

## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall round and flat-oval ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Hangers and supports.
- B. Related Sections:
  - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

#### 1.4 SUBMITTALS

- A. Shop Drawings:
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Factory- and shop-fabricated ducts and fittings.
  - 3. Duct layout indicating sizes, configuration, and static-pressure classes.
  - 4. Elevation of top of ducts.
  - 5. Dimensions of main duct runs from building grid lines.
  - 6. Fittings.
  - 7. Reinforcement and spacing.
  - 8. Seam and joint construction.
  - 9. Penetrations through fire-rated and other partitions.
  - 10. Equipment installation based on equipment being used on Project.
  - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment, and vibration isolation.

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Lindab Inc.
    - b. McGill AirFlow LLC.
    - c. SEMCO Incorporated.
    - d. Sheet Metal Connectors, Inc.
    - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

### 2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  - 2. Tape Width: 3 inches (76 mm).
  - 3. Sealant: Modified styrene acrylic.
  - 4. Water resistant.
  - 5. Mold and mildew resistant.
  - 6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
  - 7. Service: Indoor and outdoor.
  - 8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
  - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  - 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.



- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### PART 3 - EXECUTION

#### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation

with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

### 3.2 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
  - 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
  - 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
  - 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
  - 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
  - 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
  - 8. Conditioned Space, Exhaust Ducts: Seal Class B.
  - 9. Conditioned Space, Return-Air Ducts: Seal Class C.

### 3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing;

install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

END OF SECTION

## SECTION 237413 - NATATORIUM DEHUMIDIFICATION AIR HANDLING UNITS

### PART 1 - GENERAL

#### 1.1 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. Note: The Rooftop Unit Schedule shown on the plans shall override this specification wherever conflicting or incomplete information occurs.

#### 1.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

- 1. Pool dehumidification units with packaged refrigeration.

#### 1.1 QUALITY ASSURANCE

- A. NFPA Compliance: Units and components shall be designed, fabricated and installed in compliance NFPA 90A.
- B. NEMA Compliance: All motors shall comply with applicable NEMA standards.
- C. AMCA Compliance: All plenum fans shall bear the AMCA seal for sound and air performance. FC DWDI fans shall bear the AMCA seal for air performance.
- D. ARI Compliance: Coil shall be rated in accordance with ARI standard 410 and bear the ARI seal.
- E. AHRI Compliance: Air to air energy recovery components shall comply with AHRI 1060.
- F. ETL Compliance: Complete unit shall be listed and labeled by ETL per standards ANSI/UL 1995 and CAN/CSA C22.2 #236-05.
- G. Unit shall be completely factory assembled, wired, piped, and test run prior to shipping. All controls shall be factory adjusted and preset to the design conditions. A factory test report shall be available upon request.
- H. Unit shall be capable of live remote monitoring of the unit during factory testing shall be available via the internet.
- I. The unit shall have a mechanical vestibule where the electrical panel, compressors, pool water heat exchangers, receivers and most of the refrigeration controls are out of the process air stream.
- J. Unit shall have a microprocessor controller with unit mounted refrigerant pressure transducers on each independent compressor circuit, multiple temperature sensors

and an Ethernet connection for factory monitoring, adjusting and control via the internet. The refrigerant pressure transducers shall be actively used for unit control. A weekly graph of the space conditions shall be provided to the customer. Demonstration of these capabilities must be carried out at the engineer's office prior to bid day.

- K. Internet Start-Up assist: The unit shall be capable of remote factory start-up capability via the Internet.
- L. The unit shall be capable of 24-7 remote computer monitoring with automated alarm notifications and system performance alerts.

## 1.2 SUBMITTALS

- A. Product Data: Submit literature that indicates dimensions, weights, capacities, ratings, component performance, gauges and types of materials, electrical and control characteristics and connection requirements.

## 1.3 PRODUCT HANDLING

- A. Deliver equipment to the job site with all exposed openings temporarily closed off with plywood, sheet metal or shrink-wrap. All equipment intended for indoor use must be shrink-wrapped prior to shipment.

## 1.4 WARRANTY

- A. Warranty: The entire system shall have a 24 month limited parts warranty from ship date. The manufacturer must submit a written warranty agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period. The warranty does not include parts associated with routine maintenance, such as air filters, etc.
  - 1. The system shall be covered by an additional 1-year labor warranty when it is connected to the factory via live internet monitoring system from date of initial start-up.
  - 2. The compressor(s) shall have a 5-year warranty from ship date.
  - 3. The internal airside coils shall have a 5-year warranty from ship date.
- B. The unit shall have live remote service capability via the internet with the ability for field service technicians to receive service and trouble alerts via email and make adjustments via smart-phone application remote control.

## 1.5 EXTRA MATERIALS

- A. Furnish extra material described below that match the product installed, are packaged with protective covering for storage, and are identified on the shipping bill of lading:
  - 1. Filters: Furnish one (1) spare set of pre-filters for each pre-filter bank provided.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Provide pool dehumidification unit as manufactured by SERESCO.

- B. Alternate manufacturers must be pre-approved at least 2 weeks in advance of bid date and are subject to compliance with all the requirements listed in this specification. Written approval by the engineer must be received in order to be acceptable. An addendum will be issued to show added manufacturers if they are preapproved. Do not solicit bids with unapproved manufacturers as they will be dismissed.
- C. The manufacturer must have a minimum of 10 years of experience building custom air handling equipment.
- D. Project is based on the specified equipment. Any additional re-engineering or installation costs associated with using alternate manufacturer's equipment shall be borne by the installing contractor.

## 2.2 GENERAL

The natatorium control system shall include:

- A. Mechanical process dehumidification
- B. Outdoor configuration
- C. Integral packaged outdoor air-cooled condenser/dry cooler for AC heat rejection.
- D. The unit shall have an indirect fired natural gas heater installed downstream of the blower, sized to meet the skin losses and outdoor air heating loads or as specified by the design engineer.
- E. Pool water heating type: potable water rated coaxial
- F. Air filtration type: MERV 8 2-inch filters for return and outdoor air.
- G. Purge mode
- H. Minimum Exhaust Fan.
- I. Heat recovery between the minimum exhaust air and outdoor air streams and via a glycol run around loop.
- J. Programmable microprocessor controller with Live, 24-7 remote internet access, monitoring and control.
- K. Remote operator panel
- L. Unit shall have a service vestibule where the compressor, refrigeration specialties and control valves and all electronics are outside of process air stream.

## 2.3 CONSTRUCTION

- A. The Cabinet shall be designed for Outdoor installation and shall be 2" double walled with painted inner liner.
- B. Cabinet Construction: All cabinet 16, 20, 24 gauge sheet metal shall be galvanized G90 steel or Galvalume TM alloy, mill applied zinc phosphate primer fol-



lowed by an exterior grade white silicone modified polyester top coat. The sheet metal is engineered to form a cabinet with maximum strength and rigidity. Panels shall be fastened to the frame with stainless steel hardware. Panels shall be isolated from the steel frame with dielectric gaskets to prevent galvanic corrosion. All seams shall be caulked with silicone inside and out to prevent air and water leakage.

1. Base Rails: The unit base frame shall be formed of 2 layers of 10 gauge galvanized steel. Lifting lugs shall be provided on the base frame for rigging the unit.
2. The cabinet walls shall be 20 gauge pre-painted steel, 2-inch double-wall construction with a fully painted inner metal liner and 2-inch fiberglass insulation.
3. The cabinet floor 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 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 pop rivets. Where bolts are required bright zinc plated bolts shall be used.
6. Access doors shall be supported on multiples hinges and have multiple compression latches to provide quick access. Doors shall be provided for entrance to all sections housing components requiring routine maintenance. Full height access doors have "hold back" latches to prevent door closure during the performance of service procedures.
7. The unit shall have non-corroding protective mesh screens on all air intake openings.
8. The units 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.

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.

## 2.4 BLOWER/MOTOR

A. Supply blowers (RTU-9):

1. The Supply 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 and is 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.
2. 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.
3. The fan assembly shall be suitable for a maximum temperature of 60°C.
4. The fan shall be statically and dynamically balanced on precision electronic balancers.

B. Supply blowers (RTU-10):

1. The direct driven supply air blower wheel shall be a single width/single inlet airfoil plenum type, secured a machined, ground and polished solid steel shaft. The wheel shall be G90 galvanized steel with baked powder paint coating. The shaft shall be coated with a rust inhibitor.
2. The complete blower assembly shall be statically and dynamically balanced on precision electronic balancers.
3. The blower assembly shall be mounted on a 1" deflection spring isolated rack.

4. The fan inlets shall be equipped with accidental contact protection screen.
5. 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.
6. The motor shall be provided with a low motor noise and high starting torque VFD for air balancing purposes. The VFD shall have a drive efficiency of 96 to 98% with displacement power factor of 0.98, output maximum frequency of 400 Hz with torque boost. The VFD shall have protective features including: torque limit, heat sink over-temperature, current-limiting DC bus fuse, electronic motor overload with phase-to-phase and ground fault short circuit protection; current limit, over / under torque protection; over / under voltage protection; short circuit current rating: 30kA rms symmetrical and 100kA rms symmetrical.

C. Exhaust blowers:

1. The exhaust blower (EF1) sized to maintain the Natatorium's negative pressure requirement during normal operation shall be unit mounted and its operation tied to the unit'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. Shall be packaged with the heat recovery module.

D. 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.

- a. (RTU-9) 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.
  - b. (RTU-10) 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-optimized, sickle-blade profile, patterned with serrated trailing edge and winglets on the blade outer edge for energy and noise-optimized operation.
2. The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels.
  3. The fan assembly shall be suitable for ambient temperatures of -40°C to max. +70°C.
  4. Thermal contacts installed in the windings compliant with THCL 155.
  5. Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection.
  6. High corrosion resistance design with high quality and reliability.
  7. 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.

## 2.5 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 condenser 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
- C. Coils shall have a 3-year warranty extension for a total of 5-year coverage.
- D. Heat Recovery Coils
  - 1. The unit shall have heat recovery between the minimum exhaust and outdoor air streams per specifications.
    - a. The heat recovery coils shall be sized for heat transfer between the two air streams
    - b. The heat recovery fluid circulating between coils shall be glycol. The module shall be a complete package and independent circuit that includes a circulating pump, fill valves and expansion tank.
  - 2. 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.
  - 3. Aluminum fin and copper tube joints mechanically bonded to assure high heat transfer

## 2.6 DAMPERS

Internal dampers shall be parallel blade and made from extruded anodized Aluminum with 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.

- A. Unit shall be provided with a power open and spring return outside air and exhaust air dampers. Dampers adjust between 0% to 100% open position.
- B. Outdoor air and exhaust air dampers shall be opposed blade, power open and spring return. Dampers blades shall be  $\frac{3}{4}$ " insulated type made from extruded anodized Aluminum with neoprene double seal tips to minimize leakage. Damper leakage shall be less than 1% of maximum flow at 4-inch W.C. differential. Damper blades shall be mounted on steel rods which rotate on nylon bushings. All damper hardware shall be corrosion resistant.

## 2.7 FILTERS



Filters shall be standard sized, replaceable, off-the-shelf filters used throughout including:

- A. Return Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure on a face loading rack.
- B. Exhaust Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure
- C. Outside Air: 2-Inch MERV 8, 30% pleated filters with rust-free non-metallic structure
- D. Filter Pressure Monitoring: Magnahelic pressure gauges shall be provided across all filter racks with a rain/sun shield provided on all outdoor mounted equipment. Filter differential pressure switches shall be provided across all filter racks.

## 2.8 HEATING

Unit-mounted indirect fired gas heater shall be sized to meet the scheduled heating capacity and have the following characteristics:

- A. Modulating control.
- B. The heater shall be spark ignition natural gas indirect fired type with capacity as shown in this submittal and is installed 'blow through' or downstream from the blower. The heat exchanger tubes are constructed of formed and welded series 409 stainless steel, 16 gauge 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.
- C. 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.
- D. The natural gas heater section 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.
- E. The complete unit shall be test fired and preliminary adjustments made prior to leaving the factory.

## 2.09 COOLING

Integral Air-cooled air conditioning via condenser (RTU-9)

- A. Unit shall be equipped with air conditioning mode where excess compressor heat is rejected to a factory packaged integral outdoor air-cooled condenser. The outdoor air-cooled condenser shall be capable of rejecting 100% of the compressor heat rejection with an air on temperature at summer design conditions. The outdoor condenser shall be equipped with a 24VAC control including contactor for fan motor.
- B. Unit shall be provided with a dry contact rated for 24VAC/5A to operate the remote outdoor condenser control.



Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

- C. Refrigeration circuit shall include refrigerant valves, receiver with pressure relief valve set at 650 psig, pressure control valve and pressure differential valve, and two manual shutoff valves to isolate the outdoor condenser.
- D. Coils shall be tested at 600 PSIG and mounted vertically for complete surface utilization. Coils shall be counter flow with a minimum of 10 degrees of liquid sub-cooling and have adequate capacity to dissipate the total heat rejection of the system at design conditions. Condensers shall have guards to protect the coils from vandalism and weather related damage.
- E. The fan shall be a 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-optimized, sickle-blade profile, patterned with serrated trailing edge and winglets on the blade outer edge for energy and noise-optimized operation.
  - 1. The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels.
  - 2. The fan assembly shall be suitable for ambient temperatures of -40°C to max. +70°C.
  - 3. Thermal contacts installed in the windings compliant with THCL 155.
  - 4. Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection.
  - 5. High corrosion resistance design with high quality and reliability.

Integral Air-cooled air conditioning via fluid-cooler/condenser (RTU-10):

- A. Unit shall be equipped with air conditioning mode where excess compressor heat is rejected to a factory packaged integral outdoor air-cooled heat exchanger (aka Dry Cooler) via a glycol fluid loop. The unit mounted 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. The outdoor heat exchanger shall be equipped with a 24VAC control including contactor for fan motor.
- B. Unit shall be provided with a dry contact rated for 24VAC/5A to operate the remote outdoor condenser control.
- C. Refrigeration circuit shall include refrigerant valves, receiver with pressure relief valve set at 550 psig, pressure control valve and pressure differential valve, and two manual shutoff valves to isolate the outdoor condenser.
- D. Coils shall be tested at 600/425 PSIG and mounted vertically for complete surface utilization. Coils shall be counter flow (with a minimum of 10 degrees of liquid

sub-cooling for RTU-9) and have adequate capacity to dissipate the total heat rejection of the system at design conditions. Dry-cooler/condenser shall have guards to protect the coils from vandalism and weather related damage.

- E. The fan shall be a direct driven axial fan made with a dual speed external rotor motor with innovative bionic blades in die-cast aluminum molds.
  - 1. The fan assembly shall be balanced in Class G 6.3 acc DIN ISO 1940, dynamic on two levels.
  - 2. The fan assembly shall be suitable for ambient temperatures of -40°C to max. +70°C.
  - 3. Thermal contacts installed in the windings compliant with THCL 155.
  - 4. Drive motor in external rotor principle, sealed in protection class IP54 with moisture protection impregnation of the windings, topical protection.
  - 5. High corrosion resistance design with high quality and reliability.

## 2.10 ELECTRICAL

- A. Wire units according to NEC and ETL list the entire unit. ETL listing of electrical panel only is unacceptable. All major electrical components shall be UL listed. Factory wire unit for single point power connection. Enclose all power wiring in conduit.
- B. Provide non-fused disconnect, fan motor starters/protectors, contactors, control transformer, control circuit fusing, service switch, and terminal block. Units supplied with VFDs shall have individual branch fusing per drive. A motor protector shall be provided if equipment manufacturer's manual bypass is required.
- C. Provide NEMA 3R electrical/control panel.
- D. Factory test wiring and controls before shipment.
- E. A phase protection relay shall be provided for each unit. Upon sensing a loss of phase the unit shall be de-energized.
- F. Lights: Provide vapor proof marine fixtures with LED bulbs in all access sections. Wire lights to a single light switch. Mount light switch near the electrical panel and wire switch to a terminal strip in the electrical panel. Separate 120V power must be provided to the switch for indoor mounted equipment. A transformer will be provided to provide power to the lighting circuit for outdoor mounted equipment.
- G. Convenience Receptacles: Provide a GFCI duplex receptacle mounted near the electrical panel and wire receptacle to a terminal strip in the electrical panel. Separate 120V power must be provided to the receptacle for indoor mounted equipment. A transformer will be provided to provide power to the circuit for outdoor mounted equipment.
- H. Dirty filter indicators: Provide differential pressure switches across all filter racks. Wire pressure switches to terminal block in main electrical panel.

## 2.11 MICROPROCESSOR CONTROL

- A. A microprocessor controller with the following characteristics will be provided:

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

1. All set points and adjustments are preprogrammed at the factory during quality control and test operation.
  2. The microprocessor program has an updatable FLASH memory.
  3. The Flash memory will be updatable via an internet connection.
  4. A minimum: 11 Analog inputs, 4 Analog outputs, 24 Digital inputs and 16 Digital outputs.
  5. Four serial interface ports including both RS232 and RS485 types.
  6. An Ethernet port with RJ-45 connector and LED activity indicator.
  7. A real time clock to time stamp unit operation log with programmable 7-day occupied/unoccupied scheduling capabilities.
  8. Two manual demand forced modes to allow user a manual bypass of the microprocessor in the event of controller failure.
  9. Keypad and display panel shall have a backlit graphic liquid crystal display.
- B. Unit shall have pressure transducers monitoring the refrigerant high and 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 display panel:
1. Space temperature
  2. Space relative humidity
  3. Pool water temperature
- E. The following sensors shall be unit-mounted and monitored at the display panel. All information from these items shall be actively used in the control and operation strategies for the unit:
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
- 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

## 2.12 CONTROL SEQUENCE

Unit shall be designed and sized to maintain the specified conditions. The unit operation shall be as follows:

### A. Unit Startup

1. Power is turned on or system is restarted.
2. After a short initial delay to allow sensors to stabilize, the blower starts and operates continuously.
3. Based on unit mounted sensor feedback the unit shall begin/resume operation and will operate based on the sequence described below.

### B. Airside Configuration

1. The unit delivers specified supply air continuously to the Natatorium.
2. The minimum exhaust air volume is set to meet the engineer's schedule.
3. The minimum outdoor air volume is set to meet the engineer's schedule.

### C. Dehumidification Mode

1. Return air relative humidity is above humidity setpoint.
2. Compressor starts using Compressor Start sequence.
3. Initially all compressor hot gas will be diverted to condense at the reheat coil. The supply air temperature is warmer than the return air temperature.

4. If the unit cannot maintain relative humidity within setpoint, compressor 2 will start.

D. Air Conditioning Mode

1. Return air temperature is above room temperature setpoint.
2. Compressor starts if not already operating in dehumidification mode.
3. Unneeded compressor hot gas is diverted to the outdoor air cooled condenser for up to 100% heat rejection at summer design ambient conditions.
4. If the unit cannot maintain return air temperature within setpoint, compressor 2 will start.

E. Space Heating Mode

1. Return air temperature is below room temperature setpoint.
2. The Microprocessor space heating output signal is sent to the heating coil controller.

F. Pool Water Heating Mode

1. Return pool water temperature is below pool water setpoint.
2. If compressor is already operating from a Dehumidification or Air Conditioning demand, the control valves divert the compressor hot gas through the coaxial heat exchanger/pool water heater and the rest of the compressor heat is rejected at either the reheat coil or the AC heat exchanger.
3. If there is no pre-existing demand for the compressor to operate, the microprocessor sends a signal to the auxiliary pool water heater (remote by others) to operate. The compressor will not normally operate solely for a pool water heating demand unless configured to do so at the controller.

G. Exhaust Air Heat Recovery Mode

1. The minimum outdoor air damper and minimum exhaust fan are tied to the unit's occupancy scheduler and will operate on/off as programmed.
2. Once the outdoor air temperature falls below the heat recovery setpoint (65 F adjustable) the glycol pump shall operate and circulate glycol between exhaust air and outdoor air heat recovery coils and recovering heat from the high energy/warm exhaust air and using it to preheat the incoming outside air.

H. Purge Mode

1. This mode is manually triggered by an operator when super-chlorinating the pool. It can be triggered at the operator panel (unit mounted or optional remote), WebSentry or BACnet.
2. It has an adjustable timed duration after which the system automatically resumes normal operation.
3. Once triggered by the operator:
  - a. The compressors (if operating) pump down and cycle off.
  - b. Signal from the microprocessor sets the exhaust fan(s) to maximum CFM.
  - c. The unit mounted outdoor air dampers open fully. The return air dampers close.
  - d. The system is in 100% outdoor air ventilation mode.
  - e. After time period expires, all dampers and fans return to normal operating settings and the unit resumes normal operation.
  - f. Unit will control heating based on supply air temperature.

I. Economizer Cooling Mode

1. Return air temperature is above room temperature setpoint.
2. The microprocessor will compare the temperature of the outside air with the cooling setpoint.
3. When outside air as determined to be suitable by the microprocessor, it will be used as the first stage of cooling.
4. Unit will switch over to using compressor(s) if outside air cannot satisfy the space temperature conditions.

J. Economizer Dehumidification Mode

1. Return air relative humidity is above humidity setpoint.
2. The microprocessor will compare the moisture content of the outside air to the dehumidification setpoint.
3. When outside air as determined to be suitable by the microprocessor, it will be used as the first stage of dehumidification.
4. Unit will switch over to using compressor(s) if outside air cannot satisfy the space humidity conditions.

K. Freeze Protection

1. Supply air temperature falls below freeze-stat set-point or optional freeze-stat sensor indicates a freezestat condition.



2. All exhaust fans are stopped and all outdoor air dampers are fully closed.
3. Freezestat alarm is tripped. Alarm has to be manually cleared by operator.

### 2.13 ACCESSORIES

- A. Adapter Roof curb: A prefabricated insulated Retro Mate roof curb will be provided for each unit. The curb will be shipped assembled. Final duct connections by mechanical contractor

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install unit per manufacturer's recommendations and instructions as described in the Installation, Operation and Maintenance (IOM) manual.
- B. Contractor shall NOT use the units to provide temporary heating, cooling or ventilation to the building during construction.

### 3.2 EXAMINATION

- A. After completing the installation, inspect the air handler for damage, dirt or debris. Remove all dirt, construction debris and repair any damage to the finish including chips, scratches or dents.
- B. Replace the filters used during the construction phase.

### 3.3 FIELD QUALITY CONTROL

- A. After the equipment is installed, the manufacturer's representative shall inspect the installation and recommend any corrective actions. Do not startup the equipment until the following operations are completed:
  1. All controls are installed and fully operational.
  2. Power is connected to the unit.
  3. Shipping materials have been removed.
  4. Filtration media is installed and clean.
  5. Piping and duct connections are installed and operational.
  6. Leak checks are completed on all water connections.
  7. All wiring, refrigerant piping, gasketing and hardware are properly installed on any multiple section units.

### 1.3 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
  2. Inspect for visible damage to furnace combustion chamber.
  3. Inspect for visible damage to compressor, coils, and fans.
  4. Inspect internal insulation.
  5. Verify that labels are clearly visible.
  6. Verify that clearances have been provided for servicing.
  7. Verify that controls are connected and operable.
  8. Verify that filters are installed.
  9. Clean condenser coil and inspect for construction debris.
  10. Clean furnace flue and inspect for construction debris.
  11. Connect and purge gas line.
  12. Inspect operation of barometric relief dampers.
  13. Verify lubrication on fan and motor bearings.
  14. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
  15. Adjust fan belts to proper alignment and tension.
  16. Start unit according to manufacturer's written instructions.
    - a. Start refrigeration system.
    - b. Do not operate below recommended low-ambient temperature.
    - c. Complete startup sheets and attach copy with Contractor's startup report.
  17. Inspect and record performance of interlocks and protective devices; verify sequences.
  18. Operate unit for an initial period as recommended or required by manufacturer.
  19. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
    - a. Measure gas pressure on manifold.
    - b. Inspect operation of power vents.
    - c. Measure combustion-air temperature at inlet to combustion chamber.
    - d. Measure flue-gas temperature at furnace discharge.
    - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
  20. Calibrate thermostats.
  21. Adjust and inspect high-temperature limits.
  22. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
  23. Start refrigeration system and measure and record the following:
    - a. Coil leaving-air, dry- and wet-bulb temperatures.
    - b. Coil entering-air, dry- and wet-bulb temperatures.
    - c. Outdoor-air, dry-bulb temperature.
    - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

24. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
25. Verify operation of internet access to control unit.
26. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

END OF SECTION

## SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electrical installation requirements.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

#### 1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

### 2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 3. Pressure Plates: Plastic, Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.



Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### 3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

END OF SECTION

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.

#### 1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

#### 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. Comply with NFPA 70.

#### 1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alcan Products Corporation; Alcan Cable Division.
  - 2. American Insulated Wire Corp.; a Leviton Company.
  - 3. General Cable Corporation.
  - 4. Senator Wire & Cable Company.
  - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THWN.

### 2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Hubbell Power Systems, Inc.
  - 3. O-Z/Gedney; EGS Electrical Group LLC.
  - 4. 3M; Electrical Products Division.
  - 5. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

### 2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.
  - 4. Pipeline Seal and Insulator, Inc.
  
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Plastic, Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
  
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THWN, single conductors in raceway.
  
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THWN, single conductors in raceway.
  
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN, single conductors in raceway.
  
- D. Exposed Branch Circuits, Including in Crawlspace: Type THWN, single conductors in raceway.
  
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THWN, single conductors in raceway.

- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THWN, single conductors in raceway .
- G. Class 1 Control Circuits: Type THWN, in raceway.
- H. Class 2 Control Circuits: Type THWN, in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.



- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

### 3.6 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors, for compliance with requirements.
- B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment:
  - 1. Underground distribution grounding.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
  - 1. Grounding arrangements and connections for separately derived systems.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
  - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
    - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
    - b. Include recommended testing intervals.

#### 1.4 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. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

### 2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. branch circuits.
  - 2. Flexible raceway runs.
- C. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment ground conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.

END OF SECTION

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.5 SUBMITTALS

- A. Product Data: For the following:



Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

1. Steel slotted support systems.
  - B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
    1. Trapeze hangers. Include Product Data for components.
    2. Steel slotted channel systems. Include Product Data for components.
    3. Equipment supports.
  - C. Welding certificates.
- 1.6 QUALITY ASSURANCE
- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - B. Comply with NFPA 70.
- 1.7 COORDINATION
- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
  - B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

## PART 2 - PRODUCTS

- 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Allied Tube & Conduit.
      - b. Cooper B-Line, Inc.; a division of Cooper Industries.
      - c. ERICO International Corporation.
      - d. GS Metals Corp.
      - e. Thomas & Betts Corporation.
      - f. Unistrut; Tyco International, Ltd.
      - g. Wesanco, Inc.
    2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
    3. Painted Coatings: Manufacturer's standard painted coating applied according to

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69] [Spring-tension clamps.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils .
- B. Touchup: Comply with requirements in Division 09 Painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

## SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members in the paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.



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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflec Inc.
  - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 5. Electri-Flex Co.
  - 6. Manhattan/CDT/Cole-Flex.
  - 7. Maverick Tube Corporation.
  - 8. O-Z Gedney; a unit of General Signal.
  - 9. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
  - 2. Fittings for EMT: Steel type.
- H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  2. EGS/Appleton Electric.
  3. Erickson Electrical Equipment Company.
  4. Hoffman.
  5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  6. O-Z/Gedney; a unit of General Signal.
  7. RACO; a Hubbell Company.
  8. Robroy Industries, Inc.; Enclosure Division.
  9. Scott Fetzer Co.; Adalet Division.
  10. Spring City Electrical Manufacturing Company.
  11. Thomas & Betts Corporation.
  12. Walker Systems, Inc.; Wiremold Company (The).
  13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, typed FD with gasketed cover.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.

## 2.3 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex Co.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
  - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Comply with the following indoor applications, unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: Rigid steel conduit.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- B. Minimum Raceway Size: 3/4-inch trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a

flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where otherwise required by NFPA 70.
- L. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC in damp or wet locations not subject to severe physical damage.
- M. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

### 3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

#### 3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

#### 3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION



## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
  - 5. Coordination charts and tables and related data.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

Hoffman Estates Park District  
Prairie Stone Sports and Wellness Center – Natatorium HVAC Units Replacement  
WT Project #M15420

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
4. Coordination charts and tables and related data.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

#### 1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

#### 1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Cooper Bussmann, Inc.
  2. Edison Fuse, Inc.
  3. Ferraz Shawmut, Inc.
  4. Littelfuse, Inc.

## 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Motor Branch Circuits: Class RK1, time delay.

### 3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

### 3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

HOFFMAN ESTATES PARK DISTRICT  
Hoffman Estates, Illinois

FORM OF PROPOSAL

Proposal of \_\_\_\_\_, hereinafter called the  
"BIDDER", (a) / (an) \_\_\_\_\_,  
(Corporation, Partnership,  
individual) doing business as \_\_\_\_\_, to Hoffman Estates  
Park District, hereinafter called the "OWNER."

\* \* \*

The Bidder, in response to your advertisement for bids for \_\_\_\_\_ and delivery, having  
examined the Specifications and other Documents and being familiar with all of the conditions  
surrounding the proposed work (purchase/sale) including availability of materials and labor,  
hereby proposes to furnish all labor, materials and supplies and to construct the project in  
accordance with the Contract Documents, within the time set forth therein and at the prices  
stated below. These prices are to cover all expenses incurred in performing the work required  
under the Contract Documents of which this proposal is a part.

Bidder acknowledges receipt of the following Addenda, which are a part of the Contract

Document: Numbers: \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.

Bidder hereby agrees to start work within five (5) days after receipt of "Notice to Proceed" from  
the Owner and to complete the project no later than \_\_\_\_\_, 2016.

Bidders agree to provide and install all equipment described in the Specifications for the sum of:  
\_\_\_\_\_ (in writing)  
(Dollars)

HOFFMAN ESTATES PARK DISTRICT

FIRM NAME \_\_\_\_\_

BY: \_\_\_\_\_  
(Sign and Date)

ADDRESS \_\_\_\_\_

BY: \_\_\_\_\_  
(Sign and Date)

PHONE \_\_\_\_\_

EMAIL: \_\_\_\_\_

BY: \_\_\_\_\_  
(Sign and Date)

Accompanying this is a

\_\_\_\_\_  
(Bid Bond, Certified Check, Bank Draft)

In the amount of \_\_\_\_\_  
(Dollars)

(\$\_\_\_\_\_) being ten percent (10%) of the Base Contract Bid, the same being subject to forfeiture in the event of default by the undersigned.

In submitting this bid, it is understood that the right is reserved by the Owner to reject any and all bids and it is agreed that this bid may not be withdrawn during the period of days in the Contract Documents.

The Bidder hereby certifies:

- A. That this bid is genuine and is not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation.
- B. That he has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.
- C. That he has not solicited or induced any person, firm, or corporation to refrain from bidding.
- D. That he has not sought by collusion or otherwise to obtain for himself any advantage over any other bidder or over the "Owner."
- E. That he will comply with all provisions of the Prevailing Wage Ordinance #O-14-03 adopted by the Hoffman Estates Park District.
- F. That he is in compliance with the Criminal Code Act of 1961, Article 33E-11, Public Contracts, and Public Act 85-1295.
- G. That all materials, methods and workmanship shall conform to the drawings, specifications, manufacturer's standards and specifications, and all applicable Codes and Standards.

CERTIFICATION

I, \_\_\_\_\_ (Officer), having been first duly sworn on Oath, do  
depose and state that I presently reside at \_\_\_\_\_ (Address), and  
that I am the duly authorized principal, officer or agent of \_\_\_\_\_  
(Name of Contractor) and do hereby certify to Hoffman Estates Park District, its  
Commissioners, Officers and Employees that neither I nor \_\_\_\_\_  
(Name of Contractor) are barred from bidding on the Contract for which this bid is  
submitted, and as a result of violation of either Section 33E-3 (Bid-rigging") or  
Section 33E-4 ("Bid-rotating") of Article 33E of the Criminal Code of 1961 of the  
State of Illinois approved July 28,1961, as amended.

\_\_\_\_\_  
On behalf of Contractor

Subscribed and sworn to before me

this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

\_\_\_\_\_  
- Notary Public -

My Commission Expires:

\_\_\_\_\_

**SUBCONTRACTORS**

The following list includes all Subcontractors who will perform work representing five percent (5%) or more of the total base bid. The Bidder represents that the Subcontractors are qualified to perform the work required.

<b>Category</b>	<b>Subcontractor Name</b>	<b>Address</b>
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____
11.	_____	_____
12.	_____	_____
13.	_____	_____
14.	_____	_____
15.	_____	_____



## REFERENCES

### References for:

1. Company Name: \_\_\_\_\_

Address: \_\_\_\_\_

City-state: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Contact Person: \_\_\_\_\_

2. Company Name: \_\_\_\_\_

Address: \_\_\_\_\_

City/State: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Contact Person: \_\_\_\_\_

3. Company Name: \_\_\_\_\_

Address: \_\_\_\_\_

City/State: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Contact Person: \_\_\_\_\_

4. Company Name: \_\_\_\_\_

Address: \_\_\_\_\_

City/State: \_\_\_\_\_

Phone Number: \_\_\_\_\_

Contact Person: \_\_\_\_\_

## STATEMENT OF EXPERIENCE

The Bidder shall list all recent projects for which he provided services of a similar nature to the subject project.

Project/Location	Contract Amount	Reference/Phone #
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____
9.	_____	_____
10.	_____	_____
11.	_____	_____
12.	_____	_____
13.	_____	_____
14.	_____	_____
15.	_____	_____

HOFFMAN ESTATES PARK DISTRICT  
Hoffman Estates, Illinois

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Please list all of the equipment you will be using on this specific job.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_
6. \_\_\_\_\_
7. \_\_\_\_\_
8. \_\_\_\_\_
9. \_\_\_\_\_
10. \_\_\_\_\_
11. \_\_\_\_\_
12. \_\_\_\_\_
13. \_\_\_\_\_
14. \_\_\_\_\_
15. \_\_\_\_\_