INSTALLATION, OPERATION AND MAINTENANCE MANUAL

50/60 Hz

DUNHAM-BUSH

Products That Perform...By people Who Care

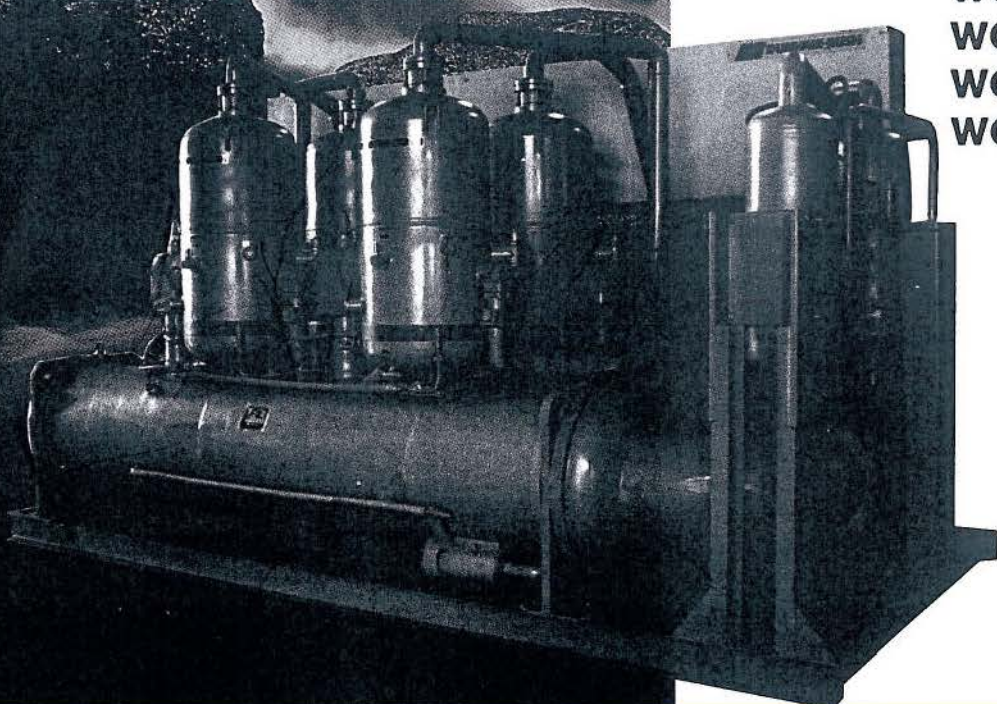# Water-Cooled Rotary Screw *Tandem* Water Chillers

515 to 720 Tons

MODEL:

WCFX 30-30
WCFX 30-33
WCFX 33-33
WCFX 33-36
WCFX 36-36

TABLE OF CONTENTS

INTRODUCTION

This equipment is a factory built and tested packaged chiller designed for the purpose of cooling water or other non-corrosive liquid. The liquid to be cooled is to be circulated through the tubes of a refrigerant evaporator where the temperature is reduced to the desired level. The heat absorbed by the refrigerant in the evaporator is rejected via the condenser where it raises the temperature of another liquid stream (usually water) being circulated through the tubes. This heat is usually rejected by a cooling tower or closed circuit cooler.

To assure satisfactory operation and to avoid damage to the unit, the installation should be made by a qualified refrigeration mechanic. It is assumed that the reader of this manual and those who install, operate and maintain this equipment have a basic understanding of the principles of air conditioning, refrigeration and electrical controls. These instructions are general in nature and are for standard catalog units. Non-standard units may vary in some respects from these instructions.

Your Dunham-Bush packaged chiller has been manufactured under a careful quality control system. It has been performance tested at the factory at specified field operating conditions as a final verification of reliability. If it is installed, operated and maintained with care and attention to these instructions, it will give many years of satisfactory service.

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 out at this time and forwarded to the Dunham-Bush Sales & Services Sdn Bhd.

1.2 RIGGING AND MOVING

Each unit has been carefully tested and inspected at the factory where every precaution was taken to ensure that it reaches its destination in perfect condition. It is very important that the installers, movers, and riggers use the same care in handling the unit. The unit is designed to be lifted from the lifting holes in the steel structural base. For proper rigging, see Figure 1.2.

It is important to protect the unit from damage during storage, rigging and installation. Particular care should be given to avoid damage to controls and piping. Do not allow the unit to be used as a ladder or scaffold!

1.3 DIMENSIONAL DATA

Dimensional outline drawings and physical data of the packages are shown in Figures 1.3 and Table 1.3 respectively. Note especially the space and clearance requirements necessary for servicing the unit.

1.4 APPLICATION PRECAUTIONS

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

1.4.1 Water Conditions

Standard construction of the evaporator and condenser used in Dunham-Bush model WCFX Tandem chillers is copper tubes with steel tube sheets and liquid heads.

These materials are generally suitable for use with 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.

Because Dunham-Bush has no control over the condition of the water used in these machines, we can take no responsibility for failure of tubes or tube sheets due to water corrosion or erosion. It is recommended that the buyer obtain the services of local water treatment specialists to prescribe water treatment.

1.4.2 Chilled Water Flow

The Dunham-Bush WCFX Tandem Chiller is 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 can

RIGGING TO BE DONE IN A MANNER SO THAT NO STRAIN IS PLACED
ON UNIT COMPONENTS OTHER THAN AT CABLE CONNECTION POINTS

SPREADERS
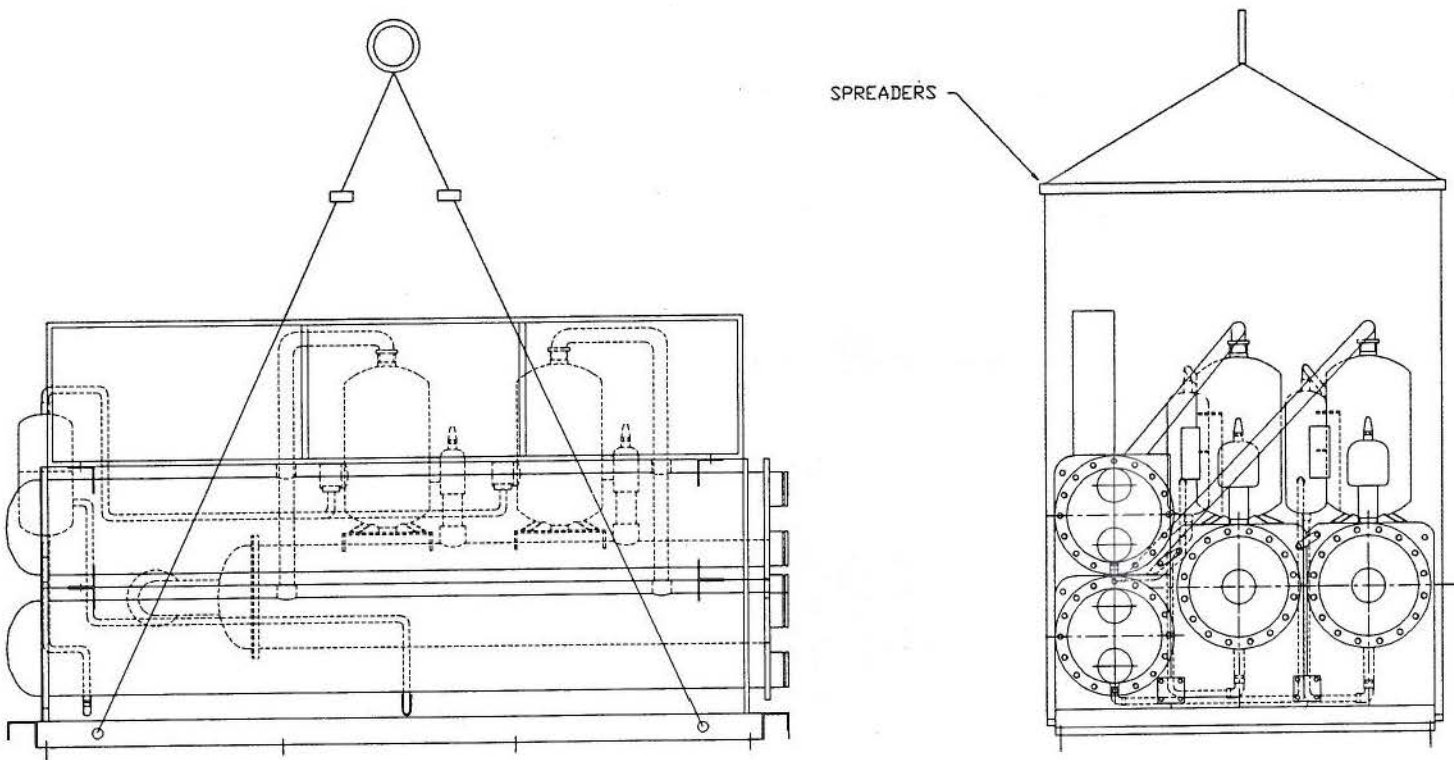
Note: Protect unit from cables.

TABLE 1.3 PHYSICAL SPECIFICATIONS   50 HZ

WCFX 30-30, 30-33, 33-33, 33-36, 36-36

UNIT MODEL	30-30	30-33	33-33	33-36	36-36
NOMINAL TONS	515	555	570	610	625
COMPRESSORS	1215(4)	1215(3)/1218(1)	1215(2)/1218(2)	1215(1)/1218(3)	1218(4)
RPM	2950	2950	2950	2950	2950
ELECTRICAL INFORMATION			400-3-50Hz		
COMPRESSOR : RLA, EACH	155(4)	155(3)/186(1)	155(2)/186(2)	155(1)/186(3)	186(4)
1ST STEP INRUSH, EACH	360(4)	360(3)/446(1)	360(2)/446(2)	360(1)/446(3)	446(4)
LRA, EACH	991(4)	991(3)/1233(1)	991(2)/1233(2)	991(1)/1233(3)	1233(4)
UNIT : MCA (MIN. CIRCUIT AMPS)	659	698	729	760	791
MFS (MAX. ALLOW. FUSE)	800	800	900	900	900
EVAPORATOR MODEL - 2 NOS.	L2	L2	L3	L3	M1
DESIGN PRESS. WATER SIDE (PSIG)	150	150	150	150	150
DESIGN PRESS. REFRIG. SIDE (PSIG)	300	300	300	300	300
WATER VOLUME, GALLONS (EACH)	46.6	46.6	49.0	49.0	53.2
MIN. GPM (1 PASS)	436	436	482	482	526
MAX. GPM (1 PASS)	2138	2138	2358	2358	2580
CONDENSER MODEL - 2 NOS.	J3	J3	K1	K1	K2
DESIGN PRESS. WATER SIDE (PSIG)	150	150	150	150	150
DESIGN PRESS. REFRIG. SIDE (PSIG)	300	300	300	300	300
WATER VOLUME, GALLONS (EACH)	54.9	54.9	59.1	59.1	61.2
MIN. GPM (2 PASS)	250	250	276	276	300
MAX. GPM (2 PASS)	1065	1065	1175	1175	1270
GENERAL INFORMATION					
SHIPPING WT. LB.	23216	23532	23848	24537	25226
OPERATING WT. LB	25858	26232	26606	27446	28286
APPROX. REFRIG. CHARGE, LB. R-22	960	1008	1056	1104	1152

Notes: a.) Fouling factors for both cooler & condenser = 0.00025

b.) The above performance data are based on standard vessels selection, consult factory for other mix-match vessel selection.

c.) The above performance is based on 10°F range for condenser and chilled water temperature.

ton is equal to 3.5168525 kilowatts

TABLE 1.3 PHYSICAL SPECIFICATIONS   60 HZ

WCFX 30-30, 30-33, 33-33, 33-36, 36-36

UNIT MODEL	30-30	30-33	33-33	33-36	36-36
NOMINAL TONS	590	635	655	705	720
COMPRESSORS	1215(4)	1215(3)/1218(1)	1215(2)/1218(2)	1215(1)/1218(3)	1218(4)
RPM	3500	3500	3500	3500	3500
ELECTRICAL INFORMATION	460-3-60Hz				
COMPRESSOR : RLA, EACH	155(4)	155(3)/186(1)	155(2)/186(2)	155(1)/186(3)	186(4)
1ST STEP INRUSH, EACH	360(4)	360(3)/446(1)	360(2)/446(2)	360(1)/446(3)	446(4)
LRA, EACH	991(4)	991(3)/1233(1)	991(2)/1233(2)	991(1)/1233(3)	1233(4)
UNIT : MCA (MIN. CIRCUIT AMPS)	659	698	729	760	791
MFS (MAX. ALLOW. FUSE)	800	800	900	900	900
EVAPORATOR MODEL - 2 NOS.	L2	L2	L3	L3	M1
DESIGN PRESS. WATER SIDE (PSIG)	150	150	150	150	150
DESIGN PRESS. REFRIG. SIDE (PSIG)	300	300	300	300	300
WATER VOLUME, GALLONS	60	60	64	64	75
MIN. GPM (1 PASS)	436	436	482	482	526
MAX. GPM (2 PASS)	2138	2138	2358	2358	2580
CONDENSER MODEL - 2 NOS.	J3	J3	K1	K1	K2
DESIGN PRESS. WATER SIDE (PSIG)	150	150	150	150	150
DESIGN PRESS. REFRIG. SIDE (PSIG)	300	300	300	300	300
WATER VOLUME, GALLONS	67	67	77	77	82
MIN. GPM (1 PASS)	250	250	276	276	300
MAX. GPM (2 PASS)	1065	1065	1175	1175	1270
GENERAL INFORMATION					
SHIPPING WT. LB.	23216	23532	23848	24537	25226
OPERATING WT. LB	25858	26232	26606	27446	28286
APPROX. REFRIG. CHARGE, LB. R-22	960	1008	1056	1104	1152

Annotations (hand-marked):
- MIN. GPM (1 PASS) evaporator: 1650 L/min, 99m3/h
- MAX. GPM (2 PASS) evaporator: 8092 L/min, 486m3/h
- MIN. GPM (1 PASS) condenser: 946 L/min, 57m3/h
- MAX. GPM (2 PASS) condenser: 4031 L/min, 242m3/h
- Gallons Per Minute. 1 Gallon =3,785 liter

Notes: a.) Fouling factors for both cooler & condenser = 0.00025

b.) The above performance data are based on standard vessels selection, consult factory for other mix-match vessel selection.

c.) The above performance is based on 10°F range for condenser and chilled water temperature.

FIGURE 1.3 DIMENSIONAL DATA   50/60 Hz

WCFX 30-30, 30-33, 33-33, 33-36, 36-36

VESSEL LENGTH (VL):				
		VESSEL CODE (EVAP/COND)		
EVAP CONN.	COND CONN.	L/J	L/K	M/R
1 PASS	2 PASS (L/H)	173"	180"	180"
1 PASS	2 PASS (R/H)	173"	180"	180"
1 PASS	1 OR 3 PASS	177"	179"	179"

DIMENSIONAL CHART

MODEL MATCHES	EVAPORATOR WATER CONN. "R"	CONDENSER WATER CONN. "S"			A	B	C	D	E	F
	1 PASS	1 PASS	2 PASS	3 PASS						
30-30	10"	10"	6"	6"	22 3/4"	89"	9 1/8"	11 1/4"	12"	11 1/4"
30-33	10"	10"	6"	6"	22 3/4"	89"	9 1/8"	11 1/4"	12"	11 1/4"
33-33	10"	10"	8"	6"	22 3/4"	89"	9 5/8"	12 3/16"	14"	12 3/16"
33-36	10"	10"	8"	6"	22 3/4"	89"	9 5/8"	12 3/16"	14"	12 3/16"
36-36	12"	10"	8"	6"	23 3/4"	90"	9 5/8"	12 3/16"	14"	12 3/16"

NOTES:

1 – WATER PIPING TO BE SUPPORTED TO MINIMIZE LOAD ON UNIT.

2 – ALL DIMENSIONS ARE IN INCHES.

3 – VENT AND DRAIN CONNECTIONS PROVIDED ON EVAPORATOR AND CONDENSER.

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

5 – 36" OF FLEXIBLE CONDUIT SHOULD BE USED.

6 – ALL WATER NOZZLES ARE IPS, WITH VICTAULIC GROOVES, SUITABLE FOR VICTAULIC COUPLINGS OR SLIP ON FLANGES.

7 – SPRING ISOLATORS ARE OPTIONAL.

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 such as an automatic modulating valve should be provided in the system to maintain steady flow through the evaporator.

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

If the chilled water system is arranged 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 the method of control must be such that water temperature entering the evaporator never exceeds 90°F.

1.4.3 Water Cooled Condensers

The water cooled condenser is also designed for constant water flow rate, and should be supplied with the design GPM ±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 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/min. and does not go below 60°F. One or more of the following methods may be used to control the tower:

1.4.3.1 A modulating three-way valve which by-passes tower sprays at low load and low ambient temperature.

1.4.3.2 Tower fan staging in response to a thermostat in the tower sump. Fan thermostat should have a differential of at least 20°F to avoid short-cycling.

1.4.3.3 A modulating three-way valve which by-passes the cooling tower to blend warm leaving condenser water with cold tower water.

1.4.4 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.

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 Figure 2.1. The unit must be leveled to within 1/16" per foot for proper operation.

2.2 VIBRATION ISOLATION

Where structure-borne vibration may be of concern, it is recommended that the unit be mounted on vibration isolators. Rubber-in-shear isolators or spring isolators are available for this unit as optional equipment. If spring isolators are installed, it is also necessary to provide isolation in condenser water and chilled water pipes by means of flexible connectors and in main power supply conduit through use of flexible conduit. Isolation of piping and electrical conduit is desirable in any event, to avoid noise transmission.

2.3 WATER PIPING CONNECTIONS

Refer to Figures 1.3. for water piping connection locations. Note that the condenser water inlet must be on the bottom. If necessary, evaporator or condenser heads can be reversed, left to right or vice versa. Leaving chilled water temp sensor must be located in leaving chilled water stream. After the unit has been leveled and isolators (if any) installed and adjusted, connect evaporator and condenser water piping. Piping must be properly supported to avoid stress on unit water connections. Install air vent valves in all high

connections on evaporator and condenser heads. Install drain valves in similar low points to facilitate gravity draining of the system. It is important that water systems be cleaned before start-up to avoid collecting debris in cooler and condenser. The best way to do this is to install strainers in both systems upstream of the unit. After filling systems with water, bleed trapped air from the various vent valves. Check for proper flow rates by measuring water pressure drop across heat exchangers and reading GPM from charts, Figure 2.3. Compare measured GPM's with values specified on purchase order. Check in Table 1.3. to see that evaporator and condenser GPM's fall between min. and max. limits.

2.4 ELECTRICAL WIRING

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

- All field wiring is to 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 to be connected with copper conductors only, sized per ampacity listed on unit data plate.

- Connections to unit should match the unit nameplate in volts, phase and Hertz. Voltage must not vary beyond ±10% of nameplate value and voltage imbalance between phases must not exceed 2% at any time during operation of the unit.

- Phase sequence to connections L_1, L_2, L_3 shall be in that order. Check with Amprobe phase sequence adapter PSA-1 or equivalent.

2.0 INSTALLATION

FIGURE 2.1 FLOOR LOADING DIAGRAM   50/60 Hz

WCFX 30-30, 30-33, 33-33, 33-36 & 36-36
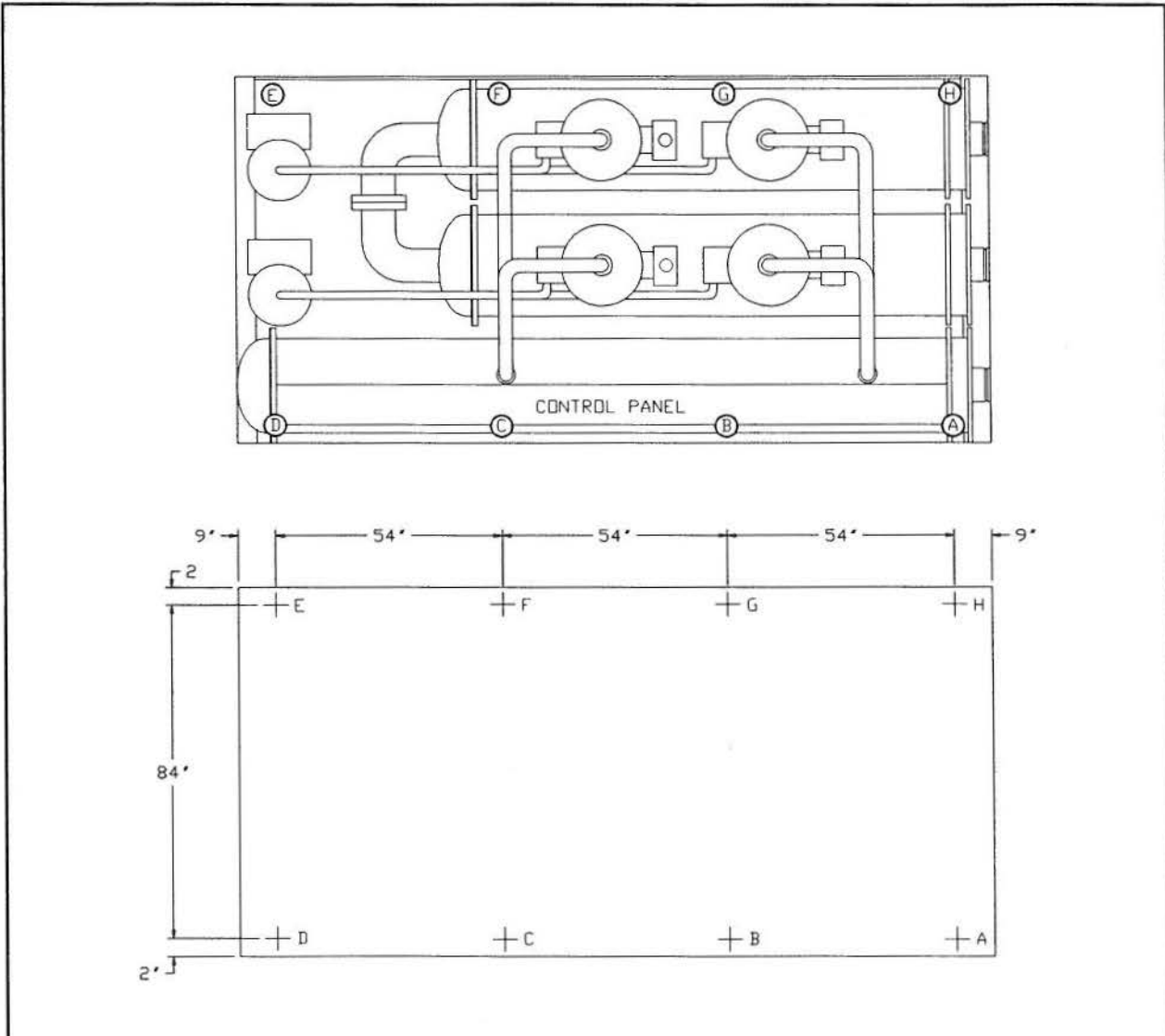
Point Loading, LBS

POINT LOAD \ UNIT MODEL	WCFX 30-30	WCFX 30-33	WCFX 33-33	WCFX 33-36	WCFX 36-36
A	4128	4175	4039	4080	4246
B	3886	3928	3840	3884	4034
C	3642	3685	3643	3684	3820
D	3400	3438	3444	3487	3608
E	2278	2316	2742	2784	2924
F	2561	2602	3042	3085	3247
G	2844	2887	3341	3382	3568
H	3128	3173	3641	3682	3891

2.0 INSTALLATION

FIGURE 2.3 PRESSURE DROPS   50/60 Hz

1.a.) EVAPORATOR 1 PASS (WCFX 30-30, 30-33, 33-33, 33-36 & 36-36)

1 ft w.g. = 2,99 kPa

1.b.) CONDENSER 2 PASS (WCFX 30-30, 30-33, 33-33, 33-36 & 36-36)

2.0 INSTALLATION

2.5 CONTROLS

2.5.1 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:
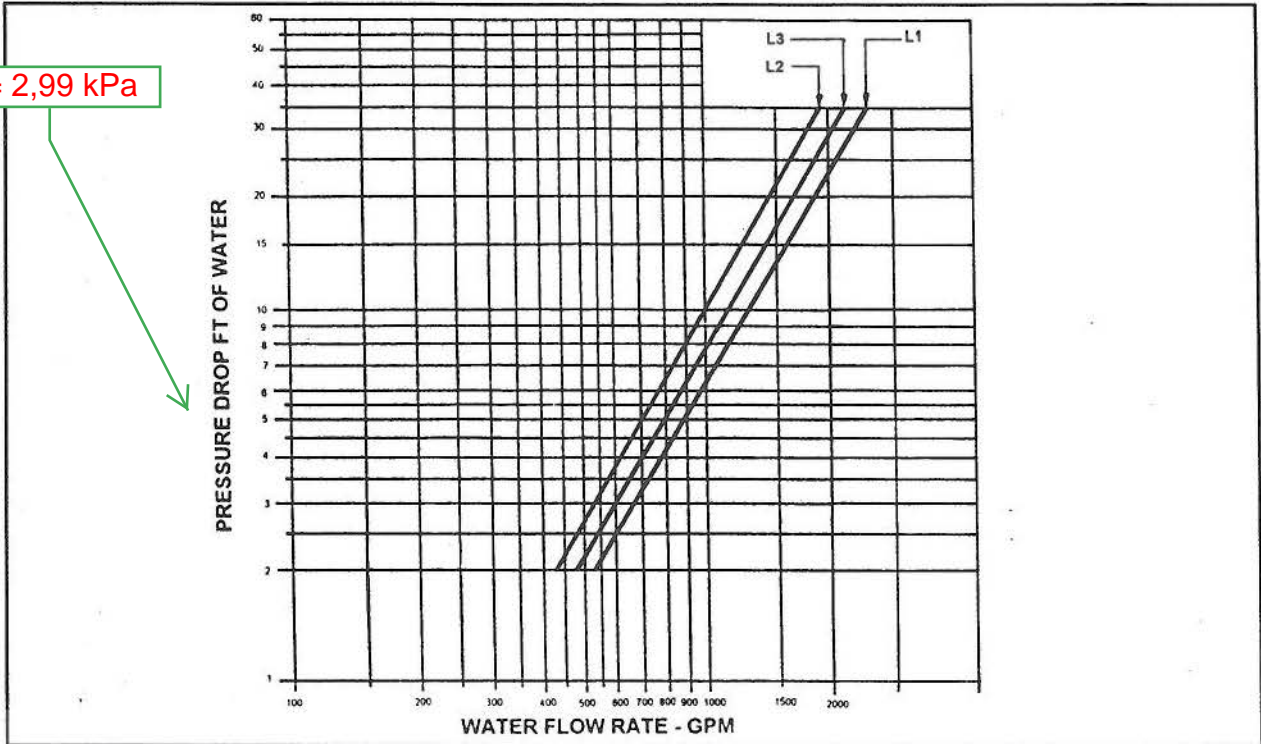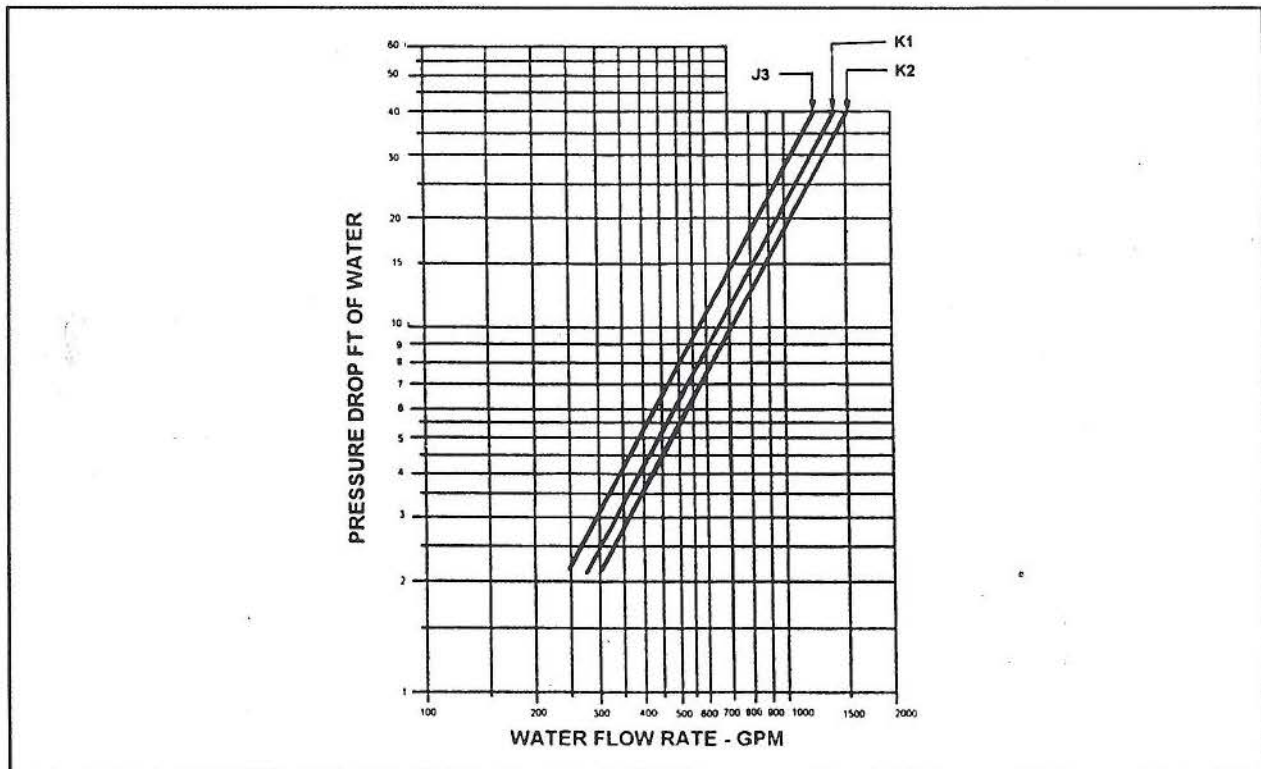
2.5.1.1 Connect a set of normally open auxiliary contacts from chilled water pump contactor into unit controls as shown on unit wiring diagram.

2.5.1.2 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 2.5.1.1.

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

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

2.5.2 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 factory recommendations.

2.6 REQUEST FOR START-UP REPRESENTATIVE

After the installation has been completed and checked, contact the Dunham-Bush Sales & Services for an authorized start-up representative to perform the initial start-up of the Dunham-Bush packaged chiller. The purchaser must have competent service and operating personnel in attendance to assist in the work involved, and also to be trained in the service and maintenance of this unit. (During the warranty period, the manufacturer is responsible for parts only upon proof of defective workmanship or manufacture).

Following this contact a representative will be sent to the customer. He will inspect the installation to determine whether it meets Dunham-Bush requirements, perform the initial start-up of the installation, determine whether it is in satisfactory operating condition, and instruct the specified customer personnel in its operation and maintenance for the length of time specified in the purchase contract.

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
The compressor(s) should be started initially ONLY under the direct supervision of an Authorized Dunham-Bush Start-Up Representative.

3.0 OPERATION

3.1 SYSTEM WATER FLOW RATE

The quantity of chilled water being circulated can be measured quite accurately (±5%) by determining the water pressure drop through the evaporator and reading GPM 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 GPM is to measure pressure difference from pump inlet to outlet and read GPM 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, removing all vent and drain plugs from both heads of each vessel, and blow out tubes with compressed air.

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

3.2.3 It is recommended that an oil sample be taken from each compressor and submitted for laboratory analysis.

Dunham-Bush offers this service in its Oil Kare Program. This analysis should be done at the beginning and end of each operating season, or every six months if the unit is used year round.

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 Energize power supply to unit. Unit must be energized for 24 hours in order to warm up compressor oil sump before starting. Control circuit power switch should be off during this period to prevent compressor operation. Clean water side heat transfer surface of condenser and evaporator by removing heads and brushing tubes.

3.3.3 Check water circuits to see that cooling tower is ready for operation, and both circuits are filled. Start pumps and check for flow in both cooler and condenser.

3.3.4 Turn control circuit power switches on, turn compressor switch on, and press reset on computer keyboard. Compressor should start after start-up clock times out and leaving water temperature should be automatically controlled. Check refrigerant charge and check for normal suction and discharge pressures.

3.3.5 Have a trained service mechanic check the function of all control setpoints. Check signal lights for proper operation.

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

3.0 OPERATION

3.4 SAFETY RELIEF VALVES

Each pressure vessel is protected by a safety relief valve as required by ASME Code. Each condenser has one relief valve. Local codes may require that all safety relief valves be piped to the outdoors. Never install a hand valve in a safety relief vent line.

3.5 REFRIGERATION CYCLE

Refer to Figure 3.5 for the piping schematic of one system. Each vertical screw compressor discharges hot, high pressure gas through a discharge check valve (A) into the condenser, where it condenses outside tubes, rejecting heat to cooling tower water flowing inside the tubes. The liquid refrigerant drains to the bottom of the condenser and exits into the economizer feed line.

The refrigerant flows through the economizer feed ball valve (B), dropping its pressure, causing it to flash. It then flows into the flash economizer tank (C) which is at an intermediate pressure between condenser and evaporator. Liquid is centrifugally separated from the flash gas and the liquid drains to the bottom of the tank, exits via the economizer drain line, and passes through the economizer drain ball valve (D). Both economizer ball valves are actuated by a Modutrol motor (U) that adjusts flow to maintain an appropriate refrigerant level in the evaporator, determined by a liquid level float switch (V).

From the drain line, liquid refrigerant flows into the flooded evaporator, where it boils, cooling the water flowing inside evaporator tubes. Vapor from the boiling refrigerant flows up the suction pipes through a shut-off valve (E), suction check valve (F) and suction filter (G) (inside compressor) into the compressor where it is compressed and starts the cycle again.

Vapor flows from the top of flash economizer into the compressor at the vapor injection port, which feeds it into the compressor part way through the compression process. Check valve (H) prevents backflow at shutdown in multi-compressor units. All compressors operate in parallel on a common evaporator and condenser.

3.6 OIL MANAGEMENT SYSTEMS (SEE FIG. 3.5)

The compressors are oil lubricated and discharge 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 two taps in the shell, a filter-drier (L) between isolation valves (K), and into a manifold that serves all compressors. At each compressor, this oil rich liquid flows through a check valve (Q), sight glass (R), and into a jet pump (N) which feeds into the compressor suction line. Gas from each compressor flows through valve (S), solenoid (P), and then drives the jet pump.

Oil overflow feeds from the C4 port on the compressor through an overflow valve (S), sightglass (T), and check valve (Z), and is shared between compressors by feeding through the overflow feed solenoid valves (P) into the operating compressors.

CONDENSER

EVAPORATOR
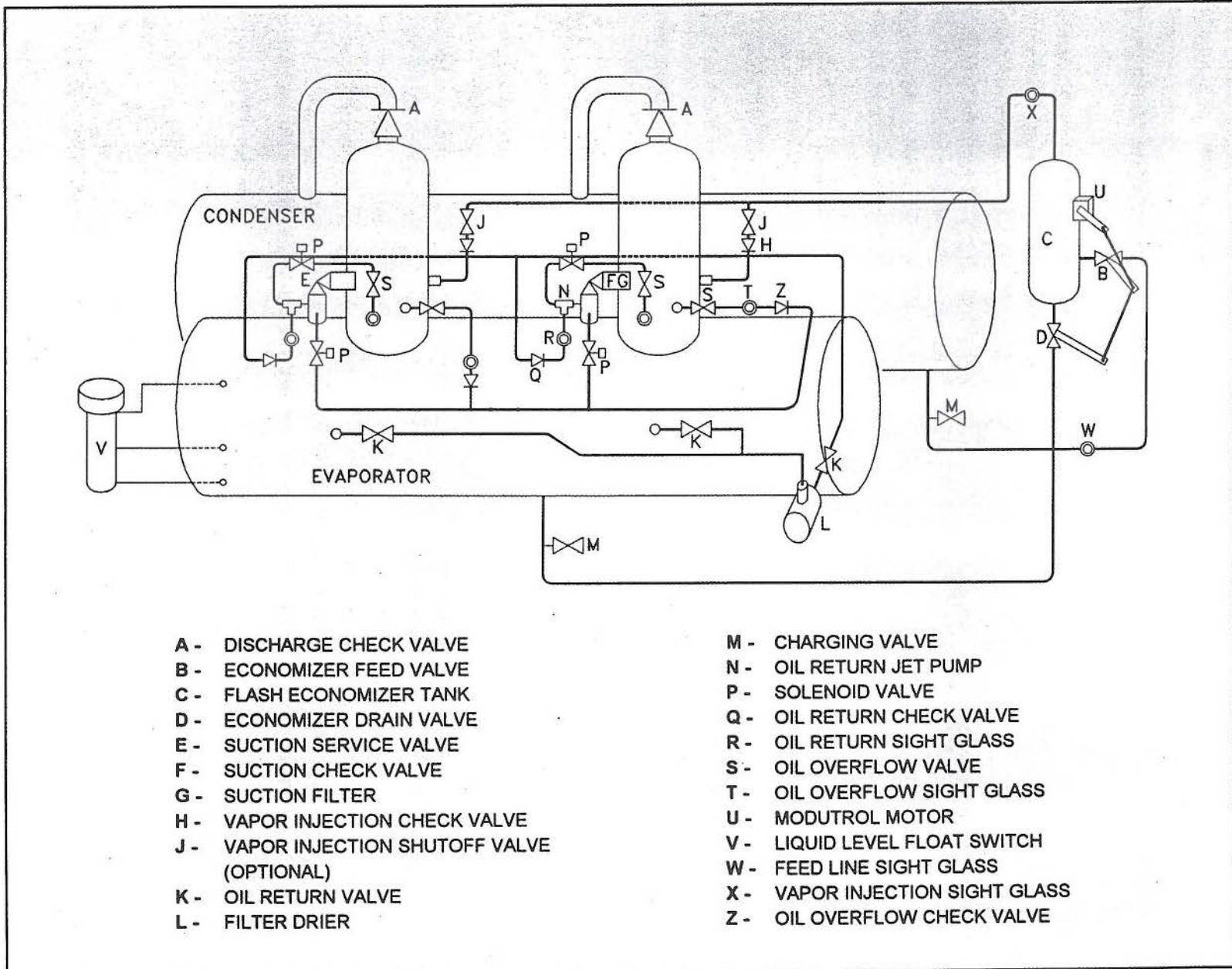
A -	DISCHARGE CHECK VALVE
B -	ECONOMIZER FEED VALVE
C -	FLASH ECONOMIZER TANK
D -	ECONOMIZER DRAIN VALVE
E -	SUCTION SERVICE VALVE
F -	SUCTION CHECK VALVE
G -	SUCTION FILTER
H -	VAPOR INJECTION CHECK VALVE
J -	VAPOR INJECTION SHUTOFF VALVE (OPTIONAL)
K -	OIL RETURN VALVE
L -	FILTER DRIER

M -	CHARGING VALVE
N -	OIL RETURN JET PUMP
P -	SOLENOID VALVE
Q -	OIL RETURN CHECK VALVE
R -	OIL RETURN SIGHT GLASS
S -	OIL OVERFLOW VALVE
T -	OIL OVERFLOW SIGHT GLASS
U -	MODUTROL MOTOR
V -	LIQUID LEVEL FLOAT SWITCH
W -	FEED LINE SIGHT GLASS
X -	VAPOR INJECTION SIGHT GLASS
Z -	OIL OVERFLOW CHECK VALVE

3.7 HYDRAULIC CAPACITY CONTROL SYSTEM
(SEE FIG. 3.7.)

Each compressor has a hydraulic control system to position the capacity control slide valve, thereby regulating compressor capacity. It is composed of a normally closed solenoid valve (A), a normally open solenoid valve (B), an internal pressure regulating valve, a loading rate control valve (C), and an unloading rate control valve (D).

With valves A and B both energized (A open, B closed) during normal compressor operation, high pressure oil is directed to the slide valve. This pressure acts on the surface of the slide valve piston creating 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.

The rates of loading and unloading are regulated by load rate needle valves C and D respectively. The proper time for total slide valve travel (loading or unloading) is 40 ± 10 seconds. Load and unload rates will be slower when the compressor is cool and at low head than when hot and at high head. To adjust load or unload rate, remove the socket head O ring plugs to reach the needle valves. To decrease rate, turn needle valve clockwise.

See table for a summary of solenoid valve operation vs. slide valve operation.

FIGURE 3.7 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)	CLOSE (ENERGIZED)	CLOSED (ENERGIZED)
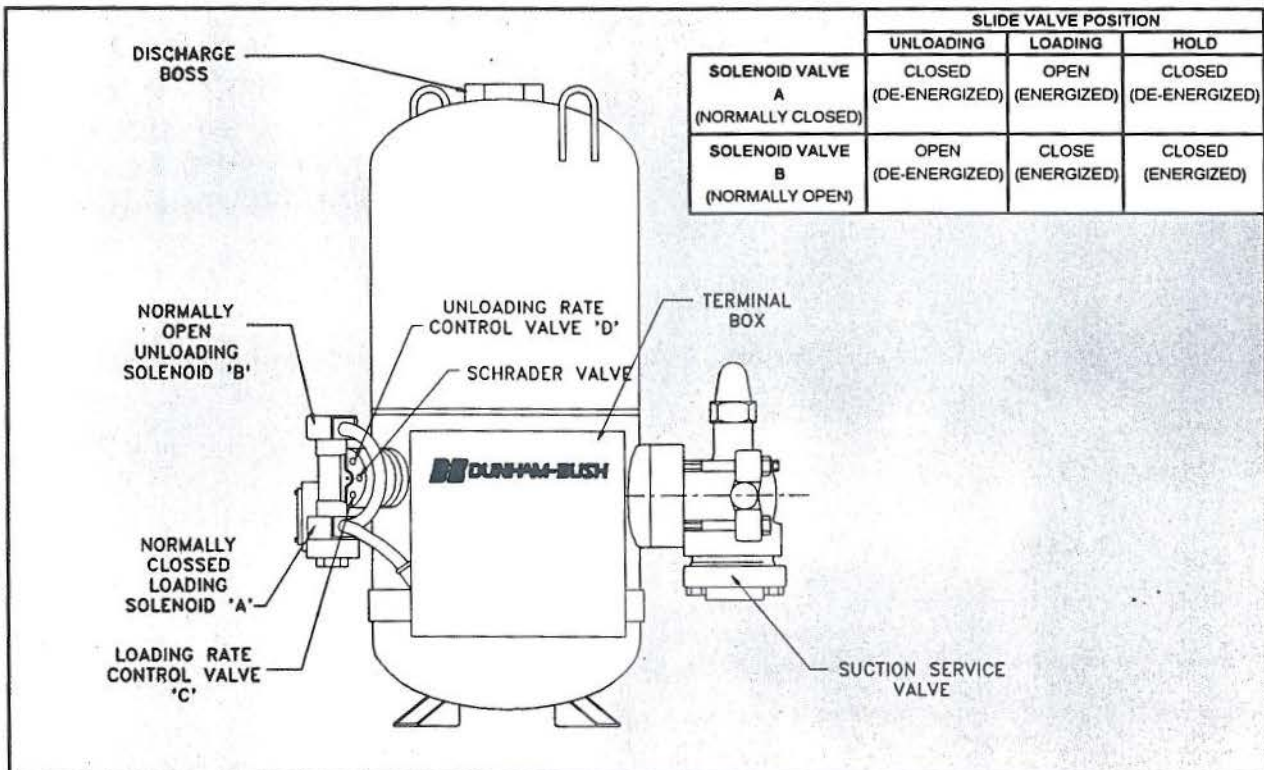
3.0 OPERATION

3.8 FREEZE PREVENTION

If water (or brine) is allowed to freeze within the tubes and heads of the evaporator or condenser, severe damage will result; split and leaking tubes and cracked and leaking heads. 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:

3.8.1 Standby at Low Ambient Temperatures

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

3.8.2 In Operation

Freezing of water in cooler tubes is a possibility if chilled water flow stops and if the low suction pressure cutout (normally set for 58 psig, or 32°F saturation) and the low water temperature cutout both fail. If the chilled water flow switch and pump interlock are properly applied (See 2.5.1.1 and 2.5.1.2) 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.

3.8.3 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 58 psig, if water is not flowing, it is possible to freeze 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 50/60 Hz

UNIT MODEL			NOM. VOLTS		UNIT		EACH COMPRESSOR		
	50 HZ	60HZ	50 HZ	60HZ	MCA	MFS	RLA	INR	LRA
WCFX 30-30	AU	AR	400	460	659	800	155 (4)	360 (4)	991 (4)
WCFX 30-33	AU	AR	400	460	698	800	155 (3) 186 (1)	360 (3) 446 (1)	991 (3) 1233 (1)
WCFX 33-33	AU	AR	400	460	729	900	155 (2) 186 (2)	360 (2) 446 (2)	991 (2) 1233 (2)
WCFX 33-36	AU	AR	400	460	760	900	155 (1) 186 (3)	360 (1) 446 (3)	991 (1) 1233 (3)
WCFX 36-36	AU	AR	400	460	791	900	186 (4)	446 (4)	1233 (4)

NOTES: MCA - MINIMUM CIRCUIT AMPACITY
MFS - MAXIMUM FUSE SIZE
RLA - RATED LOAD AMPS AT ARI COS
INR - FIRST STEP INRUSH AMPS
LRA - LOCKED ROTOR AMPS

4.2 WIRING DIAGRAM

Figure 4.2 are typical wiring diagrams for a Tandem chiller unit. This may not be an accurate representation of your 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:

- system voltage above undervoltage relay (UVR) setting
- chilled water pump running
- chilled water flow switch made
- compressor circuit breakers on
- customer unit control contact closed
- control switch and compressor switches on
- reset pressed on microcomputer keypad
- power has been on the microcomputer for 15 minutes
- all safety conditions satisfied
- leaving chilled water temperature 2°F or more above setpoint

A compressor is started by first energizing 1M1 followed by 1M2 after 1 second if step start is activated (see 4.5.4). Otherwise, both contactors energize together. 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, voltage using 3T, 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.

If the safety conditions are satisfied for the #2 compressor, at least 1 minute has elapsed since starting #1 compressor, and leaving water temperature remains above the deadband; 2M1 and 2M2 will be activated by the micro-computer, (2M2 will close after 1 second delay, if step start is desired.) #2 compressor also has a 15 minute anti-recycle timer built into the microcomputer. Loading of the #2 compressor is controlled the same as compressor #1. Compressors #3 and #4 operate in a similar manner.

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.

4.4 MICROCOMPUTER CONTROLLER

This unit is controlled by a microcomputer control system. The system is composed of four microcomputer boards, a display board and analog and digital sensors. The following sections describe the system and how to operate it.

The display board has a 20-key keypad and a 2 x 40 LCD display. The keypad and display can be used to determine the status of the compressor, and refrigeration system. Various setpoints can also be displayed and altered.

The status of the machine can also be monitored by a computer terminal either locally or remotely by a modem. The terminal must be able to handle RS232 communications. For more information, Please contact Dunham-Bush Sales & Services.

FIGURE 4.2 TYPICAL WIRING DIAGRAM

50/60Hz
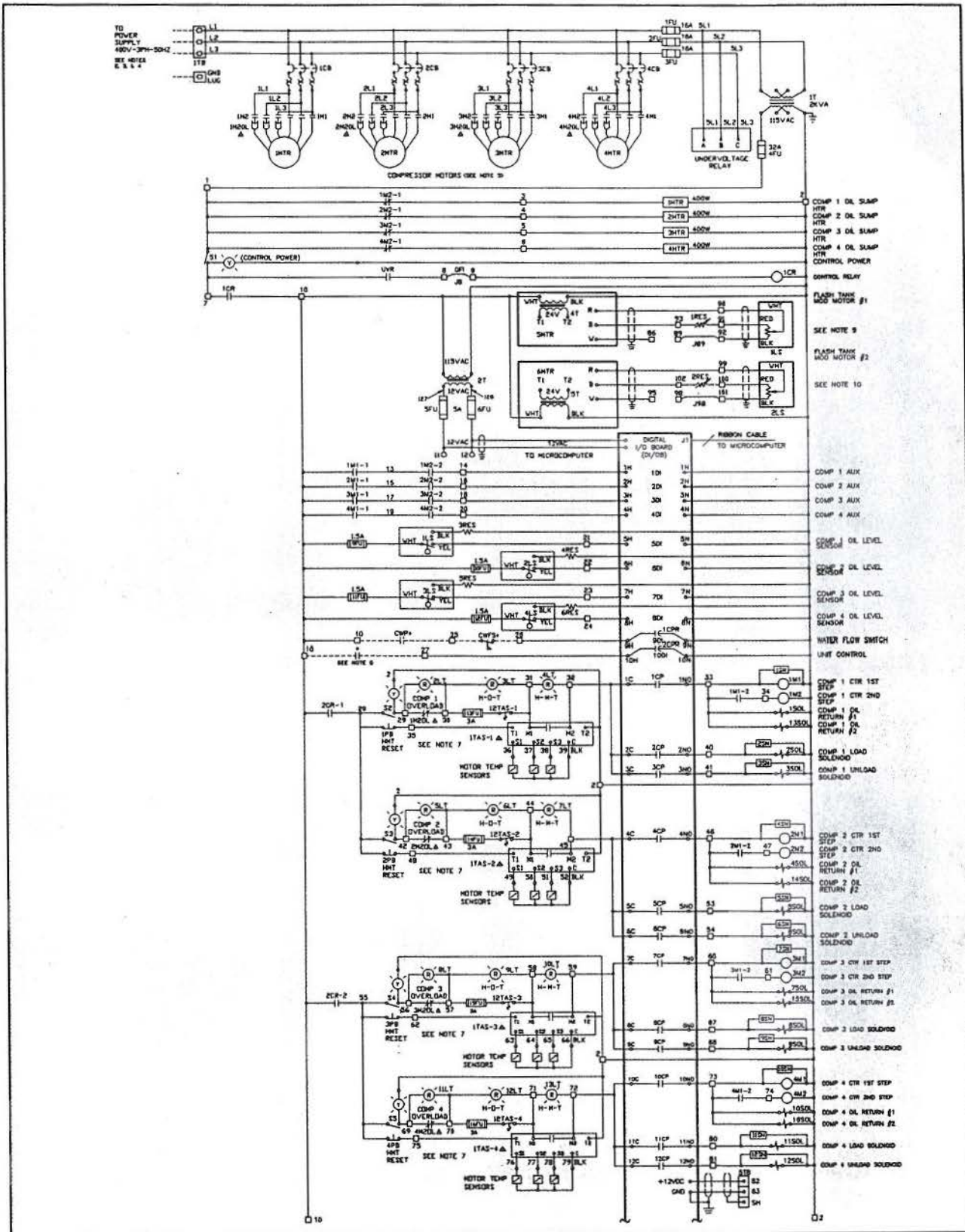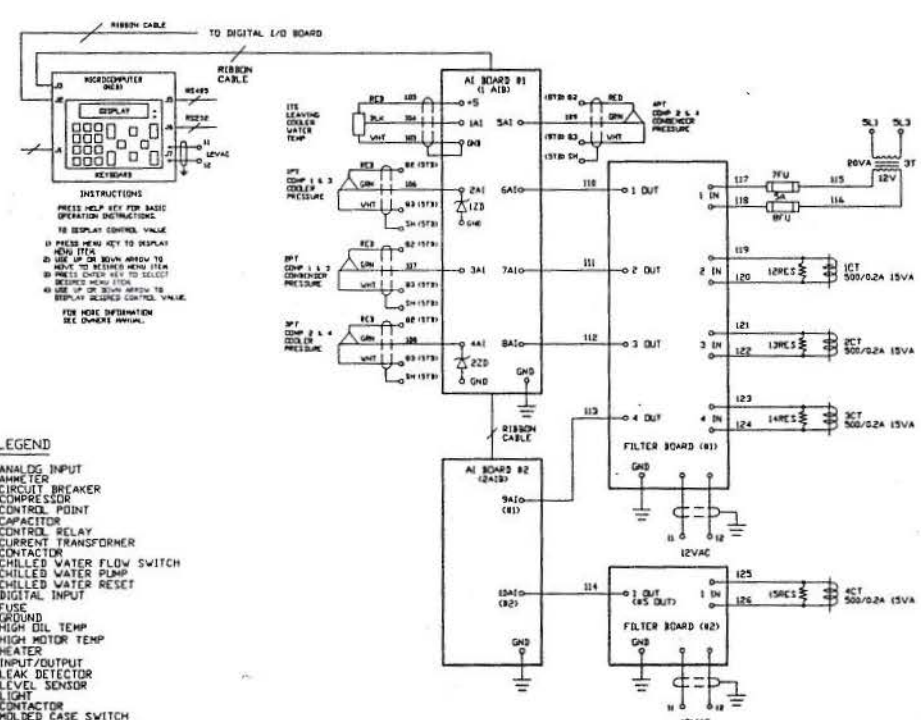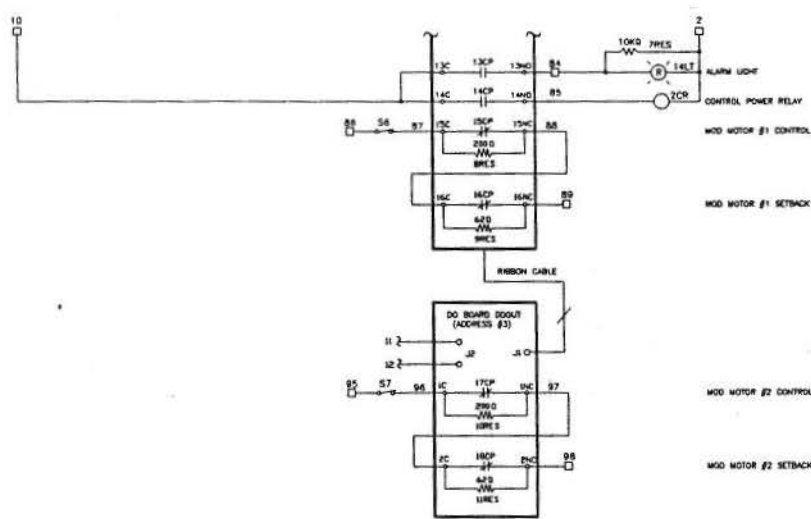
LEGEND

AI	ANALOG INPUT
AM	AMMETER
CB	CIRCUIT BREAKER
COMP	COMPRESSOR
CP	CONTROL POINT
CPR	CAPACITOR
CR	CONTROL RELAY
CT	CURRENT TRANSFORMER
CTR	CONTACTOR
CWFS	CHILLED WATER FLOW SWITCH
CWP	CHILLED WATER PUMP
CWR	CHILLED WATER RESET
DI	DIGITAL INPUT
FU	FUSE
GND	GROUND
H-O-T	HIGH OIL TEMP
HMT	HIGH MOTOR TEMP
HTR	HEATER
I/O	INPUT/OUTPUT
LD	LEAK DETECTOR
LS	LEVEL SENSOR
LT	LIGHT
M	CONTACTOR
MCS	MOLDED CASE SWITCH
MOV	METAL OXIDE VARISTOR
MTR	MOTOR
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
OL	OVERLOAD
PB	PUSH BUTTON
PT	PRESSURE TRANSDUCER
RES	RESISTOR
RLY	RELAY
SS	PUMP DOWN SWITCH
SC	STARTS COUNTER
SH	SHIELD
SN	SNUBBER
SOL	SOLENOID
TAS	THERMOSTAT
TB	TERMINAL BLOCK
TLW	TEMP LEAVING WATER
TR	TIMER
TS	TEMP. SENSOR
UVR	UNDERVOLTAGE RELAY
VM	VOLTMETER
ZD	ZENOR DIODE
△	MANUAL RESET
▢	FACTORY TERMINAL
— —	FIELD WIRING
∗	FIELD SUPPLIED

NOTES

1- FUSES SHALL BE TIME DELAY TYPE.

2- ALL FIELD WIRING SHALL COMPLY WITH LOCAL, STATE AND NATIONAL CODES.

3- USE COPPER CONDUCTORS ONLY. CONTROL WIRING 14AVG.

4- DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY INSTALLER.

5- IF POWER SUPPLY HAS BEEN INTERRUPTED FOR A PROLONGED PERIOD, OIL SUMP HEATERS MUST BE ENERGIZED FOR 24 HOURS MINIMUM BEFORE STARTING COMPRESSORS.

6- DO NOT RUN CT WIRES IN WIRE BUNDLES.

7- TO RESET 1TAS HOLD PB FOR 5 SECONDS.

8- CUSTOMER CONTROL CONTACTS MUST BE WIRED BETWEEN TERMINAL 10 & 27.

9- 1RES CAN BE WIRED BETWEEN TERMINALS 93 & 91 OR BETWEEN TERMINALS 89 & 92. IF 1RES IS WIRE BETWEEN 89 & 92, J89 MUST BE REMOVED AND A JUMPER WIRE (J93) MUST BE ADDED BETWEEN TERMINALS 93 & 91. 1RES IS FACTORY SET. DO NOT ADJUST IN THE FIELD.

10- 2RES CAN BE WIRED BETWEEN TERMINALS 102 & 100 OR BETWEEN TERMINALS 98 & 101. IF 2RES IS WIRED BETWEEN 98 & 101, J98 MUST BE REMOVED AND A JUMPER WIRE (J102) MUST BE ADDED BETWEEN TERMINALS 102 & 100. 2RES IS FACTORY SET. DO NOT ADJUST IN THE FIELD.

4.0 ELECTRICAL

4.4.1 To Display Data From The Menu

1. Press the MENU key.
2. Use the up or down arrow keys to select the type of information desired. The main menu items are:

   DATE & TIME SET
   CONTROL POINTS
   ANALOG SENSORS
   DIGITAL SENSORS
   SETPOINTS A & B
   ALARMS
   AUTHORIZATION
3. Press the ENTER key.
4. Use the up or down arrow keys to select the desired data. For control points, additional data such as compressor operating hours and number of starts can be viewed with the right and left arrow keys.

NOTE: When displaying analog sensors, the PAGE MODE key can be pressed to display two new analog inputs after each arrow key is pressed. Press PAGE MODE again to return to displaying one new analog input.

4.4.2 To Reset All Control Points To Computer Control

1. Press the RESET key. The display will show RESET ALL CPs to COM MODE? N Y
2. Press the right arrow key to select Y.
3. Press the ENTER key. The reset will not be accepted if a lockout control point is active. Resolve the problem and reset again.

4.4.3 To Display Alarms

1. Press the MENU key.

2. Use the up or down arrow to select ALARMS.
3. Press ENTER.
4. The day, time, and alarm code is displayed. Alarm 1 is the most recent alarm.
5. Press the down arrow to view previous alarms.
6. Determine identity of alarm from alarm codes on computer instruction label.

4.4.4 To Become Authorized

1. Select AUTHORIZATION on the main menu. Press ENTER.
2. If the current status shown is VIEW, press the authorization code (64) on the number keys.
3. Press ENTER. the current status will change to PROG (program) if accepted.

4.4.5 To Alter Setpoint Data

1. You must be authorized and in the PROG mode. See section 4.4.4.
2. Select SETPOINTS A & B on the main menu. Press ENTER.
3. Use the up or down arrow keys to select the setpoint to be changed. Press ENTER. A cursor will flash over the setpoint A value.
4. a.) If you want to change setpoint A, press in the desired new value and press ENTER. if the new value is within allowable limits, it will be stored in memory. The cursor will then move to setpoint B.

   b.) If you do not want to change setpoint A, press ENTER.
5. Repeat 4, for Setpoint B.

4.4.6 To Calibrate Temperature And Pressure Sensors

1. You must be authorized and in the PROG mode. See Section 4.4.4.
2. Display the analog sensor to be calibrated on the top line of the display.
3. Press ENTER to show ZERO CALIBRATION value.
4. Use an accurate gauge to measure the analog value when it is stable and near design conditions.
5. Determine the revised zero calibration required as follows: Meter Reading - AI Display + Zero Calibration = New Zero Calibration. The new zero calibration must be rounded to the nearest whole number.
6. Press ENTER to place the cursor on the zero calibration value.
7. Enter the new value from 5. Negative values are entered by pressing LOWER FUNCTION +/- before the number.
8. Press ENTER to store the revised zero calibration.

For example, if a suction pressure gauge shows 58 psig and the computer displays 60.3 psig with a zero calibration of -1, then new calibration would be 58 - 60.3 + (-1)= -3.3(-3). So the zero calibration should be changed to -3. Then the computer will display 58.3.

4.4.7 To Set Date And Time

1. You must be authorized. See Section 4.4.4.
2. Select DATE & TIME SET on the main menu. Press ENTER to display current date and time.
3. Press ENTER key to move cursor to each date/time item.

4. As each item flashes, use the number keys to enter revised data if necessary.
5. Press ENTER to continue. The last ENTER will store the new date and time.

WARNING: Setting the clock will cause a system reset. The entire unit will shut down and start over again. If the change was started inadvertently, press MENU key before completing the change.

4.4.8 To Display Data Without Accessing Menu

1. Press LOWER FUNCTION.
2. Press function desired (blue subscript)
3. Press item number to be displayed.
4. Press ENTER.
   EX: To display analog input #5, press LOWER FUNCTION, ANALOG INPUT, 5, ENTER.

4.4.9 Unit Schedule Of Operation

If a seven day time schedule of unit operation is desired, the internal real time clock of the microcomputer can be used. When the SCHEDULE control point is ON, the compressor is allowed to operate. The following procedure is used to modify the operating schedule.

1. Perform the authorization procedure (See 4.4.4).
2. Press MENU key.
3. Use Up and Down to select CONTROL POINTS.
4. Press ENTER.
5. Use Up and Down to select SCHEDULE control point.

4.0 ELECTRICAL

6. Use → to display the first schedule. The standard display screen would show:
CP 17 SCHEDULE GRP: 1 SCH: 1 0000 2400 DAYS: *** ALL DAYS ***.
This indicates that control point 17 named SCHEDULE is controlled by schedule group (GRP) #1. The first schedule (SCH:1) turns on at 0000 hours and off at 2400 hours (military time) every day of the week. Thus it is on all the time.

7. To change this schedule, press ENTER. The cursor will flash over the turn-on time.

8. Use the number keys (0-9) to enter the revised turn on time using military format.

9. Press ENTER. The cursor will move over to the turn-off time.

10. Use the number keys to enter the turn-off time in military format.

11. Press ENTER. The cursor will move to DAYS during which this schedule is active.

12. To change the days for this schedule, press one or more of the following number keys: 0- Clear all current days; 1- Sunday(S); 2- Monday(M); 3- Tuesday(T); 4- Wednesday(W); 5- Thursday(R); 6- Friday(F); 7- Saturday(A); 8- *** ALL DAYS***.

13. Press ENTER. The revised schedule number is now stored.

14. To add another schedule, press the right arrow key and repeat steps 7-13.

15. To delete a schedule, clear all of the days by pressing 0 at Step 12. The schedule group turns on when any of the individual schedules turns on. The turn on time does not have to be earlier than the turn off time. Schedules turn on by time

and day, but turn off by time alone. For example, a schedule from 1900 to 0700 Saturdays would turn on at 7:00 PM Saturday (time and day) and turn off at 7:00 AM Sunday (time only).

EXAMPLE: If a unit is to operate at all times except between the hours of 1:00 AM and 6:00 AM, the following schedules would be entered:
CP 17 SCHEDULE GRP :1 SCH: 1 0000 0100 DAYS:
*** ALL DAYS ***
CP 17 SCHEDULE GRP:1 SCH: 2 0600 2400 DAYS: ***ALL DAYS ***

ANOTHER EXAMPLE: A typical building may require cooling from 6:00 AM to 7:00 PM Monday - Friday and from 7:00 AM- 3:00 PM on Saturdays. The schedules would be entered as follows:
CP 17 SCHEDULE GRP:1 SCH: 1 0600 1900 DAYS: MTWRF
CP 17 SCHEDULE GRP: 1 SCH: 2 0700 1500 DAYS: A.

4.5 CONTROL FUNCTIONS

4.5.1 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 RESET must be pressed to clear the alarm.

NOTE: The flow switch or pump interlock cannot be used for normal control of the unit. (See 4.5.2).

4.0 ELECTRICAL

4.5.2 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.

4.5.3 Anti-Recycle Timer (Microcomputer)

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 microcomputer will not restart the compressor motor until the 15 minutes have elapsed. COFF is displayed when the compressor control point (1 CP, 4CP, 7CP or 10CP for compressors 1, 2, 3 or 4 respectively) is addressed, and when other conditions for compressor start are satisfied. See Section 4.3.

4.5.4 Part Wind Start Timer (10TR)

Each compressor is served by two contactors. If required, a one-second delay between steps can be initiated to give stepped rise of inrush current. Remove the jumpers across 10TR if this feature is desired. If stepped start is not required, it is best to leave the jumper in place, which results in across-the-line starting of the compressor. This minimizes wear on compressor and contactors.

4.5.5 Load Control (Microcomputer)

The microcomputer 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 microcomputer 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 current limit function (see Section 4.5.7) overrides the temperature control.

The status of the compressor can be observed by displaying the compressor control point (1CP, 4CP, 7CP or 10CP). One of the following messages will be displayed:

COMP # LOAD Automatic load
COMP # HOLD Automatic hold
COMP # UNLD Automatic unload
COMP # OFF Off on temperature or customer control
COMP # COFF Off on timer (C lock off)
COMP # LOFF Manual off or safety shutdown

Where # is 1, 4, 7 or 10 for compressors 1, 2, 3 or 4 respectively.

4.5.6 Ramp Control (Microcomputer)

Another feature of the microcomputer 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,

4.0 ELECTRICAL

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 A setpoint can be set anywhere from 0.1 to 0.4, smaller values producing slower loading rates. The ramp start B setpoint can be set anywhere between 10 and 50%. The compressor will load quickly to this value and then follow the ramp slope from there. See Table 4.5.6 for ramp rates at various settings.

4.5.7 Current Limiting (Microcomputer)

A maximum desired current is specified by amp limit B setpoint for each compressor. Above the B setpoint, the compressor will not load. If the amps rise above the A setpoint, the computer will give an unload command to the compressor until the current drops below the A setpoint. The amp value in the A setpoint should be 10% of RLA higher than the B setpoint.

4.5.8 Staging Control (Microcomputer)

On multiple-compressor machines, when the microcomputer 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.

4.5.9 Modmotor Setback Control (Microcomputer)

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

4.5.10 Evaporator Pressure Control (Microcomputer)

This control function seeks to prevent a low differential pressure alarm. (See 4.6.12). It monitors the difference between condenser and evaporator pressure. If this difference is less than 30 psi for more than 60 seconds, and evaporator pressure is above 75 psig, the computer 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 30 psig, modmotor control returns to normal.

TABLE 4.5.6 Ramp Rates for Several Setpoints (In Minutes)

Ramp Rate Setpoint	1 Compressor		2 Compressors		3 Compressors		4 Compressors	
	Start Point Setpoint		Start Point Setpoint		Start Point Setpoint		Start Point Setpoint	
	25%	50%	25%	50%	25%	50%	25%	50%
0.1	25	17	58	50	91	83	125	117
0.2	13	8	29	25	46	42	63	58
0.3	8	6	19	17	30	28	42	39
0.4	6	4	15	12	23	21	31	29

4.0 ELECTRICAL

4.5.11 Manual Lead-Lag Control (Microcomputer)

On multi-compressor machines, the lead compressor can be chosen by storing 0.0, 1.0, 2.0 or 3.0 in the lead setpoint B position. 0.0 is for lead on compressor #1, 1.0 is for lead on compressor #2 and 2.0 is for lead on compressor #3. 3.0 is for lead on copressor #4.

4.5.12 Manual Load-Unload Control (Microcomputer)

Loading of the compressor can be controlled manually. To place computer in manual control, do the following:

1. Press RESET if the compressor is locked out.
2. Obtain authorization per 4.4.4.
3. Select CONTROL POINTS on the main Menu. Press ENTER.
4. Use up or down arrow to select the compressor to be controlled manually. Press ENTER.
5. Press up or down arrow to select MAN ON. Press ENTER. The compressor will start and operate on manual control.
6. Use the following keys to control the status of the compressor:
   1 - Hold
   2 - Load
   3 - Unload

Manual control is maintained for 15 minutes after the last manual entry. After this, the compressor reverts to automatic control. To retain manual control, enter a 1, 2, or 3 command to the compressor at least once every 15 minutes. (See Item 5 above)

In manual control, to transfer from one compressor to another or to display data, press MENU, then continue as above.

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

4.5.13 Chilled Water Reset and Customer Control Interlock (Optional)

The chilled water temperature setpoint can be raised automatically by a 0-5VDC signal provided by an external controller. The reset signal must be between 0VDC and 5VDC, with 0VDC being no reset and 5VDC being max. reset. The maximum temperature reset (increase) desired must be stored in CWR max. B setpoint. For example, to raise the chilled water setpoint from 44°F to 50°F (6.0°F) with a 5VDC input, a 6.0 is stored in CWR max. setpoint.

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

4.5.14 Hot Gas Bypass (Factory-Installed Option)

When hot gas bypass has been supplied with the package, an output from the computer controls the solenoid. The solenoid is turned on if the target percent capacity of the compressor drops below the hot gas bypass B setpoint. If the target percent capacity then climbs above the hot gas bypass A setpoint, the solenoid is turned off. Typical setpoints are 40% for the B setpoint and 80% for the A setpoint.

4.0 ELECTRICAL

4.5.15 Sump Heater Control

Each compressor is fitted with an oil sump band-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.

4.5.16 Low Pressure Load Limit

A low suction pressure limit feature is provided to help prevent low pressure cut-off by preventing the compressor from loading if suction pressure falls below the suction limit hold setpoint B. It suction pressure falls below the suction limit unload setpoint A, the compressor will be unloaded.

4.5.17 High Pressure Load Limit

A high discharge pressure unit feature is provided to help prevent high pressure cut-off by preventing the compressor from loading if discharge pressure rises above the discharge B. If discharge pressure rises above the discharge limit unload setpoint A, the compressor will be unloaded.

4.6 SAFETY FUNCTIONS

4.6.1 Control Power Loss (Microcomputer)

The microcomputer can be set up to start automatically or manually after a power failure to the microcomputer. The power loss B setpoint is factory set to 0.0 to allow automatic start after a control power loss. To select manual reset, set power loss B setpoint to 1.0. In this case, a power loss alarm will be stored by the microcomputer and RESET must be pressed to start.

4.6.2 Low Pressure Cut-off (Microcomputer)

This function protects the unit from operating at abnormally low evaporator refrigerant pressure. The microcomputer 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 microcomputer. Reset by pressing the RESET button on the microcomputer. Standard setpoint is 58 psig for water systems.

4.6.3 Evaporator Freeze Shutoff (Microcomputer)

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

4.6.4 High Pressure Cut-off (Microcomputer)

This function protects the compressor from operating at abnormally high discharge refrigerant pressures. The microcomputer 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 micro-computer. Reset by pressing the RESET button on the micro-computer. Setpoint is 250 psig.

4.6.5 Oil LEVEL SENSOR (LS)

An oil level sensor switch is located in each compressor. If low oil indication (digital input is OFF) persists for 60 seconds during compressor operation, the microcomputer will then shut down the compressor. The status of the level sensor can be seen on the computer display or the associated LED of the Digital I/O Board. Failure is indicated on the alarm pilot light. The low oil alarm code will be recorded by the computer. Press the RESET key to reset the system. See Section 5.6.2 concerning oil level.

4.6.6 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. 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 button on microcomputer.

4.6.7 Motor Temperature Protector (1 TAS)

Three thermistor sensors are embedded in the windings of each compressor motor. They are monitored by a solid state motor temperature protector. If any exceed safe temperature, the protector opens the compressor run circuit and lights the appropriate "high motor temperature" (HMT) pilot light. The microcomputer then stores a No-Run error. To reset the motor temperature protector, press the appropriate "HMT RESET" button on the control panel. **Hold reset button for 5 seconds.** Then press RESET button on the microcomputer.

4.6.8 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 button on micro-computer must also be pressed to clear the alarm. A no-run error is stored in the microcomputer.

4.0 ELECTRICAL

4.6.9 Undervoltage Relay (UVR)

The UVR protects the unit from the following electric supply malfunctions: Undervoltage, phase reversal and single phasing. If the UVR trips, a control relay (lCR) will de-energize and open the control circuit. A LFD light, located on the UVR, indicates a good voltage supply. The power loss A setpoint is factory set to 0.0 to allow automatic start after UVR failure. Compressor will not start for 15 minutes after failure. To select manual reset, set power loss A setpoint to 1.0. In this case, a power loss alarm will be stored by the microcomputer and RESET must be pressed to start.

4.6.10 Sensor Alarm (Microcomputer)

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

4.6.11 No-Stop Alarm (Microcomputer)

If the microcomputer turns off a compressor, but the compressor digital input does not turn off, a No-Stop alarm is generated. The computer 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.

4.6.12 Low Differential Pressure Alarm (Microcomputer)

For proper lubrication, a compressor requires a 30 psi differential pressure between condenser and evaporator pressures. If the differential pressure is less than 30 psi for 3 minutes while a compressor is operating, all compressors will be shut down. The microcomputer will store the low differential pressure alarm code and turn on the alarm light. The RESET key must be pressed to clear the alarm.

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 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, Section 5.8. If any abnormal operation is observed, try to determine cause and remedy it. See Trouble-shooting Guide, Section 5.7.

5.3 MONTHLY INSPECTION

Check cooling tower 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. Put compressor in manual control and time rate of loading and unloading. Adjust needle valves as necessary to get load and unload time of 40±10 sec., then return to automatic control. Check feed line sight glass (W) for proper refrigerant charge level See Charging, Section 5.6.

5.4 WATER SIDE CLEANING OF VESSELS

See Section 1.4.3 Condensing Water Treatment. The effects of fouling of the cooler or condenser heat transfer surfaces can be detected by recording full load performance data on the log sheet. The best measure of performance of cooler 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 cooler and condenser pressures on the computer. Then use Table 5.4 to find corresponding saturated temp. for each. 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

Cooler Approach = T lvg chilled water - T sat cooler

If the approach for either vessel increases by more than 2°F above the approach recorded at clean conditions, the tubes should be cleaned. It is generally advisable to clean the water side 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 they attack the metal surfaces.

Vessel tubes may be physically cleaned by first draining the water, then removing the heads and brushing each tube individually with a tube cleaning brush until clean. The brush should have stiff nylon bristles. Brush kits are available from D/B North American Service. For best results, always remove both heads before cleaning the tubes. Replace the heads, 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. See Repair Parts List.). INSPECT CAREFULLY.

TABLE 5.4 R-22 PRESSURE/TEMPERATURE PROPERTIES (PSIG-F) 50/60 Hz

PRESS	TEMP.	PRESS	TEMP.	PRESS	TEMP.	PRESS	TEMP.	PRESS	TEMP.	PRESS	TEMP.
0	-41.4	55	30.1	110	64.4	165	88.6	220	108.0	276	124.5
1	-38.8	56	30.9	111	64.9	166	89.0	221	108.3	278	125.1
2	-36.4	57	31.7	112	65.4	167	89.4	222	108.6	280	125.6
3	-34.1	58	32.4	113	65.9	168	89.8	223	109.0	282	126.1
4	-31.8	59	33.2	114	66.4	169	90.2	224	109.3	284	126.7
5	-29.7	60	33.9	115	66.9	170	90.6	225	109.6	286	127.2
6	-27.7	61	34.7	116	67.4	171	91.0	226	109.9	288	127.7
7	-25.7	62	35.4	117	67.9	172	91.3	227	110.2	290	128.3
8	-23.8	63	36.1	118	68.3	173	91.7	228	110.5	292	128.8
9	-22.0	64	36.9	119	68.8	174	92.1	229	110.8	294	129.3
10	-20.2	65	37.6	120	69.3	175	92.5	230	111.2	296	129.8
11	-18.5	66	38.3	121	69.8	176	92.8	231	111.5	298	130.3
12	-16.9	67	39.0	122	70.2	177	93.2	232	111.8	300	130.9
13	-15.3	68	39.7	123	70.7	178	93.6	233	112.1	302	131.4
14	-13.7	69	40.4	124	71.2	179	93.9	234	112.4	304	131.9
15	-12.2	70	41.0	125	71.7	180	94.3	235	112.7	306	132.4
16	-10.7	71	41.7	126	72.1	181	94.7	236	113.0	308	132.9
17	-9.2	72	42.4	127	72.6	182	95.0	237	113.3	310	133.4
18	-7.8	73	43.0	128	73.0	183	95.4	238	113.6	312	133.9
19	-6.4	74	43.7	129	73.5	184	95.8	239	113.9	314	134.4
20	-5.1	75	44.3	130	74.0	185	96.1	240	114.2	316	134.9
21	-3.8	76	45.0	131	74.4	186	96.5	241	114.5	318	135.4
22	-2.5	77	45.6	132	74.9	187	96.9	242	114.8	320	135.9
23	-1.2	78	46.3	133	75.3	188	97.2	243	115.1	322	136.4
24	0.0	79	46.9	134	75.8	189	97.6	244	115.4	324	136.8
25	1.2	80	47.5	135	76.2	190	97.9	245	115.7	326	137.3
26	2.4	81	48.1	136	76.6	191	98.3	246	116.0	328	137.8
27	3.6	82	48.7	137	77.1	192	98.6	247	116.3	330	138.3
28	4.8	83	49.4	138	77.5	193	99.0	248	116.6	332	138.8
29	5.9	84	50.0	139	78.0	194	99.3	249	116.9	334	139.2
30	7.0	85	50.6	140	78.4	195	99.7	250	117.2	336	139.7
31	8.1	86	51.2	141	78.8	196	100.0	251	117.5	338	140.2
32	9.2	87	51.7	142	79.3	197	100.4	252	117.8	340	140.7
33	10.2	88	52.3	143	79.7	198	100.7	253	118.1	342	141.1
34	11.3	89	52.9	144	80.1	199	101.1	254	118.3	344	141.6
35	12.3	90	53.5	145	80.5	200	101.4	255	118.6	346	142.1
36	13.3	91	54.1	146	81.0	201	101.7	256	118.9	348	142.5
37	14.3	92	54.6	147	81.4	202	102.1	257	119.2	350	143.0
38	15.3	93	55.2	148	81.8	203	102.4	258	119.5	352	143.4
39	16.2	94	55.8	149	82.2	204	102.8	259	119.8	354	143.9
40	17.2	95	56.3	150	82.6	205	103.1	260	120.1	356	144.3
41	18.1	96	56.9	151	83.0	206	103.4	261	120.3	358	144.8
42	19.1	97	57.5	152	83.4	207	103.8	262	120.6	360	145.2
43	20.0	98	58.0	153	83.9	208	104.1	263	120.9	362	145.7
44	20.9	99	58.6	154	84.3	209	104.4	264	121.2	364	146.1
45	21.8	100	59.1	155	84.7	210	104.8	265	121.5	366	146.6
46	22.6	101	59.7	156	85.1	211	105.1	266	121.8	368	147.0
47	23.5	102	60.3	157	85.5	212	105.4	267	122.0	370	147.5
48	24.4	103	60.8	158	85.9	213	105.7	268	122.3	372	147.9
49	25.2	104	61.3	159	86.3	214	106.1	269	122.6	374	148.3
50	26.1	105	61.8	160	86.7	215	106.4	270	122.9	376	148.8
51	26.9	106	62.4	161	87.1	216	106.7	271	123.1	378	149.2
52	27.7	107	62.9	162	85.7	217	107.0	272	123.4	380	149.6
53	28.5	108	63.4	163	87.9	218	107.4	273	123.7		
54	29.3	109	63.9	164	88.3	219	107.7	274	127.0		

5.0 MAINTENANCE

5.5 ELECTRICAL MALFUNCTION

The unit has five devices designed to protect the compressor motor from electrical malfunctions: computer current limiting function, motor overload relay, undervoltage relay, motor over-temperature protector, and circuit breaker.

If the undervoltage 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.

5.6 CHARGING

5.6.1 Refrigerant Charge

The WCFX Tandem unit is given a complete charge of refrigerant at the factory. All standard units use refrigerant **R22** and the amount necessary to charge the unit can be found in the physical specifications, Figure 2.1.

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

In order to check proper refrigerant charge, check feed line sightglass (Figure 3.5, item W)

during unit operation. If bubbles are visible in sightglass, unit is undercharged. Refrigerant should be added through the charging valve on the cooler feed line until the condenser drain sightglass clears. Sight glass should be clear at all operating conditions. When operating at full load, the cooler tube bundle (visible through sightglass on cooler shell) should be covered. At light load, tubes may be visible. To add refrigerant, connect a refrigerant vessel to the liquid line charging valve under the cooler. 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 cooler, refrigerant will flow from the vessel into the unit. The need for additional refrigerant is indication of refrigerant leakage. In the interest of environmental protection as well as economy, the leak should be found and corrected.

5.6.2 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 Suniso 4GS 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.

5.0 MAINTENANCE

5.7 TROUBLESHOOTING

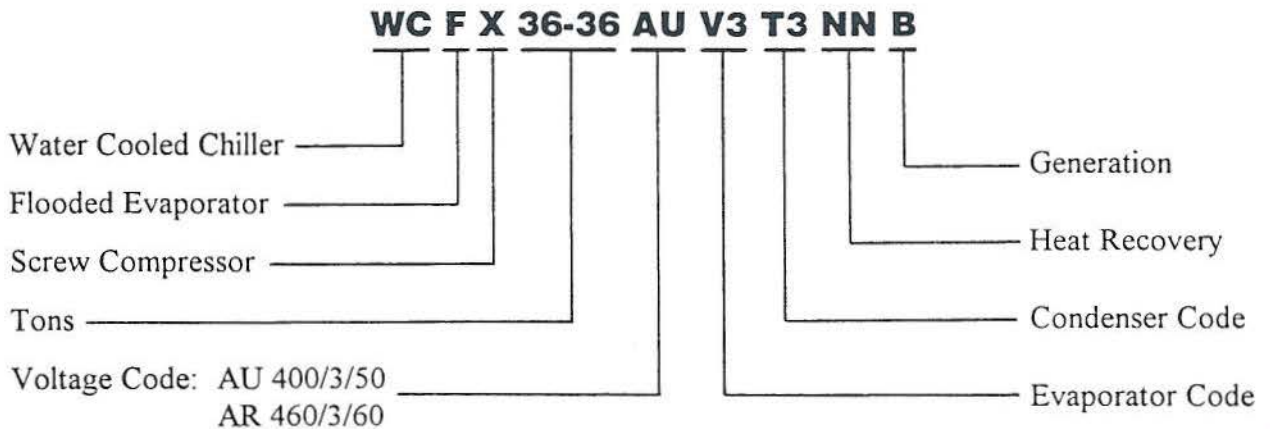| SYMPTOM	POSSIBLE CAUSE	INDICATION	CORRECTIVE ACTION
1. Unit will not start.	a.) Power off.	a.) No voltage on unit.	a.) Check main disconnect switch and main line fuses.
	b.) No control power.	b.) Control switch on, only high voltage present.	b.) Check control transformer fusing. or customer supplied source.
	c.) Compressor circuit breakers open.	c.) Breaker handle in off or tripped position.	c.) Close circuit breakers. If tripped, check compressor.
	d.) Undervoltage relay open.	d.) Pilot light on relay off.	d.) Check for power supply problems (low voltage, phase imbalance). When corrected, press RESET on computer.
	e.) Flow Switch open.	e.) Pumps off, on flow.	e.) Start pumps, check flow switch.
	f.) Compressor switch open.	f.) Switch off.	f.) Turn switch on.
	g.) Microcomputer shutdown not reset.	g.) Compressor control point indicates LOFF.	g.) Check alarm status. Correct problem. Press RESET button.
	h.) Customer control interlock is open.	h.) Related digital input is off.	h.) Close control contacts.
2. Compressor will not start when reset button is pushed. Check lights: None	a.) Cooling not required.	a.) Cooler leading water temp. less than 2°F above setpoint.	a.) Apply load.
	b.) Computer's time delay active.	b.) Control point indicates COFF.	b.) Wait 15 minutes max.
	c.) Undervoltage relay open.	c.) See (d.) above.	c.) See (d.) above.
	d.) Flow Switch open.	d.) See (e.) above.	d.) See (e.) above.
	e.) Compressor switch open.	e.) See (f.) above.	e.) See (f.) above.
	f.) Burned out signal light.	f.) Check voltage across light.	f.) Check signal light bulbs.
	g.) Wiring problems.	g.) Other indicates not satisfied.	g.) Check wiring against drawing.
3. Compressor overload.	a.) Compressor drawing high amps.	a.) Compressor overload light on.	a.) Check motor megohms. Reset overloads, run compressor and check amps. Do not exceed RLA x 1.25. Call D/B serviceman.
4. High oil temperature	a.) Motor windings failing.	a.) HOT light on.	a.) Check megohms.
	b.) Insufficient motor cooling.	b.) Same.	b.) Open oil return valve slightly.
5. High motor temperature	a.) Motor windings failing.	a.) HMT light on.	a.) Check megohms. Reset by holding HMT button for 5 seconds.

SYMPTOM	POSSIBLE CAUSE	INDICATION	CORRECTIVE ACTION
6. Low suction pressure.	a.) Inadequate feed to cooler.	a.) Low suction pressure indication on computer and light on.	a.) Check to see that liquid line ball valve is open.
	b.) Inadequate refrigerant charge.	b.) Same.	b.) See information on charging in Section 5.6.
	c.) Fouling of water side of cooler.	c.) Same.	c.) At high load, check cooler approach (See 5.4). If approach is more than 2°F above clean valve, fouling is probably the trouble. See 5.4.
	d.) Inadequate chilled water flow.	d.) Same.	d.) Measure pressure drop across vessel and determine gpm from figure 1.3. If gpm is low, check chilled water pump, valves and strainers.
	e.) Too much oil in system.	e.) Same.	e.) If oil level sight glasses is full at all times, remove oil until oil level shows at top of glass on a compressor.
7. High discharge pressure.	a.) Inadequate condenser water flow.	a.) High discharge pressure indication on computer and light on.	a.) Check condenser GPM, either with condenser pressure drop curve or with pump curve.
	b.) Fouling of water side of condenser.	b. High discharge pressure indication on computer and light on.	b.) At high load, check difference between saturated R22 temp. and leaving water temp. If 2°F or more above start-up conditions, remove heads and clean tubes.
8. Oil low in sump.	a.) Low oil level in compressor.	a.) Oil low in sight glass on compressor.	a.) Low oil level in compressor is sight glass acceptable.
10. Low oil shutdown.	a.) Low oil in compressor.	a.) Status of oil float analog input is 0.0.	a.) See section 5.6.2.
11. Freeze warning.	a.) Operating setpoint too low.	a.) Freeze light on. Indication on computer.	a.) Check leaving water setpoint on microcomputer.
	b.) Load changing too rapidly.	b.) Same.	b.) Load on package must drop at reasonable rate for automatic control to work properly.
12. Improper capacity control.	a.) Compressor load/ unload too fast or slow.	a.) Observe amps while manually loading and unloading.	a.) Adjust needle valves for 40 second load/ unload rate when loading/ unloading with microcomputer in manual control mode.
	b.) Ramp rate incorrect.	b.) See 4.5.13.	b.) See 4.5.15.

6.o *RENEWAL PARTS*

6.3 UNIT MODEL NUMBER CODE

WC F X 36-36 AU V3 T3 NN B

Water Cooled Chiller
Flooded Evaporator
Screw Compressor
Tons
Voltage Code: AU 400/3/50
AR 460/3/60

Generation
Heat Recovery
Condenser Code
Evaporator Code

EVAPORATORS

P/N CODE	L2	L3	M1
Tube H012368A1	X	X	X
Gasket, 2-Pass H013774	A6	A6	A7

CONDENSERS

P/N CODE	J3	K1	K2
Tube H007014A2	X	X	X
Gasket, 2-Pass H013774	A4	A5	A5

Note: When ordering gaskets for 2-Pass vessel, order (1) 2-pass and (1) 1-Pass gaskets

DUNHAM-BUSH
Products That Perform...By people Who Care

6.0 RENEWAL PARTS

6.2 WCFX TANDEM ELECTRICAL PARTS   50/60HZ

Unit Voltage Codes	AU	400V	50Hz
	AR	460V	60Hz

DESCRIPTION	PART NO.	MODEL NUMBER				
		30-30	30-33	33-33	33-36	36-36
Circuit Breaker						
250A	H014457C1	(4)AU,(4)AR	(3)AU,(3)AR	(2)AU,(2)AR	(1)AU,(1)AR	
300A	H014457C2		(1)AU,(1)AR	(2)AU,(2)AR	(3)AU,(3)AR	(4)AU,(4)AR
Circuit Breaker Handle Kit						
250A C/B	H013832A1	(4)AU,(4)AR	(3)AU,(3)AR	(2)AU,(2)AR	(1)AU,(1)AR	
300A C/B	H013832A2		(1)AU,(1)AR	(2)AU,(2)AR	(3)AU,(3)AR	(4)AU,(4)AR
Contactor						
120A	HCTRD12N10	(8)AU,(8)AR	(6)AU,(6)AR	(4)AU,(4)AR	(2)AU,(2)AR	(4)AR
150A	HCTRD15N10		(2)AU,(2)AR	(4)AU,(4)AR	(6)AU,(6)AR	(8)AU,(8)AR
Under Voltage Relay						
335-405V	H005183B2	(2)AU	(2)AU	(2)AU	(2)AU	(2)AU
425-500V	H005183B3	(2)AR	(2)AR	(2)AR	(2)AR	(2)AR
Solid State Overload						
95A	H053676A5	(4)AU,(4)AR	(3)AU,(4)AR	(2)AU,(4)AR	(1)AU,(2)AR	
140A	H053676A6		(1)AU	(2)AU	(3)AU	(4)AU
Fuses						
5 AMP FNQ	HFUS308	(4)AR	(4)AR	(4)AR	(4)AR	(4)AR
6.25 AMP FNQ	H004292C7	(4)AU	(4)AU	(4)AU	(4)AU	(4)AU
12 AMP FRN	HFUS34	(2)AU,(2)AR	(2)AU,(2)AR	(2)AU,(2)AR	(2)AU,(2)AR	(2)AU,(2)AR
5 AMP ABC	HFUS266	4	4	4	4	4
4 AMP ABC	H013362A1	4	4	4	4	4
Transformer						
1.) Control Panel 2T						
1.0KVA 400V	HTSE5	(2) AU	(2) AU	(2) AU	(2) AU	(2) AU
1.0KVA 230/480V	HTSF6	(2) AR	(2) AR	(2) AR	(2) AR	(2) AR
2.) Current TSF CT						
500:0.1 1"Dia	H009640A1	(4)AU,(4)AR	(4)AU,(4)AR	(4)AU,(4)AR	(4)AU,(4)AR	(4)AU,(4)AR
3.) Computer Power						
Transformer 2T	H009638A2	2	2	2	2	2
4.) Voltage Signal						
Transformer 3T	H009639A2	2	2	2	2	2
Computer Components						
Computer Board	H009635A3	2	2	2	2	2
Chip, Data Base	* H014409	2	2	2	2	2
Digital input/ output Board	H009636A5	2	2	2	2	2
Analog Input Board	H009637A1	2	2	2	2	2
Filter Board	H009645A1	2	2	2	2	2
Power Cable	H009644A2	6	6	6	6	6
Ribbon Cable Connector	H009643A1	8	8	8	8	8
Control Components						
Relay DPDT (1CR)	H000879A1	2	2	2	2	2
Timer, 1 sec (10TR)	H004981A1	4	4	4	4	4
Pressure Transducers						
Cooler	H009510A5	2	2	2	2	2
Condenser	H009510A6	2	2	2	2	2
Motor Temp Protector (1TAS)	HCNT137T3	4	4	4	4	4
Water Temp Sensor (TS)	H009509A3	2	2	2	2	2
3 phase Toggle Switch	H014405A1	2	2	2	2	2

*Suffix depends on logic. Need factory order # to identify.
Note: All voltages 3 phase, 50 Hz

6.0 RENEWAL PARTS

6.1 COMPRESSOR & COMPRESSOR PARTS   50/60 Hz

Electrical Code (from Model No.)

AU	AR

*Compressor Code (insert Comp. P/N)

BJ	BJ

P/N MODEL	30-30	30-33	33-33	33-36	36-36
Compressor					
H1215NHF6W4K_*_OC	4	3	2	1	
H1218NHF6W4K_*_OC		1	2	3	4
Suction Gasket					
HGKT64	4	4	4	4	4
Discharge Gasket					
HGKT63	4	4	4	4	4
Load Control Solenoid Coil					
H053800A1	8				
Oil Sight Glass					
H00458P29	4				
O-Ring					
HGLS3	8				
Suction Filter Kit for 1215,1218					
H0054145A6	4				

Note: For flanged compressor, substitute "B" for "N" in compressor part number.

5.0 MAINTENANCE

5.8 SAMPLE LOG SHEET

SHEET NO. _____

DUNHAM-BUSH WATER COOLED ROTARY SCREW TANDEM WATER CHILLERS

NAMEPLATE 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 PRESSURE									
CONDENSER PRESSURE									
DISCHARGE TEMPERATURE	1.								
	2.								
	3.								
	4.								
CONDENSER REFRIGERANT DRAIN TEMPERATURE									
CONDENSER WATER TEMPERATURE-IN									
CONDENSER WATER TEMPERATURE-OUT									
COOLER WATER TEMPERATURE-IN									
COOLER WATER TEMPERATURE-OUT									
COOLER PRESSURE DROP PSI/IN WATER									
COOLER WATER FLOW (GPM)									
CONDENSER PRESSURE DROP PSI/IN WATER									
CONDENSER WATER FLOW (GPM)									
ACTUAL VOLTAGE (NOT NOMINAL)									
COMPRESSOR AMPS	1.								
	2.								
	3.								
	4.								
TONS = GPME X ΔTE / 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.