

# HVAC Guide Specifications

CBM Specification August 25, 2008

**Chiller/boiler/pump station single and three phase package system  
6 ton – 25 ton chiller with 80,000 to 399,000 BTU boiler**

*Size Range: As per Table below:*

Capacities			Air Cooled 4 Pipe System				Hybrid Water & Air Cooled 6 Pipe System			
Cooling BTU's	Nom Tons	Heating BTU's	Model	EER	Ph	Stages	Model	EER	Ph	Stages
72,000	6	80,000	CBMA060303080	12	1-3	2	CBMA060303080HY	16	1-3	2
		140,000	CBMA060303140				CBMA060303140HY			
		199,000	CBMA060303199				CBMA060303199HY			
84,000	7	140,000	CBMA070304140	12	1-3	2	CBMA070304140HY	16	1-3	2
		199,000	CBMA070304199				CBMA070304199HY			
96,000	8	140,000	CBMA080404140	12	1-3	2	CBMA080404140HY	16	1-3	2
		199,000	CBMA080404199				CBMA080404199HY			
108,000	9	140,000	CBMA090405140	12	1-3	2	CBMA090405140HY	16	1-3	2
		199,000	CBMA090405199				CBMA090405199HY			
120,000	10	140,000	CBMA100505140	12	1-3	2	CBMA100505140HY	16	1-3	2
		199,000	CBMA100505199				CBMA100505199HY			
144,000	12	140,000	CBMB12040404140	12	3	3	CBMB12040404140HY	16	3	3
		199,000	CBMB12040404199				CBMB12040404199HY			
		399,000	CBMB12040404399				CBMB12040404399HY			
180,000	15	140,000	CBMB15050505140	12	3	3	CBMB15050505140HY	16	3	3
		199,000	CBMB15050505199				CBMB15050505199HY			
		399,000	CBMB15050505399				CBMB15050505399HY			
216,000	18	140,000	CBMB18060606140	12	3	3	CBMB18060606140HY	16	3	3
		199,000	CBMB18060606199				CBMB18060606199HY			
		399,000	CBMB18060606399				CBMB18060606399HY			
288,000	20	140,000	CBMB2005075075140	12	3	3	CBMB2005075075140HY	16	3	3
		199,000	CBMB2005075075199				CBMB2005075075199HY			
		399,000	CBMB2005075075399				CBMB2005075075399HY			
288,000	23	140,000	CBMB23075075075140	12	3	3	CBMB23075075075140HY	16	3	3
		199,000	CBMB23075075075199				CBMB23075075075199HY			
		399,000	CBMB23075075075399				CBMB23075075075399HY			
300,000	25	140,000	CBMB25075075010140	12	3	3	CBMB25075075010140HY	16	3	3
		199,000	CBMB25075075010199				CBMB25075075010199HY			
		399,000	CBMB25075075010399				CBMB25075075010399HY			

## **Part 1 — General**

### **1.01 - SYSTEM DESCRIPTION**

PLC controlled [hybrid] air-cooled [and water-cooled] liquid chiller with high efficiency boiler and hydronic pump system contained within a single enclosure. System shall allow simultaneous operation of chiller and boiler. The chiller, boiler and pump station have detailed specification section contained in the following sections of this document.

### **1.02 - QUALITY ASSURANCE**

- A. Unit shall be rated in accordance with ARI Standard 550/590, latest revision (U.S.A.).
- B. Unit construction shall comply with ASHRAE 15 Safety Code, NEC, and ASME applicable codes (U.S.A. codes).
- C. Unit shall be full load run tested at the factory.

### **1.03 - DELIVERY, STORAGE AND HANDLING**

- A. Unit controls shall be capable of withstanding 150° F (66° C) storage temperatures in the control compartment.
- B. Unit shall be stored and handled per unit manufacturer's recommendations.

### **1.04 – WARRANTY**

- A. Boiler and chiller components 5 years
- B. Pump station components 2 years.

## **Part 2 — Products**

### **2.01 - CABINET**

- A. General:  
Unit shall be designed for easy service access. All equipment shall be serviceable and removable with direct access service panels. Service panels shall have captured fasteners.
- B. UNIT CABINET:
  - 1. Frame shall be of heavy-gage carbon steel coated with rust inhibitor type paint.
  - 2. Cabinet shall be stainless steel.
  - 3. Each cabinet shall be equipped with vibration isolation pads at unit mounting points.

### **2.02 - PUMP SECTION**

#### **2.02.1- PUMPS**

- A. General:  
Chilled water and hot water loops shall be completely independent and piped to allow simultaneous operation of each loop. Hybrid models shall have an additional condenser water pump dedicated to circulation of fluid to heat exchangers.
- B. Materials of construction:  
Bronze or stainless steel casing, stainless steel cartridge, non-metallic impeller.
- C. Performance data:  
Pump shall provide 3 GPM per ton of cooling and 1 GPM per 10,000 btu of heating with a temperature range of 40° F (4° C) to 230° F (110° C) with a maximum working pressure of 125 PSI. Condenser water pump shall be matched to water cooled heat exchanger flow parameters.

#### **2.02.2 - HYDRONIC ACCESSORIES**

- A. All hydronic accessories to have a maximum working pressure of 125 PSI.
- B. Balancing valves, pressure relief valves and auto-fill devices are provided by installer.
- C. Gauges:  
Each loop shall be fitted with a 2” pressure-temperature gauge.
- D. Flow switch/sensors:  
Each loop shall be fitted with a bronze flow switch or flow sensor to prevent low/no flow operation .

### **2.03 – CHILLER SECTION**

#### **2.03.1 - Equipment**

- A. General:

Factory assembled, single-piece chassis, air-cooled [and water-cooled] liquid chiller. Contained within the unit cabinet shall be all factory wiring, piping, controls, refrigerant charge (R-22), and any special features required prior to field start-up. Each chiller circuit shall be a complete independent system consisting of compressor, evaporator and condensing coil to ensure redundant operation. Each A style cabinet shall contain (2) two independent chiller circuits. Each B style cabinet shall contain (3) independent chiller circuits.

B. Fans:

1. Condenser fans shall be direct-driven, 8-blade airfoil cross-section, reinforced polymer construction, shrouded-axial type, and shall be statically and dynamically balanced with inherent corrosion resistance.
2. Variable-speed operation shall allow reduced sound levels and minimize energy consumption. The fan speed shall vary based upon liquid line temperature.
3. Air shall be discharged vertically upward.
4. Fans shall be protected by coated steel wire safety guards.

C. Compressors:

1. Fully hermetic scroll type compressors.
2. Direct drive, 3500 rpm (60 Hz) 2900 rpm (50 Hz), protected by either line break device with discharge and suction gas pressure limit switches, suction gas cooled motor.
3. External vibration isolation using rubber in shear mounting and discharge line vibration isolation to condenser coil(s).

D. Evaporator:

1. Evaporator shall be rated for a refrigerant working-side pressure of 450 psig (3103 kPa) and shall be tested for a maximum fluid-side pressure of 150 psig (1034 kPa) (in Canada, 250 psig [1724 kPa] per Canadian National Registry requirements).
2. Shall be single-pass, ANSI type 316 stainless steel, brazed plate construction.
3. Shell shall be insulated with  $\frac{3}{4}$ -in. (19 mm) closed-cell, polyvinyl-chloride foam with a maximum K factor of 0.28.

F. Condenser:

1. Air cooled condenser coil shall be constructed of aluminum or copper fins mechanically bonded to seamless copper tubes. Tubes shall be cleaned, dehydrated, and sealed.
2. Water cooled condenser shall be single-pass, ANSI type 316 stainless steel, brazed plate construction.
3. Assembled condenser coils shall be leak tested and pressure tested at 450 psig (3103 kPa).

G. Refrigeration Components:

Refrigerant circuit components shall include filter drier, thermal expansion device, and complete operating charge of both refrigerant R-22 and compressor oil.

H. Controls, Safeties, and Diagnostics:

1. Controls:

Unit controls shall include the following minimum components:

- a. Single finger safe terminal block for incoming power.
- b. Segregated low voltage terminal block for external or internal selectable staging.
- c. Voltage-Phase monitor.
- d. Control transformers to serve all controllers, relays, and control components.
- e. Programmable Logic Controller with non-volatile memory.
- f. Touch screen for monitoring and input.
- g. Replaceable mechanical relay panels with indicator lights and controllers.
- h. Flow sensors to monitor chilled water, hot water [and condenser water] flow rates.
- i. Externally mounted indicator lights to monitor functions.
- j. Pressure switches to monitor compressor suction and discharge pressures.
- k. Thermistors to monitor:
  - i. Chilled water supply and return temperatures
  - ii. Hot water supply and return temperatures
  - iii. Compressor liquid line temperatures
  - iv. Condenser water supply and return temperatures]

2. Unit controls shall include the following functions:

- a. Power fluctuation protection.
- b. Automatic circuit lead/lag for multi-circuit chillers.

- c. Digital set point controllers with integral time delay to prevent short cycling.
- d. Variable fan speed controller for condenser fan(s).
- e. Pump start/stop control.
- f. Boiler enable signal to initiate heating system mode.
- g. Boiler lead/lag for multiple boiler systems.

3. Diagnostics:

- a. Each unit shall include lighted relays which signal operation.
  - i. Each unit shall include externally mounted indicator lights for flow and system operation.
- b. B style units shall have a programmable logic control device with illuminated touch screen to display unit operation and trouble shooting indicators as outlined in the installation and operation manual for such models.
- c. Information included on the touch screen display shall include:
  - 1) Call for heating and/or cooling.
  - 2) Flow status and rate.
  - 3) Chilled water supply and return temperatures, hot water supply and return temperatures [and condenser water supply and return temperatures.
  - 4) Condenser fan speed.
  - 5) Alarm status.
  - 6) Alarm history.
  - 7) Thermistor malfunction.
  - 8) Compressor lockout.

4. Safeties:

Unit shall be equipped with thermistors and all necessary components in conjunction with the control system to provide the unit with the following protections:

- 1) Loss of refrigerant charge.
- 2) Loss of fluid flow in hydronic loop
- 3) Low chilled fluid temperature.
- 4) Thermal overload.
- 5) High refrigerant system pressure.
- 6) Electrical overload or undersupply.
- 7) Reverse rotation.

I. Operating Characteristics:

- 1. Unit shall be capable of starting and running at outdoor ambient temperatures from 45° F (7° C) to 120° F (50° C).
- 2. Unit shall be capable of starting up with 95° F (35° C) entering fluid temperature to the cooler.

J. Motors:

Condenser fan motors shall be totally enclosed single speed, 1-phase type with permanently lubricated bearings. Speed control shall provide variable fan speed relative to condensing temperatures.

K. Electrical Requirements:

- 1. Unit primary electrical power supply shall enter the unit at a single location.
- 2. Primary electrical power supply shall be rated to withstand 120° F (50° C) operating ambient.
- 3. Unit shall operate on [3] 1-phase power at the voltage shown in the equipment schedule.
- 4. Control points shall be accessed through terminal block.
- 5. Unit shall be shipped with factory control and power wiring installed.

L. Coil Protection Grilles:

Unit shall be supplied with factory grilles to protect the condenser coil from physical damage.

M. Additional Specifications:

Copper-copper Condenser Coil Materials:

- 1. Galvanized steel tube sheets shall not be acceptable. A polymer strip shall prevent coil assembly from contacting sheet metal coil pan to minimize potential for galvanic corrosion between the coil and pan. All copper construction shall provide protection in moderate coastal applications.
- 2. Water Cooling (heat recovery option):
  - a. Extra pump and heat exchanger to utilize condenser water from a water reservoir (swimming pool) or geothermal system.

- b. Temperature controller to automatically alternate or blend between condenser fan function and geothermal system depending upon comparative temperatures.

## 2.04 – BOILER SECTION

### 2.04.1 – Description:

1. This specification describes requirements for a high efficiency compact condensing boiler.
2. Provide load modulating high efficiency condensing volume hot water boilers, see schedule below.

### 2.04.2 – Design Requirements

1. The boiler shall be high efficiency condensing units that meet or exceed an efficiency of 95.1% tested and certified to AFUE standards, and exceed ASHAE/103-93 minimum efficiency requirements. The boiler shall be Energy Star approved. The boiler shall be constructed in accordance with ANSI Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers, ANSI Z21.13b-1994, Canadian National Standard CGA-4.9-1999.26UB, UL/ULC (File #MH27745) Listed and be in accordance with all codes and authorities having jurisdiction. The boiler shall bear the ASME “H “ designation for working pressure of 125 psi and shall be national board listed.
2. The boiler heat exchanger and combustion shell shall be constructed entirely of 316L stainless steel. The combustion shell shall be designed to collect condensation in the back of the heat exchanger section. The condensate is discharged by gravity from the rear of the boiler down a Rubber Neoprene hose with a built in trap. The Heat Exchanger Tubes containing water shall be rolled and formed in a helical pattern in a wet base design. The heat exchanger tubes shall be water tight with high temperature o-rings to the header, which are held in place with stainless steel banding.
3. The boiler shall be a sealed combustion system of natural or liquid propane gas-fueled with a modulating power burner and positive pressure discharge. The intake/exhaust shall be piped with PVC or ABS schedule 40, 80 solid, Non Foam Core. Boiler shall be approved for both direct-horizontal venting as well as vertical venting. The exhaust shall maintain a minimum of ¼”/foot slope toward boiler to control condensate and rainwater. All related intake/exhaust piping shall be approved for zero clearance to any combustible surface. The combustion block shall be insulated and secured in an ABS plastic enclosure. All components shall be located in the front of the heater for access of serviceability. The boiler’s total combined equivalent venting length, inclusive of elbows and fittings, shall not exceed 85’ in 3” or 125’ in 4” pipe for boilers less than 200,000 BTU inputs; shall not exceed 85’ in 4” pipe size or 125’ in 6” for boilers of 399,000 BTU inputs.
4. Condensate shall be directed outside or to a drain via a minimum 5/8” plastic tube at a ¼”/foot slope away from the boiler (larger diameter pipe may be necessary for longer lengths). If condensate is directed to a drain, a N1100 condensate neutralizer must be utilized. If boiler condensate proper grade is not obtainable, a condensate pump must be installed to elevate condensate to proper drain grade.
5. The boiler shall have a minimum 1¼” Supply and Return water connections, gas supply shall be a minimum size of ¾” inside diameter.
6. The operation of the boiler shall be in an closed-loop-pressurized system, which shall have properly sized thermal expansion tank(s), or meet local codes. The boilers shall be supplied with an ASME rated 125 PSI relief valve and equipped with a water pressure switch to monitor system pressure.
7. The boiler shall have a load matching modulating range of a minimum 3:1 ratio to BTU/hr output. To prevent short cycling, the boiler shall step fire on start-up before engaging full modulation.
8. The blower motor shall have permanently lubricated sealed ball bearings, with inherent overload protection. Motors shall be mounted inside the unit casing for weather protection.

### 2.04.3 - Electrical

1. The electrical system shall conform to National Electrical Code requirements. The control circuit shall be 24 volts AC, wire in accordance with NEC Class II requirements. The control circuit wire shall not be smaller than 18 AWG. Each wire shall end with a service loop and be securely fastened by an approved method. Each wire in the unit shall be numbered for ease of service tracing. All electrically actuated components shall be easily accessible from the front of the unit without reaching over exposed high voltage components or rotating parts. The blower motor shall have thermal and short circuit protection. Line voltage and 24 volt control circuit wiring shall be routed in separate bundles.

### 2.04.4 – Controls

1. Controls shall be integrated solid-state temperature and spark ignition control with integral diagnostics. service disconnect switch shall be factory installed on the exterior of the boiler. Boiler shall include factory installed control sensors on the boiler water connections inlet and outlet. The control shall have differential switch with setting 6-12-20-30 differential range with an operating range of 70° F -190° F with a reset-able ECO switch. The control shall utilize an algorithm to fully adjust the firing rate while maintaining the desired output temperature.
2. The pre-mix Stainless Steel Meshed Burner Fan shall have a low-voltage direct current drive motor with pulse width modulation, which controls the fan speed and combustion air volumes. The gas valve with venturi system shall provide a one-to-one ratio of controlled measured volumes of fuel to air through the burner.
3. The controller shall consist of a main circuit board with power supply transformer and provide the following functions on the main circuit board:
  - a. Power supply unit for voltage supply of controller.
  - b. Micro controller for controlling and monitoring the boiler unit.
  - c. Various analog sensor connections (temperature sensors).
  - d. LCD and LEDs for displaying data and operating conditions of the controller.
  - e. Pushbutton for operating the controller.
  - f. Various plug connections.
4. Control shall include self-diagnostic controls which monitor all interlocks and provide fault information with a computer interconnection port for clear data viewing and downloading to a PC.

5. Boiler shall include the following boiler control safeties, integral to control board:

- a. Safety Limit ECO w/Manual reset, factory set at 225F.
- b. Safety Limit Flue w/Manual reset, factory set at 210F.
- c. High Limit w/Manual reset on Outlet pipe, factory set at 230F.
- d. High Limit w/Manual reset on Inlet pipe, factory set at 230F.
- e. Flame Failure Lockout after three tries. Retry ignition sequence every hour.
- f. Combustion air/exhaust proving switch w/Manual reset.
- g. Gas Valve continuity check w/Manual reset.
- h. Flame sensor detector fault w/Manual reset.
- i. Supply sensor continuity check w/Manual reset.
- j. Fan Speed parameter check w/Manual reset.
- k. Water Pressure Low Limit, factory set at 8 psi, w/Auto reset.

6. The unit shall be factory assembled and fire-tested, requiring only connection to the fuel source. Complete operating and maintenance instructions are to be furnished with the unit.

### **3.01 – INSTALLATION**

3.01.1 – Installer requirements:

- A. Installing contractor shall have at least 5 years documented experience with hydronic systems including:
  - 1. Chilled water cooling with fan coils.
  - 2. Hot water heating with fan coils.
  - 3. Hot water heating with radiant systems.
  - 4. Indirect domestic hot water production with storage tank and associated controls.
  - 5. Control systems.

3.02 – Installation practices:

- A. Installation and Operation manual must be reviewed prior to installation.
- B. The unit shall be installed on a level, flat surface weight rated to the unit, with adequate drainage.
- C. The unit shall be provided with drainage for the boiler condensate.
- D. In areas subject to freezing temperatures, condensate must be protected from freezing.
- E. All local and regional codes shall be following including but not limited to the current adopted editions of the mechanical, plumbing and electrical codes.

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