**Laars E-ThermTM Commercial Air-to-Water Natural Refrigerant Heat Pump Water Heater**

**Specification**

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

1.2 WORK INCLUDED

1. Section includes single pass air source heat pump water heater that uses R744 (CO2) refrigerant to generate hot water up to 180°F. The heat pump shall be fabricated, assembled, charged, and tested by one manufacturer.

1.3 SUBMITTALS

1. Submit shop drawings, mechanical layout, flow schematics, and product data, as specified. Include certified capacity data, installation manual, startup and service instructions, spare/replacement parts lists, and electrical wiring.

1.4 QUALITY ASSURANCE AND COMPLIANCE

1. Reference Standards
	1. UL 1995 / CSA C22.2 No. 236 Safety for Heating and Cooling Equipment
	2. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
	3. International Building Code (IBC)
	4. International Plumbing Code (IPC)
	5. Uniform Plumbing Code (UPC)
	6. ANSI/ASHRAE Standard 135 BACnet – A Data Communication Protocol for Building Automation
	7. UL 916 Energy Management Systems (EMS)
2. Each submittal shall be provided with documentation certifying that all materials, products, components, and test reports comply with the design requirements for this project.
3. Furnish all equipment, materials, and accessories new and free from defects.

1.5 WARRANTY

1. Manufacturer’s Warranty: Manufacturer agrees to repair or replace components of heat pump that fail in materials or workmanship within specified warranty period.
2. Warranty Period: 1-Year limited warranty.

PART 2 – PRODUCTS

2.1 RATINGS

1. Nominal Heating Capacity: 322 MBH (94.5 kW)
2. COP: 4.0, per ANSI Standard 1300 (test condition of 70°F inlet and 120°F outlet water temperature at 80.6°F incoming air temperature).
3. Domestic Hot Water:
	1. Outlet temperature range = 120 to 180°F (49 to 82°C)
	2. Flow rate = 2.8 to 15 gpm (10.5 to 57.8 lpm)
4. Operating Conditions:
	1. Maximum inlet water pressure = 150 psi (21.8 kPa)
	2. Inlet water temperature range = 38 to 90°F (3 to 32°C)
	3. Entering air temperature range = 0 to 115°F (-18 to 46°C)
	4. Ambient temperature range = 0 to 115°F (-18 to 46°C)
5. Voltage:
	1. 480V, 3-phase
	2. MCA = 70 Amps
	3. MOP = 110 Amps
	4. FLA = 58 Amps
	5. SCCR, RMS symmetrical maximum = 10,000 Amps

2.2 CONSTRUCTION

1. Description: Laars E-ThermTM Commercial Air-to-Water Natural Refrigerant Heat Pump Water Heater, model CHV325.
2. Ratings:
3. Construction:
	1. Heat pump shall utilize R744 (CO2), a non-toxic, non-flammable refrigerant, with a Global Warming Potential (GWP) of 1, and an ozone depletion potential (ODP) of 0.
	2. Refrigerant piping shall be brazed K65 copper.
	3. Inlet and outlet water connections shall be 1-½” MNPT.
	4. Condensate drain connection shall be ¾” MNPT.
	5. Heat jacket shall be sheet metal with powder coat, thermal set with textured finish.
	6. Units shall be offered in both indoor and outdoor configurations.
	7. Heat pump shall be available with our without mounted variable speed circulator.
	8. Unit shall be available with evaporator coil coating to protect it from corrosion due to coastal air, poor air quality, and against salt spray.
	9. Resistance heat trace and insulating blanket shall be factory-installed on the internal heat exchanger, pump (if supplied), water lines, and condensate drain pan, to activate when the temperature within the enclosure falls below 35°F.
	10. Heat pump controls shall have designated 120V input terminals for use with emergency back-up power supply to power factory-installed heat trace within the heat pump.
	11. An optional weather (snow/rain) shield kit shall be available, to be factory-installed on units that are placed outdoors.

2.3 COMPONENTS

1. COMPRESSOR
	1. Compressor shall be a semi-hermetic for use with R744 refrigerant.
	2. The compressor shall be equipped with a crankcase heater, differential oil pressure switch, and shall be mounted on vibration dampers to minimize vibration transmission. The compressor shall be equipped with an internal oil cooling system.
2. EVAPORATOR
	1. The evaporator coils shall be copper, with aluminum fins with large surface area.
	2. The defrost type shall be hot gas bypass. Defrost cycles shall be accomplished by sending hot refrigerant through the evaporator to melt ice.
	3. Electric resistance heaters shall not be required for defrost cycles.
	4. An alternate evaporator coil with coating to protect it from corrosion due to coastal air, poor air quality, and salt spray shall be optionally available.
3. GAS COOLER
	1. The gas cooler shall be a brazed plate double-wall heat exchanger, to separate potable water from refrigeration loop, without the need for an additional, external heat exchanger. Potable side of the heat exchanger shall be stainless steel.
	2. The exchange of heat shall take place in countercurrent to optimize the coefficient of performance (COP) and to allow the unit to reach high temperatures.
4. FANS
	1. The unit shall be equipped with two axial fans with energy-saving EC external-rotor motors.
	2. The fans shall have IP54 protection class, and shall be equipped with outlet protection guards.
5. RECUPERATOR
	1. The recuperator shall be a single phase plate heat exchanger, with maximum temperature rating no lower than 300°F, maximum primary pressure rating no lower than 1800psi, and maximum secondary pressure rating no lower than 1600psi.
6. REFRIGERANT EXPANSION TANK
	1. To allow the heat pump to be charged at the manufacturing facility, and allow the unit to be shipped with the charge, a refrigerant expansion tank shall be included, and shall carry the ASME U Stamp.
7. CIRCULATOR
	1. The heat pump shall be available with or without a variable speed circulator.
	2. When equipped with a circulator, it shall be mounted inside the heat pump, and shall be controlled directly by the heat pump controller to modulate to maintain proper outlet temperature and maximize efficiency.
	3. The circulator shall be sized to serve the heat pump and 25 equivalent feet of external full-sized piping.
	4. A water flow switch shall be included, to prevent the heat pump from firing if there is no water flow.
8. ELECTRONIC CONTROL SYSTEM
	1. The heat pump shall be equipped with a proprietary control system that allows for automatic operation, including evaporator defrost.
	2. Control interface shall be a large LCD touchscreen display with intuitive icons and messaging, to allow for monitoring of key process variables, adjustment of setpoints, and advanced troubleshooting. The control shall have installer-level access that is only accessible via a password.
	3. Heat pump shall be able to accept calls for heat from two dry contact “break on rise” tank temperature control or thermocouple sensor, and shall be able to detect which one is present. The user shall be able to program the on and off heat demand, whether dry contact control or thermocouple sensors are used.
	4. The control shall allow for up to 16 E-Therm heat pumps to be cascaded together.
	5. User shall only need to set a temperature on the control, rather than all of the control parameters, which will be intelligently set by the control logic.
	6. The heat pump shall be optionally available with a gateway, mounted and wired, that allows for Modbus TCP/IP & RTU, and BACnet IP & MSTP, for control by a building operation system.
	7. Configuration for CTA-2045 and Measurement & Verification systems shall be optionally available, built onto the heat pump.
	8. The display’s home screen shall show the state of the HPWH, including water temperature set point, compressor pressures, inlet and outlet water temperatures, and refrigerant superheat.
	9. Information and process / instrumentation screens for CO2 and Water P&ID shall be available to allow user to have real-time visual of heat pump operation.
	10. The control shall have password-enabled security levels for user and installer access.
	11. A configure screen shall also be accessible from the home screen, to allow any configuration of set points, and to show important real-time operating parameters.
	12. A service menu shall show digital and analog inputs and outputs, digital input and outputs, data logging, IP address, diagnostics, alarm history and alarm status. Alarm alerts and manual reset faults will be indicated on the display, along with history of alerts and faults. In addition to the alert icons, the control shall display a description of the alarm. For installer mode, additional information about the compressor, defrost, evaporator fans, gas cooler valve, heat demand source and water pump shall be available, along with a manual mode to test components when necessary.
	13. Diagnostics information shall include run time hours and cycles of major components, including the compressor, each fan, and the pump.
	14. The heat pump shall be equipped with dry contacts for external exhaust fan connection and proof of fan operation.
	15. Dry alarm contacts shall open on any heat pump alarm.
	16. For units that are not built with pumps, a 0-10VDC pump speed output shall be available, along with a dry contact for water pump VFD enable signal, and a dry contact for water pump VFD fault.
	17. The control shall allow for a factory reset to default control values.
9. OPTIONAL TANK SYSTEM CONTROL
	1. An optional heat pump tank system control, with or without CTA-2045 configuration, shall be available with the features that include:
		1. Ability to cascade up to 6 E-Therm Heat Pumps, and up to 16 units with additional ethernet switches added.
		2. Ten RTD sensors, wells, and junction boxes for:
			1. Six sensors for strategic placement throughout the stratified tank system for operating the heat pump(s) and adjusting their discharge temperatures in an efficient and systematic manner.
			2. One sensor for the temperature maintenance tank (also called swing tank) to support load shift control (schedule), to allow programmable setpoint, to control re-circulation losses, to support advanced load-up features, and to disable the swing tank under critical peak events or grid emergencies.
			3. Three sensors for optional measurement and verification systems that have water flow meters, to be placed in the cold water make-up line, mixing valve outlet, and hot water return.
		3. Ability to integrate and control up to two independent back-up heat sources and two independent back-up heater pumps.
		4. Available configuration with CTA-2045 gateway that can be used for utility demand response.
		5. Building Management System (BMS) connections that allow for use with BACnet IP, BACnet MSTP, Modbus TCP/IP, and Modbus RTU protocols.
		6. Home screen that displays with pictures the system operation values and parameters, as well as navigation to the service menu.
		7. Service menu that allows access to alarm history, analog inputs and outputs, digital inputs and outputs, cascade settings, heat pump details, IP address, and CTA-2045 (if ordered with that configuration) or schedule. With installer access, additional access for manual control of components, to change setpoints, and return to factory defaults is available.
		8. Full alarm history.
		9. Details for all analog inputs, including real-time temperature readings of all sensors used, and water flow when water flow meters are used.
		10. Programmable cascade settings.
		11. Heat pump details which include how many heat pumps are being controlled, whether there is a current heat demand, and status and run hours or each heat pump.
		12. When ordered with CTA-2045 configuration, information about the connection to and from the CTA-2045 gateway and the TSC is shown.
		13. Two programmable schedules.
		14. Setup that allows the user to choose how many heat pumps, control mode, and whether there are backup heaters, backup heater pumps, swing tank interrupt used, and water meters present.
		15. User programmable setpoints for backup, normal operation, shed operation, load up operation, and advanced load up operation.
		16. Password-protected levels for User and Installers.