# **GENERAL**

Furnish and install ClimateMaster Tranquility (SB) Compact High-Capacity Series as indicated on the plans. Equipment shall be completely assembled, piped and internally wired. Capacities and characteristics as listed in the schedule and the specifications that follow.

Units shall be supplied completely factory built capable of operating over an entering water temperature range from 20° to 120°F (-6.7° to 43.3°C) as standard. Equivalent units from other

manufacturers may be proposed provided approval to bid is given 10 days prior to bid closing. All equipment listed in this section must be rated and certified in accordance with Air-Conditioning, Heating and Refrigeration Institute / International Standards Organization (AHRI / ISO 13256-1). All equipment must be tested, investigated, and determined to comply with the requirements of

the standards for Heating and Cooling Equipment UL 60335-2-40 4th Edition, UL 60335-1 6th Edition for the United States and Can/CSA C22.2 No.

60335-2-40:22, CAN/CSA C22.2 No 60335-1:16 for

Canada, by Intertek Testing Laboratories (ETL). The units shall have AHRI / ISO and ETL-US-C labels

All units shall pass a factory acceptance test. The quality control system shall automatically perform factory acceptance test via computer. A detailed report card from the factory acceptance test shall be shipped with each unit. **NOTE: If a unit fails the factory acceptance test, it shall not be allowed to ship. The unit serial number shall be recorded by factory acceptance test and furnished on report card for ease of unit warranty status.**

# **BASIC CONSTRUCTION**

Horizontal units shall have one of the following air flow arrangements: Left Return/Back Discharge, Left Return/Straight Discharge, Right Return/Back Discharge, Right Return/Straight Discharge as

shown on the plans. Unit sizes 072 to 120 can be field converted without requiring new panels or belts. **Unit sizes 072-120 that cannot be field converted shall not be acceptable.**

Vertical units shall have one of the following air flow arrangements: rear return/top discharge, front return/top discharge, rear return/front discharge, front return/rear discharge as shown on plans.

Unit sizes 072-120 can be field converted without requiring new panels or belts. **Unit sizes 072-120 that cannot be field converted shall not be acceptable.**

**If units with these arrangements are not used, the contractor is responsible for any extra costs incurred by other trades.** All units must have a minimum of two access panels for serviceability of compressor compartment. **Units having only one access panel to compressor/heat exchangers/expansion device/ refrigerant piping shall not be acceptable.**

Compressor section interior surfaces shall be lined with 1/2-inch (12.7 mm) thick, 11/2 lb/ft3 (24 kg/m3) acoustic type glass fiber insulation. Air handling section interior surfaces shall be lined with 1/2-inch (12.7 mm) thick, 13/4 lb/ft³ (28 kg/m³) foil-backed fiber insulation for ease

of cleaning. Insulation placement shall be designed in a manner that will eliminate any exposed edges to prevent the introduction of glass fibers into the air stream. **Units without foil-faced insulation in the air handling section will not be accepted.**

Units shall be fabricated from heavy-gauge galvanized steel with powder-coat finish on front access panels.

Standard insulation must meet NFPA Fire Hazard Classification requirements 25/50 per ASTM E84, UL 723, CAN/ULC S102-M88 and NFPA 90A requirements; air erosion and mold growth limits of UL-181; stringent fungal resistance test per ASTM-C1071 and ASTM G21; and shall meet zero level bacteria growth per ASTM G22. **Unit insulation must meet these stringent requirements or unit(s) will not be accepted.**

Horizontal units to have discharge air duct collar,

1-inch (25.4 mm) or 2-inch (50.8 mm) filter rails with filters factory installed, and factory-installed hanger brackets. Vertical units have discharge air duct collar shipped loose, and 1-inch (25.4 mm), 2-inch (50.8 mm), or 4-inch (101.6 mm) full filter frame with filters factory installed. **If units with these factory installed provisions are not used, the contractor is responsible for any extra costs to field install these provisions, and/or the extra costs for their subcontractor to install these provisions.**

All units must have an insulated panel separating the fan compartment from the compressor compartment. Units with the compressor in the air stream are not acceptable.

Horizontal units shall have factory installed filter rails with filter removal from either side. Vertical units shall have factory installed full filter frame with filter removal from bottom. **The contractor shall purchase one spare set of filters and replace factory shipped filters on completion of startup.** Filters shall be standard sizes. **If units utilize non-standard filter sizes then the contractor shall provide 12 spare filter sets for each unit.**

Cabinets shall have separate knockouts on front and sides for entrance of line voltage and low voltage control wiring. All factory-installed wiring passing through factory knockouts and openings shall be protected from sheet metal edges at openings by plastic ferrules. Supply and return water connections shall be copper FPT fittings, connections on both sides (installer to choose side and plug opposite) and shall be securely mounted flush to the cabinet side allowing for connection of a flexible hose without the use of a back-up wrench. **Water connections that protrude through the cabinet or require the use of a backup wrench shall not be allowed.** Water connections on only one side will not be accepted.

All water connections and electrical knockouts

must not interfere with the serviceability of unit. **Contractors shall be responsible for any extra costs involved in the installation of units that do not have this feature.** Contractors must ensure that units can be easily removed for servicing and coordinate locations of electrical conduit and lights with the electrical contractor.

**Option: Dual-point power.**

**Option: UltraQuiet package shall consist of high technology sound attenuating material that is strategically applied to the compressor and air handling compartment casings and fan scroll in addition to the standard ClimaQuiet system design, to further dampen and attenuate sound transmissions. Compressor is mounted on**

**specially engineered sound-tested isolators.**

# **FAN AND MOTOR ASSEMBLY**

All units shall have a belt-driven single centrifugal fan. Fan motor shall be premium duty, VFD compatible, permanently lubricated with thermal overload protection. Units supplied without permanently lubricated motors must provide external oilers for easy service. The fan and motor assembly must be capable of overcoming the external static pressures as shown on the schedule. Airflow/Static pressure rating of the unit shall be based on a wet coil and a clean filter in place. **Ratings based on a dry coil and/or no filter, or on an ESP less than 0.25 inches (6.35 mm w.g.) shall NOT be acceptable.**

**Option: Various blower drive packages for selectable static pressure/airflow.**

**Option: Variable Frequency Drives (VFD). VFD controls shall be factory mounted, installed and programmed. VFD controls have the capability to reduce airflow down to 37.5%. Products not containing factory mounted VFD controls shall not be acceptable.**

# **REFRIGERANT CIRCUIT**

All units shall contain an R-454B sealed refrigerant circuit including a high-efficiency scroll compressor designed for heat-pump operation, a thermostatic expansion valve for refrigerant metering, an enhanced corrugated-aluminum lanced fin and rifled copper tube refrigerant to air heat exchanger, reversing valve, coaxial (tube-in-tube) refrigerant to water heat exchanger, and safety controls including a high-pressure switch, low-pressure switch (loss-of- charge), water coil low-temperature sensor, and air coil low-temperature sensor.

Access fittings shall be factory installed on high and low-pressure refrigerant lines to facilitate field

service. Activation of any safety device shall prevent compressor operation via a microprocessor lockout circuit. The lockout circuit shall be reset at the thermostat or at the contractor supplied disconnect switch. **Units that cannot be reset at the thermostat shall not be acceptable.**

The scroll compressors shall have a dual-level vibration isolation system. The compressor(s) will be mounted on specially engineered sound-tested

EPDM vibration-isolation grommets to a large heavy gauge compressor mounting plate, which is then isolated from the cabinet base with EPDM grommets to minimize vibration and maximize vibration attenuation. Compressor shall have thermal- overload protection. Compressors shall be located in an insulated compartment isolated from air stream to minimize sound transmission.

Refrigerant to air heat exchangers shall utilize enhanced corrugated lanced aluminum fins and rifled copper tube construction rated to withstand 625 PSIG (4309 kPa) refrigerant working pressure.

Refrigerant to water heat exchangers shall be of copper inner water tube and steel refrigerant outer tube design, rated to withstand 625 PSIG (4309 kPa) working refrigerant pressure and 500 PSIG (3445 kPa) working water pressure. The refrigerant to water heat exchanger shall be “electro-coated” with a low cure cathodic epoxy material a minimum of 0.4 mils thick (0.4 – 1.5 mils range) on all surfaces. The black colored coating shall provide a minimum of 1,000 hours salt spray protection per ASTM B117-97 on all external steel and copper tubing. The material shall be formulated without the inclusion of any heavy metals and shall exhibit a pencil hardness of 2H (ASTM D3363-92A), crosshatch adhesion of 4B-5B (ASTM D3359-95), and impact resistance of 160 in-lbs (184 kg-cm) direct (ASTM D2794-93).

The unit water circuit is protected by two high pressure switches set at 300 PSI (2067 kPa). Switches will reset automatically when pressure is reduced. Units that do not have auto-reset water high pressure switches are not acceptable.

Refrigerant metering shall be accomplished by thermostatic expansion valve only. Expansion valves shall be dual port balanced type with external equalizer for optimum refrigerant metering. Units shall be designed and tested for operating ranges of entering water temperatures from 20°

to 120°F (-6.7° to 48.9°C). A reversing valve shall be a four-way solenoid activated refrigerant valve, which shall default to heating mode should the solenoid fail to function. If the reversing valve solenoid defaults to cooling mode, an additional low-temperature thermostat must be provided to prevent over-cooling an already cold room.

Individual refrigeration circuits charged with 62 ounces or greater of R-454B shall be supplied with a Refrigerant Detection System (RDS) with sensors to be strategically placed within the cabinet. In the event of a refrigerant leak, the RDS disables compressor operation, and the unit blower runs to disperse any concentration of leaked refrigerant in compliance with UL 60335-2-40 safety standards for flammable refrigerants. **Individual refrigeration**

**circuits charged with 62 ounces or greater of R-454B that do not have an RDS shall not be acceptable.**

**Option: The unit shall be supplied with extended range insulation option, which adds closed cell insulation to internal water lines,**

**and provides insulation on suction side refrigeration tubing including refrigerant to water heat exchanger.**

**Option: The refrigerant to air heat exchanger shall be coated.**

**Option: The unit shall be supplied with a WSE. The WSE will consist of hydronic coil, three-way valve, and aquastat. The aquastat will be adjustable type and factory set at 45°F (7.2°C). Units with WSE will require heat pump thermostat with two-stage cooling.**

**Option: The Refrigerant Detection System (RDS) package shall consist of the RDS module and sensors to be strategically placed within the cabinet. In the event of a refrigerant leak, the RDS disables compressor operation, and the unit blower runs to disperse any concentration of leaked refrigerant in compliance with UL 60335-2-40 safety standards for flammable refrigerants.**

# **DRAIN PAN**

The drain pan shall be constructed of galvanized steel and have a powder coat paint application to further inhibit corrosion. This corrosion protection system shall meet the stringent 1,000-hour salt spray test per ASTM B117. If plastic type material is used, it must be HDPE (High Density Polyethylene) to avoid thermal cycling shock stress failure over the

lifetime of the unit. Drain pans shall be fully insulated. Drain pan outlet shall be located to ensure positive unobstructed drainage of condensate. Drain outlet for horizontal units shall be connected from pan directly to 3/4-inch FPT fitting. For vertical units drain pan hose assembly can be connected to either

side, drain outlet to be 1-inch FPT fitting. The unit as standard will be supplied with solid-state electronic condensate overflow protection. **Mechanical float switches will NOT be accepted.**

**Option: The unit shall be supplied with stainless steel drain pan.**

# **ELECTRICAL**

A control box shall be located within the unit compressor compartment and shall contain a 75 VA transformer with load side circuit breaker protection, 24V activated, two- or three-pole compressor contactor, terminal block for thermostat wiring, and solid-state controller for complete unit operation.

Reversing valve and fan motor wiring shall be routed through this electronic controller. Units shall be name-plated for use with time delay fuses or HACR circuit breakers. Unit controls shall be 24-volt and provide heating or cooling as required by the remote thermostat/sensor. Two-compressor units shall have a solid-state time delay relay and random start to

prevent both compressors from starting simultaneously.

# **ENHANCED SOLID-STATE CONTROL SYSTEM (CXM2)**

Units shall have a solid-state control system. **Units utilizing electro-mechanical control shall not be acceptable.** The control system microprocessor board shall be specifically designed to protect against building electrical system noise contamination, EMI, and RFI interference.

The control system shall interface with a heat pump type thermostat. The control system shall have the following features:

1. Anti-short cycle time delay on compressor operation.
2. Random start on power up mode.
3. Low-voltage protection.
4. High-voltage protection.
5. Unit shutdown on high- or low-refrigerant pressures.
6. Unit shutdown on low water temperature.
7. Condensate overflow electronic protection.
8. Option to reset unit at thermostat or disconnect.
9. Automatic intelligent reset. Unit shall automatically reset the unit 5 minutes after trip if the fault has cleared. If a fault occurs 3 times sequentially without thermostat meeting

temperature, then lockout requiring manual reset will occur.

1. Ability to defeat time delays for servicing.
2. The low-pressure switch shall not be monitored for the first 120 seconds after a compressor start command to prevent nuisance safety trips.
3. 24V output to cycle a motorized water valve or other device with compressor contactor.
4. Unit Performance Sentinel (UPS). The UPS warns when the heat pump is running inefficiently.
5. Water coil low temperature sensing (selectable for water or anti-freeze).
6. Air coil low temperature sensing.
7. Minimized reversing valve operation (Unit control logic shall only switch the reversing valve when cooling is demanded for the first time. The reversing valve shall be held in this position until the first call for heating, ensuring quiet operation and increased valve life).
8. Emergency shutdown contacts.
9. Entering and leaving water temperature sensing.
10. Leaving air temperature sensing.
11. Compressor discharge temperature sensing.

**NOTE: Units not providing the eight safety protections of anti-short cycle, low voltage, high voltage, high refrigerant pressure, low pressure (loss of charge),**

**air coil low temperature cut-out, water coil low temperature cut-out, and condensate overflow protections will not be accepted.**

When CXM2 is connected to AWC99U01 thermostat or handheld service tool, the installer/service technician can; check DIP switch S2 settings; run operation modes manually; check all physical inputs from thermostat and refrigerant pressure switches status, (Y1, Y2, W, O, G, H, ESD, NSB, OR, HP switch, and LOC switch); current or at time of fault the following temperatures - water coil (LT1), air coil (LT2), compressor discharge, leaving air, leaving water, entering water and control voltage; record last five faults, list possible reasons, and clear faults.

When the AWC99U01 communicating thermostat is used this same functionality can be viewed and adjusted remotely in the web portal or mobile app.

Systems not providing remote access, diagnosis, and adjustment functionality will not be accepted.

# **DIGITAL NIGHT SETBACK WITH PUMP RESTART (CXM2 WITH ATP32U03C/04C, AWC99U01):**

The unit will be provided with a Digital Night Setback feature using an accessory relay on the CXM2 controller with an ATP32U03C/04C or AWC99U01 thermostat and an external, field-provided time clock. The external time clock will initiate and terminate the night setback period. The thermostat will have a night setback override feature with a programmable override time period. An additional accessory relay on the unit CXM2 controller will energize the building loop pump control for the duration of the override period. **NOTE: This feature requires additional low voltage wiring. Consult Application Drawings for details.**

# **REMOTE SERVICE SENTINEL (CXM2)**

The solid-state control system shall communicate with applicable thermostats to display (at the thermostat) the unit status, fault status, and specific fault condition, as well as retrieve previously stored fault that caused unit shutdown. The Remote Service Sentinel allows building maintenance personnel or service personnel to diagnose units from the wall thermostat. The control board shall provide a signal to the thermostat, indicating a lockout. A detailed message shall be provided

at the communicating thermostat or service tool and specific fault status such as over/under voltage fault, high pressure fault, low pressure fault, low water temperature fault, condensate overflow fault, etc. **Units that do not provide this remote service sentinel shall not be acceptable.**

**Option: MPC (Multiple Protocol Control) Interface System**

Units shall have all the CXM2 features listed above and the control board will be supplied with a Multiple Protocol interface board. Available protocols are BACnet MS/TP, Modbus, or Johnson Controls

N2. The choice of protocol shall be field-selectable/ changeable via the use of a simple selector switch. Protocol selection shall not require any additional programming or special external hardware or software tools. This enables all units to be daisy- chain connected by a 2-wire twisted-pair shielded cable. The following points must be available at a central or remote computer location:

1. Space temperature
2. Leaving-water temperature
3. Discharge-air temperature
4. Command-of-space temperature setpoint
5. Cooling status
6. Heating status
7. Low-temperature sensor alarm
8. Low-pressure sensor alarm
9. High-pressure switch alarm
10. Condensate-overflow alarm
11. High-/low-voltage alarm
12. Fan “ON/AUTO” position of space thermostat as

**Hose Kits:**

# **FIELD-INSTALLED OPTIONS**

specified above

1. Unoccupied/occupied command
2. Cooling command
3. Heating command
4. Fan “ON/AUTO” command
5. Fault-reset command
6. Itemized fault code revealing reason for specific shutdown fault (any one of seven)

This option also provides the upgraded 75VA control transformer with load side short circuit and overload protection via a built-in circuit breaker.

# **WARRANTY**

ClimateMaster shall warranty equipment for a period of 12 months from startup or 18 months from shipping (whichever occurs first).

**Option: Extended 4-year compressor warranty covers compressor for a total of 5 years.**

**Option: Extended 4-year refrigeration circuit warranty covers coils, reversing valve, expansion valve and compressor for a total of 5 years.**

**Option: Extended 4-year control board warranty covers the CXM2 control board for a total of 5 years.**

All units 120,000 Btuh (35 kW) and below shall be connected with hoses. The hoses shall be 2-feet (61-cm) long, braided stainless steel; fire-rated hoses complete with adapters.

**Only fire rated hoses will be accepted.**

**Valves:**

The following valves are available and will be shipped loose:

1. Ball valve; bronze material, standard port full flow design, FPT connections.
2. Ball valve with memory stop and PT port.
3. “Y” strainer with blowdown valve; bronze material, FPT connections.
4. Motorized water valve; slow acting, 24V, FPT connections.

**Hose Kit Assemblies:**

The following assemblies ship with the valves already assembled to the hose described:

1. Supply and return hoses having ball valve with PT port.
2. Supply hose having ball valve with PT port; return hose having automatic flow regulator valve with PT ports, and ball valve.
3. Supply hose having “Y” strainer with blowdown valve, and ball valve with PT port; return hose having automatic flow regulator with PT ports, and ball valve.
4. Supply hose having “Y” strainer with blowdown valve, and ball valve with PT port; return hose having ball valve with PT port.

# **THERMOSTATS**

The thermostat shall be a ClimateMaster mechanical or electronic type thermostat as selected below with the described features:

1. **Thermostat (Communicating) (AWC99U01)**

An electronic communicating web-enabled touchscreen thermostat shall be provided. The thermostat shall offer three stages of heating and two stages of cooling with precise temperature control and have a four-wire connection to

the unit. The thermostat shall be capable of manual or automatic change-over operation and shall operate in standard or programmable mode. An integrated humidity control feature shall be included to control a humidifier and/or a dehumidifier. The thermostat shall include a utility demand reduction feature to be initiated by an independent time program or an external input. The thermostat shall provide access to via the web portal or mobile application to include temperature adjustment, schedule adjustment including occupied/unoccupied, entering-water temperature, leaving-water temperature, water- coil temperature, air-coil temperature, leaving- air temperature, and compressor-discharge temperature. A graphical system layout to

be provided with real-time operating mode

information of the temperature sensors for easy diagnostics. The thermostat shall display system faults with probable cause and troubleshooting guidance. The system shall provide in clear language the last five faults, time of faults, operating temps at time of fault, and possible reasons for the fault. The thermostat shall provide access for immediate manual control of all outputs via the web portal/mobile application for rapid troubleshooting.

1. **Multi-stage Digital Automatic Changeover (ATA22U01)**

The thermostat shall be multi-stage (2H/2C), manual or automatic changeover with HEAT- OFF-COOL-AUTO-EM HEAT system settings and fan ON-AUTO settings. The thermostat shall have an LCD display with temperature, setpoint(s), mode, and status indication. The temperature indication shall be selectable for ºF or ºC. The thermostat shall provide permanent memory of setpoint(s) without batteries. A fault LED shall be provided to indicate specific fault condition(s). The thermostat shall provide temperature display offset for custom applications. The thermostat shall allow unit to provide better dehumidification with the standard CXM2 controller by automatically using lower fan speed on stage-1 cooling (higher latent cooling) as main cooling mode, and automatically shifting to high-speed fan on stage-2 cooling.

1. **Multi-stage Manual Changeover Programmable 5-/2-Day (ATP21U01)**

The thermostat shall be 5-day/2-day programmable (with up to four setpoints per day), multi-stage (2H/1C), manual changeover with HEAT-OFF-COOL-EM HEAT system settings and fan ON-AUTO settings. The thermostat shall have an LCD display with temperature, setpoint(s), mode, and status indication. The

temperature indication shall be selectable for ºF or ºC. The thermostat shall provide permanent memory of setpoint(s) without batteries. The thermostat shall provide convenient override feature to temporarily change setpoint.

1. **Multi-stage Automatic or Manual Changeover Programmable 7-Day (ATP32U03C)**

The thermostat shall be 7-day programmable (with up to four setpoints per day), multi-stage (3H/2C), automatic or manual changeover with HEAT-OFF-COOL-AUTO-EM HEAT system settings and fan ON-AUTO settings. The thermostat

shall have a blue backlit dot matrix LCD display with temperature, setpoints, mode, and status indication. The temperature indication shall

be selectable for ºF or ºC. Time display shall be selectable for 12- or 24-hour clock. Fault identification shall be provided to simplify

troubleshooting by providing specific unit fault at the thermostat with red backlit LCD during unit lockout. The thermostat shall provide permanent memory of setpoints without batteries. The thermostat shall provide heating-setpoint range limit, cooling-setpoint range limit, temperature display offset, keypad lockout, dead-band range setting, and inter-stage differential settings. The thermostat shall provide progressive recovery

to anticipate the time required to bring space temperature to the next programmed event. The thermostat shall provide an installer setup for configuring options and for setup of servicing contractor name and contact information. The thermostat shall allow the use of an accessory remote and/or outdoor-temperature sensor (AST008). Thermostat navigation shall be accomplished via five buttons (up/down/right/ left/select) with menu-driven selections for ease of use and programming.

1. **Multi-stage Automatic or Manual Changeover Programmable 7-Day with Humidity Control (ATP32U04C)**

The thermostat shall be 7-day programmable (with up to four setpoints per day), multi-stage (3H/2C), automatic or manual changeover with HEAT-OFF-COOL-AUTO-EM HEAT system

settings and fan ON-AUTO settings. Separate dehumidification and humidification setpoints shall be configurable for discreet outputs to a dehumidification option and/or an external humidifier. Installer configuration mode shall allow the thermostat to operate with EC fan dehumidification mode via settings changes. The thermostat shall have a blue backlit dot matrix LCD display with temperature, relative humidity, setpoints, mode, and status indication. The temperature indication shall be selectable for ºF or ºC. Time display shall be selectable for 12- or 24-hour clock. Fault identification shall

be provided to simplify troubleshooting by

providing specific unit fault at the thermostat with red backlit LCD during unit lockout. The thermostat shall provide permanent memory of setpoints without batteries. Thermostat shall provide heating setpoint range limit, cooling setpoint range limit, temperature display offset, keypad lockout, dead-band range setting, and inter-stage differential settings. The thermostat shall provide progressive recovery to anticipate time required to bring space temperature to the next programmed event. The thermostat shall provide an installer setup for configuring options and for setup of servicing contractor name and contact information. The thermostat shall allow the use of an accessory remote and/or outdoor temperature sensor (AST008). Thermostat navigation shall be accomplished via five buttons (up/down/right/left/select)

with menu-driven selections for ease of use and

programming.

# **DDC SENSORS**

ClimateMaster wall mounted DDC sensor to monitor room temperature and interfaces with optional interface system described above. Several types as described below:

1. Sensor only with no display (MPC).
2. Sensor with setpoint adjustment and override (MPC only).
3. Sensor with setpoint adjustment and override, LCD display, status/fault indication (MPC).

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