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SECTION 23 70 00

CENTRAL HVAC EQUIPMENT

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. All criteria establish within Specification 23 00 00 shall apply to this section unless specifically noted otherwise.
- C. Examine all Drawings and all Sections of the Specifications for requirements and provisions affecting the Work of this Section.

1.1 SCOPE

- A. Furnish and install, where indicated, a factory-assembled, fully-enclosed, packaged environmental control system with energy recovery feature(s) designed for natatorium environment control
- B. Features shall include:
 - 1. Space heating by means of a packaged indirect-fired natural gas duct furnace module
 - 2. Cooling mode with heat rejection to a packaged outdoor air cooled fluid cooler (dry-cooler)
 - 3. Pool water heating from reclaimed compressor waste heat
 - 4. Packaged minimum exhaust fan and purge fan with economizer mode
 - 5. Unit mounted minimum Exhaust Fan with airflow measuring stations and Purge/Economizer Fan
 - 6. Integral minimum outdoor air connection
 - 7. Integral purge outdoor air connection with economizer mode

1.2 SUMMARY

- A. All requirements of Section 23 00 00 apply to this section.
- B. Section includes the following:
 - 1. Packaged, Air Cooled, Dx Rooftop Units

1.3 ACTION SUBMITTALS

- A. Provide original file copies only, scanned file copies are not acceptable. All submittals shall be submitted in hardcopy and editable and searchable electronic format.

- B. Product Data: Include manufacturer's technical literature for each item. Indicate dimensions, required tube removal and servicing spaces, weights, capacities, pressure drops, operating temperatures, performance characteristics, electrical characteristics, materials of construction, finishes for materials, and installation and startup instructions for each type of product indicated, including power and control wiring and interlocks.

- C. Specifications, Schedule, and Control Sequence Compliance Statement
 - 1. The manufacturer shall submit a point by point statement of compliance with each specification criteria listed in each paragraph for those submittals listed in Paragraph D: Product Data that are noted with an asterisk (*).
 - 2. The statement of compliance shall consist of a list of all paragraphs (line by line) identified in Part 2 and applicable Part 3 of the specification and that the unit controls will provide all manufacturer's portions of the control sequences shown on the drawings for which the submitted product in the opinion of the manufacturer complies, deviates, or does not meet.
 - 3. Where the proposed submittal complies fully, the word "comply" shall be placed opposite the paragraph number.
 - 4. Where the proposed submittal does not comply, or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
 - 5. Verify each field of the associated schedule where associated technical data is presented and sequences are shown on the drawings. Where the submitted material does not "comply" provide the value the submitted equipment will achieve based upon the specified conditions.
 - 6. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question and the product will be rejected.
 - 7. Compliance with sound levels as required by the Maximum Space Sound Power Level Report.
 - 8. Submissions which do not include a point by point statement of compliance as specified shall be disapproved.

- D. Shop Drawings: Provide the following shop drawings:
 - 1. Packaged, Air Cooled, Dx Rooftop Unit (*)

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Manual Data: For all equipment listed in Part 2.
- B. All product warranties which shall cover materials and labor for a minimum of 1 year (or longer as specified herein for some products) from the date of acceptance.
- C. Startup service reports.
- D. All testing reports.
- E. All documentation required for project completion, including contractor's project completion certificate in accordance with MA code 780CMR 107.6.3 indicating that the installation is in accordance with the approved construction documents and all applicable local, state and federal statutes and regulations. All pertinent deviations shall be specifically noted in the certificate.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be protected during delivery, storage on site, and use from water or other damaging conditions. Any damaged materials shall be replaced with new.

1.7 COORDINATION

- A. Coordinate sizes and locations of equipment base supports and hangers as required.
- B. Coordinate clearance requirements with piping and sheet metal contractors for equipment piping (including sizes of all piping vestibules) and duct space requirements.

1.8 SCHEDULING

- A. Schedule the placement of any equipment supports locations and sizes with the General Contractor or Construction Manager.

PART 2 - PRODUCTS

2.0 PACKAGED, AIR COOLED, DX ROOFTOP UNITS (POOL DEHUMIDIFIER UNIT)

- A. General Requirements
 - 1. Provide where shown on drawings, a completely factory assembled, piped, wired and tested, rooftop heating and cooling unit. Unit shall have a full charge of refrigerant, and compressor oil. The rooftop unit shall be shipped in one piece and shall have a single point power connection.
 - 2. Acceptable Manufacturers shall be Pool Pak, Seresco or Dectron.
 - a. Provided that they meet the requirements of this specification and the performance requirements listed in the equipment schedules. Note particularly the following items.
 - b. The submitted rooftop unit must produce the CFM listed in the schedule, at the static pressure, external to the unit, listed in the schedule. This performance must be accomplished using equal or less fan horsepower than the scheduled unit and at an evaporator coil face velocity equal or less than the scheduled unit.
 - c. The discharge air temperatures listed in the schedule are at the discharge of the unit into the supply ductwork, NOT the discharge temperatures at the evaporator coil. These temperatures must be produced by the submitted unit. Draw through rooftop

manufacturers must fully account for fan heat gain in determining their discharge temperatures.

- d. The scheduled sensible and total loads, listed in the schedules, are based on actual calculation, not manufacturer's catalog data. Both loads must be met at the outdoor air and return air temperature, to the unit, listed in the schedules.
- e. The rooftop unit shown on the drawings has been coordinated with architectural and structural elements, and with electrical service requirements. If a different unit is submitted, ALL mechanical, electrical, architectural and structural modifications which are required shall be performed, by the mechanical contractor, under the work of the mechanical section, under the original contract price.

B. Submittal Requirements

1. This paragraph supplements the "Submittals" paragraph, in Part One of these specifications. In addition to complying with all submittal requirements contained in Part One, the rooftop unit submittal shall contain ALL performance and other items listed in the schedule, as well as:
 - a. The air temperatures, entering and leaving the evaporator coil.
 - b. The temperature gain in degrees, due to the return (or exhaust) and supply fan.
 - c. The component pressure drops of all items internal to the unit i.e. coils, filters, dampers, furnaces etc.

C. Quality and Safety Assurance

1. The system shall be ETL listed
2. The system shall be completely assembled, wired, piped, and test-run at the factory prior to shipping. All controls shall be factory adjusted to satisfy the design conditions. A factory test report shall be available, upon request
3. Wherever possible, the system shall have a mechanical vestibule where the electrical panel, compressor(s), pool water heat exchanger(s), receiver(s) and most of the refrigeration controls are out of the process air stream
4. The system shall have a microprocessor controller with unit-mounted refrigerant pressure transducers on each refrigeration circuit, multiple temperature sensors and an Ethernet connection for factory logging and parameter adjustment via the Internet. The refrigerant pressure transducers shall be actively used for system control. The customer (or their authorised representative) shall be provided access to the online logging and parameter adjustment interface, upon request. Demonstration of these capabilities must be carried out at the engineer's office prior to bid day
5. The system shall have remote factory start-up assistance capability, when connected to a network with Internet access
6. The system shall have 24-7 remote computer logging capability with automated alarm notifications and system performance alerts transmitted via e-mail to authorised users, when connected to a network with Internet access

7. Warranty: The entire system shall have a 24-month limited parts warranty from the factory ship date
 - a. A 1-year labour warranty shall be provided by the manufacturer when the system is connected to the factory via an Internet monitoring system from the date of initial commissioning
 8. When connected to a network with Internet access, the system shall have remote service capability with the ability for field service technicians to receive service and trouble alerts by e-mail and make parameter adjustments via a browser interface on any Internet-capable device
 9. The unit shall have real-time airflow control using flow sensors, variable speed fans, and dampers. Proper airflow is maintained continuously, even as filters load, etc.
- D. Equipment Requirements
1. Cabinet
 - a. The cabinet shall be designed and configured for outdoor installation with a 2" double walled cabinet including painted inner liner
 - 1) Infill panels and doors shall be constructed with 18 gauge G90 galvanized steel exterior and 18 gauge mil aluminum finish interior suitable for chlorine and pool chemical resistance.
 - 2) The structural base frame shall be 3/16" steel channel base with 12-gauge steel cross bracing.
 - b. Cabinet Construction: All cabinet 16, 20 and 24 gauge sheet metal shall be galvanized G90 steel or Galvalume™ alloy with mill-applied zinc phosphate primer followed by an exterior grade white silicone modified polyester top coat. The sheet metal is engineered to form a cabinet with maximum strength and rigidity. All seams shall be caulked with silicone to prevent air and water leakage or infiltration
 - 1) Base Rails: The cabinet shall have a base frame comprised of 2 layers of 10 gauge mill galvanized G90 steel. Lifting lugs shall be provided on the base frame for rigging the system
 - 2) The cabinet walls shall be of double-wall construction using 20 gauge pre-painted steel with a fully painted inner metal liner and 2 inches of fiberglass insulation
 - 3) The cabinet floor shall be comprised of a 16-gauge galvanized steel panel with a 20-gauge pre-painted steel inner liner, 2-inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base frame of the unit
 - 4) The cabinet roof shall be 20-gauge pre-painted steel, 2-inch double wall engineered with structural bending for maximum rigidity and be mechanically fastened to the base walls of the unit
 - 5) The cabinets shall be mechanically assembled with stainless steel 5/32" sealed blind rivets. Where bolts are required bright zinc plated bolts shall be used
 - 6) Access doors shall be supported on multiple hinges, held shut by compression latches for quick access. Doors shall

be provided for entrance to all sections housing components requiring routine maintenance. Full height access doors shall have "hold back" latches to prevent door closure during the performance of service procedures

- 7) Access doors shall be mounted on multiple combination hinge/latch mechanisms which swing either direction 180 degrees and lifts off. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Doors shall be secured with minimum two tool-operated latches and sealed against the frame with rubber gasket material.
 - 8) The unit shall have non-corroding protective mesh screens on all air intake openings
 - 9) The system shall have non-corroding protective mesh screens covering internal fan blades, protective grates covering all floor access ports
- c. Outdoor Air Intake:
- 1) Purge /Economizer and Minimum Outdoor Air connections with motorized dampers and controls.
 - 2) Minimum outdoor air intake with airflow sensing elements.
- d. Insulation: The unit shall be insulated per the following standards:
- 1) All exterior cabinet sections shall be insulated with two (2) inch thick fiberglass inside the double walled cabinet
 - 2) Fire resistant rating to conform to NFPA Standard 90A and 90B
 - 3) Sound attenuation coefficient shall not be less than 1.02 at a frequency of 1,000 Hz as per ASTM Standard C423
 - 4) Thermal conductivity shall not exceed 0.26 Btu/in-h-sqft-F at 75 °F
- e. Cabinet configuration shall include:
- 1) A filter rack with separate access doors shall be provided for the return air and minimum outdoor air streams
 - 2) Unit shall be equipped with a second outdoor air intake assembly with motorized 2 position extruded aluminum, Insulated, silicone side-sealed damper for Purge and Economizer operation
 - 3) Mechanical vestibule: The unit shall have the compressor, receiver, solenoid valves and the electrical panel in a separate compartment out of the processed air stream. All components shall be serviceable while the unit is in operation without disturbing the airflow
 - 4) Electrical panel: The unit shall have a built-in electrical control panel in a separate compartment in order not to disturb the airflow within the dehumidifier during electrical servicing. All electrical components shall be mounted on a 16 gauge galvanized sub-panel
 - a) Supply Air: 2-inch MERV 8, 30% pleated filters with rust-free non-metallic structure on face loading rack.
 - b) Exhaust Air: 2-inch MERV 8, 30% pleated filters with rust-free non-metallic structure.

2. Filters
 - a. Wherever possible, air filters shall be standard sized, replaceable, off-the-shelf filters including:
 - b. Outside Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure
 - 1) Outside Air: Washable, aluminum media type with aluminum U-channel frame wrapped around the perimeter of crimped layers of aluminum media. The frame is designed with drain holes to ensure removal of excess water.
3. Coils
 - a. Evaporator/dehumidifier coils shall be designed for maximum moisture removal capacity
 - 1) Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
 - 2) Coil shall have galvanized casing and end plates
 - 3) Aluminum fin and copper tubes mechanically bonded to assure high heat transfer.
 - b. Air reheat coils shall be sized for variable heat transfer into the air with a capacity of 100% of the compressors total required heat of rejection
 - 1) Coils shall be fully dipped and coated with a polyester/enamel coating for maximum corrosion protection. Coating shall comply with ASTM B117/D1654 and ASTM D2126 for corrosion resistance against common acids, salt and gases
 - 2) Coil shall have galvanized casing and end plates
 - 3) Aluminum fin and copper tube joints mechanically bonded to assure high heat transfer
4. Drain Pans
 - a. Each evaporator coil shall be provided with a positive draining, compound-sloped, baked powder paint coated aluminum drain pan with fully-welded corners to ensure zero water retention
5. Blowers and Blower Motors
 - a. Supply blowers:
 - 1) The complete blower assembly shall be statically and dynamically balanced on precision electronic balancers
 - 2) The blower assembly shall be mounted on a 1" deflection spring isolated rack
 - 3) The fan inlets shall be equipped with accidental contact protection screen
 - 4) Motor(s) shall be Premium efficiency painted cast iron construction TEFC, NEMA MG1-PART 31 Inverter Duty 15:1 Constant Torque Severe Duty with a service factor 1.25. Motors shall be 6 Pole 1200 RPM synchronous speed with HOA switch with motor safeties against overloading at 60 Hz operation directly on mains. Motors

shall have double lip seals on both ends with re-greasable bearings 254T frame and larger with Polyurea grease.

b. Exhaust blowers:

- 1) The packaged exhaust blower (EF1) shall be sized to maintain the negative pressure requirement in the space during normal operation and its operation tied to the system's occupancy scheduler
- 2) The blower shall be impeller plenum fan complete with backward curved, three-dimensional, profiled blades made of high performance composite material. The blower shall be completely corrosion resistant and be maintenance free a direct drive via a direct current (DC) electronic commuted (EC) motor. The EC-Motor shall have zero slippage design and have continuously variable speed control when connected to the unit's controller
- 3) The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels
- 4) The fan assembly shall be suitable for ambient temperatures of -40°C to max. +70°C
- 5) Thermal contacts installed in the windings compliant with THCL 155
- 6) Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection
- 7) High corrosion resistance design with high quality and reliability
- 8) The exhaust fan shall be controlled from an end switch on the power open of the exhaust air damper. The exhaust dampers shall be protected by louvers to divert rain from the face of the dampers
- 9) The exhaust fan assembly shall include airflow measuring stations

c. Purge blowers:

- 1) The ventilation/economizer/purge exhaust blower (PEA) shall be unit mounted and sized to provide full exhaust from the space when operating with EF1
- 2) The fan shall be direct driven axial fan made of high-strength composite material in which the motor and controller are integrated. It includes FE2owlet blades combined with guide vanes and EC commutated direct-current external rotor motors provides maximum efficiency the quietest performance. The EC motor shall have maintenance-free electronic circuitry, a rotor with permanent magnets, and an integral controller to provide the windings with electrical current so that, the motor rotates continuously and quietly. The fan is aerodynamically-optimised, sickle-blade profile, patterned with serrated trailing edge and winglets on the blade outer edge for energy and noise-optimised operation
- 3) The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels

- 4) The fan assembly shall be suitable for ambient temperatures of -40°C to max. $+70^{\circ}\text{C}$
- 5) Thermal contacts installed in the windings compliant with THCL 155
- 6) Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection
- 7) High corrosion resistance design with high quality and reliability
- 8) The exhaust fan shall be controlled from an end switch on the power open and spring return outside air damper. The gravity exhaust dampers shall be protected by louvers to divert rain from the face of the dampers

6. Dampers

- a. Internal dampers shall be made from extruded anodized aluminium with a parallel blade configuration and neoprene double-seal tips to minimize leakage. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant
 - 1) The system shall be provided with normally closed outside air and exhaust air dampers equipped with spring-return actuators. The dampers adjust between 0% to 100% open position.
 - 2) The outdoor air and exhaust air dampers shall be of opposed blade configuration. Dampers shall have 0.750-inch insulated blades made from extruded anodized aluminium with neoprene double-seal tips to minimize leakage. Damper leakage shall be less than 1% of maximum flow at 4-inch water column differential. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant

7. Minimum Outside Airflow Measuring Elements

- a. The outside air shall be monitored via factory installed air monitoring stations.
- b. Stations shall not require periodic calibration or maintenance.
- c. Airflow monitor measurement accuracy shall be plus or minus, 2% of reading.
- d. Monitors shall be constructed of anodized rods and mounting blocks shall be 304 stainless steel.
- e. Shall be permanently mounted within the unit.

8. Pool Water Heater

- a. Coaxial heat exchanger with corrosion-resistant cupro-nickel water circuit tubing
 - 1) Coaxial heat exchanger with corrosion-resistant cupro-nickel water circuit tubing
 - 2) Self-purging and self-draining counter flow design
 - 3) Water circuit piping shall consist of transparent braided PVC hose
 - 4) Terminating connections are PVC schedule 40 NPT fittings located at the cabinet wall for easy connection
 - 5) The maximum loop operating pressure is 60 psig

9. Compressors
 - a. Hermetic, scroll action compressor, suction gas cooled, suitable for refrigerant R-410A
 - b. The compressor(s) shall be mounted on rubber-in-shear isolators to limit the transmission of noise and vibration
 - c. The compressor(s) shall be equipped with removable crankcase heater(s) for liquid migration protection
 - d. The compressor(s) shall be located outside the conditioned air stream in the system's service vestibule
 - e. The compressor manufacturer must have a wholesale outlet for replacement parts in the nearest major city
10. Refrigeration Circuit
 - a. The system shall consist of two factory sealed refrigeration circuits for dehumidification and sensible cooling. No site refrigeration work shall be required
 - b. Each refrigeration circuit shall have pressure transducers monitoring the refrigerant discharge (high) and suction (low) pressures. The refrigeration circuit shall be accessible for diagnostics, adjustment and servicing without the need for service manifold gauges
 - c. All refrigeration circuits shall have solenoid control valves, check valves, a liquid line filter-drier, liquid and moisture indicator, thermostatic expansion valve and a pump down solenoid valve
 - d. The system shall have an externally adjustable balanced port design mechanical thermostatic expansion valve. The valve shall have a removable power head
 - e. Tamper proof, hermetically sealed non-adjustable high and low pressure switches and refrigeration service valves shall be installed using Schrader type valves. Refrigeration service valves shall be located outside of the airstream
 - f. The receiver shall have two refrigerant level (maximum and minimum) indicating sight glasses
 - g. The suction line shall be fully insulated with 0.500-inch closed cell insulation
11. Control Panel
 - a. The electrical contractor shall be responsible for external power wiring and disconnect switch fusing. Power block terminals shall be provided
 - b. The system shall include a factory-installed non-fused disconnect
 - c. Shall be mounted inside the service vestibule outside of the process air stream
 - d. Blower motors shall be protected with thermal trip overloads
 - e. The system shall have a voltage monitor with phase protection
 - f. Available dry contacts shall include:
 - 1) Alarm
 - 2) Blower interlock
 - 3) Stage 1 & 2 heating
 - 4) Outdoor air damper control
 - 5) Remote exhaust fan #1
 - 6) Remote exhaust fan #2
 - 7) Outdoor-air cooled equipment
 - 8) System on
 - 9) Auxiliary pool heater 1

- 10) Heat recovery
 - g. Terminals shall be provided to send 24-volt power to the outdoor air cooled condenser or fluid cooler fan contactor
 - h. All wiring shall be installed in accordance with UL or CSA safety electrical code regulations and shall be in accordance with the NFPA All components used in the system shall be UL or CSA listed
 - i. Wiring diagrams shall be located near the electrical panel(s) on the system. These diagrams shall provide colour-coding and wire numbering for easy troubleshooting. All wires shall be contained in a wire duct.
 - j. The compressor(s) shall have a time delay on start to prevent short cycling
 - k. Pressure transducers for measuring refrigerant discharge (high) pressure and suction (low) pressure shall be provided.
 - l. An airflow switch and a dry contact for alarm(s) shall be provided
 - m. Controls supporting airflow measurement shall be provided.
12. Microprocessor Control
 - a. A microprocessor controller with the following characteristics will be provided:
 - 1) All set points and parameter adjustments are pre-programmed at the factory during quality control testing
 - 2) The microprocessor program shall be stored on updatable FLASH memory
 - 3) A minimum of 11 analogue inputs, 4 analogue outputs, 24 digital inputs and 16 digital outputs
 - 4) Four serial interface ports including both RS232 and RS485 types
 - 5) An Ethernet port with RJ-45 connector and LED activity indicator
 - 6) A real time clock to time-stamp the system operation log and to enable a programmable 7-day occupation schedule
 - 7) Two manual demand forced modes to allow the user to manually bypass the microprocessor in the event of controller failure
 - 8) The local and remote operator panel(s) shall have a backlit graphic liquid crystal display with touch controls
 - b. The system shall have pressure transducers monitoring the refrigerant discharge (high) and suction (low) pressures. The refrigeration circuit shall be accessible for diagnostics, adjustment and servicing without the need of service manifold gauges.
 - c. The following status LEDs shall be on the controller:
 - 1) Alarm - indicates there has been a failure requiring service.
 - 2) Dehumidification - indicates that the system is dehumidifying the space.
 - 3) Cooling - indicates that the air-conditioning mode.
 - 4) Pool Heating - indicates that the system is heating the pool water with recycled energy.
 - 5) Space Heat - indicates that the space heating is operating.

- 6) Maintenance - indicates whether or not maintenance is required.
 - 7) Manual - indicates that the system has been set to manual operation.
- d. The following set points shall be accessible and adjustable from the operator panel:
- 1) Space temperature
 - 2) Space relative humidity
 - 3) Pool water temperature
 - 4) Supply Airflow
 - 5) Min Outside Air %
 - 6) Space Pressure %
- e. The following sensors shall be unit-mounted and monitored at the operator panel. All information from these items shall be actively used in the system control and operation strategies:
- 1) Refrigerant high pressure
 - 2) Refrigerant low pressure
 - 3) Return air temperature
 - 4) Supply air temperature
 - 5) Return air relative humidity
 - 6) Entering pool water temperature
 - 7) Leaving pool water temperature
 - 8) Evaporator leaving air temperature
 - 9) Suction temperature
 - 10) Discharge temperature
 - 11) Supply Airflow
 - 12) Min Outside Airflow
 - 13) Min Exhaust Airflow
- f. System Fault: Shall indicate via text message to the display what systems require attention or servicing. Built-in monitoring and diagnostics shall allow the user to view the following:
- 1) Power failure
 - 2) Dirty air filter
 - 3) Refrigerant high and low pressure
 - 4) System off
 - 5) Anti-short cycle delay

13. Air Heating

- a. The packaged indirect-fired natural gas duct furnace module shall be sized to meet the scheduled heating capacity and have the following characteristics:
- 1) Modulating (0-10V) auxiliary air heat control
 - 2) The duct furnace module shall be a natural gas indirect-fired type using spark ignition with a heating capacity as shown in this submittal and is installed in a 'blow through' configuration downstream from the blower. The heat exchanger tubes are constructed of formed and welded 16-gauge series 409 stainless steel suitable for installation downstream of the cooling coil and satisfactory for air inlet temperatures below 40 °F. The burner is the power firing type and incorporates a primary combustion air blower and spark ignition transformer

- 3) The duct furnace module shall be a propane gas indirect-fired type using spark ignition with a heating capacity as shown in this submittal and is installed in a 'blow through' configuration downstream from the blower. The heat exchanger tubes are constructed of formed and welded 16-gauge series 409 stainless steel suitable for installation downstream of the cooling coil and satisfactory for air inlet temperatures below 40 °F. The burner is the power firing type and incorporates a primary combustion air blower and spark ignition transformer
- 4) Standard controls shall include a modulating gas valve, intermittent spark ignition, overheat control, rollout flame supervision, combustion air flow proving switch, positive burner safety switch, pilot cock, main gas cock with 100% shut off, adjustable main and pilot pressure regulators
- 5) The natural gas duct furnace module shall be an ETL recognized component. The gas train shall be complete with all controls factory mounted to comply with requirements of ETL. The gas train is complete with a modulating main gas valve and is ready for connection to a natural gas supply with pressure between 7 in and 14 in WC
- 6) The liquid propane duct furnace module shall be an ETL recognized component. The gas train shall be complete with all controls factory mounted to comply with requirements of ETL. The gas train is complete with a modulating main gas valve and is ready for connection to a propane gas supply with pressure between 7 in and 14 in WC
- 7) The complete system shall be test-fired and preliminary adjustments made prior to leaving the factory

14. Air Conditioning

a. Air-cooled air conditioning via a fluid cooler

- 1) The system shall be equipped with an air conditioning mode where excess compressor heat is rejected to a factory packaged integral outdoor air-cooled heat exchanger (aka Dry Cooler) via a single glycol fluid loop. No site refrigeration work shall be required. The packaged fluid cooled condenser and outdoor air-cooled heat exchanger shall both be capable of rejecting 100% of the compressor heat rejection with an air on temperature at summer design conditions
- 2) The system shall be provided with a dry contact rated for 24VAC/5A to operate the remote outdoor fluid cooler control
- 3) Each refrigeration circuit shall include refrigerant valves, a receiver with pressure relief valve set at 650 psig, a pressure control valve and a pressure differential valve, and two manual shutoff valves to isolate the outdoor fluid cooler
- 4) Coils shall be tested at 425 PSIG and mounted vertically for complete surface utilization. Coils shall be counter flow and have adequate capacity to dissipate the total heat rejection of the system at design conditions

- 5) The fan(s) shall be direct driven axial fan(s) with dual speed external rotor motor(s) and innovative bionic blades in die-cast aluminum moulds
 - a) The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels
 - b) The fan assembly shall be suitable for ambient temperatures of -40°C to max. +70°C
 - c) Thermal contacts installed in the windings compliant with THCL 155
 - d) Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection
 - e) High corrosion resistance design with high quality and reliability
15. Factory Performance Testing
 - a. The system shall be thoroughly tested under factory test conditions. A copy of the original test report shall be available to the engineer upon request
 - b. Microprocessor controls shall be factory adjusted and pre-set to the design conditions during testing

PART 3 - EXECUTION

3.0 GENERAL

- A. The natatorium control system shall include:
 1. Mechanical process dehumidification
 2. Outdoor cabinet configuration
 3. Packaged outdoor air-cooled fluid cooler (dry cooler) for AC heat rejection
 4. A packaged indirect-fired natural gas duct furnace module installed downstream of the blower, sized as specified by the design engineer to meet the skin losses and outdoor air heating loads
 5. Coaxial condensing heat exchanger(s) for pool water heating using reclaimed compressor waste heat
 6. Purge and economizer modes
 7. Minimum exhaust and purge exhaust fan(s) with economizer mode
 8. Heat recovery between the minimum exhaust air and outdoor air streams by means of a glycol run-around loop
 9. Programmable microprocessor controller with remote Internet logging and parameter adjustment
 10. Remote operator panel(s)
 11. A service vestibule where the compressor, refrigeration specialties, control valves and all electronics are outside of process air stream
 12. Outside air measuring elements

3.1 AIR HANDLING UNITS

- A. Examination
 1. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

2. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
 3. Examine roughing-in for hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
 4. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Factory Inspection and Testing (Custom Air Handling Units only)
1. The manufacturer shall notify the Owner of all tests and inspections at least four (4) weeks prior to conducting said test or inspection.
 - a. The Owner, the engineer, and the installing contractor shall be provided the ability to witness the test at their own costs.
 - b. The manufacturer shall provide inspection and test procedures for equipment to the Owner for review and approval at least two weeks prior to conducting said test or inspection.
 2. The general assembly of the equipment shall be supervised and inspected by the manufacturer's representative. The assembly shall conform to the specifications, attachments, and any documented and agreed upon changes.
 - a. All arrangements and dimensions shall be verified.
 - b. Component tagging will be verified.
 - c. Component model and serial number shall be verified, as applicable.
 - d. Assembly and compliance with procedures and arrangement shall be verified.
 3. Air volume and discharge static pressure test shall be performed at an AMCA accredited laboratory to verify volume output is within the range of 100 to 110 percent of the nominal airflow requirements when operating with one (1) inch water column suction pressure at the casing inlet, and with a casing discharge pressure equal to the sum of the inlet pressure drops, and the external pressure, as specified on the Attachment(s).
 4. Casing leakage test shall be performed at an AMCA accredited laboratory to verify the leakage rate does not exceed percentage rate of the unit's rated supply volume at one and the static pressure conditions as stated in Part 2. Conduct leakage tests using the standard sealing system employed by the unit manufacturer. Temporary sealing methods (such as caulking, etc.) in the factory are not acceptable to meet the test criteria.
 5. Test and rate air-handling unit in accordance with AMCA Standards.
 - a. Comply with AMCA Standards 210, 300, 301 and 500.
 - b. The maximum permissible equivalent A-rated sound level is 85 dBA, at a distance of five (5) feet.
 6. Perform a routine commercial test to demonstrate that the motors are free from mechanical and electrical defects. Routine tests shall be as listed in NEMA MG1 and shall be made in accordance with IEEE 112 and 114.
- C. Installation
1. The mechanical contractor is responsible for submitting a plan and coordination drawings prior to beginning work in the mechanical rooms. Manufacturer shall review plan and approve.

2. Manufacturer shall coordinate with controls contractor to ensure the controls contractor is able to integrate the manufacturer's controls into the Owner's control system.

D. Startup Service

1. Factory-authorized service representative to perform startup service.
 - a. Complete installation and startup checks according to manufacturer's written instructions.
 - b. Verify that shipping, blocking, and bracing are removed.
 - c. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.
 - d. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
 - e. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.
 - f. Vibration Testing: Each fan shall be energized after field assembly and successful completion of dynamic assembly balancing for a thorough vibration analysis. Three (3) vibration readings shall be taken for each bearing in the horizontal, vertical, and axial directions. These vibration signatures shall be recorded and consist of vibration amplitude verses frequency. The maximum allowable fan vibration shall be 0.10 in/sec peak velocity (filter-in). Fan bearing measurement points shall be marked/scribed on bearings for permanent record and future use by Owner.
 - g. Perform a routine commercial test to demonstrate that the motors are free from mechanical and electrical defects. Routine tests shall be as listed in NEMA MG1 and shall be made in accordance with IEEE 112 and 114.
 - h. Verify that outdoor- and return-air mixing dampers open and close, and maintain minimum outdoor-air setting.
 - i. Comb coil fins for parallel orientation.
 - j. Install new, clean filters.
 - k. Verify that manual and automatic volume control and any fire and/or smoke dampers in connected duct systems are in fully open position.

E. Adjusting

1. Adjust damper linkages for proper damper operation.

F. Commissioning

1. Provide all test report and field inspection reports to commissioning agent.
2. Allow for two (2) full days of commissioning per air handling unit. Manufacturer's representative shall be required while unit is being commissioned.

END OF SECTION 23 70 00