WCGA

Direct Fired Absorption Chillers

100 through 770 tons

FEATURES

- Multi-shell design
- Advanced proactive microcomputer
- On line purging
- Hybrid system equipped

Absorption Chillers CFC Free Ozone Friendly

DUNHAM-BUSH®

Form No. 6066A

INTRODUCTION

Dunham-Bush has a legacy of innovation that spans most of this century. Since the early 1900's the company has been providing its customers with innovative solutions for their air conditioning, heating and commercial refrigeration needs.

Dunham-Bush now continues this legacy with the introduction of a complete line of absorption cooling products. Space Conditioning, later acquired by Dunham-Bush, was a bit ahead of its time in 1962 when it introduced a double effect absorption chiller. Although this machine never really caught on, it was a pioneer in the market place and continued the Dunham-Bush tradition of innovation.

Today, Dunham-Bush brings this technology into the future with a complete line of Absorption Chillers. This fact allows Dunham-Bush to have a better, more expansive service force for our customers. Dunham-Bush continues to offer complete solutions for our customers, so choose Dunham-Bush Absorption Chillers for your future needs.

Table Of Contents

Nomenclature

W C G A - 100

Water Cooled

Heat Source
- G = Gas
- O = Oil
- D = Gas or Oil (Dual Fuel)

Absorption

Nominal Capacity (TR)

100	360
120	400
150	450
180	500
210	550
240	620
280	690
320	770

The Absorption Cycle

Basic principle

The boiling point of water is directly proportional to the pressure. At atmospheric pressure water boils at 212°F (100°C). At lower pressure it boils at a lower temperature. At 0.24" Hg absolute (6mmHg absolute) the boiling point of water is 38.7°F (3.7°C).

Lithium Bromide (LiBr) is a chemical similar to common salt (NaCl). LiBr is soluble in water. The LiBr water solution has a property to absorb water due to its chemical affinity. As the concentration of LiBr solution increases, its affinity towards water increases. Also as the temperature of LiBr solution decreases, its affinity to water increases.

Further there is a large difference between the vapor pressure of LiBr and water. This means that if we heat the LiBr-water solution, the water will vaporize but the LiBr will stay in the solution and become concentrated.

Absorption systems use heat energy to produce a refrigerating effect. In these systems the refrigerant, i.e. water, absorbs heat at a low temperature and pressure during evaporation and releases heat at a high temperature and pressure during condensation.

FEATURES, SPECIFICATIONS AND BENEFITS

The Dunham-Bush Absorption Chillers have a multi-shell design, consisting of the upper shell which houses the condenser and low temperature generator, lower shell which houses the evaporator and absorber, high temperature generator with a suitably sized burner, heat exchangers, absorbent and refrigerant pump, purge pump, purge unit, inter-connecting piping and a machine mounted control panel. Each chiller goes through a series of tests for leak tightness at the factory including the stringent helium leak detection test, for achieving highly reliable operation. Also the number of valves and gasketed joints is kept to the minimum to ensure leak tightness.

High Temperature Generator

The high temperature generator has a direct flue type furnace with a wetback and wetfront to ensure maximum heat exchange. The shell is made of carbon steel SA 516 Gr 70 and the seams are welded by TIG welding. The tubesheet, similarly made of carbon steel SA 516 Gr 70, has drilled holes to accommodate the tube and each hole incorporates a groove so as to enable leakproof locking.

The Dunham-Bush Absorption Chiller uses straight and plain, round tubes made of boiler quality, with 2" (50.8 mm) diameter and 0.144" (3.66 mm) wall thickness. Each tube is individually expanded and seal welded from the outside to the tubesheet. The advantages of this construction are:

- Large diameter tubes mean less soot deposition, even when heavier fuels are used.
- Plain tubes without any spirals/turbulators mean less cleaning frequency even though it increases the size of the high temperature generator. Plain tubes also ensure that soot deposition is limited and thus problems like increased back-pressure, improper combustion, burner backfiring and in some cases even furnace collapse are eliminated.
- Using round tubes means that the tubes can be evenly expanded and thus need to be welded only on the outside. These tubes can be removed in the eventuality of tube leak. Some manufacturers use elliptical or oblong tubes, which have to be welded both internally and externally and thus cannot be removed easily during leakage problems.
- This design can accommodate a higher sulfur content in the fuel as compared to that normally acceptable to other manufacturers.
- Heat release rate for the Dunham-Bush Absorption Chiller is 100,000 Btu/hr (29.3 kW) as compared to heat flux of 150,000 Btu/hr (41.0 kW) normally used by other manufacturers. A bigger furnace with lower heatflux reduces the depletion of corrosion inhibitor at high temperatures.
- Access is provided to tubes for cleaning.
- Flue gas pressure drop is maximum 3.15" H^2O (80 mm kPa) and the stack temperature is limited to around 392°F.
- Reliable burner is used.

Burner

The UL listed burner is supplied along with the chiller/heater unit, capable of firing on one of the following fuels:

a. Natural gas
b. No. 2 fuel oil

The burner supplied meets all major insurance, military and local codes. The burner is provided with a burner mounted control panel and is provided with necessary controls and stand alone safeties to provide safe and efficient working.

With a wide and established network of service centers throughout the country, the Dunham-Bush Absorption Chiller has an added advantage of being the only chiller and burner combination supplied from one manufacturer. The burner control panel is designed to interface directly with the microcomputer based chiller/heater control panel, to provide integrated burner firing control for the chiller/heater operation.

Upper Shell Assembly

Condenser and low temperature generator

The low temperature generator and condenser sections are housed in a common fabricated carbon steel shell, but with separate compartments for each section. The condenser and low temperature generator are separated by a partition plate fitted with stainless steel (SS-430) eliminators. The Dunham-Bush Absorption Chiller uses plain DLP (Deoxidized Low Phosphorous) copper tubes in the condenser section. The condenser has marine type hinged water headers, with side exit nozzles for ease of maintenance. The tubes of the low temperature generator are low finned copper.

Lower Shell Assembly

Evaporator and absorber (side by side construction)

The lower shell houses the evaporator and absorber sections, separated by eliminators of SS-430, to prevent any liquid carryover. The Absorption Chiller uses plain DLP (Deoxidized Low Phosphorous) copper tubes in the evaporator and absorber sections. All the tubes are subjected to hydrostatic pressure and eddy current tests.

The advantage of specifically using the more expensive DLP copper, with phosphorous content of less than 0.005 ppm, instead of the DHP grade tubes used in competitive machines is:

Phosphorous content of higher than 0.005 ppm in the tubes of absorption machines results in "**stress corrosion cracking**". At a microscopic level, stress corrosion cracking takes place at grain boundaries by the attack of a salt (e.g. lithium bromide) on the grain boundary.

The absorber has marine type hinged water headers, with side exit nozzles for ease of opening during maintenance. The evaporator has headers with side exit nozzles. The advantage of using these headers is that normally the water piping need not be removed/ cut before the headers can be opened for tube cleaning and other maintenance activities.

Heat Exchangers

There are two heat exchangers - low temperature and high temperature heat exchanger. Both the heat exchangers are shell and tube type, designed for maximum heat exchange between the two circulating streams of LiBr. The tube material for low temperature heat exchanger is spiral copper and for high temperature heat exchanger is spiral cupro-nickel (90:10).

Overflow Pipe (Auto Decrystalization Line)

An overflow pipe is provided connecting the shell side of the low temperature generator to the absorber and bypassing the heat exchanger. The blockage of the strong solution line from the low temperature generator to the absorber leads to the accumulation of concentrated LiBr in the low temperature generator. This causes the solution level to rise in the low temperature generator, and the overflow of hot concentrated LiBr from the low temperature generator to the absorber directly begins. The heated weak solution warms up the crystallized solution on the shell side of the heat exchanger and hence melts the crystals.

Canned Motor Pumps

The Dunham-Bush Absorption Chiller uses only one absorbent and one refrigerant pump, thus minimizing the electrical consumption and reducing the maintenance, as these pumps are the only moving parts in an absorption chiller. These pumps are low net positive section head pumps and are self lubricating type. These canned motor pumps are cooled by the fluids they handle. The canning of the stator eliminates any chances of shorting. Both the pumps have separate motors and hence are independent of each other. The absorbent pump has both the over-current and high temperature protection to prevent motor burnout.

These canned motor pumps are provided with an inbuilt bearing monitoring terminal, which enables the condition of the pump bearings (TRG reading) to be evaluated for wear, externally, without stopping the chiller.

Further to facilitate the pump maintenance and repair without breaking the chiller vacuum, specially fabricated and leak tight isolation valves are provided at the suction and discharge ends for both pumps. This drastically reduces the downtime.

Gravity Feed Trays

The refrigerant from the condenser is not directly sprayed over the chilled water tube bundle. The water (refrigerant) from the condenser is first simply allowed to fall into the evaporator section alongside the shell. This water flashes and self cools itself to approximately 39°F (3.9°C), and collects at the bottom of the evaporator from where the refrigerant pump pumps it to the top of the feed trays. The Dunham-Bush Absorption Chillers have gravity feed trays for the spray of refrigerant in the evaporator and LiBr in the absorber section. These feed trays are manufactured with utmost precision and have perforations perfectly aligned with and running along the entire length of the tubes. Refrigerant and the LiBr droplets fall on the center of each tube ensuring maximum area coverage and hence maximum heat transfer in the respective section.

Purge Pump, Purge Storage Tank And Purging Mechanism

The purging unit consists of a factory mounted and tested electrical motor driven purge pump, storage tank and all the necessary piping and valves. Any non-condensable gas, like hydrogen and oxygen, generated due to the chemical reaction inside the chiller, moves toward the low pressure lower shell. These gases are automatically purged to the purge tank thereby maintaining the vacuum inside the chiller.

The purge tank is a double walled cylinder with the outer cylinder connected to the absorber shell. A tapping from the absorbent pump running through the center of the inner cylinder sprays the LiBr through a nozzle. The high velocity generates a low pressure area, which sucks the non-condensables from the absorber section and bubbles through the LiBr solution to get trapped in the annular space between the two cylinders. The purge pump can then be operated to remove these stored gases from the purge tank.

Solution Level Control

The Dunham-Bush Absorption Chillers use highly reliable floatless level electrodes for controlling the level of the refrigerant in the evaporator and the level of lithium bromide solution in the high temperature generator and also to prevent the pumps from cavitation. These floatless level electrodes ensure that proper signals are transmitted to the refrigerant and absorbent pumps for starting/ stopping. The use of float valves for level control is avoided.

Corrosion Inhibitor

A corrosion inhibitor is added to the lithium bromide solution to minimize the possibility of any corrosion occurring in the absorption machine. The Absorption Chillers use lithium molybdate as the inhibitor. Lithium molybdate has excellent corrosion inhibition properties. The use of lithium nitrate is avoided as it desiccates at high temperatures, and therefore will not protect the absorption machine. Lithium intrate is also a substance controlled by the EPA.

Sight Glasses And Service Valves

The Dunham-Bush Absorption Chiller is provided with an optimum number of sight glasses and service valves for easy diagnosis, user-friendly operation and trouble-shooting. The number of sight glasses and service valves is kept to a minimum to reduce the number of potential leakage points. The sight glasses are provided at the evaporator absorber shell and high temperature generator to monitor the refrigerant and solution levels.

Other Features

- The unit is charged with a positive charge of nitrogen gas, to avoid any ingress of air inside the unit during shipping. Shipment of chiller under vacuum is not recommended.

- The Dunham-Bush Absorption Chiller is provided with a factory-mounted, wired and tested microcomputer-based control panel.

- The crossover piping from the absorber to the condenser is a standard feature of the Dunham-Bush Absorption Chiller. This feature saves the installing contractor both labor and material.

Optional Features

- **On-line standby canned motor pumps**

On-line standby absorbent and refrigerant pumps can be offered for extremely critical operations where continuous operation is required.

- **On-line bearing monitoring for canned motor pumps**

As a special option Dunham-Bush can provide a TRG meter for on-line bearing monitoring of the pumps. By continuously measuring the bearing clearance, through eddy currents, the TRG reading proactively lets the user know the condition of the bearings at any given instant.

- **Special tube material for evaporator/ absorber/condenser**

The selection of tube material is done purely on the basis of the water quality available. Dunham-Bush can offer the following special tube material depending on the available water quality:

► Cupro-nickel (90:10)
► Cupro-nickel (70:30)
► SS-316 L
► Titanium

- **Three piece shipment**

The Dunham-Bush Absorption Chiller can be shipped in three sections, comprising of lower shell assembly, upper shell assembly and high temperature generator, for convenience of rigging the chiller inside the existing building structure.

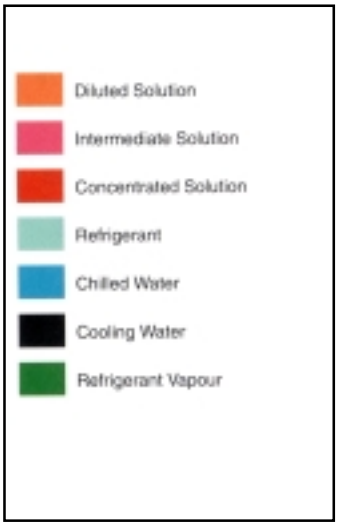
- **Cooling water flow switch**

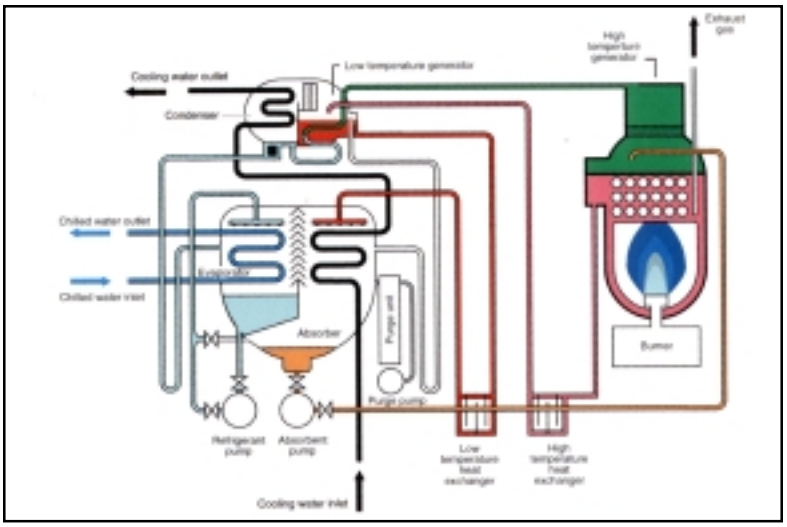
As an optional feature, paddle type flow switch is available for the absorber- condenser water circuit. The chilled water flow switch is a standard supply.

- **Inverter drive for absorbent pump**

A microprocessor-based inverter drive can be offered on the Dunham-Bush Absorption Chiller. The inverter drive suitably varies the flow of the dilute solution from the absorber to the high temperature generator, thus limiting the input steam to the generator. This assists the chiller to obtain superior part load performance.

Double Effect Direct Fired





Selection Data: Double Effect Gas Fired Absorption Chiller

All double effect gas/oil fired chillers are rated for the following standard parameters:

Chilled water temperature in / out	:	54 / 44°F	(12.2 / 6.7°C)
Cooling water temperature in / out	:	85 / 95.4°F	(29.4 / 35.2°C)
Chilled water / cooling water fouling factors	:	0.00025 ft^2-hr-°F/Btu	(0.000044 m^2- /kW)
Minimum gas pressure at the inlet of the gas train	:	.66 ft H^2O	(2.0 kPa)
Maximum working pressure in the water system	:	113.8 psi	(784.5 kPa)
Calorific value of natural gas	:	1084.4 Btu/ft^3	(9650 Kcal/Nm^3)

Burner is supplied with the chiller.

For conditions other than mentioned here, please contact the nearest Dunham-Bush Office / Sales Representative

Technical Specification Sheet Gas Fired Absorption Chiller

Model: WCGA		100	120	150	180	210	240	280	320
Chilled water circuit									
Capacity	Tons	93	112	140	167	195	223	260	298
	kW	327.4	394.2	492.8	587.8	686.4	785.0	915.2	1049.0
Flow rate	gpm	224.8	271	338.8	403.9	471.7	539.4	629.2	720.7
	L/S	14.2	17.1	21.4	25.5	29.8	34.0	39.7	45.5
Pressure drop	Ft H^2O	16.1	18	17.1	16.4	18.4	18.7	24.3	24
	kPa	48.0	53.9	51.0	49.0	54.9	55.9	72.5	71.5
Connection diameter	in	4	4	4	4	5	5	5	6
	mm	102	102	102	102	127	127	127	152
No. of passes (Evaporator)		6	6	4	4	4	4	4	4
Cooling water circuit									
Flow rate	gpm	409.2	492.8	616	739.2	862.4	985.6	1148.4	1311.2
	L/S	25.8	31.1	38.9	46.6	54.4	62.2	72.4	82.7
Pressure drop	Ft H^2O	12.5	13.1	17.7	20.3	16.7	18.7	26.2	24
	kPa	37.2	39.2	52.9	60.8	50	55.9	78.4	71.5
Connection diameter	in	5	5	5	5	6	6	6	8
	mm	127	127	127	127	152	152	152	203
No. of passes (Absorber)		3	3	2	2	2	2	2	2
No. of passes (Condenser)		1	1	1	1	1	1	1	1
Fuel circuit									
Gas Consumption	ft^3/hr	1095	1341.7	1624.3	1977.4	2330.5	2813	3072	3460.4
	m^3/hr	31	38	46	56	66	74	87	98

SELECTION DATA & TECHNICAL SPECIFICATIONS (CONT.)

Model: WCGA		360	400	450	500	550	620	690	770
Chilled water circuit									
Capacity	Tons	335	372	419	465	512	577	642	716
	kW	1179.2	1309.4	1474.9	1636.8	1802.2	2031.0	2259.8	2520.3
Flow rate	gpm	810.5	899.8	1013.8	1124.2	1238.6	1395.7	1553.2	1734.5
	L/S	51.1	56.8	64.0	70.9	78.1	88.1	98.0	109.4
Pressure drop	Ft H^2O	23.3	24.9	24	23.3	27.9	28.9	21.3	23.3
	kPa	69.6	74.5	71.5	69.2	83.3	86.2	63.7	69.6
Connection diameter	in	6	6	8	8	10	10	10	10
	mm	152	152	203	203	254	254	254	254
No. of passes (Evaporator)		4	4	4	4	4	4	3	3
Cooling water circuit									
Flow rate	gpm	1474.0	1636.8	1843.6	2046	2186.8	2464	2741.2	3058
	L/S	93.0	103.3	116.3	129.1	138	155.4	172.9	192.9
Pressure drop	Ft H^2O	21.3	23	20.3	20.3	24	25.3	34.8	36.4
	kPa	63.7	68.6	60.8	60.8	71.5	75.5	103.9	108.8
Connection diameter	in	8	8	10	10	12	12	12	12
	mm	203	203	254	254	305	305	305	305
No. of passes (Absorber)		2	2	2	2	2	2	2	2
No. of passes (Condenser)		1	1	1	1	1	1	1	1
Fuel circuit									
Gas Consumption	ft^3/hr	3707.6	4237.2	4943.4	5437.1	5826.2	6744.2	7521	8227.2
	m^3/hr	105	120	140	155	165	191	213	233

APPLICATION INFORMATION

Location And Space Requirements

The Dunham-Bush Absorption Chillers have negligible noise and vibration and may generally be located at any level in a building. The chiller plant room should be sufficiently ventilated to provide enough circulation of air and also to ensure that the burner gets the required quantity of air for efficient combustion. The unit should be placed on a level foundation. Sufficient space at either end of the unit should be provided for tube cleaning/removal. Also sufficient clearances should be provided on the remaining sides of the unit for the necessary access and maintenance. Refer to the physical dimensional table for space and clearance requirements.

Since water is the refrigerant, the unit must be located where the ambient temperature does not fall below the freezing point.

Water Circuits

Water Piping: All chilled water and cooling water piping should be designed and installed in accordance with the accepted piping practice. The piping should be adequately supported to avoid any strain on the chiller components. All water piping should be thoroughly flushed clean before connecting to the unit. A suitably sized expansion tank should be provided in the chilled water line.

Pressure gages should be installed at the inlet and outlet water lines of the unit. Air vents should be located at all high points in the water piping system. All drain points should be located at low points to facilitate complete system drainage. Both the chilled and cooling water pumps should be located to discharge a positive pressure and required flow through the unit. Shut-off valves should be provided to allow unit isolation during maintenance. The chilled water piping should be insulated to minimize heat gain, and to prevent condensation of moisture.

Water Quality: Proper quality of water should be monitored and maintained to ensure long life, and trouble free and efficient operation of the entire cooling system. Impurities in water can cause scale formation, thereby causing a reduction in heat transfer and affecting the performance of the unit. The impurities can also be a potential for mechanical damage to the unit and the system. The use of properly sized water strainers and water treatment may be necessary to maintain the required water quality. It is desirable to set the appropriate water quality control values under the guidance of a water processing specialist who will periodically control it.

Suggested Guide Of Cooling And Chilled Water For The Dunham-bush Absorption Chiller

Items	Unit	Cooling Water		Chilled Water
		One-pass or circulating	Make-up Water	Circulating
pH at 77°F (25°C)		6.5~8.0	6.5~8.0	6.5~8.0
Electrical conductivity at 77°F(25°C)	Micro S/cm	800 or less	200 or less	500 or less
M alkalinity	ppm	100 or less	50 or less	100 or less
Total hardness	ppm (CaCO3)	200 or less	50 or less	100 or less
Chloride ion	ppm (Cl)	200 or less	50 or less	100 or less
Sulfuric acid ion	ppm (SO4)	200 or less	50 or less	100 or less
Total iron	ppm (Fe)	1.0 or less	0.3	1.0 or less
Sulfur ion	ppm (S)	Not detected	Not detected	Not detected
Ammonium ion	ppm (NH4)	1.0 or less	0.2 or less	0.5 or less
Silica ion (SiO2)	ppm SiO2	50 or less	30 or less	50 or less
Free carbonic acid	ppm (HCO3)	-	-	0

If such water conditions exist which cannot be corrected by proper water treatment, it may be necessary to provide a larger fouling/scaling allowance and/or choose special tube material suitable for the water quality.

Fuel And Exhaust Piping

The Dunham-Bush Absorption Chiller utilizes natural gas or oil no. 2 as the fuel source. Depending on the requirement, the chiller is equipped with a suitable burner, capable of firing either one, or both fuels. The dual-fuel firing capability gives the user more flexibility. The fuel and the exhaust piping should be designed and installed in accordance with the standard engineering practice and conforming to the local codes. The site erected exhaust gas duct should have a removable section above the unit, to facilitate the duct and the machine maintenance. For multiple units, it is important to provide separate ducts from the unit to the main chimney (stack) and also each duct should be provided with a suitable damper. This damper should be shut-off for the unit, while the unit is not in operation.

Cooling And Heating Modes

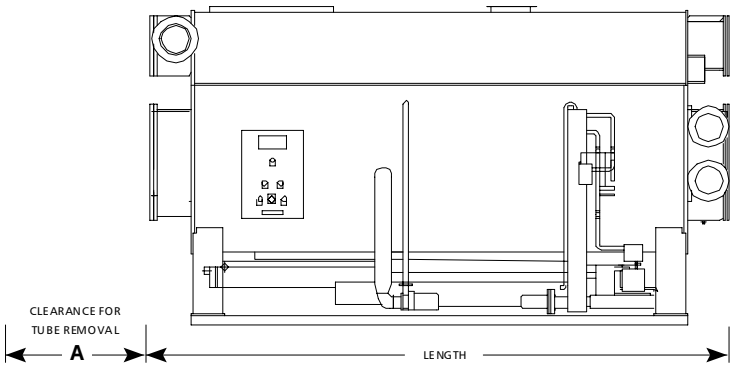
The Dunham-Bush Direct Fired Absorption Chiller can be utilized to meet both heating and cooling requirements of a building. For hot water temperatures below 140°F (60°C), a two-pipe system is utilized. Thus the same set of piping, pumps, etc. can be used for either cooling or heating purposes. If the required temperature of hot water is higher than 140°F (60°C), then a four-pipe system can be utilized, by the addition of an optional heat exchanger on the unit. This feature assists the owner to eliminate any additional heating equipment, and also saves the plant room space and reduces the maintenance. An optional heat exchanger is also added onto the unit if the requirement is for simultaneous heating and cooling.

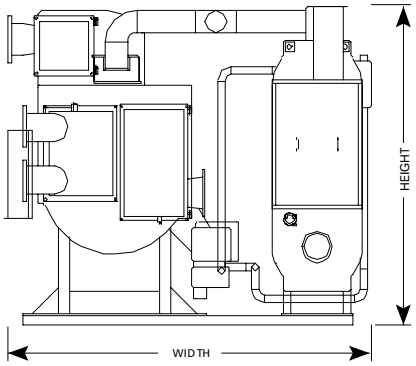
PHYSICAL DIMENSIONS

Direct Oil/Gas Fired Absorption Chiller

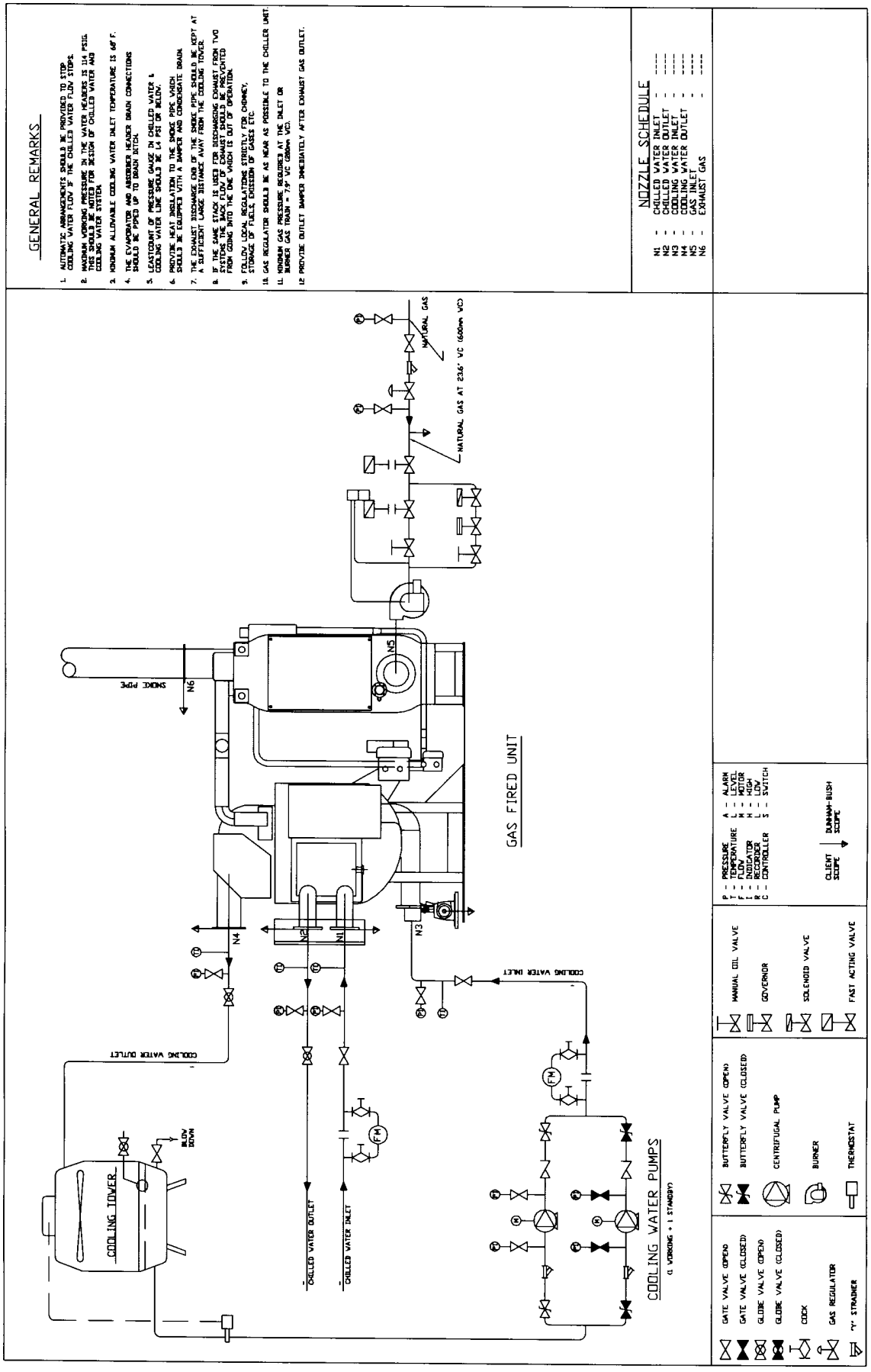
Model: WCGA		100	120	150	180	210	240	280	320
Length:	in	148.2	144.3	157.1	149.0	162.0	169.5	172.4	175.2
	mm	3765	3665	3990	3785	4115	4305	4380	4450
Width:	in	100.8	103.1	106.3	109.3	110.0	110.0	113.0	119.5
	mm	2560	2620	2700	2775	2795	2795	2870	3035
Height:	in	93.1	94.7	94.7	95.5	104.8	99.3	109.1	109.1
	mm	2365	2405	2405	2425	2661	2521	2772	2772
Clearance for tube cleaning: A	in	94.5	94.5	133.9	133.9	133.9	133.9	161.4	161.4
	mm	2400	2400	3400	3400	3400	3400	4100	4100
Shipping method		ONE SECTION							
Max shipping weight:	lb	15212	16314	19401	20503	24692	26676	29983	36376
	kg	6900	7400	8800	9300	11200	12100	13600	16500
Total shipping weight:	lb	15212	16314	19401	20503	24692	26676	29983	36376
	kg	6900	7400	8800	9300	11200	12100	13600	16500
Operating weight:	lb	16094	17196	20503	21605	26235	28439	31967	38581
	kg	7300	7800	9300	9800	11900	12900	14500	17500

Model: WCGA		360	400	450	500	550	620	690	770
Length:	in	175.2	181.3	175.2	187.2	228.7	228.7	277.2	277.2
	mm	4450	4605	4450	4755	5810	5810	7040	7040
Width:	in	121.5	121.5	129.3	129.3	132.7	133.9	133.9	133.9
	mm	3085	3085	3285	3285	3370	3400	3400	3400
Height:	in	113.0	113.0	116.4	120.7	120.7	123.9	128.2	130.4
	mm	2870	2870	2956	3067	3067	3147	3257	3312
Clearance for tube cleaning: A	in	161.4	161.4	161.4	161.4	209.4	209.4	258.3	258.3
	mm	4100	4100	4100	4100	5320	5320	6560	6560
Shipping Method		ONE SECTION							
Max shipping weight:	lb	38360	47085	46738	48501	60627	65036	74736	78704
	kg	17400	18500	21200	22000	27500	29500	33900	35700
Total shipping weight:	lb	38360	47085	46738	48501	60627	65036	74736	78704
	kg	17400	18500	21200	22000	27500	29500	33900	35700
Operating weight:	lb	40785	43431	49824	51808	64154	68784	78925	83334
	kg	18500	19700	22600	23500	29100	31200	35800	37800

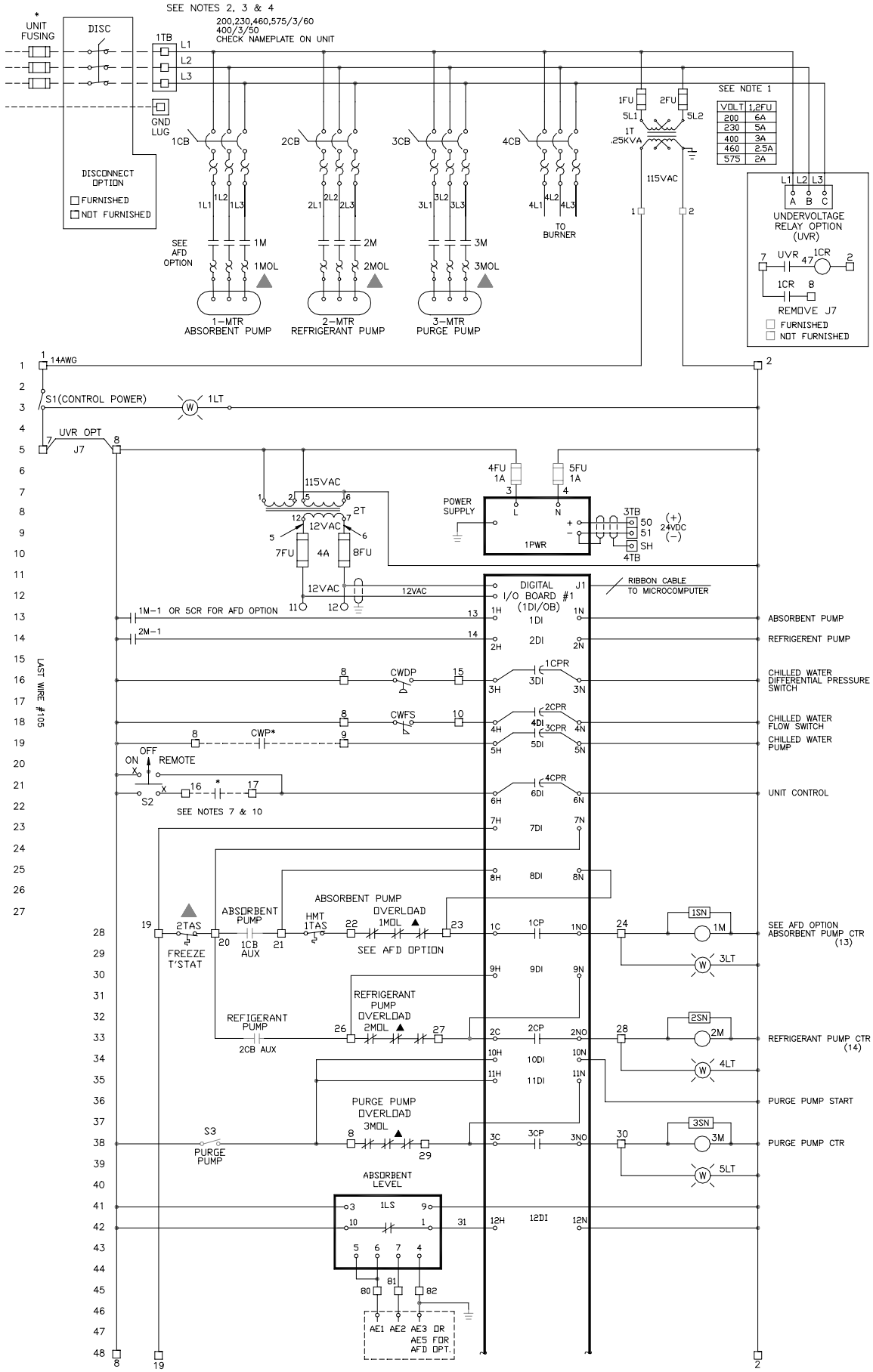




TYPICAL PIPING SCHEMATIC

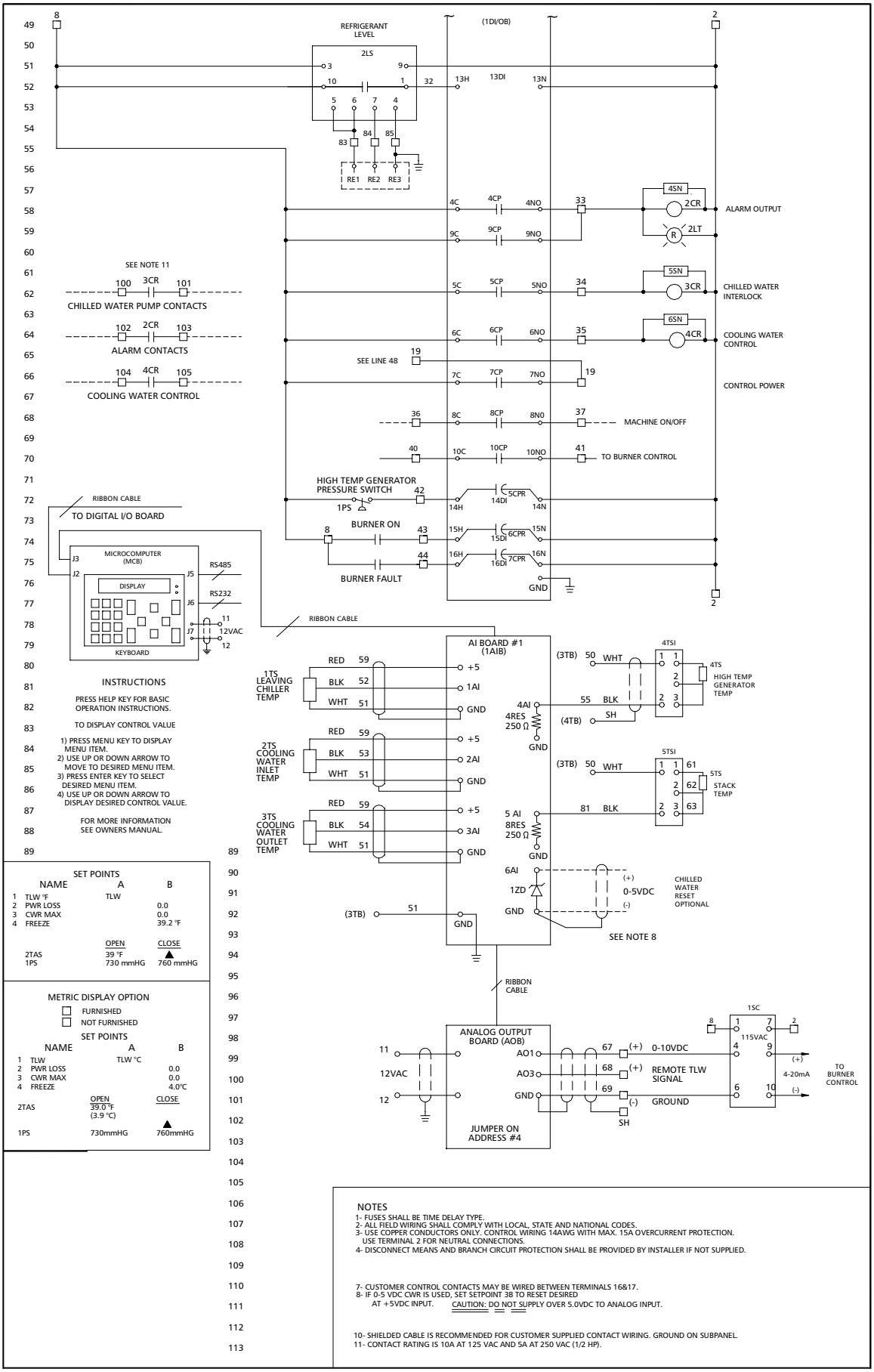


ELECTRICAL WIRING DRAWINGS



WCGACTAA.DWG

ELECTRICAL WIRING DRAWINGS (CONT.)



SET POINTS

	NAME	A	B
1	TLW °F	TLW	
2	PWR LOSS		0.0
3	CWR MAX		0.0
4	FREEZE		39.2 °F

	OPEN	CLOSE
2TAS	39 °F	▲
1PS	730 mmHG	760 mmHG

METRIC DISPLAY OPTION

☐ FURNISHED
☐ NOT FURNISHED

SET POINTS

	NAME	A	B
1	TLW	TLW °C	
2	PWR LOSS		0.0
3	CWR MAX		0.0
4	FREEZE		4.0°C

	OPEN	CLOSE
2TAS	39.0 °F (3.9 °C)	▲
1PS	730mmHG	760mmHG

NOTES

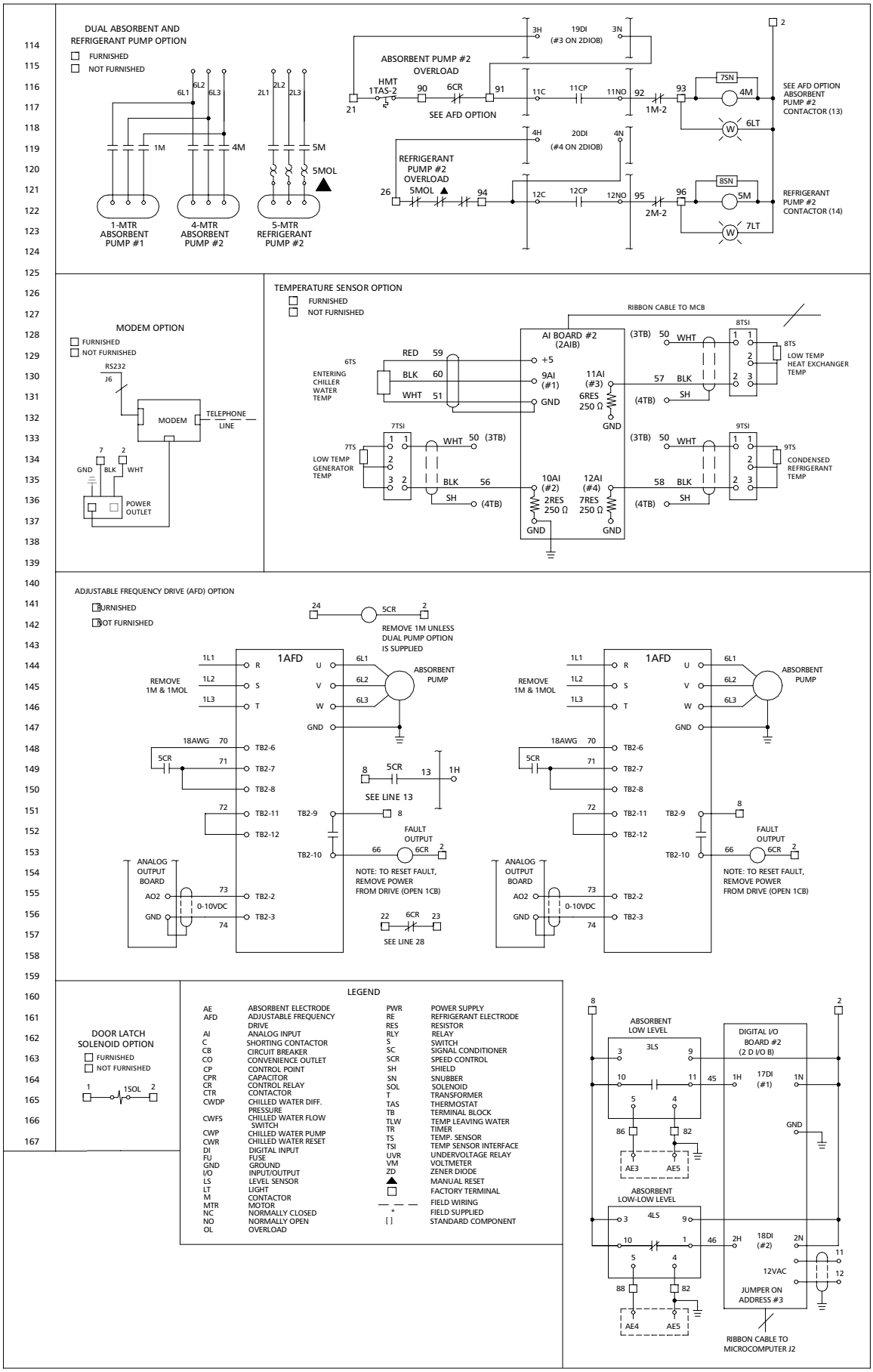
1- FUSES SHALL BE TIME DELAY TYPE.
2- ALL FIELD WIRING SHALL COMPLY WITH LOCAL, STATE AND NATIONAL CODES.
3- USE COPPER CONDUCTORS ONLY. CONTROL WIRING 14AWG WITH MAX. 15A OVERCURRENT PROTECTION. USE TERMINAL 2 FOR NEUTRAL CONNECTIONS.
4- DISCONNECT MEANS AND BRANCH CIRCUIT PROTECTION SHALL BE PROVIDED BY INSTALLER IF NOT SUPPLIED.

7- CUSTOMER CONTROL CONTACTS MAY BE WIRED BETWEEN TERMINALS 16&17.
8- IF 0-5 VDC CWR IS USED, SET SETPOINT 3B TO RESET DESIRED AT +5VDC INPUT. CAUTION: DO NOT SUPPLY OVER 5.0VDC TO ANALOG INPUT.

10- SHIELDED CABLE IS RECOMMENDED FOR CUSTOMER SUPPLIED CONTACT WIRING. GROUND ON SUBPANEL.
11- CONTACT RATING IS 10A AT 125 VAC AND 5A AT 250 VAC (1/2 HP).

WCGACTBA.DWG

ELECTRICAL WIRING DRAWINGS (CONT.)



WCGACTCA.DWG

Provide .....no.(s) factory assembled, leak tested Natural Gas/Fuel oil no.2 Fired Double Effect Dunham-Bush Absorption Chiller. Each chiller shall have a capacity of ..... TR, cooling ..... gpm of chilled water from .....ºF to ..... ºF, when supplied with condenser water at a temperature of .....ºF. The unit selection shall be based upon a fouling factor of ..... for the evaporator and ..... for the condenser/absorber circuit. Natural gas/fuel oil no. 2 at a pressure of ..... psi shall be provided before the inlet of burner. The supply power characteristics shall be .....Volts, ...Phase, ...Hz.

The chiller shall be of multi-shell design consisting of lower shell assembly, upper shell assembly, high temperature generator mounted with a suitably sized burner, heat exchangers, absorbent pump, refrigerant pump, purge pump, purge unit and inter-connecting piping & accessories.

The unit shall operate on Water-Lithium Bromide cycle.

1. Mechanical description

All the heat exchangers shall be of shell and tube type welded construction. The material of shell, tube sheets and water boxes shall be as per SA 515/516 Gr 70/60 or IS 2002 Gr 2 or IS 2062.

2. Lower shell assembly

The evaporator and absorber sections shall be housed in a common fabricated carbon steel shell, but with separate compartments for each section. The evaporator and absorber shall be separated by rows of stainless steel (SS-430) eliminators. Material for evaporator and absorber tubes shall be plain DLP (Deoxidized Low Phosphorous) grade copper. All the tubes shall be fitted in the respective tube sheets duly expanded for a tight fit. All the tubes shall be individually replaceable from either end of the chiller. The absorber shall have marine type hinged water headers with side nozzles for easy opening and access to the tube bundle. The evaporator water headers shall have side nozzles for easy opening and access to tube bundle.

3. Upper shell assembly

The low temperature generator and condenser sections shall be housed in a common fabricated carbon steel shell, but with separate compartments for each section. The condenser and low temperature generator shall be separated by a partition plate fitted with stainless steel (SS-430) eliminators. Material for condenser tubes shall be plain DLP (Deoxidized Low Phosphorous) grade copper. The tubes of the low temperature generator shall be low finned copper.

All tubes in the condenser shall be individually replaceable from either end of the chiller. The condenser shall have marine type hinged water headers with side nozzles for easy opening and access to the tube bundle. All the tubes shall be fitted in the respective tube sheets expanded into grooved holes.

4. High temperature generator

The high temperature generator shall have straight and plain, circular carbon steel boiler quality tubes, adequately sized and 0.144" wall thickness. All the tubes shall be fitted in the respective tube sheets duly expanded for a tight fit and welded. Inside welding of the tubes shall be avoided to facilitate the removal of tubes at the site, if required. A suitably sized burner for firing natural gas/fuel oil no. 2 shall be mounted on the high temperature generator.

Burner:

The chiller unit shall be supplied with a UL listed burner, capable of firing on one or both of the following fuels:

a. Natural gas
b. No. 2 fuel oil

The burner shall be provided with a burner mounted control panel, necessary controls and stand alone safeties to provide safe and efficient working.

5. Heat exchangers

The heat exchangers shall be of shell and tube type welded construction. There shall be three heat exchangers - low temperature, high temperature and drain heat exchanger. The tube material for low temperature heat exchanger shall be spiral copper, for high temperature heat exchanger shall be spiral cupro-nickel (90:10) and for drain heat exchanger (heat reclaimer) shall be stainless steel (SS-430) titanium stabilized, for maximum heat transfer between the circulating fluids.

6. Refrigerant and absorbent pump

The unit shall be provided with two motor-pump assemblies - a refrigerant pump for even distribution of refrigerant on the evaporator tube bundle through gravity feed arrangement and one absorbent pump to deliver the dilute solution to the generator. Both the pumps shall be canned motor, self lubricating type and shall be cooled by the fluid being pumped. The absorbent pump shall be provided with both over-current and high temperature protection safeties to prevent the motor from burnout. Both the pumps shall be provided with isolating valves at both the suction and discharge ends for ease of removal of the pumps for maintenance, without breaking the vacuum inside

the chiller. Both the pumps shall have a external bearing monitoring system to enable the user to check the condition of the bearing, without dismantling the pumps.

7. Purge recovery unit

The purge unit shall be sized to automatically and continuously remove the non-condensable gases from the shell to the storage tank, when the chiller is in operation. The purge unit shall be provided with a factory mounted and tested electrical motor driven purge pump to remove these gases from the storage tank. The unit shall be provided with a solenoid valve or a non-return valve to avoid air from entering the absorption chiller, in case the power fails while the purge pump is in operation.

8. Gravity feed trays

The chiller shall be provided with stainless steel (SS-430) gravity-feed trays for even distribution of refrigerant and absorbent over the respective tube bundles. The gravity feed trays shall be located just above the top of the respective tube bundle and shall have perforations perfectly aligned with and running along the entire length of the tube bundle. The gravity feed arrangement enhances the machine life by eliminating the chances of erosion of spraying nozzles and disruption of flow due to clogging of nozzles with impurities.

9. Sight glasses and service valves

The unit shall be provided with a minimum yet sufficient number of sight glasses and service valves for easy diagnosis, user-friendly operation and trouble-shooting. The number of sight glasses and service valves shall be kept to a minimum to reduce the number of potential leakage points. The use of threaded type sight glasses shall be avoided. The sight glasses shall be provided at the following locations to monitor the refrigerant and solution levels:

Evaporator shell, absorber shell and high temperature generator shell.

10. Piping

The various sections of the chiller shall be inter-connected by suitably sized seamless steel piping. All piping shall be of welded construction complete with necessary valves and fittings. The absorber to the condenser crossover piping shall be suitably welded by the supplier.

11. Auto-decrystalization line

The unit shall be provided with an overflow pipe connecting the low temperature generator to the absorber and bypassing the heat exchanger, to enable the hot solution to flow directly from the low temperature generator to the absorber and hence decrystalize the unit.

12. Liquids

The absorption chiller shall operate on water-lithium bromide cycle. A suitable charge of both the refrigerant and a suitably inhibited lithium bromide shall be supplied by the manufacturer. The inhibitor used shall be environment friendly and shall not be chromate or nitrate based. Also a suitable quantity of heat transfer additive shall be charged in the unit.

13. Controls and safeties

Each unit shall be equipped with a factory mounted and pre-wired control system. The chiller shall be equipped with two panels - a combined power and control center, and a burner control panel.

The burner control panel shall be designed to interface directly with the microcomputer-based chiller control panel, to provide integrated burner firing control for the chiller operation. The control system shall provide for modulation of the burner based on the desired chilled water leaving temperature, control and monitoring of absorbent, refrigerant and purge pumps and control interlocks for chilled water and cooling water pumps.

The control equipment shall be enclosed in a NEMA 1 type sheet metal enclosure mounted on the chiller. The safety and control circuit shall consist of the following:

- Terminal blocks for control and power connections
- Microcomputer based control system
- Individual circuit breakers for each pump and the burner
- Ambient compensated overloads for all pumps
- Control transformer
- Level controller and electrodes for evaporator refrigerant level control and first stage generator (high temperature) solution level control. The use of a float valve for level controls shall be avoided.
- High motor temperature cutout for absorbent pump
- Interlock terminals for chilled and cooling water pumps
- On/off/remote selector switch for unit control Purge pump control switch
- Indicator lights for control power, absorbent pump, refrigerant pump, purge pump and alarm
- Temperature sensors and digital display for the following:
- Chilled water leaving temperature, cooling water entering and leaving temperature and first stage (high temperature) generator temperature
- Freeze protection thermostat
- Factory mounted flow switch & differential pressure switch for chilled water
- Burner control and monitoring

Information display

The computer shall have a simple keyboard accessed input system and shall be complete with a two line 80 character alphanumeric display. The input shall be accomplished through simple menu driven display screens, with on-line help available by pressing a help button at any time during operation. The information shall be in the English language with numeric data provided in English units. The following information shall be provided on the computer:

- Leaving chilled water temperature
- Entering and leaving cooling water temperatures
- First stage (high temperature) generator temperature
- Operating hours of the chiller
- Indication of refrigerant, solution and purge pump's manual/auto operation
- Burner firing rate (in %)
- Number of starts of the chiller
- Number of purge cycles (Cumulative)

The computer shall be complete with all hardware and software necessary to enable remote monitoring of all data through the addition of only a simple, optional, phone modem and terminal. The microcomputer shall be complete with an RS232 “local” communications port and an RS485 long distance differential communications port. The microcomputer shall also accept a remote start and stop signal, and a 0 - 5 VDC chilled water temperature reset signal.

The microcomputer shall be able to transmit all the operating, setpoint and shutdown information to a remote terminal. This transmission occurs as needed and can be printed. The microcomputer shall store a history data of the last eight safety shutdowns.

Capacity control

The computer shall automatically vary the burner firing rate in order to maintain the leaving chilled water setpoint for variable cooling loads. The following parameters shall be programmable directly from the keypad using a security access code, for safe operation:

- Chilled water leaving temperature in increments of 0.1°F
- Chilled water leaving temperature reset based on 0 - 5 VDC signal
- Package control based on 7 day weekly schedule with up to 8 holiday schedules
- Ramp-up of unit capacity on start-up

Proactive controls for unit protection

Cooling water limits - The microcomputer shall restrict the burner firing rate in case the cooling water entering temperature exceeds lower or upper limits.

Chilled water limit - If the leaving chilled water temperature reduces below the low setpoint value, the microcomputer shall shut off the refrigerant pump. The pump shall be restarted automatically when the chilled water temperature rises above the high setpoint value.

Shutdown controls

1. Safety shutdown :

The microcomputer shall be preprogrammed to shut down the unit when any one or more of the following conditions occur:

- Refrigerant or absorbent pump current overload
- High motor temperature cut-out for absorbent pump motor
- Burner alarm/failure
- High stack temperature
- Chilled water flow switch trip
- Chilled water differential pressure switch trip
- Freeze protection thermostat trip
- Low cooling water entering temperature
- First stage (high temperature) generator high temperature
- First stage (high temperature) generator high pressure
- Sensor failure monitoring
- Power failure (when “automatic restart after power failure” setting is not utilized)

In case of safety shutdown controls, a manual operation to restart the unit is required. Whenever a safety shutdown occurs, the computer shall record the following information and store it in its memory:

- Day and time of shutdown
- Reason for shutdown

2. Cycling shutdown:

In case of a cycling shutdown, automatic restart of the unit occurs. The following conditions are included under the cycling shutdown condition:

- Low leaving chilled water temperature
- Power failure (when automatic restart setting is utilized)
- Loss of condenser water flow (Optional)
- Scheduling of unit operation set for shutdown

1. In addition to the standard temperatures, the Microcomputer can monitor the following temperatures:
   - Entering chilled water temperature
   - Condensed refrigerant temperature (at the U-tube)
   - Strong solution leaving temperature from the heat exchanger

2. Optional modem can be provided for remote monitoring of the unit with a terminal or personal computer.

3. Under voltage and phase sequence protection relay.
4. Unit disconnect switch with external handle.
5. Inverter drive for absorbent pump: A fully microprocessor-based inverter drive can be offered on the Dunham-Bush Absorption Chiller. The inverter drive suitably varies the flow of the dilute solution from the absorber to the high temperature generator, thus limiting the input energy to the generator and assisting in achieving superior part load performance.

Specifications subject to change without notice.

DUNHAM-BUSH®

101 Burgess Road, Harrisonburg, VA 22801
Phone: (540) 434-0711 Fax: (540) 434-4595
www.dunham-bush.com

July 2000 Printed in U.S.A. Form No. 6066A