

# Delta T Solutions Heating Specification

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## \*NOTE TO SPECIFIER

If gas fired unit heaters are not to be used, delete gas fired unit heater section.

If hot water heat is not to be used, delete hot water heating section.

Input air temperature requirements

Input zone requirements

Choose system design parameters

Choose heat source requirements

Choose radiation requirements

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## 2.23 HEATING

### a. Heating system general description:

#### 1. Design requirements

- a. Inside Air Temperature: 70 °F
- b. Outside Air Temperature: -10 °F
- c. Temperature Difference: 80 °F
- d. Wind 15 MPH

#### 2. System design:

- a. Gas fired heating system to provide 100% of greenhouse system heating load
- b. Hot water heating system to provide 100% of greenhouse system heating load
- c. Hot water heating system shall provide the primary heating load and gas fired unit heaters shall supplement the balance of the heating load.

## A. GAS FIRED UNIT HEATERS

1. Gas fired unit heaters shall be provided where indicated on the drawings. Heaters shall be high efficiency gas-fired (**specify:** natural gas *or* propane) horizontal propeller type units. Heaters shall be mounted from the greenhouse structure with the proper hangers. Gas supply piping and final electrical connection by others.

- a. Cabinet shall 20 gauge Stainless steel constructions.
- b. Primary heater exchanger shall be 20 gauge non-welded stainless steel tubes with curved serpentine design.
- c. The burners shall be stainless steel inshot design.
- d. The burner ignition shall be an intermittent-duty direct spark pilotless design.

- e. A balanced broad blade fan shall be direct driven by a totally enclosed motor selected to match the fan requirements.
- f. Units shall be equipped with combination solenoid, safety pilot, pressure regulator and manual shut off valve. Units shall carry the American Gas Association (AGA) certification for safety or CSA Certification.
- g. Installation shall include stack with proper saddles or other accessories for a weather tight penetration of the greenhouse skin, and weather cap.
- h. Unit heaters shall be as manufactured by Sterling Manufacturing Company.

## B. HOT WATER HEATING SYSTEM

**1. General Requirements** — The heating system for the greenhouse shall be a Delta T Solutions Hot Water Heating System. The system is designed under the following conditions:

- a. Hot Water Supply: 180 °F
- b. Hot Water Return: 160 °F
- c. Temperature Differential 20 °F
- d. Relief Valve Maximum Pressure: 60 psi
- e. Operating Pressure: 12 psi

**General system description:**

Hot water heating system with variable water flow supplied to the system based on the quantity zones that have heating demand. The hot water shall be pumped through radiating materials to control heat to the desired temperature in each zone.

**The system shall consist of:**

(enter # zones) heating zones that will be controlled using the following components to maintain the desired zone temperatures:

**1. Heating Source:** The heat source that will be supplying the hot water to the radiating materials: (choose one and insert the specification shown on page 6)

- a. Supplied by others with the required flow being supplied as per the design drawing.
- b. Shall be a natural gas fired boiler (see specification)
- c. Shall be oil fired boiler (see specification)
- d. Shall be a steam to hot water generation package (see specification)

**2. System Pumps:** The pumps shall be centrifugal pumps

- a. Federal in line-

- i. Casing – Standard pumps are built with the suction connection 180° from the discharge connection. Casings can be field rotated for a 90° position changes. Suction and discharge connections are standard ASA Flanges. Top pull-out design permits removal of the rotating assembly without disconnection the suction or discharge piping. Centerline discharge permits straight through piping
- ii. Impeller – single-piece enclosed bronze balanced impellers, with diameters cut for specified condition points.
- iii. Shaft – The pump end is mounted directly on the motor shaft, eliminating alignment problems. A bronze shaft sleeve prevents contact between the shaft and the liquid being pumped.
- iv. Mechanical Shaft seal – A leak-less mechanical shaft seal is standard on all models with the ceramic and carbon faces and stainless steel metal parts. A copper by-pass flushes the seal chamber to prevent dead-ending of abrasives.
- v. Motors – Pumps are built with totally enclosed fan cooled motors. Fractional horsepower single-phase motors have built-in overload protection. All motors must have motor starters supplied by others.

**b. Grundfos in line**

- i. The pump shall be a maintenance-free, in-line, single stage, wet rotor type with the motor mounted directly to the pump volute. The pump models shall be furnished as shown on the plans and installed in accordance with manufacturer's recommendations. The pump shall be capable of delivering gallons per minute when operating at a total developed head as shown on the pump schedule shown on the plans.
- ii. The pump shall be capable of operating continuously at temperatures from 14°F to 230°F (-10°C to 110°C) for closed systems and 32°F to 140°F (0°C to 60°C) for open systems.
- iii. Maximum working pressure shall be 145 psi (10 bars).
- iv. The pump volute shall be constructed of close-grained cast iron (closed systems) or bronze (open systems).
- v. The impeller, impeller seal ring, rotor can, bearing plate, motor shaft, and rotor cladding shall be constructed of stainless steel. The impeller shall be secured directly to the motor shaft by means of a stainless steel tapered split cone and locking nut.
- vi. The motor shaft shall have tungsten carbide bearing journals and shall be supported by two aluminum oxide ceramic radial bearings. The motor shaft shall have a stainless steel mounted carbon thrust bearing. The pump shall not have a coupling or mechanical seal.
- vii. The integral motor shall be of the horsepower, voltage, phase, and frequency as shown on the drawings. For 115, 208, and 230 volt models, the pump shall operate on each of three speeds selected using a built in, three-speed switch (460 & 575\* volt models are two speed only). The motor shall be cooled and lubricated by the pumped fluid and shall require no scheduled maintenance.

viii. Furnish GRUNDFOS VersaFlow UPS circulators or approved equal.

3. **System pump control** shall be Delta T Solutions variable frequency drive system using a VFD drive by Baldor that will vary the amount of flow based on the quantity of zones that need heat. The input to the drive shall be supplied by the differential pressure switch control package manufactured by Delta T Solutions.
4. **Zone Control** — Two-way valve zone controls shall be able to supply water to the zone or stop water from entering the radiating material based on air temperature demand. A constant designed flow rate using an automatic flow control will balance the flow rates going to the various zones. Control of the actuated valve shall be a 24v-3 wire floating control.
  - a. **Control Valves** — Two-way control valves shall be manufactured by Honeywell, Belimo, or approved equal. Valve actuator shall be removable and be connected to 24V power to open and power to close control. Valve shall be bronze construction up to 2.0" with removable internal parts without removing the valve from the piping, EPDM O-ring and stainless steel stem. Valves provided by and installed by greenhouse contractor.
  - b. **Automatic flow controls** shall be manufactured by AutoFlow factory set to automatically limit the flow within 5% of specified amount. Internal wear surfaces of the valve cartridge are nickel and stainless steel with stainless steel spring.
5. **Radiation** shall supply total heat loss based on the design criteria using the following materials: (choose required radiation for application)
  - a. **Radiation — Fin Tube:** Radiating materials shall be the Delta-T Fin SF125 aluminum finned pipe installed around the perimeter low on the wall or under the gutter, using water temperatures up to 230°F and will consist of the following components:
    - i. 1.25" schedule 40 aluminum pipe with 3.25"x 3.25"x 0.025" aluminum fins at 48 fin/ft or 24 fins/ft based on design requirements. Pipe shall have each end grooved to accept the grooved coupling provided.
    - ii. Coupling shall be grooved style with aluminum casting and high temperature gasket rated for -60°F to 230°F. Coupling and external grooved fin system shall absorb expansion from heated aluminum. Pressure ratings of 125 psi at 230°F.
    - iii. Elbows shall be sch 40 aluminum sweeps with grooved connections.
    - iv. Expanded metal mesh fin tube covers to be provided over the Fin Tube heating system in compartments with "low" perimeter fin position.
    - v. All aluminum slide brackets shall be used on all fin when attached to side walls.
    - vi. Piping in the greenhouse compartments shall be schedule 40 aluminum pipe and shall be installed with grooved coupling technology. All piping

that is exposed and will have casual contact shall be insulated with 1.0-inch fiberglass insulation and be covered with aluminum cover per drawing.

**b. Radiation — Radiant heat:** Radiating material shall be ½” PEX Cross link Polyethylene tubing with Oxygen barrier installed on 12 inch spacing 2 inches below the concrete surface. Tubing shall be attached to Wire mesh using wire ties every 2 feet. Water temperatures of 90°F to 120°F shall be pumped through the tubing at 20°F temperature difference. Tubing shall be attached to a copper manifold using a crimp ring. Each manifold shall be installed into a Steel / galvanized box in the concrete slab and covered with aluminum Diamond plate cover.

**c. Radiation — Hot water unit heater:** Furnish and install where indicated or scheduled on plans, Sterling Model HS horizontal steam/hot water unit heaters. Unit shall be equipped as specified herein. All units shall be installed in a neat and work man like manner in accordance with this specification and the manufacturer's

- i. Casings shall be 20-gauge die-formed steel. Casing substrates shall be prepared for finishing with a hot wash, iron phosphatizing, clear rinse, chromic acid rinse and oven drying. Paint finish shall be lead-free, chromate-free, alkyd melamine resin base and applied with an electrostatic two-pass system. Finish shall be baked at 350°F.
- ii. Coil elements and headers shall be of heavy wall drawn seamless copper tubing. Element tubes shall be brazed into extruded header junctions. Pipe connection saddles shall be of cast bronze. Aluminum fins shall have drawn collars to assure permanent bond with expanded element tubes and exact spacing. All Element Assemblies are submersion tested at factory at 250 P.S.I., and are rated at 150 pounds of saturated steam pressure at 366°F, under maximum load conditions. We recommend operating pressure of 75 P.S.I. at 320°F for long life.
- iii. Motors shall be totally enclosed fan cooled, resilient mounted with class “B” windings. All motors shall be designed for horizontal mounting. Motors under 1/3 H.P. are totally enclosed, frame mounted, 115/1/60 with thermal overload protection and permanently lubricated sleeve bearings with optional solid state speed controller available. 1/3 H.P. (115/1/60) motors are open frame construction, with thermal overload protection and ball bearings. 1/3 H.P. at (230V) and all 1/2 H.P. motors are open frame construction, with thermal overload protection and ball bearings. 1/3 and 1/2 H.P.

**6. All main piping** in the corridors feeding the zones shall be schedule 40 steel piping using grooved connections to all fittings.

\* All straight piping shall be insulated with 1-inch fiberglass insulation and covered with aluminum cover.

\* All piping shall be labeled with directional arrows and description.

- \* All zone control valves shall be tagged with metal tags and chain.
- \* All drain valves will be provided with caps attached with chain.
- \* All necessary elbows, nipples, drain plugs, air bleeders, expansion joints, etc., to complete the system shall be included with the system package.

7. **System control** — environmental controller will control the zone actuators based on air temperature inside each compartment and corridor.
8. **Engineering and design** for the heating system shall meet uniform mechanical code. All drawings shall be blue lined drawings on standard D size, Stamped by a mechanical engineer.
9. **Installation** — Full installation of the above system will be responsibility of the greenhouse contractor. The installation shall be done with a crew experienced for not less than 3 years of installing hot water heating systems.

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\*NOTE TO SPECIFIER

Insert appropriate boiler specification into the boiler section above

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**Fan Assisted Boiler**

1. The Boiler shall be **RBI Dominator** Model DB \_\_\_\_\_  
having an input rating of \_\_\_\_\_ MBH and \_\_\_\_\_ MBH  
output. The Boiler shall operate on \_\_\_ NATURAL GAS \_\_\_ PROPANE GAS.  
The efficiency shall be up to 85.1%.
  - a. The Boiler shall be designed certified and tested by International Approval Services. The Boiler shall meet the requirements of ANSI Standard Z21.13 and the Canadian Gas Association Standard CAN1-3.1. SCAQMD certified (sub 30 ppm NO<sub>x</sub>).
  - b. The Boiler shall operate on negative stack pressure and Category I according to ANSI Standards or Class I according to CGA Standards. The Boiler shall operate on positive stack pressure and Category III vent material. A listed stainless steel vent must be used. The Boiler shall be approved for indoor or outdoor installation. The Boiler shall be approved for Sidewall, Direct Vent Vertical and Direct Vent Horizontal sealed combustion up to 35' equivalent length. Flue outlet shall be field convertible to allow venting from top or rear outlet of Boiler. Side air intake standard; rear intake optional on 750 - 2100 only.
  - c. The combustion chamber shall be sealed and completely enclosed with high temperature ceramic fiberboard insulation. The burners shall be constructed of "4509 Uginox" stainless steel alloy and fire on a horizontal plane. The Boiler shall have two-speed integral combustion air blowers to precisely control the fuel/air mixture for maximum efficiency across the firing range.
  - d. The heat exchanger shall be inspected and bear the A.S.M.E. Section IV seal of approval. The A.S.M.E. Section IV seal of approval will not be provided as standard for jurisdictions not requiring the A.S.M.E. Section IV seal of approval. The heat exchanger shall be a two pass design with maximum working pressure of 160 psi. The water tube shall be of straight 7/8" I.D., .064" minimum wall thickness; integral finned copper tube, 7 fins per inch, with a fin height of 3/8". The water tubes shall be set horizontally with heavy galvanized steel "V" baffles tightly secured above the tubes throughout the length of the water tubes. Each end of the water tubes shall be strength rolled onto a steel tube sheet. The headers shall be secured to the tube sheet by properly placed stud bolts, flange nuts and with the use of o'rings. Headers will be of cast iron construction. O'rings must be constructed of EPDM and Silicone, capable of withstanding temperature of 540° F, 282° C. The use of red o'rings constructed of Neoprene and Silicone with temperature ratings of 250° F, 121° C will not be allowed.

The Boiler shall have a heat exchanger drawer guide rail so that the heat exchanger may slide out for ease of service and maintenance. A pressure relief valve of 45 lb/sq. in. shall be equipped with the boiler.

- e. Boiler staging will be controlled by a PID logic based two-stage or four-stage set point control. A relay logic board will incorporate all relay functions and purge time delays. Standard control system will be a United Technologies Controls 600A Series spark-to-pilot proven ignition with full flame monitoring capability. Hot surface ignition systems of any type will not be permitted. The control panel shall have a master switch with an indicating light and sequential and diagnostic indicator lights. Standard controls shall include factory mounted: high limit control with manual reset, aquastat, low air and blocked flue pressure switches to monitor fan operation, inlet and outlet temperature gauges, flow switch, relief valve and 24 VAC control circuit.
- f. The firing mode shall be one of the following:
  - i. **STANDARD 2-STAGE-** (MODELS 600 - 950)
  - ii. **4-STAGE** - (MODELS 1050 - 2100 ONLY)
- g. The Venting mode shall be one of the following:
  - i. Standard Venting
  - ii. Horizontal & Vertical Outside Air Venting
  - iii. Thru-Wall Venting
  - iv. Outdoor Venting
- h. The gas train shall include a main ball valve (600 - 2100 only), pilot valve, pilot gas pressure regulator, main gas valve, safety valve (600 - 2100 only), and firing valve. Gas train shall be CSD-1 approved.
- i. The Cabinet construction shall be Brushed stainless steel.

### High Efficiency Condensing Boiler

- 2. The Boiler shall be **RBI Futura Fusion** Model CB \_\_\_\_\_ having an input rating of \_\_\_\_\_ MBH and \_\_\_\_\_ MBH output. The Boiler shall operate on \_\_\_ NATURAL GAS \_\_\_ PROPANE GAS. The efficiency shall be up to 99.1%.
  - a. The Boiler shall be designed certified and tested by International Approval Services. The Boiler shall meet the requirements of ANSI Standard Z21.13 and the Canadian Gas Association Standard CAN1-3.1. SCAQMD certified (sub 30 ppm NO<sub>x</sub>).
  - b. Water heaters shall be CSA design certified as a condensing boiler. Water heaters shall be equipped to accept return water temperatures as low as 40°F, 4°C and operate in the condensing mode at all times. Water heaters shall be designed for a minimum of 4:1 continuous turn down with constant CO<sub>2</sub> over the turndown range. The water heater shall operate with natural gas or propane and have a I=B=R certified input rating as noted on the drawings, and a thermal efficiency rating of 94.9% at rated input and 99.1% at minimum input. The water heater shall incorporate a symmetrically air-fuel coupled such that changes in combustion air flow or flue flows affect the BTUH input without affecting combustion quality.



The water heater will automatically adjust input for altitude and temperature induced changes in air density. The water heater will use a proven pilot interrupted spark ignition system. The water heater shall use a UL approved flame safeguard ignition control system using UV detection flame sensing. The design shall provide for silent burner ignition and operation. Burner shall be premix radial-type and fire in a 360° vertical pattern. Water heater shall be able to vent a horizontal distance of 60 equivalent feet

- c. The water heaters shall be provided with stainless steel jacket panels, minimum 16-gauge, with push-button fasteners for easily accessing all serviceable components. Sheet metal screws may not be used in the securing of jacket panels to the boiler. The water heaters shall not be manufactured with large enclosures, which are difficult to remove and reinstall. All accesses must seal completely as not to disrupt the sealed combustion process. All components must be accessible and able to adjust with the removal of a single cover or cabinet component.
- d. The combustion chamber shall be constructed of minimum 16-gauge stainless steel. Aluminum or galvanized steel is not acceptable. An access door shall be provided for ease of service and inspection of the heat exchanger.
- e. Gas Burner — Metal fiber mat premix burner shall fire to provide equal distribution of heat throughout the entire heat exchanger. Burner composition shall be Fecralloy™. The burner shall be easily removed for maintenance without the disruption of any other major component of the water heater. Ignition electrodes shall be removed for inspection and proper alignment without removing the burner. A window view port shall be provided for visual inspection of the flame during firing.
- f. Ignition Components — The ignition hardware shall consist of dual Alumina ceramic insulated ignition electrodes and UV sensing tube permanently arranged to ensure proper ignition electrode and UV alignment. Electrodes must be capable of removal while leaving the burner intact. Hot surface ignition systems of any type *will not* be accepted.
- g. Rated Capacity — The water heater shall be capable of operating at rated capacity with pressures as low as 2" W.C. at the inlet to the burner pressure regulator. Water heaters that cannot provide full BTUH inputs at 2" W.C. will not be accepted.
- h. The burner shall be capable of 99.1% efficiency without exceeding a NOx reading above 20 ppm.
- i. The burner and gas train shall be provided with the following trim and features:
  - i. Burner Firing: Full modulation with 3:1 turndown @ Continuous CO<sub>2</sub>
  - ii. Burner Ignition: Intermittent spark

- iii. Safety Controls: Energize ignition, limit time for establishing flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, and allow gas valve to open.
  - iv. Flue Gas Collector: Enclosed combustion chamber with integral combustion air blower and single venting connection.
  - v. Gas Train: Manual gas valves (2), main gas valve (motorized), 'B' valve, pilot gas pressure regulator, and automatic pilot gas valve. All components to be factory mounted.
  - iv. Safety Devices: Optional high/low gas pressure switches, air flow switch, and blocked flue detection switch. All safeties to be factory mounted.
- j. The heat exchanger shall be inspected and bear the A.S.M.E. Section IV seal of approval. The heat exchanger shall be a four-pass heat exchanger with a maximum working pressure of 160 psi. The heat exchanger's vertical design shall provide equal amounts of heat transfer throughout the entire heating surface. Each heat exchanger shall have copper tubes, with an integral copper finned tube of 7/8" I.D., .064" minimum wall thickness, 7 fins per inch, with a fin height of 3/8". Each end of the water tubes shall be strength rolled into the header. The heat exchanger shall be gasket less. Each individual tube can be retubed without the disturbance of the surrounding tubes. A pressure relief valve of 125 lb/sq in shall be equipped with the water heater and factory mounted. The headers shall be of bronze construction only; cast iron shall not be acceptable.
  - k. The secondary heat exchanger shall be inspected and bear the ASME Section VIII seal of approval. The heat exchanger shall have a maximum working pressure of 160 psi. Each heat exchanger shall be constructed of 316L stainless steel throughout the internal vessel and 304L stainless steel for the external shell. Secondary heat exchangers constructed of finned copper or cupronickel tubes shall not be acceptable.
  - l. Safety Relief Valve — ASME rated, factory set to protect water heater and piping as per schedule/drawings.
  - m. Gauge — Combination water pressure and temperature shipped factory installed. LCD inlet/outlet temperature gauges to be an integral part of the front water heater control panel to allow for consistent easy monitoring of temperatures factory mounted and wired.
  - n. Flow Switch — Prevent burner operation when water falls below a safe level or when water flow is low. Flow switch shall be factory mounted and wired. Provision for installation of a low water cut off shall be provided.
  - o. The boiler control package shall be a MTI Heat-Net or equivalent, integrated boiler management system. The control system must be integral to each boiler, creating a control network that eliminates the need for a "wall mount" stand-alone boiler system control. Additional stand-alone control panels, independent of a Building Management System (BMS), shall not be allowed to operate the boiler network.
  - p. The Heat-Net control shall be capable of operating in the following ways:

- i. As a stand-alone boiler control system using the Heat-Net protocol, with one “Master” and multiple “Member” units.
  - ii. As a boiler network, enabled by a Building Management System (BMS), using the Heat-Net protocol, with one “Master” and multiple “Member” units.
  - iii. As “Member” boilers to a Building Management System (BMS) with multiple input control methods.
- q. Operating Controls — Water heater shall be provided with a Honeywell RM7800 series digital flame safe guard. The flame safeguard shall be capable of pre-purge cycles.
- r. Operating Temperature Control — Shall be a digital P.I.D. controller adjustable from 40°F to 240°F, 4°C to 116°C. Control shall have the capability to provide outdoor air reset function. Control shall be factory mounted and sense the inlet and outlet temperature of the water heater through a resistance sensor.
- s. High Limit — Temperature control with manual reset limits boiler water temperature in series with the operating control. High limit shall be factory mounted and sense the outlet temperature of the boiler through a dry well.
- t. The Venting mode shall be one of the following:
  - i. Standard Venting
  - ii. Horizontal & Vertical Outside Air Venting
  - iii. Thru-Wall Venting
  - iv. Outdoor Venting
- u. The gas train shall include a main ball valve (600 - 2100 only), pilot valve, pilot gas pressure regulator, main gas valve, safety valve (600 - 2100 only), and firing valve. Gas train shall be CSD-1 approved.