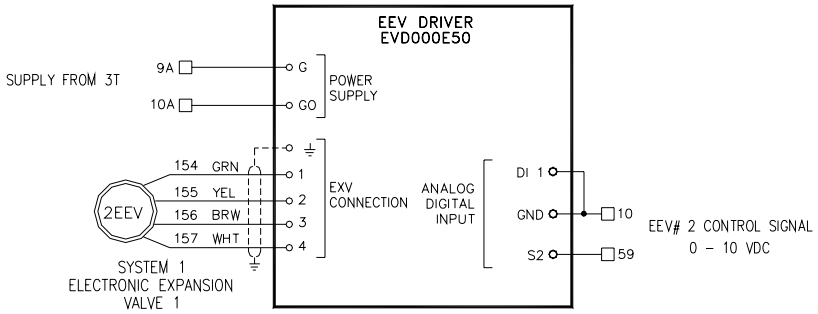


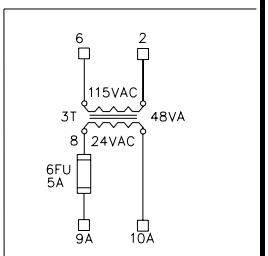
4.0 ELECTRICAL

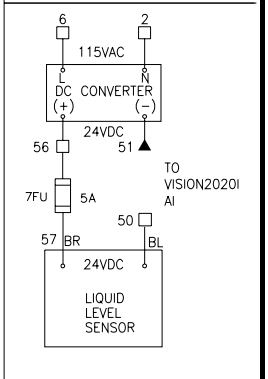


4.0 ELECTRICAL









4.0 ELECTRICAL

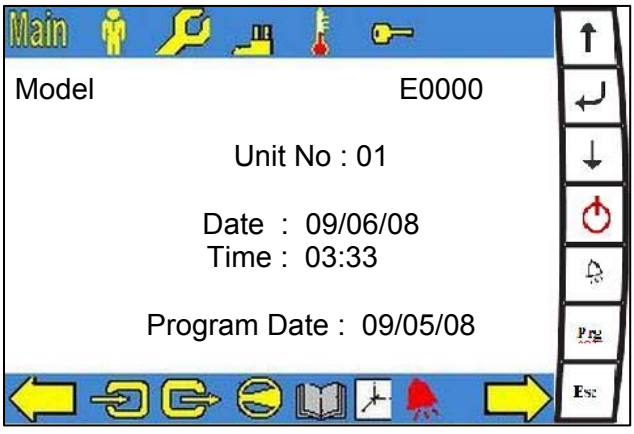
4.4 VISION 2020i CONTROLLER AND TERMINAL

Vision 2020i controller is equipped with user friendly 5.7" touch screen display with 256 colors and 320 × 240 pixel on graphic resolution. It is connected with controller through twisted pair shielded cable. The graphic display terminal allows carrying out all program operations. The user terminal allows displaying the unit working conditions, component run times, alarm history at any time and modifying the parameters. The terminal also has an automatically self-test of the controller on system start-up. Multiple messages will be displayed by automatically scrolling from each message to the next. All of these messages are spelled out in English language on the screen.

4.4.1 TOUCH SCREEN TERMINAL DISPLAY

The touch screen keypad consists of 14 touch keys, and 7 physical keys:

Figure 4.4.1 Vision 2020i keypad



The top right 'Authorization' button is for password log in to gain authorization, to the access setting menu.

The three buttons at the top row which is to access different level of setting changes. These are 'User', 'Technician' and 'Factory' levels.

It can only be access depend on the password level. The higher password can access the lower password level's setting and not vice versa.

4.4.1.1 The fourteen touch keys:

Key		Description
Main	MAIN	Display the main screen
	USER	User Control Changeable Settings.
	TECHNICIAN	Technician Control Changeable Settings.
	FACTORY	Factory Control Changeable Settings.
	SETPOINT	Displays the status of set points.
	AUTHORIZATION	To log in the level of passwords
	MENU	Unit information / Compressor Information.
	CLOCK/SCHEDULE	Displays the date, time and day.
	ALARM RESET	Display the active alarms and to perform alarm manual resets.
	LEFT	Scroll the various screens when the cursor is in the top left of the display. If the cursor is inside a numeric field, the button increases or decreases the corresponding value. If the field is a selection, pressing the button displays the available options.
	RIGHT	See the LEFT arrow
	INPUT STATUS	Displays the analog inputs and digital inputs status measured by the probes/sensors.
	OUTPUT STATUS	Displays the relay outputs and analog outputs status.
	COMPRESSOR STATUS	Displays the status of Compressor 1, 2 and so on.

4.4.1.2 The seven physical keys:

Key		Description
	UP	Scroll the various screens when the cursor is in the top left of the display. If the cursor is inside a numeric field, the button increases or decreases the corresponding value. If the field is a selection, pressing the button displays the available options.
	ENTER	To move the cursor around the screens and to save the values of the set parameters
	DOWN	See the UP arrow
	MENU	Unit information / Compressor Information.
	ALARM RESET	Display the active alarms and to perform alarm manual resets.
Prg	AUTHORIZATION	To log in the level of passwords
Esc	INPUT STATUS	Displays the analog inputs and digital inputs status measured by the probes/sensors.

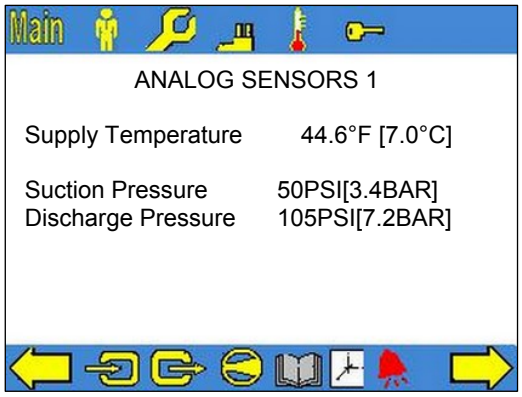
4.0 ELECTRICAL

4.4.2 STATUS READING

4.4.2.1 Input status key

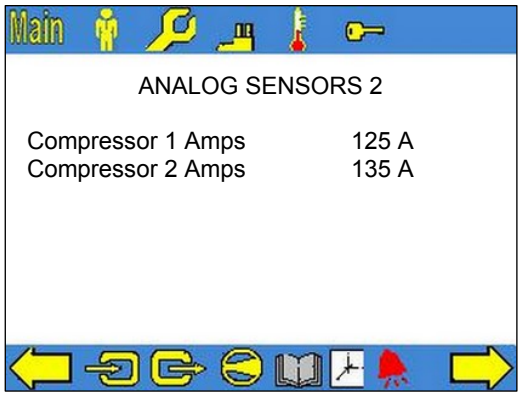
To read inputs status, touch on input status key:

The display is showing the data as follows:



Touch on right arrow key or input key to go to next screen:

The display is showing the data as follows:

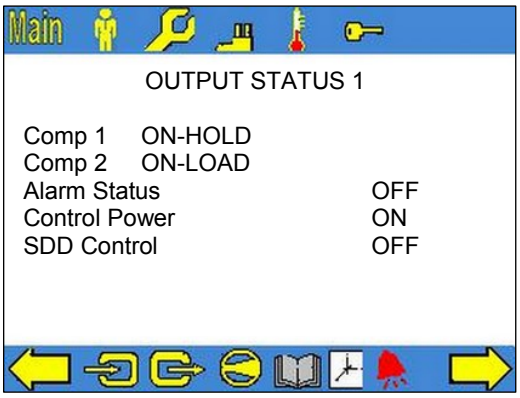


Repeat the same steps to go to other sensor inputs screen:

4.4.2.2 Output status key

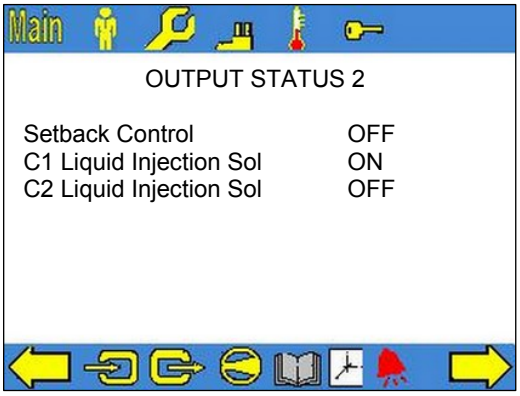
To read relay outputs status, touch output status key:

The display is showing the data as follows:



Touch on right arrow key or output key to go to next screen:

The display is showing the data as follows:

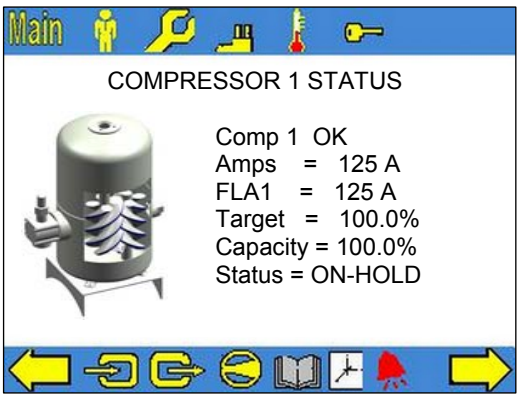


Repeat the same steps to go to other relay outputs screen:

4.4.2.3 Compressor status key

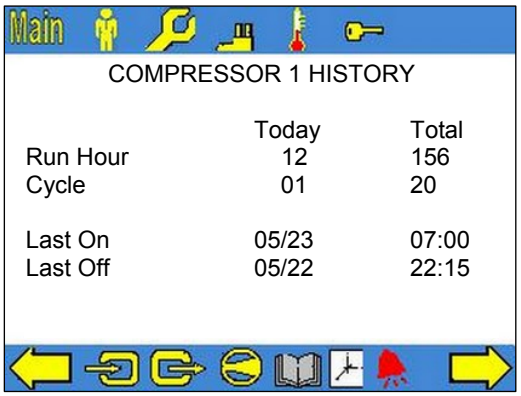
To read compressor status, touch on compressor status key:

The display is showing the data as follows:



Touch on right arrow key or compressor key to go to next screen:

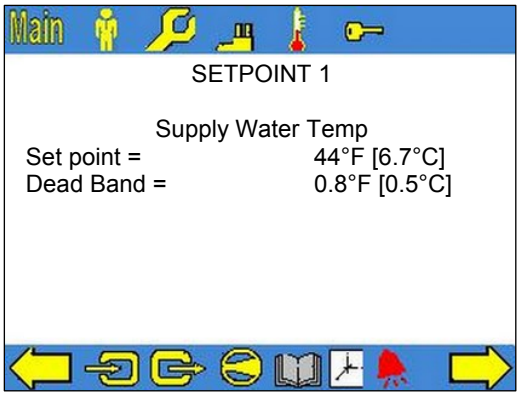
The display is showing the data as follows:



4.4.2.4 Setpoint key:

To read the setpoint value, touch on setpoint key

The display is showing the data as follows:



To alter set point data, you must be authorized. See the authorization procedure and you must be authorized at least as user level.

Touch on the selected set point which written in blue color and underlined. Use the keypad to key in the desired setpoint and press **OK** key to confirm the change. If the value you key in is out of acceptable range, the setpoint will not change and the keypad will remain to receive another value.

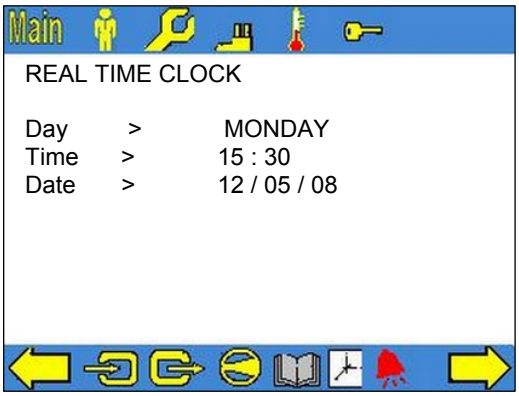
Touch on right arrow key or setpoint key to go to next screen:

Repeat the same steps to go to other setpoints screen and perform setpoint modification.

4.4.2.5 Clock key:

To read the current day, time and date, unit scheduling and Ice-cel mode scheduling (optional), touch on the clock key

The display is showing the data as follows:



To set the date and time, you must be authorized. See the authorization procedure and log in at least as user level.

Touch on the date or time which is written in blue color and underlined to change the setpoint. Use the up or down keys of the keypad below to change the value and touch on **OK** key to confirm.

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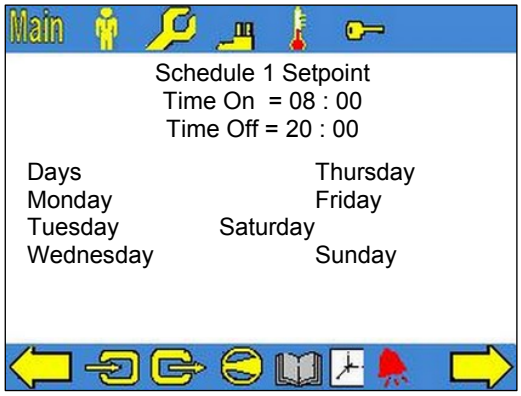
Touch on right arrow key or clock key to go to next screen:

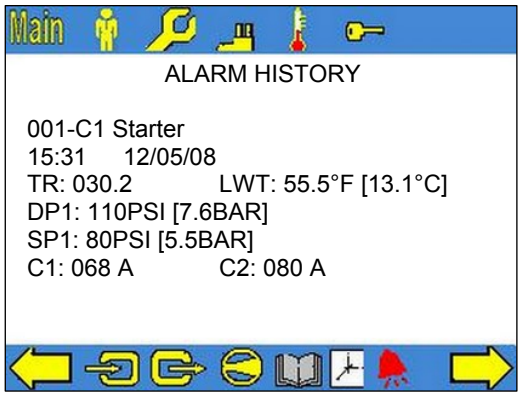
The display is showing the data as follows:



4.4.2.6 Alarm history key:

To view the unit alarm history, touch on Main key to go to main menu, and then touch on alarm history key:

The display is showing the data as follows:



Touch on left arrow key or alarm history key to go to next screen for other alarm history:

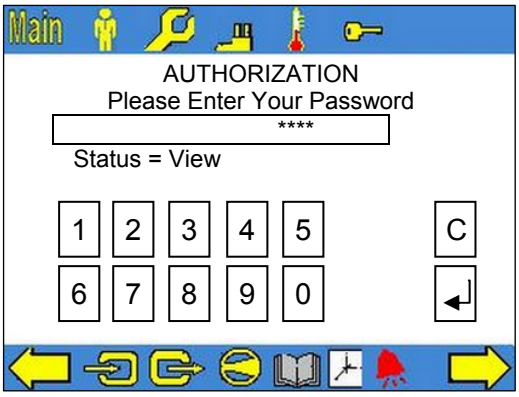
To clear alarm history, press “Prg” key and “Esc” key together at the right hand side of the terminal and then press the alarm key again. Now the display should be showing “No alarm”

4.4.3 AUTHORIZATION

4.4.3.1 Authorization key

To get authorization level, touch on authorization key:

The display is showing the current access level as view only



Key in the password by using the touch keys and touch on Enter key to confirm.

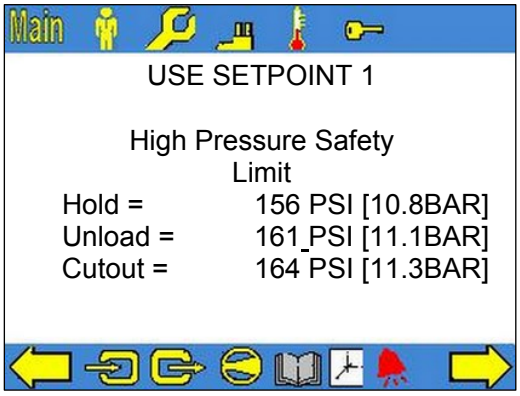
Now the authorization status changes to different access level.

4.4.4 ADVANCED USER KEY AND MENU

4.4.4.1 User Key

User key is use to view and change the pressure, ampere safety limits and liquid injection temperature set points, unit of measurements. In order to gain access to this button, you must be authorized and log in at least as user level

Touch on the user key and display is showing the data as follows:



Touch on right arrow key or user key to go to the next screen or setpoints.

To alter setpoint data, press on the setpoint which in written in blue color and underlined. Use the keypad below to change the value and press **OK** key to confirm. If the value you key in is out of acceptable range, the setpoint will not change and the keypad will remain to receive another value.

Repeat the above steps for other setpoints.

4.4.5 TECHNICIAN KEY AND MENU

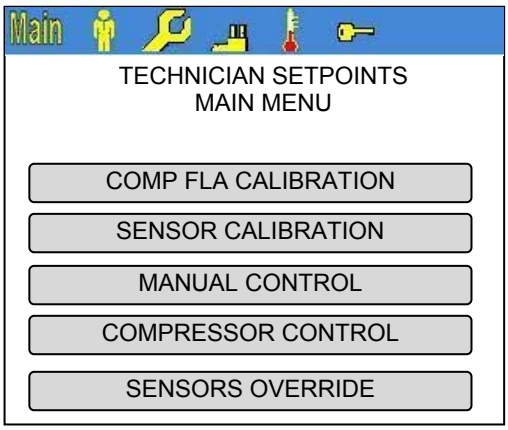
4.4.5.1 Technician status key

This key is use to view and change the compressor FLA setpoint, sensors calibration, manually control digital inputs and outputs, manually control compressor and override sensor reading. In order to gain access to this button, you must be authorized and log in at least as technician level. See the authorization section about this procedure.

4.4.5.2 Technician status key - main menu

Touch on technician key to go to technician set points main menu:

The display is showing the data as follows:

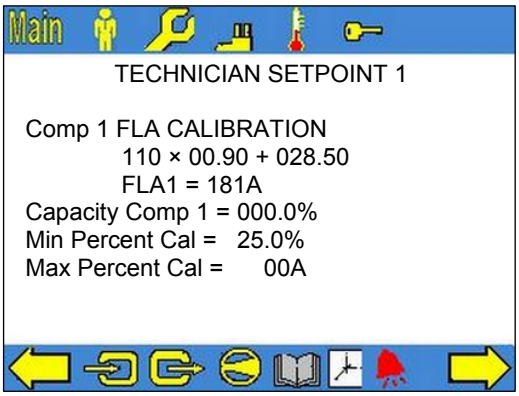


Touch on on the selected sub-menu to move the next page to the sub menu.

4.4.5.3 Compressor FLA Calibration:

To calibrate compressor FLA, touch on the sub-menu 'Comp FLA Calibration',

The display is showing the data as follows:

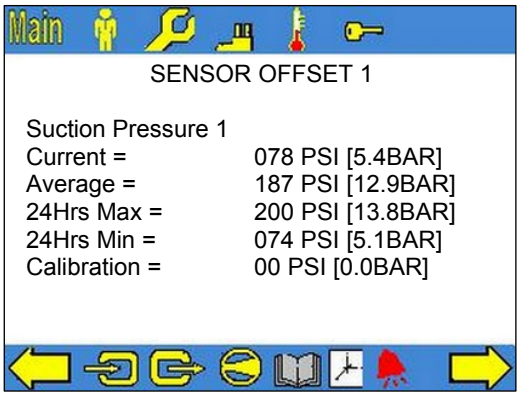


Touch on the desired setpoint with blue color and underlined to calibrate the comp FLA and use the keypad shown as below to change the value and press OK key to confirm.

4.4.5.4 To Perform Sensor Calibration:

To perform sensor calibration, touch on the 'Sensor Calibration' sub-menu:

The display is showing the data as follows:



Touch on the selected sensor calibration and key in the calibration value by using the keypad.

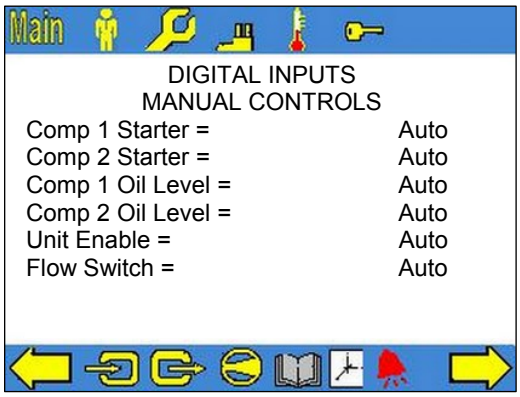
Press OK to confirm. Repeat the above steps for others sensors calibrations.

4.4.5.5 Manual Control:

A digital input sensor or relay output can be controlled manually with the keypad. Digital input sensor or relay output can be turned on, off manually and placed back to auto mode. To place a digital input or relay output in manual control, the operator must be authorized at technician level or higher.

Touch on technician key to go to technician set points main menu and touch on the 'Manual Control' sub-menu:

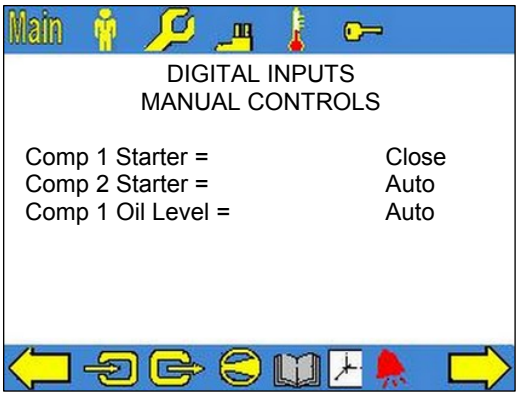
The display is showing the data as follows:



Touch on desired point with blue color and underlined for manual control.

Use the keypad shown as below to change to the desired digital input to AUTO/CLOSE/OPEN. Touch on OK to confirm.

The display is showing the data as follows:



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For manual control of digital outputs, use the following keypad to change the desired digital output to AUTO/ON/OFF. Touch on OK to confirm.

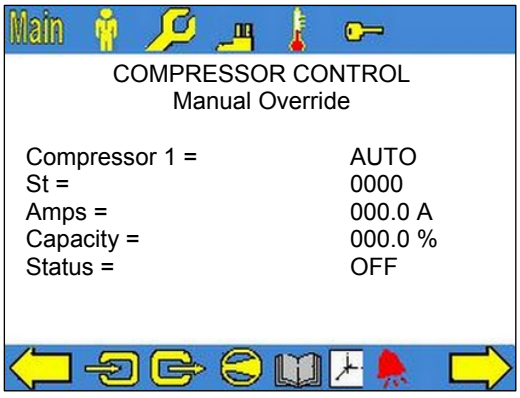
4.4.5.6 Compressor Control:

Screw compressors can be controlled manually with the keypad. A compressor can be turned on, off, or placed in computer control. When a compressor is controlled manually, it can be commanded to load, hold, or unload. If safety limiting condition is active, it will not accept a load command.

To place a compressor in manual control, the operator must be authorized and log in as technician level and higher.

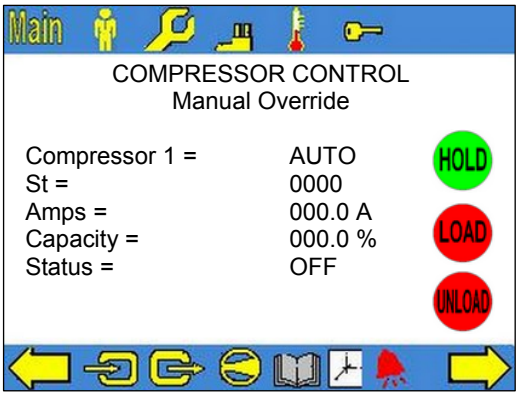
Touch on technician key to go to technician setpoints main menu and touch on the 'Compressor Control' sub-menu:

The display is showing the data as follows:



Use the keypad shown as below to change to the compressor control to AUTO/MANUAL/OFF. Touch on OK to confirm.

If the compressor control is placed on MANUAL control, the display is showing data as follow:



Touch on HOLD, LOAD or UNLOAD key to manually control the compressor running status.

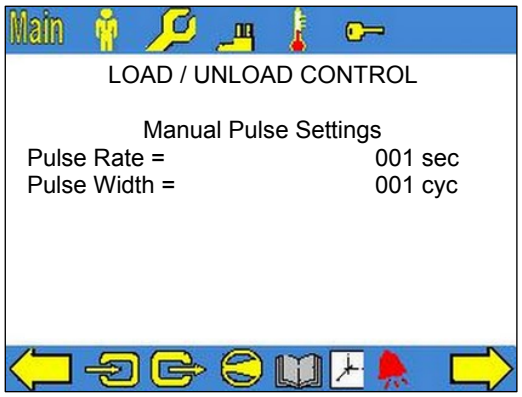
If a safety condition is exceeded while operating manually, the compressor will shutdown.

CAUTION: Anti-recycle timer is bypassed by manual control. **DO NOT** starts a compressor more than once every 15 minutes.

NOTE: All compressors will revert back to automatic control if the computer is the computer is not given a load, unload, or hold command at least once every 15 minutes. A command can be repeated to meet the 15 minute requirement for manual control.

To the change the settings of compressor load/Unload, follow the above steps and go

to compressor control. Use right arrow key to move to the following page as shown:

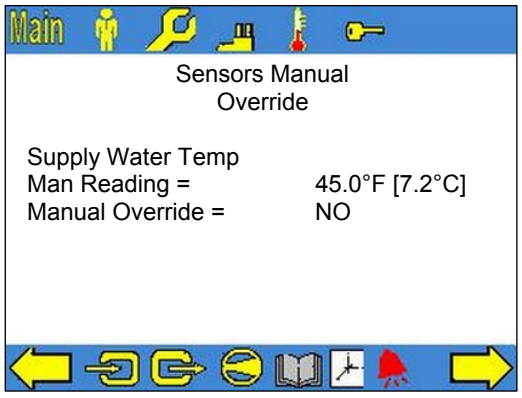


4.4.5.7 Sensors Override

Value of analog readings can be temporary override during sensor failure.

To override the analog readings, the operator must be authorized at technician level or higher.

Touch on technician key to go to technician setpoints main menu and touch on 'Sensors Override' sub-menu:
The display is showing the data as follows:



Touch on the value to key in the override reading. Then, touch on NO/YES key with blue color and underlined to enable, or disable the manual override control.

Repeat the above steps for other sensors override.

CAUTION: Sensors override require continuous monitoring and observation by the field service personnel at all time during the unit operation. Faulty sensor shall be replaced as soon as possible in order to allow the unit to be running in automatic mode.

4.4.6 CONTROL FUNCTIONS

4.4.6.1 Chilled Water Pump Interlock And Flow Switch (CWP And CWFS)

These are field installed switches, both of which are used to ensure chilled water flow before the unit is allowed to start. Failure of either one during operation will cause the compressor to shut down.

A water flow alarm will be generated and 'Rest Alarm' must be pressed to clear the alarm.

4.4.6.2 Customer Control Interlock

Control contacts from an external controller can be used to enable or disable operation of the unit. The wiring diagram specifies the terminals to which the contacts must be wired. To enable the unit, the contacts must be closed. To disable the unit, the contacts must be opened.

4.4.6.3 Anti-Recycle Timer

The compressor motor requires an anti-recycle time delay which prevents restart for 15 minutes after a start. The purpose of this feature is to avoid frequent starts which tend to elevate the motor winding temperature and impose undue wear on contactors. The controller will not restart the compressor motor until the 15 minutes have elapsed.

4.4.6.4 On Delay Timer

A Compressor on delay timer of one or two minutes is incorporated to prevent two compressors from starting at the same time and ensures that the system load requires another compressor. The compressor output status will display the timer count-down during this timing.

4.4.6.5 Load Control

The controller controls the leaving water temperature within a narrow deadband by pulsing load and/ or unload solenoids on the compressor. The load and unload solenoids position the slide valve within the compressor to control its capacity. The controller determines a desired level of loading and varies pulse duration depending on difference between load target and actual load. The load target is varied based on rate of approach to desired temperature preventing significant temperature oscillations. The status of the compressor can be observed by displaying the compressor output status.

4.0 ELECTRICAL

4.4.6.6 Ramp Control

Another feature of the controller is ramp control, which is the ability to vary load time of the machine from start. Often when the machine is started, the water in the chilled water circuit is warm, and the unit will go to full load quickly. With ramp control, the user can program the computer so that it loads at a predetermined rate. This is a valuable tool, since it can help reduce power consumption and demand charges. Two variables are used to define the ramp profile: Ramp rate and start point. Ramp rate defines the length of time the unit takes to load from start point to full load. Start point is the percent of full load at which the ramp begins. The ramp rate setpoint can be set anywhere from 0.1 to 1.0, smaller values producing slower loading rates. The ramp start setpoint can be set anywhere between 0 and 50%. The compressor will load quickly to this value and then follow the ramp slope from there. See Table 4.4.6.6 for ramp rates at various settings.

4.4.6.7 Staging Control

On multiple-compressor machines, when the controller determines that a compressor is fully loaded and temperature is not being maintained, another compressor is added. When unloading, a compressor is taken off line when the computer determines that the remaining compressors can control water temperature.

4.4.6.8 Modmotor Setback Control

A computer contact and a resistor are wired in parallel in the modmotor control circuit. The contact is controller controlled to open under light load conditions. This lowers liquid level slightly, preventing excessive liquid level in the evaporator.

4.4.6.9 Suction/ Discharge Pressure Differential Control (SDD Control)

This control function seeks to prevent a low differential pressure alarm. It monitors the difference between condenser and evaporator pressure. If this difference is less than 25 psid [1.7BAR] for more than 10 seconds, and evaporator pressure is above 39 psig [2.6BAR], the controller will open a set of contacts in the modmotor circuit, causing valves to travel in the closed direction. This starves the evaporator, which increases pressure difference. When this difference exceeds 25 psid [1.7BAR], modmotor control returns to normal.

CAUTION: Do not start compressor manually more than once every 15 minutes. Verify that chilled water flow switch is closed.

4.4.6.10 Sump Heater Control

Each compressor is fitted with an oil sump heater. The heater is energized at all times when compressor is off and de-energized when the compressor is running.

Its purpose is to prevent refrigerant migration into the oil during shut down. For this reason, it is essential that heaters be energized for 24 hours before starting a compressor.

4.4.6.11 Low Pressure Cut-off

This function protects the unit from operating at abnormally low evaporator refrigerant pressure. The controller will shut down the compressor when cooler pressure falls below the low pressure setpoint and turn on the alarm pilot light.

A low pressure alarm will be recorded by the controller. Reset by pressing the 'Reset Alarm' on the controller. Standard setpoint is 28 psig [1.9BAR] for water-cooled systems.

4.4.6.12 Evaporator Freeze Shutoff

If the leaving chilled water temperature drops below the freeze setpoint, the controller will shut down the unit and store the freeze alarm. After solving the problem, press 'Reset Alarm' on the controller to clear the alarm.

4.4.6.13 High Pressure Cut-off

This function protects the compressor from operating at abnormally high discharge refrigerant pressures. The controller will shut down the compressor when condenser pressure reaches the high pressure set point, and turn on the alarm indicator lamp on the control box. The high discharge pressure alarm will be recorded by the controller. Reset by pressing the 'Reset Alarm' button on the controller. Setpoint for water-cooled system is 164 psig [11.3BAR].

TABLE 4.4.6.6 Ramp Rates for Several Setpoints (In Minutes)

Ramp Rate Setpoint	1 Comp.			2 Comp.			3 Comp			4 Comp		
	Start Point Setpoint			Start Point Setpoint			Start Point Setpoint			Start Point Setpoint		
	30%	50%	75%	30%	50%	75%	30%	50%	75%	30%	50%	75%
0.1	12.0	9.0	4.5	22.0	18.5	14.0	29.0	25.5	21.0	33.0	29.0	25.0
0.2	6.0	5.0	2.0	11.5	10.0	8.0	16.0	14.0	12.0	18.0	16.0	14.0
0.3	4.0	3.0	1.5	8.0	7.0	5.5	11.0	10.0	9.0	13.0	12.0	11.0
0.4	3.0	2.5	1.0	6.5	5.5	4.5	9.0	8.0	7.0	11.0	10.0	9.0

4.4.6.14 Standard Oil Level Sensor (LS)

An standard oil level sensor is located in each compressor. If low oil indication (digital input is OFF) persists for 60 seconds during compressor operation, the controller will then shut down the compressor. The status of the oil level sensor can be seen on the computer display.

Failure is indicated on the alarm pilot light. The low oil alarm will be recorded by the controller.

4.4.6.15 High Oil Temperature Thermostat (12TAS)

A thermostat is located in each compressor which will open the compressor run circuit if oil temperature exceeds 203°F [95°C]. The high oil temperature pilot light will indicate an excessive oil temperature and a No-Run error will be recorded by the computer. Reset is activated by pressing the 'Reset Alarm' button on controller.

4.4.6.16 Overload Protector (M2OL)

A solid state overload protects each compressor by three phase current monitoring to prevent high current draw. The trip setting is factory set and is reset by pressing button on overload after correcting problem. The 'Reset Alarm' button on controller must also be pressed to clear the alarm. A no-run error is stored in the controller.

4.4.6.17 Phase Control Relay (PCR)

The PCR protects the unit from the following electric supply malfunctions: Undervoltage, phase reversal and single phasing. If the PCR trips, a control relay (ICR) will de-energize and open the control circuit. A green LED indicates presence of power supply. The yellow LED indicates a good voltage supply. The power loss setpoint is factory set to AUTO to allow automatic start after PCR failure. Compressor will not start for 15 minutes after failure. To select manual reset, set power loss setpoint to MANUAL. In this case, a power loss alarm will be stored by the controller and 'Reset Alarm' must be pressed to start.

4.4.6.18 Sensor Alarm

If the controller measures an analog value (temperature, pressure.) that is far beyond normal operating values, the associated compressors are shutdown. The controller then stores the alarm code corresponding to the sensor alarm. A sensor alarm indicates a problem in the analog measurement system.

4.4.6.19 No-Stop Alarm

If the controller turns off a compressor, but the compressor digital input does not turn off, a No-Stop alarm is generated. The controller will turn off the control power relay which disables all compressor control circuits and will turn on the alarm light. This alarm indicates a wiring or hardware error.

4.4.6.20 Low Differential Pressure Alarm

For proper lubrication, a compressor requires a 25 psid [1.7BAR] differential pressure between condenser and evaporator pressures. If the differential pressure is less than 25 psid [1.7BAR] for 3 minutes while a compressor is operating, all compressors will be shut down. The controller will store the low differential pressure alarm code and turn on the alarm light. The 'Reset Alarm' key must be pressed to clear the alarm.

4.5 CALIBRATION OF SCREW COMPRESSOR CAPACITY AMPS AT FULL LOAD & MINIMUM LOAD PERCENTAGE

1. Check calibration of all sensors (pressure sensors, current transducers, temp sensors and etc.). All calibration on sensors shall be done in this step.
2. Load the compressor to full load. If the amps reading do not match with calculated FLA value within 2-3A, do this calculation: Amps – FLA

   For example, FLA = 150A, however the max amps at full load is 130A, so, do the calculation

   130 – 150 = -20
3. Key in this value into "*Max Percent Cal*" of the compressor in "*COMPRESSOR FLA CALIBRATION*" mask under technician key.
4. Therefore, the value of FLA will change. Verify that amps and FLA now match closely.
5. Manually unload the compressor all the way.
6. Locate the minimum percentage of capacity for the compressor. If this value is 25% ± 3%, no change required. Else, enter this value into "*Min Percent Cal*" in the same mask. The default value of "*Min Percent Cal*" is 25%.

   For example, the minimum percentage of capacity for the compressor is 32.2%, therefore, enter 32.2 at "*Min Percent Cal*".
7. Repeat this procedure for each compressor.

4.0 ELECTRICAL

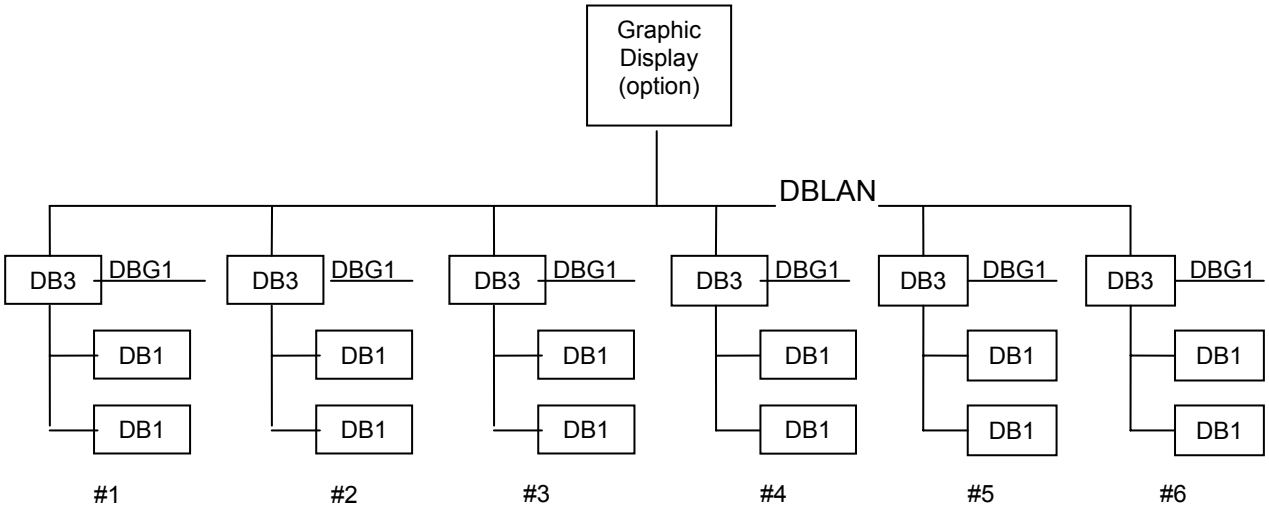
4.6 MASTER/ SLAVE CONTROL SEQUENCE

The optional master/slave control sequence is used to sequence multiple chillers in one installation according to the building load demand. It also controls the dedicated chilled water pump or motorized valve.

Vision 2020i Controller offers this feature with minimized field wiring cost compare to conventional method that involves lots of hardware cost. It is carried out this control function via the advanced DBLAN communication bus to implement the network management for multiple chillers lead/lag communication, sequencing and monitoring.

4.6.1 PRINCIPLE OF OPERATION VIA DBLAN COMMUNICATION BUS

Example: 6 chillers network with 4 units on duty and 2 units standby



Notes

a) Each chiller has a stand-alone master DB3 board and dedicated display panel DBG1 with multiple DB1 expanders board connected to J23 on DB3

b) Each chiller DB3 will be connected to DBLAN network through J11 connector

c) The chiller lead/lag selection can be determined by
   - Manual lead/lag setpoint
   - Schedule and holiday setup
   - Alarm conditions

d) The lead/lag selection determine the chiller operation sequence as follows,

Lead chiller selection	Normal chillers operation sequence	When DBLAN fails
1	1, 2 & 3 on duty, 4, 5 & 6 standby	1, 2 & 3 on duty
2	2, 3 & 4 on duty, 5, 6 & 1 standby	2, 3 & 4 on duty
3	3, 4 & 5 on duty, 6, 1 & 2 standby	3, 4 & 5 on duty
4	4, 5 & 6 on duty, 1, 2 & 3 standby	4, 5 & 6 on duty
5	5, 6 & 1 on duty, 2, 3 & 4 standby	5, 6 & 1 on duty
6	6, 1 & 2 on duty, 3, 4 & 5 standby	6, 1 & 2 on duty

e) If the lead/lag selection is changed over to a different chiller, the sequence of operation will be rotated

f) Each chiller will use a network address setpoint to determine individual chiller network address

g) Each chiller will require a dedicated chilled water pump or motorized valve digital output, unit enable and chilled flow status digital inputs as well as enable next output command

4.6.2 SEQUENCE OF OPERATION

1. When the customer enable input is ‘on’ to start the lead unit, the chilled water pump starter or motorized valve control point will close and water will start to flow through the evaporator, this will activate the flow switch. The flow switch and water pump status are interlocked and feedback as digital input to the chiller and upon receipt of a valid 'on' signal, the lead chiller will begin to execute its running program.
2. The controller will start and load the compressor(s), upon achieving full load; it will send an output signal via the DBLAN to enable second unit (lag 1)
3. The second unit will now command its chilled water pump to start if the customer unit enable is activated. The second chiller will start and load the compressor(s) until it reaches full load
4. When the second chiller or lag 1 unit reaches full load, it will enable the third chiller.
5. The chiller will keep cascading until all chillers on duty are at full load.
6. If the leaving water temperature falls below setpoint, all of the chillers will begin to unload evenly.
7. If the load drops below 45% total capacity, delay the last unit (lag 3) will be disabled, and the remaining three units will load up to compensate if necessary. The pump for chiller 4 will be shut off.
8. As the load demand falls, the lag 2 unit will be disabled below 45% total capacity, and so on until the load falls enough to shut off the lead chiller.
9. Each unit in the network can monitor the operation of other units via DBLAN. If the master unit is having critical alarm, the lag 1 will take over as the master unit automatically.
10. In order to enable next unit, the following conditions must met
    a) LWT ≥ (LWT Setpoint + Enable Next deadband)
    b) After a enable next time delay of 3 minutes (adjustable) and
    c) When the lead unit’s packaged capacity is higher than “Next on setpoint”,

for example, WCFX2, %Capacity C1 & %Capacity C2 ≥ Next on setpoint

or it is being lockout by an alarm.

4.7 VISION 2020i LOCAL AREA NETWORK (DBLAN)

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

Every DBLAN node must be addressed to be identified by the other nodes. Each address (an integer number) must be unique in the network for avoiding messages mismatch: in case two or more nodes have the same identifying address the network cannot work.

The max address number selectable is in the 1-16 for the Vision 2020i controller boards and 17-32 range for the Vision 2020i DBG1 User terminal.

The three chiller unit combinations:

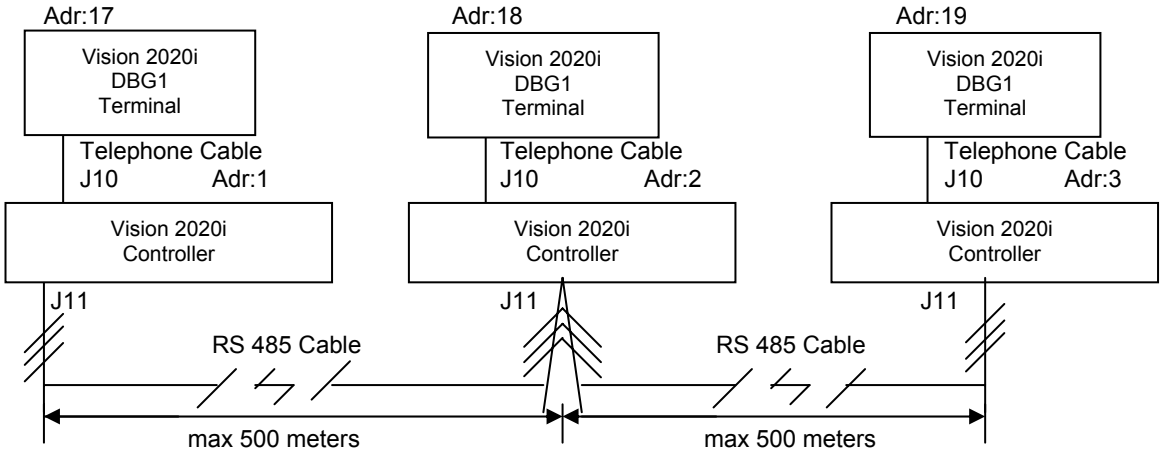
Controller with address of 1 connect to Terminal with address of 17

Controller with address of 2 connect to Terminal with address of 18

Controller with address of 3 connect to Terminal with address of 19

Follow the following steps:

4.8 NETWORK CONNECTION DIAGRAM



The 6 core telephone cables (to J10 socket) are supply by the manufacturer.
The 3 core RS 485 data cables (to J11 socket) are supply by the customer.
Pay attention to the network polarity:
RX+/TX+ on one controller must be connected to RX+/TX+ on the other controller; the same is true for RX-/TX- and GND.

4.0 ELECTRICAL

4.9 HARDWARE SETTINGS

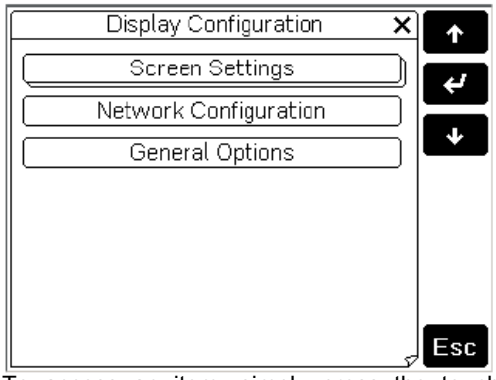
4.9.1 VISION 2020I CONTROLLER WITH DBG2/DBG3 DISPLAY

The menus can be accessed by pressing any point on the touch screen together with the ↑ (up) and **Prg** buttons for at least one second. Alternatively, press the ↑ (up) / ↓(down), ↵ (enter) buttons together for at least one second.

The following operations exit the menu:

1. Pressing the Esc button;
2. Automatically 1 minute after a button was pressed or the touch screen touched;
3. Pressing the "X" symbol when displayed at the top right.

As shown in the following figure, the buttons that can be used during the configuration phase are also visible on the right side of the display:



To access an item, simply press the touch screen on the corresponding indication, or press the ↑ (up) / ↓ (down) buttons until selecting it and then confirm by pressing ↵ (enter).

To modify the value of a field, after having activated it (a field is active when the cursor is flashing inside), press the ↑ (up) / ↓ (down) buttons to change the value and press ↵ (enter) to save it. Pressing **Esc** before ↵ (enter) cancel the modifications made to the field.

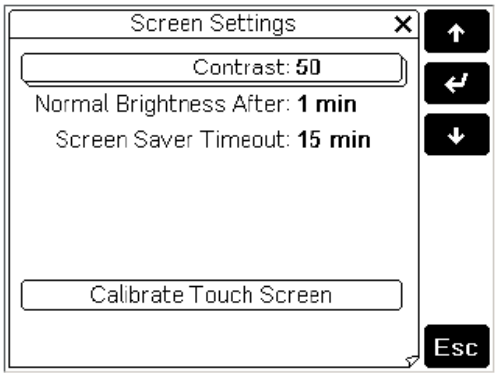
4.9.1.1 Description of the menu

Main menu

The main menu, visible in the previous image "Display Configuration", is used to select the main three configuration categories, that is:

- Screen Settings: Settings relating to the screen
- Network Configuration: Settings relating to the RS485 network
- General Options: Various settings

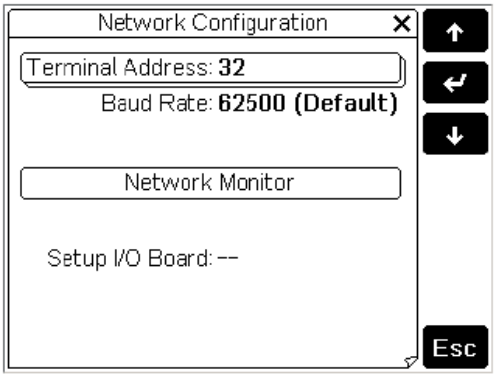
"Screen Settings" menu



The following options are available:

- Contrast: Used to set the contrast of the display (from 0 to 100, default: 50).
- Normal Brightness After: Used to set the time after the touch screen or the buttons are last pressed that the display switches from "high brightness" to "normal brightness". The possible values range from 30 s to 15 min, default: 1 min.
- Screen Saver Timeout: Used to set the time after the touch screen or the buttons are last pressed that the display switches off, after having switched to "normal brightness". The possible values range from 30 s to 4 hours (4 hrs), default: 15 min.
- Calibrate Touch Screen: The touch screen can be calibrated if it is evidently misaligned. To align the touch screen, press the exact centre of the crosses displayed in sequence. The message "Done: touch the screen to ESC" indicates that the operation has been completed correctly. If, on the other hand, the message "Bad: touch to ESC and repeat" is displayed, the operation will need to be repeated.

"Network Configuration" menu

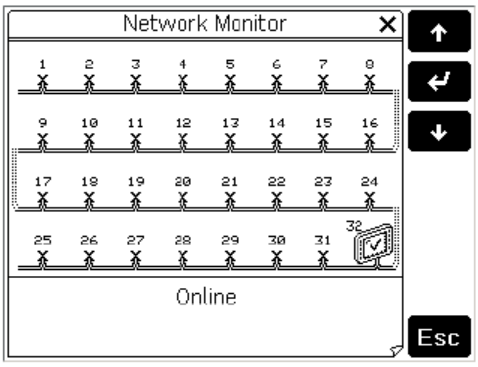


The following options are possible:

- Terminal Address: Used to set the address of the terminal (from 1 to 32, default: 32). If the value "--" is set (two dashes are displayed) the terminal will communicate with the Vision 2020i board using the "Point-Point" protocol : the "Baud Rate", "Network Monitor" and "Setup I/O Board" fields will then disappear, as they have no meaning.

- Baud Rate: Used to set the DBLAN communication baud rate. The possible values are 62500 (default) or 115200 (used only if all the devices in the network are configured for this speed). Note that not all the DBLAN devices support the 115200 setting.
- Network Monitor: This is used to display the status of the network (see next paragraph)
- Setup I/O Board Setup: These fields are used to modify the list of terminals associated with each individual ***Vision 2020i*** board.

Network Monitor



This screen is used to display the status of the network when master-slave sequencing control is furnished, indicating graphically which devices are connected for each address. The meaning of the symbols is the following:


Vision 2020i controller active in the network


Any type of terminal active in the network


Current terminal

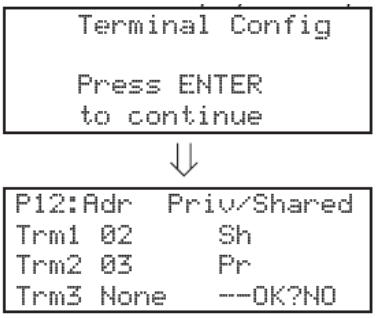

Device not connected

If activity is detected on the network, the message "Online" is displayed. To exit the screen, press the **Esc** button.

Assigning the list of private and shared terminals

The list of terminals associated with each individual ***Vision 2020i*** board can be modified from the "Network Configuration" menu, as follows:

1. Select the address of the required board using the ↑(up) / ↓ (down) buttons in the "Setup I/O Board" field (only the boards that are effectively on-line can be selected) and confirm by pressing ↵(enter). If the DBLAN network is not working correctly, or no ***Vision 2020i*** board is present, the field is not modifiable, and "--"(two dashes) will be displayed.
2. Press the "Setup" button: the following screens will be displayed in sequence:

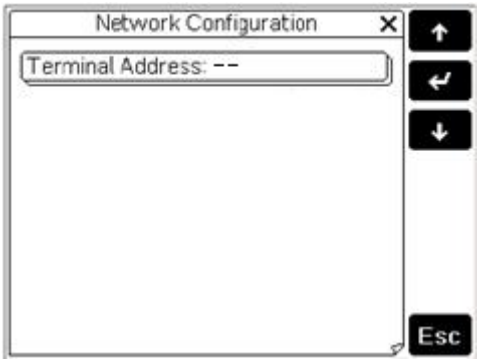


3. Now the ↵ (enter) button is used to move the cursor from one field to the next, and ↑ (up) / ↓ (down) change the value of the current field. The "P:xx" field shows the address of the selected board (in the example, board number 12 has been selected);
4. To exit the configuration procedure and save the data, select the "OK ?" field, set "Yes" and confirm by pressing ↵ (enter). Alternatively, if the terminal remains inactive (no button is pressed) for more than 30 s, the configuration procedure is automatically ended without saving the changes.

Important: the DBG2/3 terminals cannot be configured as "Sp" (shared printer) as the printer output is not featured. Selecting this mode has no effect on the management of printed messages sent via DBLAN.

Assigning the I/O Board Address of the Controller

In order to configure the I/O board address of the ***Vision 2020i*** controller, the terminal address must set to "--". Please refer to "Network Configuration Menu" for procedures to configure the terminal address. The following display will appear:

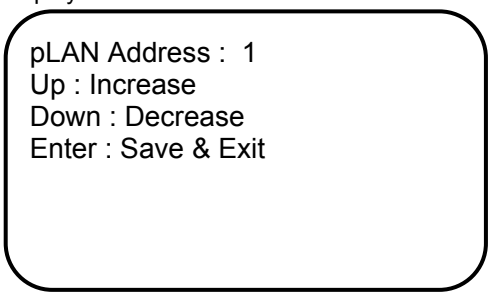


Switch off power supply of the controller now. Disconnect connectors at J11 and J23 on the controller. Press and hold "alarm reset" and "up" key, then resume power supply of the controller.

After a few seconds, the controller commences the start-up sequence, and then the following display is shown.

4.0 ELECTRICAL

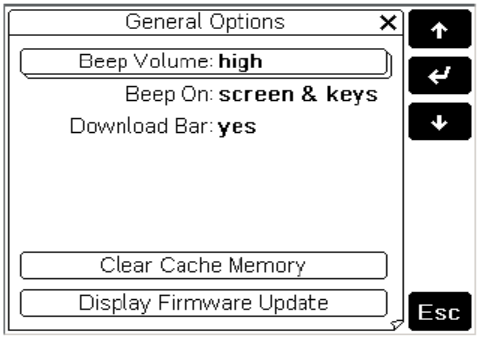
When this screen appears, wait 10 seconds and then release the buttons. The controller stops the start-up sequence and the following display is shown.



Then, set the "pLAN Address" using the "Up" and "Down" buttons on the terminal. Confirm the setting by pressing "Enter" button. The controller completes the start-up sequence and uses the specified address.

Now, configure the "Terminal Address" to its desired setting. Terminal display address shall be set to "17" if it is connected to a ***Vision 2020i*** controller with I/O address "01". If the terminal is connected to a ***Vision 2020i*** controller with I/O address "02", terminal display address shall be set to "18".

"General Options" menu

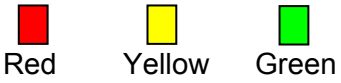


The following options are possible:

1. Beep Volume: Used to set the volume associated of the "Beep" with the buttons and the touchscreen pressing.
   The possible values are "off", "low", "high". Default: high.
   This parameter has no effect on the alarm signal, which is activated or deactivated by the ***Vision 2020i***.
2. Beep On: Used to set when the "Beep" sounds. The possible values are: "active items" (associates a sound with the active area of the display), "screen" (associates a sound with any point on the touch screen) and "screen & keys" (associates a sound with both the touch screen and the keypad). Default: "screen & keys".
3. Download Bar: activates ("yes") or deactivates ("no") the display of the status bar that indicates the progress of the page. Default: "yes".
4. Clear Cache Memory: deletes the cache memory used to accelerate the display of the screens. This function may be useful if there are errors in the graphics. Pressing the button displays a window that prompts for confirmation. Press "yes" to confirm the operation or "no" to abort it.
5. Display Firmware Update: starts the DBG2/3 firmware update procedure.

4.9.2 VISION 2020I CONTROLLER LED STATUS

Vision 2020i controller have three LEDs between the J3 and J4 connectors for indicating basic node status. They are Red, Yellow and Green coloured.



At the start-up all LEDs are ON and after few seconds OFF again. After 5 – 15 seconds elapse, then LED configuration is among those listed below.

Table 4.9.2 LED Status

LED	STATUS	DESCRIPTION
GREEN	ON	Vision 2020i controller is synchronized with all the other DBLAN nodes. The node is working correctly.
	OFF	Vision 2020i controller is not network connected or it doesn't receive any signal from the DBLAN
YELLOW	BLINKING	Vision 2020i controller is transmitting data to other network nodes.
	OFF	Vision 2020i controller is not transmitting messages.
RED	OFF	No hardware and software problem.
	ON	Vision 2020i controller software not compatible or variables database not correct, contact Dunham-Bush Service Personnel.
	BLINKING	Vision 2020i hardware is not compatible - Ram is smaller than 32 KB. The Vision 2020i controller is just for working in stand-alone mode.

5.0 MAINTENANCE

5.1 GENERAL

As with all mechanical equipment, a program of regular inspection, cleaning and preventive maintenance by trained personnel will contribute greatly to the long satisfactory service life of this product. Some of this care can easily be provided by owner personnel. However, a Dunham-Bush authorized service mechanic should inspect the unit at least annually and evaluate the unit performance.

5.2 PERIODIC INSPECTION

Read essential temperatures and pressures periodically to see that they indicate normal operation. It is a good idea to record these readings on a log sheet. See sample record sheet in Section 5.8. If any abnormal operation is observed, try to determine cause and remedy it. See Trouble-shooting Guide, Section 5.10.

5.3 MONTHLY INSPECTION

Check water treatment system. Wipe down external surfaces of unit. Shut unit down, open main disconnect, inspect control panel, checking for loose wires, burned contacts, signs of overheated wires, etc. Restart unit and check performance of controls and time rate of loading and unloading.

5.4 WATER SIDE CLEANING OF VESSELS

The effects of fouling on the evaporator or condenser heat transfer surfaces can be detected by recording full load performance data on the log sheet. The best measure of performance of evaporator and condenser is approach, which is the difference between leaving water temperature and saturated refrigerant temperature at the pressure in the vessel. At full load, read evaporator and condenser pressures on the computer. Then use Table of Refrigerant Pressure/ Temperature Properties to find corresponding saturated temperature for each pressure. Read leaving chilled water temperature on the computer. Read leaving condenser water temperature on computer if option is provided, or with field installed thermometer. Then calculate approaches as follows:

Condenser Approach = T sat condenser - T lvg cond. water

Evaporator Approach = T lvg chilled water - T sat evaporator

If the approach for either vessel increases by more than 2°F [1.1°C] above the approach recorded at clean conditions, the tubes should be cleaned. It is generally advisable to clean the waterside surfaces at least annually and more often if severely foul water is used. This cleaning can be done chemically or physically. In chemical cleaning, a caustic solution is pumped through the heat exchanger, which attacks dirt, slime and mineral deposits and flushes them away. Chemicals can be recommended by water treatment specialists, but it is important to rinse the system thoroughly after cleaning to remove the chemicals before the chemicals attack the metal surfaces.

Vessel tubes may be physically cleaned by first draining the water, then removing the headers and brushing each tube individually with a tube cleaning brush until it is clean. The brush should have stiff nylon bristles. For best results, always remove both headers before cleaning the tubes. Replace the headers, being careful to properly position gaskets, and refill the system with water.

Head gaskets need not be renewed after each head disassembly operation. Gaskets should and must be renewed if they are physically disfigured or otherwise deteriorated. New gaskets are available from the factory. INSPECT CAREFULLY.

5.5 SHUT OFF VALVES

All shut off devices require tooling for actuation. The valves are not adjusted during operating. The valves are just one time setting during commissioning.

The shut off devices are not be mounted in crawl spaces or in piping shafts designed for human entry.

5.6 CHANGES OF GLAND SEAL

If it is not possible to tighten or change the gland packing/seal(s) while the valve is exposed to system pressure, it shall be possible to isolate the valve from the system, or means shall be provided to evacuate refrigerant from the part of the system where the valve is located.

There are angle valves and ball valve installed at the piping. The component can be serviced and changed by isolating the angle valve and the ball valve without evacuate refrigerant from the system.

5.7 SAFETY PROTECTIVE MEASURE

5.7.1 GENERAL SAFETY INSTRUCTIONS

Always ensure that all required safety measures are followed, including those in this document, such as: wearing protective clothing (gloves, shoes) and safety glasses, using appropriate tools, employing qualified and skilled technicians (electricians, refrigeration engineers) and following local regulations.

5.0 MAINTENANCE

The following instructions taken from the standards, rules, ordinances and laws listed:

1. Smoking is prohibited in the refrigeration machinery room.
2. Store suitable personnel protective equipment at an accessible point of the refrigeration machinery room (acc. to EN 378-4).
3. Store fire extinguishers at an accessible point of the machinery room (acc. to EN 378-3).
4. Escape routes must be free from obstacles.
5. Any work on units and chillers may only be carried out by appropriately trained and instructed staff.
6. The refrigeration units must not be operated unless full functional and operational safety and reliability of all components, safety devices and circuits (refrigerant and oil circuits, secondary refrigerant and cooling water circuits) and of the electrical switchgear is ensured.
7. The elements of the safety chain, the alarm sensors, pilot lamps and controllers shall be adjusted according to the designed values and must not be set out of operation, not in part either.

5.7.2 INSTALLATION/ OPERATION OF EQUIPMENT

The following European norms, rules, ordinances and laws have to be strictly observed to ensure the safety and functional reliability of the compressor packages:

1. For the installation of refrigeration machines and the protection of personnel (EN378-3)
2. For testing the refrigeration machine prior to its start-up (EN378-2)
3. For renewal testing (EN378-2)
4. For testing for corrosion (EN378-2)
5. For taking a plant record (EN378-2 and EN378-4)
6. For taking measures in case of emergency (EN378-2)
7. For instruction of the competent operating personnel (EN378-4)
8. For maintenance and repair (EN378-4)
9. For recovery, reuse and disposal of refrigerants, oil, secondary refrigerants and parts of the refrigeration machine (e.g. filters, driers, heat insulation) (EN378-4)
10. For handling and storage of refrigerants (EN378-4)

IMPORTANT: Dunham Bush is not liable for damage resulting from the operator's infringement of the mentioned rules or other laws and regulations binding at the respective place of installation.

5.7.3 SERVICE INSTRUCTIONS FOR DRAINING USED REFRIGERANT OIL

To drain used refrigerant oil from compressor oil sump, oil separator, receiver or any part of the refrigeration machine with minimum refrigerant release to the environment in accordance with CE requirements.

1. Connect a refrigerant hose between oil drain valve and external receiver.
2. Connect a refrigerant transfer pump between external receiver and refrigeration machine.
3. Drain used refrigerant oil from compressor oil sump, oil separator, receiver or refrigeration machine by virtue of pressure difference.
4. Evacuate external receiver and transfer refrigerant vapor back into the refrigerant machine through refrigerant transfer pump. The refrigerant pressure within the external receiver must be of positive pressure in order to prevent inward leakage from the atmosphere.
5. Heat external receiver with trace heaters in order to facilitate boiling of dissolved refrigerant within the used refrigerant oil.
6. Drain and dispose used refrigerant oil through the oil drain valve located at the bottom of the external receiver in accordance with CE requirement and other local directives.

5.0 MAINTENANCE

5.8 ELECTRICAL MALFUNCTION

The unit has four devices designed to protect the compressor motor from electrical malfunctions: computer current limiting function, motor overload relay, phase control relay, and circuit breaker.

If the phase control relay trips, it is a sign of trouble in incoming power. If it trips again after resetting, call your electric utility to investigate the problem. If the circuit breaker or motor overload relay trips, this is a sign of possible motor trouble. DO NOT reset and try to run compressor again. Call authorized service representative to check for motor trouble. Resetting these safety devices and repeated starting could turn a minor motor problem into a costly major motor burnout.

5.9 CHARGING

5.9.1 REFRIGERANT CHARGE

The WCFX unit is given a complete charge of refrigerant at the factory. All standard units use refrigerant and the amount necessary to change the unit can be found in the physical specifications.

If the unit must be charged on the jobsite, it should be done by a qualified refrigeration mechanic.

Refrigerant should be added through the charging valve on the evaporator feed line until the condenser drain sight glass is clears. Sight glass should be clear at all operating conditions. When operating at full load, the evaporator tube bundle (visible through sight glass on evaporator shell) should be immersed. At light load, tubes may be visible. To add refrigerant, connect a refrigerant vessel to the liquid line charging valve under the evaporator. Purge the air from the tube. With the unit running, open the refrigerant vessel liquid connection slightly. If the refrigerant vessel is warmer than the evaporator, refrigerant will flow from the vessel into the unit. The need for additional refrigerant is an indication of refrigerant leakage. In the interest of environmental protection as well as operating cost, the leak should be found and corrected.

5.9.2 REFRIGERANT DISCHARGE

Before opening a refrigerant circuit, purge and consult the pressure gauges. Be sure pressure is at 0 kPa before removing components and opening a circuit.

Follow the applicable regulations for the refrigerant removal and storage operations.

Note: The refrigerant shall not be discharged directly into the atmosphere. It must be removed using approved reclamation techniques and equipment and then safely stored, in accordance to the applicable legislation.

Any refrigerant transfer and recovery operations must be carried out using a transfer unit. A 3/8” SAE connector on the manual liquid line valve is supplied with all units for connection to the transfer station.

Important: Never re-use disposable (non-returnable) cylinders or attempt to refill them. It is dangerous and illegal. When cylinders are empty, evacuate the remaining gas pressure, and move the cylinders to a place designated for their recovery.

5.9.3 OIL CHARGE

The proper oil charge is in the unit as supplied from the factory. The compressor should show oil return at all times. If for some reason, the compressor runs low on oil, a low oil level switch in the compressor will shut it down before any damage is done. In the event of a low oil shutdown, call a D/B authorized service agent to correct the problem. **DO NOT ADD OIL TO THE SYSTEM.**

NOTE: Only DB 18 oil may be used in this package. Use of other oil is not approved by Dunham-Bush, and will result in poor performance of the package. **It is recommended to change oil after the first year of operation. Oil analysis is required for the subsequent years to ensure the oil is within its characteristics limit.**

5.0 MAINTENANCE

Table 5.4 R134a Pressure/ Temperature Properties

PRESS		TEMP.		PRESS		TEMP.		PRESS		TEMP.		PRESS		TEMP.		PRESS		TEMP.	
PSIG	KPA	°F	°C	PSIG	KPA	°F	°C	PSIG	KPA	°F	°C	PSIG	KPA	°F	°C	PSIG	KPA	°F	°C
0.00	101.38	-14.70	-25.94	53.00	466.90	56.90	13.83	106.00	832.41	90.90	32.72	159.00	1197.93	115.00	46.11	212.00	1563.45	134.10	56.72
1.00	108.28	-12.00	-24.44	54.00	473.79	57.70	14.28	107.00	839.31	91.50	33.06	160.00	1204.83	115.40	46.33	213.00	1570.34	134.40	56.89
2.00	115.17	-9.50	-23.06	55.00	480.69	58.50	14.72	108.00	846.21	92.00	33.33	161.00	1211.72	115.80	46.56	214.00	1577.24	134.70	57.06
3.00	122.07	-7.10	-21.72	56.00	487.59	59.30	15.17	109.00	853.10	92.50	33.61	162.00	1218.62	116.20	46.78	215.00	1584.14	135.10	57.28
4.00	128.97	-4.80	-20.44	57.00	494.48	60.10	15.61	110.00	860.00	93.00	33.89	163.00	1225.52	116.60	47.00	216.00	1591.03	135.40	57.44
5.00	135.86	-2.60	-19.22	58.00	501.38	60.90	16.06	111.00	866.90	93.50	34.17	164.00	1232.41	117.00	47.22	217.00	1597.93	135.70	57.61
6.00	142.76	-0.50	-18.06	59.00	508.28	61.60	16.44	112.00	873.79	94.00	34.44	165.00	1239.31	117.40	47.44	218.00	1604.83	136.00	57.78
7.00	149.66	1.50	-16.94	60.00	515.17	62.40	16.89	113.00	880.69	94.50	34.72	166.00	1246.21	117.70	47.61	219.00	1611.72	136.40	58.00
8.00	156.55	3.50	-15.83	61.00	522.07	63.10	17.28	114.00	887.59	95.00	35.00	167.00	1253.10	118.10	47.83	220.00	1618.62	136.70	58.17
9.00	163.45	5.30	-14.83	62.00	528.97	63.90	17.72	115.00	894.48	95.50	35.28	168.00	1260.00	118.50	48.06	221.00	1625.52	137.00	58.33
10.00	170.34	7.20	-13.78	63.00	535.86	64.60	18.11	116.00	901.38	96.00	35.56	169.00	1266.90	118.90	48.28	222.00	1632.41	137.30	58.50
11.00	177.24	8.90	-12.83	64.00	542.76	65.30	18.50	117.00	908.28	96.50	35.83	170.00	1273.79	119.30	48.50	223.00	1639.31	137.60	58.67
12.00	184.14	10.60	-11.89	65.00	549.66	66.00	18.89	118.00	915.17	97.00	36.11	171.00	1280.69	119.70	48.72	224.00	1646.21	138.00	58.89
13.00	191.03	12.30	-10.94	66.00	556.55	66.80	19.33	119.00	922.07	97.50	36.39	172.00	1287.59	120.00	48.89	225.00	1653.10	138.30	59.06
14.00	197.93	13.90	-10.06	67.00	563.45	67.50	19.72	120.00	928.97	98.00	36.67	173.00	1294.48	120.40	49.11	226.00	1660.00	138.60	59.22
15.00	204.83	15.50	-9.17	68.00	570.34	68.20	20.11	121.00	935.86	98.40	36.89	174.00	1301.38	120.80	49.33	227.00	1666.90	138.90	59.39
16.00	211.72	17.00	-8.33	69.00	577.24	68.90	20.50	122.00	942.76	98.90	37.17	175.00	1308.28	121.20	49.56	228.00	1673.79	139.20	59.56
17.00	218.62	17.50	-8.06	70.00	584.14	69.50	20.83	123.00	949.66	99.40	37.44	176.00	1315.17	121.50	49.72	229.00	1680.69	139.50	59.72
18.00	225.52	20.00	-6.67	71.00	591.03	70.20	21.22	124.00	956.55	99.90	37.72	177.00	1322.07	121.90	49.94	230.00	1687.59	139.80	59.89
19.00	232.41	21.40	-5.89	72.00	597.93	70.90	21.61	125.00	963.45	100.30	37.94	178.00	1328.97	122.30	50.17	231.00	1694.48	140.10	60.06
20.00	239.31	22.80	-5.11	73.00	604.83	71.60	22.00	126.00	970.34	100.80	38.22	179.00	1335.86	122.60	50.33	232.00	1701.38	140.40	60.22
21.00	246.21	24.10	-4.39	74.00	611.72	72.20	22.33	127.00	977.24	101.30	38.50	180.00	1342.76	123.00	50.56	233.00	1708.28	140.80	60.44
22.00	253.10	25.40	-3.67	75.00	618.62	72.90	22.72	128.00	984.14	101.70	38.72	181.00	1349.66	123.40	50.78	234.00	1715.17	141.10	60.61
23.00	260.00	26.70	-2.94	76.00	625.52	73.50	23.06	129.00	991.03	102.20	39.00	182.00	1356.55	123.70	50.94	235.00	1722.07	141.40	60.78
24.00	266.90	28.00	-2.22	77.00	632.41	74.20	23.44	130.00	997.93	102.70	39.28	183.00	1363.45	124.10	51.17	236.00	1728.97	141.70	60.94
25.00	273.79	29.20	-1.56	78.00	639.31	74.80	23.78	131.00	1004.83	103.10	39.50	184.00	1370.34	124.50	51.39	237.00	1735.86	142.00	61.11
26.00	280.69	30.50	-0.83	79.00	646.21	75.50	24.17	132.00	1011.72	103.60	39.78	185.00	1377.24	124.80	51.56	238.00	1742.76	142.30	61.28
27.00	287.59	31.70	-0.17	80.00	653.10	76.10	24.50	133.00	1018.62	104.00	40.00	186.00	1384.14	125.20	51.78	239.00	1749.66	142.60	61.44
28.00	294.48	32.80	0.44	81.00	660.00	76.70	24.83	134.00	1025.52	104.50	40.28	187.00	1391.03	125.50	51.94	240.00	1756.55	142.90	61.61
29.00	301.38	34.00	1.11	82.00	666.90	77.30	25.17	135.00	1032.41	104.90	40.50	188.00	1397.93	125.90	52.17	241.00	1763.45	143.20	61.78
30.00	308.28	35.10	1.72	83.00	673.79	78.00	25.56	136.00	1039.31	105.30	40.72	189.00	1404.83	126.30	52.39	242.00	1770.34	143.50	61.94
31.00	315.17	36.20	2.33	84.00	680.69	78.60	25.89	137.00	1046.21	105.80	41.00	190.00	1411.72	126.60	52.56	243.00	1777.24	143.80	62.11
32.00	322.07	37.30	2.94	85.00	687.59	79.20	26.22	138.00	1053.10	106.20	41.22	191.00	1418.62	127.00	52.78	244.00	1784.14	144.10	62.28
33.00	328.97	38.40	3.56	86.00	694.48	79.80	26.56	139.00	1060.00	106.70	41.50	192.00	1425.52	127.30	52.94	245.00	1791.03	144.40	62.44
34.00	335.86	39.50	4.17	87.00	701.38	80.40	26.89	140.00	1066.90	107.10	41.72	193.00	1432.41	127.70	53.17	246.00	1797.93	144.70	62.61
35.00	342.76	40.50	4.72	88.00	708.28	81.00	27.22	141.00	1073.79	107.50	41.94	194.00	1439.31	128.00	53.33	247.00	1804.83	145.00	62.78
36.00	349.66	41.50	5.28	89.00	715.17	81.50	27.50	142.00	1080.69	108.00	42.22	195.00	1446.21	128.40	53.56	248.00	1811.72	145.30	62.94
37.00	356.55	42.50	5.83	90.00	722.07	82.10	27.83	143.00	1087.59	108.40	42.44	196.00	1453.10	128.70	53.72	249.00	1818.62	145.60	63.11
38.00	363.45	43.50	6.39	91.00	728.97	82.70	28.17	144.00	1094.48	108.80	42.67	197.00	1460.00	129.10	53.94	250.00	1825.52	145.90	63.28
39.00	370.34	44.50	6.94	92.00	735.86	83.30	28.50	145.00	1101.38	109.20	42.89	198.00	1466.90	129.40	54.11	251.00	1832.41	145.20	62.89
40.00	377.24	45.50	7.50	93.00	742.76	83.90	28.83	146.00	1108.28	109.70	43.17	199.00	1473.79	129.70	54.28	252.00	1839.31	146.40	63.56
41.00	384.14	46.40	8.00	94.00	749.66	84.40	29.11	147.00	1115.17	110.10	43.39	200.00	1480.69	130.10	54.50	253.00	1846.21	146.70	63.72
42.00	391.03	47.40	8.56	95.00	756.55	85.00	29.44	148.00	1122.07	110.50	43.61	201.00	1487.59	130.40	54.67	254.00	1853.10	147.00	63.89
43.00	397.93	48.30	9.06	96.00	763.45	85.60	29.78	149.00	1128.97	110.90	43.83	202.00	1494.48	130.80	54.89	255.00	1860.00	147.30	64.06
44.00	404.83	49.20	9.56	97.00	770.34	86.10	30.06	150.00	1135.86	111.30	44.06	203.00	1501.38	131.10	55.06	256.00	1866.90	147.60	64.22
45.00	411.72	50.10	10.06	98.00	777.24	86.70	30.39	151.00	1142.76	111.80	44.33	204.00	1508.28	131.40	55.22	257.00	1873.79	147.90	64.39
46.00	418.62	51.00	10.56	99.00	784.14	87.20	30.67	152.00	1149.66	112.20	44.56	205.00	1515.17	131.80	55.44	258.00	1880.69	148.20	64.56
47.00	425.52	51.90	11.06	100.00	791.03	87.80	31.00	153.00	1156.55	112.60	44.78	206.00	1522.07	132.10	55.61	259.00	1887.59	148.50	64.72
48.00	432.41	52.70	11.50	101.00	797.93	88.30	31.28	154.00	1163.45	113.00	45.00	207.00	1528.97	132.40	55.78	260.00	1894.48	148.70	64.83
49.00	439.31	53.60	12.00	102.00	804.83	88.80	31.56	155.00	1170.34	113.40	45.22	208.00	1535.86	132.80	56.00	261.00	1901.38	149.00	65.00
50.00	446.21	54.40	12.44	103.00	811.72	89.40	31.89	156.00	1177.24	113.80	45.44	209.00	1542.76	133.10	56.17	262.00	1908.28	149.30	65.17
51.00	453.10	55.30	12.94	104.00	818.62	89.90	32.17	157.00	1184.14	114.20	45.67	210.00	1549.66	133.40	56.33	263.00	1915.17	149.60	65.33
52.00	460.00	56.10	13.39	105.00	825.52	90.40	32.44	158.00	1191.03	114.60	45.89	211.00	1556.55	133.80	56.56	264.00	1922.07	149.90	65.50

Note : Pressure and temperature are stated in Psig[kPa] and °F[°C] respectively.

5.0 MAINTENANCE

5.10 TROUBLESHOOTING

Symptom	Possible Cause	Remedy
1. Unit will not start.	a.) Power off. b.) No control power. c.) Compressor circuit breakers open. d.) Phase control relay open. e.) Flow Switch open. f.) Compressor switch open. g.) Microcomputer shutdown not reset.	a.) Check main disconnect switch and main line fuses. b.) Check control transformer fusing. c.) Close circuit breakers. If trip, check compressor. d.) Check for power supply problems (low voltage, phase imbalance). When corrected, press reset button. e.) Start pumps, check flow switch. f.) Turn switch on. Check alarm status. Correct problem. g.) Press reset button.
2. Compressor hums but does not start.	a.) Low voltage. b.) No power on one phase of 3 phase unit. c.) Faulty starter or contactor.	a.) Check at main entrance and at unit. Consult power company if voltage is low and increase wire size to the unit if voltage is normal at main and low at unit. Voltage must be within 10% of motor name plate rating. b.) Check fuses and wiring. c.) Check the contacts and time delay on part wind start.
3. Compressor will not start when reset button is pushed. Check light: None	a.) Cooling not required. b.) Computer's time delay active. c.) Phase control relay open. d.) Flow switch open. e.) Compressor switch open. f.) Burned out signal light. g.) Wiring problem	a.) Apply load. b.) Wait 15 minutes max. c.) See 1.(d.) above. d.) See 1.(e.) above. e.) See 1.(f.) above. f.) Check signal light bulbs. g.) Check wiring against drawing.
4. Compressor overload.	a.) Compressor drawing high amps.	a.) Check motor megohms. Reset overloads; run compressor an check amps. Do not exceed RLA x 1.25. Call D/B serviceman.
5. High oil temperature	a.) Motor windings failing. b.) Insufficient motor cooling.	a.) Check megohms. b.) Open liquid injection valve slightly.
6. Low suction pressure	a.) Inadequate feed to evaporator. b.) Inadequate refrigerant charge. c.) Fouling of waterside of evaporator. d.) Inadequate chilled water flow. e.) Too much oil in system.	a.) Check to see that liquid line ball valve is open. b.) See information on charging in Section 5.9. c.) At high load, check evaporator approach (See Section 5.4). If approach is more than 2°F [1.1°C] above clean valve, fouling is probably the trouble. Clean tube. d.) Measure pressure drop across vessel and determine flow rate from Figure 2.4. If flow rate is low, check chilled water pump, valves and strainers. e.) If all oil level sight glasses are full at all times, remove oil until oil level shows at top of glass on a compressor.
7. High discharge pressure.	a.) Inadequate air flow across condenser b.) Fouling of waterside of condenser.	a.) Check condenser flow rate, either with condenser pressure drop curve or with pump curve. b.) At high load, check difference between saturated refrigerant temp. and leaving water temp. If 2°F [1.1°C] or more above start-up conditions, remove headers and clean tubes.
8. Oil low in sump.	a.) Low oil level in compressor.	a.) Low oil level in compressor sight glass is acceptable.
9. Low oil shutdown.	a.) Low oil in compressor.	a.) See Section 5.9.3.
10. Freeze warning.	a.) Operating setpoint too low. b.) Load changing too rapidly.	a.) Check leaving water setpoint on microcomputer. b.) Load on package must drop at reasonable rate for automatic control to work properly.
11. Improper capacity control.	a.) Ramp rate incorrect.	a.) See Section 4.4.6.6.

5.0 MAINTENANCE

5.11 SAMPLE LOG SHEET

SHEET NO……

DUNHAM-BUSH ROTARY SCREW COMPRESSOR PACKAGED CHILLER

NAME PLATE DATA:

UNIT MODEL NO. WCFX :..... **UNIT NO**.:..... **VOLTS:** ..... **Hz**.....

UNIT SERIAL NO.: .....

JOB NAME:..... **LOCATION:**.....

START DATE: .....

DATE									
TIME									
ELAPSED TIME METERS									
COMPRESSORS OPERATING									
EVAPORATOR REFRIGERANT PRESSURE									
CONDENSER REFRIGERANT PRESSURE									
DISCHARGE TEMPERATURE	1.								
	2.								
	3.								
CONDENSER REFRIGERANT DRAIN TEMPERATURE									
CONDENSER WATER TEMPERATURE-IN									
CONDENSER WATER TEMPERATURE-OUT									
EVAPORATOR WATER TEMPERATURE-IN									
EVAPORATOR WATER TEMPERATURE-OUT									
EVAPORATOR WATER PRESSURE DROP ftwg [kPa]									
EVAPORATOR WATER FLOW USgpm [m³/hr]									
CONDENSER WATER PRESSURE DROP ftwg [kPa]									
CONDENSER WATER FLOW USgpm [m³/hr]									
ACTUAL VOLTAGE (NOT NOMINAL)									
COMPRESSOR AMPS	1								
	2								
	3								
TONS = $\frac{GPME \times \Delta TE}{24}$									

Note: Compressor are numbered from left to right as you Face Control / Starter Panel. This Log Sheet is provided as a recommendation of the readings that should be taken on a periodic basis. The actual readings taken and the frequency will depend upon the units application, hours of use, etc. This type of information can prove very useful in preventing and/ or solving problems that might occur during the life of the unit.

5.12 COMMON DEFECTS AND MEASURES

1. Refer to **Section 5.10: TROUBLESHOOTING MANUAL** for common defects and measures.

Note: All leakage testing and break down repair on the system should be conducted by authorized personnel. Should the problem persists, please contact Dunham Bush representatives for further instructions and support.

Declaration of Conformity CE

We declare under our sole responsibility that the products WCFX series water cooled chiller described under this manual is in conformity with the following Directives/ or standardization documents:

Machinery Directive 2006/42/EC, Low Voltage Directive 2006/95/EC, EMC 2004/108/EC, EN 60204-1, EN 378-1/-2

Dunham-Bush Industries Sdn. Bhd. representative

……..……..
Samson Ambrose
QC Manager

DUNHAM-BUSH

Products that perform...By people who care

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