

**Part 1          General**

**1.1            RELATED SECTIONS**

- .1      Section 13 34 13 – Greenhouse Structure and Specialties
- .2      Section 13 35 13 – Greenhouse Computer Control System
- .3      Section 15400 – Plumbing
- .4      Section 15010 – Mechanical General Conditions
- .5      Section 15100 – Thermal Insulation for Piping
- .6      Section 15600 – Heating
- .7      Division 26

**1.2            SUBMITTALS**

- .1      Submit required submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2      Product data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each product and system used. Submit manufacturer's certifications stating that products and systems comply with requirements. List and describe features of control systems, performances and operating characteristics.
- .3      Manuals: Provide operation and maintenance manuals, in accordance with Section 01 78 00 – Closeout Submittals. Emergency instructions, safety considerations, parts listings, exploded views, parts sources. Include list of all operating components and details.

**1.3            SHOP DRAWINGS**

- .1      Shop drawings: Submit coordinated shop drawings for fabrication and installation of the greenhouse mechanical work, including; plans, elevations, sections, detail sections of custom work, hardware, mounting heights, anchorage and support details, placement of all components supplied under this section. Show and provide details of support members or other support provision for evaporative coolers, heating systems, domestic water lines, as well as all other mechanical equipment furnished by this section.
- .2      No mock-ups are required, but installation must match with existing greenhouses, except as noted in these drawings and specifications.
- .3      Follow procedures and requirements as per Section 01 33 00 – Submittal procedures.

**1.4            REFERENCES**

- .1      NBC 2010
- .2      CAN/CSA-B64 Series-01 - Backflow preventers and Vacuum Breakers
- .3      CAN/CSA B-64.2.1-01 - Vacuum Breakers, Hose Connection Type (HCVB) with Manual Draining Feature
- .4      ASTM F 441 09 Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedule 80

- .5 ASTM C 534/C534M-08 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .6 ASTM E 84 -10b Standard Test Method for Surface Burning Characteristics of Building Materials.

## 1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect materials during delivery, storage and handling to comply with manufacturers' directions and as required to prevent damage and deterioration, in accordance with Section 01 61 00 – Common Product Requirements. Store materials and equipment indoors, away from rain, snow and condensing conditions.

## Part 2 Products

### 2.1 MATERIALS AND COMPONENTS

#### .1 Hydronic Hot Water Heating Systems

##### .1 Generalities

- .1 Each of the greenhouse compartments is to be heated with a hot water system, consisting of perimeter radiation and overhead radiation, as shown on the drawings. The heating loops are to be independently controlled, by way of 4 way mixing valves and circulating pumps, located in the central corridor. Two mixing valves and two pumps, with associated pipework, valves and equipment are to be installed for each greenhouse compartment.
- .2 The greenhouse corridor is to be heated with a hot water system, consisting of overhead radiation, as shown on the drawings. The corridor heat will be controlled by a common single 4 way mixing valve and a single circulating pump.
- .3 The basement will have unit heaters with associated 2 way control valves.
- .4 Mains are to be connected to the existing greenhouse heating system where indicated on the drawings.

##### .2 Pipes:

- .1 Mains: Schedule 40 steel pipe, painted with red oxide primer.
- .2 Greenhouse supply and returns, loops: Schedule 40 steel pipe, painted with red oxide primer.
- .3 Perimeter and overhead fin pipe: copper aluminum finned tube, 32mm copper tubing with aluminum fins 102mm x102mm x 0.64mm aluminum fins at 6.35mm spacing centre to centre.
- .4 Supply complete with all aluminum hanger brackets.

##### .3 Heating Cabinets: perimeter fin pipe to be installed in perimeter heating cabinets. Cabinets to be made of flattened expanded aluminum sheet, pre formed to the profile shown on drawings. Supply complete with all aluminum hanger support and brackets.

##### .4 Hanging pipes: Overhead fin pipe to be suspended from the perimeter supports, approximately 600mm below the gutter and 200mm to one side. Suspension shall be by stainless steel threaded rod and hangers by the manufacturer of the fin pipe. Care must be taken to avoid damaging the fin material. Care must be taken to avoid damage to the shade cloth during installation and during operation.

- .5 Pipe supports: Support fin pipes at maximum 1500mm o/c.
- .6 Pipe insulation: overhead in greenhouses: bare, risers and horizontal runs within 2200 mm AFF in the greenhouses, insulated with aluminum jacket. Pipe insulation: Mains: 25mm fiberglass with aluminum jacket.
- .7 Hot water unit heaters: Horizontal delivery, hot water unit heater.
  - .1 Unit must be CSA/UL approved, suitable for damp location.
  - .2 Fan assisted with copper/aluminum finned heat exchanger.
  - .3 Baked enamel painted steel casing.
  - .4 Make and model to match existing.
  - .5 Fan to be in aluminum and balanced, equipped with a galvanized steel fan guard, and horizontal air deflectors.
  - .6 Motor designed for continuous duty and can operate in a maximum ambient temperature of 40°C.
  - .7 Motor to be 115 V, single phase, 60 Hz TEFC with thermal overload protection.
  - .8 Mounting Bracket: Provide appropriate mounting bracket and structural support within the corridor C2. All support hardware to be stainless steel.
- .8 Vent all high points in the system using automatic air vents.
- .9 Provide sediment valves at all low points in the system and isolation shut-off valves for all circuits.
- .10 Provide and install balancing valves for each heating circuit.
- .11 Isolation: Isolate all copper pipes from dissimilar metals (dielectric joints).
- .12 Pump and Valve Schedule:

Pump and Valve Schedule						
Zone	Valve Size mm	Pump Flow l/s	Pump Head m Aqua	Pump Power W	Pump Voltage VAC	Actuator Voltage VAC
Large Compartment	25	0.63	1.82	62	115	24
Medium Compartment	20	0.38	1.52	30	115	24
Upper Corridor	30	0.9	3.05	62	115	24
Unit Heater	13	n/a	n/a	n/a	n/a	24

- .2 Domestic Hot and Cold Water
  - .1 Provide domestic hot and cold water distribution, where shown on drawings.
  - .2 Make cold water connections to evaporative coolers where indicated.
  - .3 All hose bibs to be provided with vacuum breakers, 19mm FHT inlet x 19mm MHT outlet, to CAN/CSA-B64 Series-01 and CAN/CSA B-64.2.1-01.
  - .4 Hot and cold water lines: Type L copper, per drawings.
  - .5 Insulation: overhead piping in greenhouse corridors, and all other areas except greenhouse compartments: 12mm fiberglass insulation with aluminum jacket.
  - .6 Isolation: Isolate all copper pipe from dissimilar metals.

- .7 Hangers: supply and install all necessary hangers. Hangers and components to be in stainless steel or hot dip galvanized steel.
- .3 Irrigation water piping and connections:
  - .1 Irrigation fertilized water PVC piping: Schedule 80 polyvinyl chloride pipe. Opaque piping only.
  - .2 Hangers: supply and install all necessary hangers. Hangers to be in stainless steel or hot dip galvanized steel.
- .4 Irrigation Solenoid Valves: 20mm, with 24VAC coils, manual shutoff, manual actuation, flow control.
- .5 Pipe penetrations:
  - .1 All pipe penetrations must be sealed and provided with escutcheon cover plates on both sides of walls.
- .6 Air inlets:
  - .1 Supply and install air inlets in south doghouse where shown on drawings.
  - .2 Inlets to be corrosion resistant aluminum construction.
  - .3 Weather louvers: minimum 50% free area, installed with thumb screws for easy removal.
  - .4 Pre screens: 16x18mesh insect screen in frames, installed with quick release tabs.
  - .5 Thrip screen modules: pleated thrip screen in aluminum frames, installed with quick release tabs. Minimum 6:1 area ratio of screen cloth to face area. Screen to be 40um x 45um woven cloth.
  - .6 Motorized dampers, insulated, opposing blade, low leakage, with silicone seals on entire perimeter of each blade, 100mm blades, insulated frame.
  - .7 Damper actuators: 24VAC floating point direct mounted to damper jack shafts.
  - .8 Air inlet frames: aluminum construction of channel with flange to face of doghouse cladding.

### **Part 3 Execution**

#### **3.1 PREPARATION**

- .1 Examine areas and conditions where greenhouse mechanical work is to be installed. Notify general contractor in writing of conditions detrimental to proper and timely installation of work.
- .2 Coordinate and furnish hangers, supports, support brackets and pipe and duct penetrations.
- .3 Dissimilar metals: where aluminum surfaces come in contact with ferrous metals, concrete or other incompatible materials, keep aluminum surfaces from direct contact using appropriate barriers. Isolate all copper piping.

#### **3.2 ERECTION**

- .1 Install pipework, ducts and mechanical components in accordance with manufacturers' written instructions and final approved shop drawings and erection drawings.
- .2 Follow building lines and install pipe level and plumb. Provide temporary bracing and supports as required to ensure stability during installation.

- .3 Install closures, trim, caps, escutcheons and similar miscellaneous aluminum items and accessories as required for complete, weathertight and airtight installation. All work to be done keeping in mind that the finished product will be fully exposed to view.
- .4 Provide interference drawings for coordination, review and approval. These tasks must be performed and accepted prior to proceeding with the general work. This is to ensure that pipe runs, crossings, mixing groups, corridor cooler units, corridor heating pipes, corridor wall penetrations and coordination with electrical conduit runs is performed. It is critical that a 1000mm wide right of way is maintained in the center of the corridor, for lift access to the roof of the corridor. It is also critical that the exposed work is neat, properly insulated, accessible for service and properly supported.

### 3.3 INSTALLATION OF EQUIPMENT

- .1 **General**
  - .1 Install equipment in accordance with manufacturers' installation instructions and recognized industry practices to insure intended function.
  - .2 Piping:
    - .1 Make provision for thermal expansion.
    - .2 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
  - .3 Mixing valves:
    - .1 Install control valves per manufacturer's recommendations.
    - .2 Allow free access for maintenance.
    - .3 Install actuator (motor) and linkage per manufacturer's recommendations.
  - .4 Hot water unit heater:
    - .1 Install per manufacturer's recommendations. Adjust horizontal deflector for adequate air delivery.
  - .5 Automatic air vent:
    - .1 Install per manufacturer's recommendations. Install Air vents at highest points of water circuits.
  - .6 Balancing valves:
    - .1 Install per manufacturer's recommendation.
    - .2 Water flow must be correctly adjusted as per appropriate water flow.
  - .7 Coordination is required for the installation of equipment and systems specified in other divisions or sections, particularly supply and return mains, electrical work and control system work.

### 3.4 ADJUSTING AND CLEANING

- .1 **General:** after mechanical work is complete, clean all surfaces removing dirt, grease and other substances from exposed surfaces.
- .2 All surfaces, equipment enclosures, shall be handed over in a clean condition, with all foreign materials, labels, stickers, contaminants marks or scuffs removed.
- .3 Factory and shipping labels shall be removed from all surfaces.
- .4 Repair all marred or scratched surfaces of factory finished equipment, using finish materials furnished by the manufacturer.
- .5 Cleaning to be performed as per requirements indicated in Sections 01 74 11 and 23 08 02.

**3.5 COORDINATION, COMMISSIONING, STARTUP AND INSTRUCTION**

- .1 Provide commissioning services upon startup in accordance with Section 01 91 00 – Commissioning (Cx), Commissioning Specifications (Cx) and Commissioning (Cx) Plan. This includes proving all equipment and all greenhouse systems. A detailed checklist shall be submitted with the Operation and maintenance manual.
- .2 Provide complete balancing report of all hydronic systems, as per prescriptions in Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- .3 A detailed checklist shall be submitted with the operation and maintenance manual.
- .4 Provide user instruction and instruction for maintenance personnel in all greenhouse mechanical components, equipment and systems and their integrated operation.

**END OF SECTION**