FARRIS ENGINEERING

Omaha Public Schools Pool Mechanical Upgrades

OPS|OMAHA, NEBRASKA

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BID DOCUMENTS

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DIVISION 4 - MASONRY

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 PRODUCT DELIVERY AND HANDLING

A. Masonry units shall be delivered, unloaded and handled in a manner to adequately protect exposed corners, edges and faces from chipping, cracking or other damage. Such chipped or otherwise damaged units shall not be utilized in exposed wall areas but may be selected for utilization in concealed wall areas, if damaged characteristics are minor and do not affect the structural integrity of the wall.

B. Delivery of mortar materials other than aggregate and water shall be in sealed and labeled packages.

1.2 PRODUCT STORAGE

A. Masonry units shall be stored off the ground on pallets or in some manner that will prevent absorption of moisture from the ground or soiling of masonry units. Concrete masonry units shall be protected from becoming wet from rain, snow or capillary action. Reinforcing and similar items shall be stored off the ground and shall be free of loose rust or other coatings that will reduce bond. Store mortar materials in a manner to prevent deterioration or intrusion of foreign material. Material that has become unsuitable for good construction shall not be used and shall be immediately removed from the site.

1.3 JOB CONDITIONS

A. During cold and hot weather, masonry materials shall be stored, erected, and protected to meet the requirements of Technical Note No. 1 for "All Weather Construction", published by the Brick Institute of America, latest edition, or TEK Bulletin #3-1C “All-Weather Concrete Masonry Construction”, published by the National Concrete Masonry Association, latest edition.

B. Do not lay masonry units which are wet or frozen. Remove ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch. Remove all masonry determined to be damaged by freezing conditions.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS (CMU)

A. Concrete masonry units (CMU) shall be manufactured and tested by members of the National Concrete Masonry Association and shall meet the requirements of the Quality Concrete Block Specifications for the State of Nebraska or ASTM C 90 Type 1 requirements, whichever is the most stringent. All units shall be manufactured with standard weight aggregate (125 pounds per cubic feet or more, oven dry weight of concrete. Compressive strength shall be 1,900 psi minimum. Special shapes, including end and jamb blocks, solid top blocks, sill blocks and lintel and bond beam blocks, etc. shall be furnished as shown or required.

B. Size of CMU shall be the manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15 5/8" x 7 5/8" actual), unless otherwise indicated. Thicknesses shall be as indicated on the Drawings.

2.2 MORTAR MATERIALS

A. Portland Cement - ASTM C 150, Type I. Provide natural grey color cement.

B. Lime - hydrated lime, Type S, ASTM C 206 or C 207.

C. Aggregate for Mortar - ASTM C 897; use aggregate graded with 100% passing the No. 16 sieve. Aggregate color, size, shape and texture shall match the original as closely as possible.

D. Aggregate for Grout - ASTM C 404.

E. Water - Clean and free of deleterious amounts of acid, alkalies, or organic materials.

F. Air-Entraining Admixtures - ASTM 260 added in accordance with the manufacturer's instructions.

G. Anti-Freeze Compounds - Not permitted. Do not lower the freezing point of mortar by use of admixtures or anti-freeze agents.

H. Accelerators shall not be used.

I. Bonding agents shall not be used.

2.3 MORTAR TYPES

A. Use Type N mortar.

2.4 MORTAR MIXES

A. Mortar for all unit masonry shall conform to ASTM C 270. If masonry cement is used, it shall be measured, batched, and mixed according to the manufacturer's documented instructions.

B. Grout for reinforced masonry walls, lintels and bond beams shall conform to ASTM C476 and shall have a minimum 28-day compressive strength of 3,000 psi. Grout for cells of reinforced masonry shall conform to ASTM C476 and shall have a slump of 8" to 10" as tested according to ASTM C 143. Grout shall have a minimum cement content of 658 pounds per cubic yard. Where required, grout should be plastic, suitable for pumping without separation of constituents.

C. Coarse grout for reinforced masonry, lintels, and bond beams shall meet the requirements of ASTM C 476, except that aggregate gradation may be altered to use Platte River sand-gravel.

D. Unless hereinbefore allowed or disallowed by mortar manufacturer, mortar may be retempered by adding water within a basin formed with mortar and reworking the mortar within the water. Mortar which is unused two hours after initial mixing when air temperature is 80 deg. F or higher, and mortar which is unused three hours after initial mixing when air temperature is below 80 deg. F, shall be discarded.

2.5 MASONRY REINFORCING

A. Horizontal masonry reinforcement shall be ladder type reinforcement manufactured by Keystone Steel and Wire, Dur-O-Wall, Inc., AA Wire Products Company, Wire-Bond, National Wire Products or approved equal. Reinforcing shall be fabricated from cold drawn steel wire and shall consist of 9 gauge deformed side rods spaced approximately 2" less than the nominal wall thickness and weld connected to 0.188-inch diameter ladder-type cross rods at 16” o.c. maximum. Provide reinforcing in lengths of 10 feet minimum. Provide special "T" and "L" sections for corners and intersections of walls. Horizontal masonry reinforcement for interior walls shall receive the manufacturer's standard mill galvanized finish except as otherwise indicated.

B. Steel reinforcing for bond beams, lintel blocks, walls, piers and other locations shown on the Drawings shall conform to ASTM A 615 and shall be Grade 60.

2.6 MASONRY ANCHORS AND TIES

A. All reinforcing anchors and ties listed below shall be galvanized in accordance with ASTM A 641, Class 1 where steel wire is entirely embedded in mortar or grout, and Class 3 for all other wires, ties and anchors.

B. Corrugated metal ties, galvanized, 7/8" x 7" x 16 gauge, shall be used where new non-bearing masonry walls intersect existing masonry or concrete walls.

PART 3 - EXECUTION

3.1 PREPARATION

A. Installer shall examine surfaces to receive masonry work and conditions under which masonry work will be installed and shall report to the General Contractor in writing any conditions which are not in compliance with requirements. Do no proceed with installation until surfaces and conditions comply with requirements indicated in specifications for execution of other work which affects masonry work.

3.2 INSTALLATION

A. Cutting of masonry units shall be avoided, if possible. If cutting of exposed masonry units is necessary, it shall be done with a carborundum wheel, with all junctions and joints carefully and accurately fitted. No piece shorter than 4" shall be used at vertical corners or jambs unless shown otherwise on the Drawings.

B. Do not wet concrete masonry units.

C. Where fresh masonry joins masonry that is partially or totally set on concrete, the surface to be joined shall be free of loose material and lightly wetted. When necessary to "stop off" a horizontal masonry run, it shall be done by racking back 2 lengths at each course and, if grout is used, stopping grout 4" back of rack. Toothing will not be permitted.

D. Masonry shall be laid up true and plumb, with special units (corners, jamb blocks, headers, fillers, closers, etc.) as required to form corners, returns, openings, and offsets and maintain proper bond throughout length of wall.

E. All unit masonry shall be laid up in running bond. Masonry bond and interlock each course at corners and intersections, unless otherwise shown.

F. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement-type joints, returns and offsets.

G. Masonry walls shown on the Drawings as extending to the structure shall be laid up tight against or held free of beams, upper floor slabs, joists or roof deck, according to the following schedule or as shown on the Drawings:

A.	Interior Non-Bearing Walls:	Hold 3/8-inch clear of all joists, beams, upper floor slab, and bottom of roof deck lowest corrugations unless noted otherwise on the Drawings. Hold 3/8-walls inch clear and install backer rod and caulk where abutting exposed concrete and steel beam members in finished rooms unless noted otherwise. It will not be necessary to fill in between deck corrugations with grout.

H. Rack back 1/2-masonry unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if specified to be wetted), and remove loose masonry units and mortar prior to laying fresh masonry.

I. As the work progresses, build-in items specified under this and other sections of these specifications, including all door frames, steel lintels, bearing plates, anchors, sleeves and other miscellaneous items. Fill in solidly with masonry around built-in items. Where built-in items are to be embedded in cells of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into cell.

3.3 MORTAR BEDDING

A. Thickness: Unless otherwise indicated, horizontal and vertical mortar joints shall be 3/8" thick.

B. Hollow Units: Mortar bedding shall be placed under the face shells of units, but shall not extend across

webs, except that a full mortar bedding shall be required under starting courses of non-reinforced units laid on footings, solid foundation walls, and lintels, and in all courses of piers, columns, pilasters, webs adjacent to cells, face shells adjacent to cavities that are to be reinforced and/or filled with grout, and other locations shown on the Drawings. Mortar shall be applied over the full thickness and height of face shells, or solid end faces and units shoved tight to form vertical joints.

C. Solid units shall be laid in full bed joints of mortar, and vertical surfaces shall be heavily buttered so mortar will be applied over full end area of units.

D. Avoid overplumbing and pounding corners and jambs to fit stretcher units after they are set in position.

E. Do not slush head joints.

F. Protect sills, ledges and projections from droppings of mortar.

G. If it is necessary to move a unit after it has once been set in place, the unit shall be removed from the wall, cleaned, and set in fresh mortar.

H. Prevent grout, mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry. Protect base of walls from rain-splashed mud and mortar splatter by means of coverings spread on ground and over wall surface.

3.4 HORIZONTAL REINFORCING AND TIES

A. Unless otherwise noted, reinforcement shall be installed in the first and second bed joints, 8" apart, immediately above lintels and below sills at openings, and in bed joints at 16" intervals elsewhere. Reinforcement in the second bed joint above or below openings shall extend 2 feet beyond jambs. All other reinforcement shall be continuous, except that it shall not pass through vertical masonry control joints. Side rods shall be lapped at least 6" at splices. Reinforcement shall be so placed as to assure a 1/2" mortar cover on all faces.

B. Provide continuity at corners and wall intersections by use of prefabricated "L" and "T" sections. Cut and bend units as directed by manufacturer for continuity at returns, offsets, pipe enclosures and other special conditions.

3.5 LINTELS

A. Masonry lintels shall be built in place over masonry openings where masonry construction continues above, unless steel lintels are shown on the Drawings.
   1. Shoring: Wood shoring or other approved means of support shall provide a level platform of proper elevation while lintels are being built in place. Shoring shall be kept in place for a minimum of seven days, or until lintel has gained sufficient strength to support loads.
   2. Mortar Bedding: Units shall be laid end to end, with full mortar coverage on all abutting edges; the joints shall be shoved tight. Provide a minimum of 8-inches of bearing, unless shown otherwise on the Drawings. Lintel shall be set in a full bed of mortar.
   3. Reinforcing Steel: Shall be accurately placed and supported in the cavity.
   4. Grouting: Cavity shall be filled with grout, carefully rodded to insure complete filling and proper embedment of reinforcement. Take care to prevent displacement of reinforcement. Screed off excess grout and level. Lay next succeeding course of masonry in a full mortar bed.

3.6 TOOLING AND POINTING

A. Joints shall be struck flush, and after mortar has partially set but is still sufficiently plastic to bond, joints shall be tooled with a tool which compacts mortar and presses excess mortar out of the joint rather than dragging it out. All joints shall be made with a straight, clean line.

B. Exercise special care to avoid getting mortar on faces of masonry which will be exposed without paint or other finish.

C. Joints shall be tooled concave.

D. Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled.

3.7 MISCELLANEOUS MASONRY INSTALLATION REQUIREMENTS

A. Construct bond beams at locations as shown on the Drawings. Unless otherwise indicated, bond beams shall be reinforced with two No. 4 bars. Bond beams shall be bedded, reinforced and grouted the same as masonry lintels.

B. Unless otherwise shown on the Drawings, fill cores of concrete masonry units solid with grout at pilasters or piers, at two courses below bearing plates, at beam and lintel bearing and where required to secure anchors and bolts, at all jambs at metal frames, and elsewhere as shown on the Drawings. Also, the cores shall be grouted full at any course which supports at least four courses of concrete masonry units or roof loads, if the face shells of this lower course do not line up with the face shells of the course immediately above. Install metal lath in horizontal joint below cores to be filled solid with grout.

C. Openings and chases for heating, plumbing and electrical ducts, pipes and conduits shall be built into masonry walls. Cutting of units to accommodate work of others shall be performed by masonry mechanics. Openings and chases shall be kept free from mortar and debris.

D. Lintels and bearing plates shall be set on full beds of mortar, as shown on the Drawings, leveled and at correct elevation.

E. Do not apply concentrated loads for at least 3 days after completion or erection of masonry walls.

3.8 REPAIR, POINTING AND CLEANING OF NEW WORK

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. During the tooling of joints, enlarge any voids or holes, and completely fill with mortar. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

C. After completion of masonry work, or after all liability from stain or other operations on the building is passed, masonry shall be carefully cleaned, removing dirt, mortar, mortar ridges, stains, and other defacements. The use of wire brushes, strong acids, or solutions which might cause discoloration to work, disintegration of mortar, or damage to adjacent materials will not be permitted. Cleaning down shall start at the top and be continued down.

D. Clean exposed CMU by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings. Comply with recommendations in NCMA TEK Bulletin No. 08-4A.

END OF SECTION

DIVISION 6 – WOOD, PLASTIC AND COMPOSITES

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Comply with PS 20 and with applicable rules of the respective grading and inspecting agencies for species and products indicated. Comply with PS 1-74 (ANSI 199.1) or, for products not manufactured under PS 1-74 provisions, with applicable APA Performance Standard for type of panel indicated. All stress grades and stress criteria shall be based on the National Design Specifications for Wood Construction, latest edition.

1.2 STORAGE

A. Store rough carpentry materials on bunks or skids at least 6 inches above the ground, and protect materials from weather with waterproof covers.

1.3 JOB CONDITIONS

A. Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment to other work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Lumber shall be S4S, kiln dried, with 19 percent maximum moisture content at time of dressing. Lumber shall be grade stamped in accordance with the latest edition of the standard grading rules of NELMA, SPIB, WCLIB, WWPA or NLGA (or equivalent Canadian governing authority).

2.2 MISCELLANEOUS MATERIALS

A. Fasteners and anchorages shall be of the size, type, material and finish as indicated below or on the Drawings and as recommended by applicable standards complying with applicable Federal Specifications for nails, (staples), screws, bolts, nuts, washers and anchoring devices. Metal anchors shall be of the size and type recommended by the manufacturer for each use. Where rough carpentry work is exposed to the weather, in ground contact, or in areas of high humidity, provide fasteners and anchorages with a hot-dip zinc coating (ASTM A 153).

B. Miscellaneous Fastenings. Spikes, screws, lag bolts, and other miscellaneous fastenings and rough hardware shall be as shown on the Drawings, or as required to assemble and secure rough carpentry items. All fasteners associated with exterior work shall be galvanized finished.

C. Adhesives shall conform to Specification AFG-01 of the American Plywood Association.

PART 3 - EXECUTION

3.1 MISCELLANEOUS WOOD FRAMING

A. Erect miscellaneous framing as shown on the Drawings as required to secure materials to rough construction.

B. Anchoring of blocking to steel or concrete shall be by bolted connections. Bolts shall be 1/2" diameter located 12" from each end and at 4' centers maximum, unless otherwise shown on the Drawings or specified herein.

3.2 ALLOWABLE TOLERANCES

A. The following tolerances establish the range of acceptable variances. Assure that work outside this range is removed; act to prevent reoccurrence.
   1. Lumber
      a. Straightness, no bows exceeding 0.1%, i.e., 1/8-inch in 10 feet, 1/16-inch in 5 feet.
      b. No twisted or split lumber allowed.
      c. Moisture content not to exceed 14% when installed.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

Wood Ceiling Framing	Section 06 10 00

1.2 SCOPE

A. This Section relates to the following work categories:
   1. Interior plastic liner ceiling panels

1.3 QUALITY ASSURANCE

A. Comply with applicable requirements of “Architectural Woodwork Quality Standards” published by the Architectural Woodwork Institute (AWI), latest edition, except as otherwise indicated.

1.4 SUSTAINABILITY REQUIREMENTS

A. Use adhesives and sealants that comply with the following requirements:
   1. Adhesives, sealants and sealant primers must comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168, which limits their VOC content by product type.
   2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect October 19, 2000.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Material shall be delivered in the original packages, with seals unbroken and with manufacturer’s name and brand stamped clearly thereon. No seconds or remnants shall be used. Store materials indoors or on skids, at least 6 inches above the ground under waterproof coverings.

1.6 JOB CONDITIONS

A. Installer shall advise Contractor of temperature and humidity requirements for finish carpentry installation areas. Do not install interior finish carpentry materials until required temperature and relative humidity conditions have been stabilized and will be maintained in installation areas.

B. Finish carpentry materials shall not be installed until masonry is thoroughly dry and the interior of the building is dried out.

PART 2 - PRODUCTS

2.1 INTERIOR FINISH CARPENTRY MATERIALS

A. Plastic liner ceiling panels shall be 3mm thick x 4’ wide fiberglass-reinforced plastic panels meeting ASTM D790 and D638 for strength and water absorption, and Class A surface burning characteristics per ASTM E84. Panels shall have a pebbled, embossed texture. Acceptable products are Fire-X Glasboard with Surfaseal by Crane/Kemlite (or approved equal). Color shall be gray. Include all accessories and necessary for a complete installation, including, but not limited to, one-piece division bars, inside corners, outside corners, end caps, and adhesives.

2.2 FASTENERS

A. Fasteners shall be stainless steel finish nails or screws of sufficient length to penetrate wood bearings a minimum of 1-1/2 inches.

B. Screws, toggle bolts, expansion bolts, and other miscellaneous fastenings shall be as required to secure finish carpentry items in place.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

A. Discard materials which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned or too small to fabricate work with minimum of joints or optimum jointing arrangements, or which are of defective manufacture with respect to surface, sizes or patterns.

B. Install the work level, true, and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level, 1/16 inch maximum offset in flush adjoining surfaces and 1/8 inch maximum offsets in revealed adjoining surfaces. Joints shall be tight and made in a manner to conceal shrinkage. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

C. Anchor finish carpentry work to anchorage devices or blocking built-in or directly attached to substrates. Secure to grounds as required for a complete installation.

3.2 INSTALLATION OF PLASTIC LINER CEILING PANELS

A. Install components level and secure, scribed to adjacent finishes, in accordance with manufacturer's written instructions. Keep components clean during installation. Remove adhesive, sealants and other stains. Keep components clean and protect after installation. Replace stained or damaged components.

END OF SECTION

DIVISION 8 - OPENINGS

SECTION 08 16 13

FIBERGLASS DOORS AND FRAMES

PART 1 - GENERAL

PART 2 - PRODUCTS

2.1 Manufacturers

A. Tiger Door, LLC.

B. Edgewater Door

C. ChemPruf Door Company

2.2 COMPONENTS

A. Doors: Fiberglass construction with reinforced core.
   1. Thickness: 1-3/4 inch, nominal.
   2. Core Material: Manufacturer's standard core material for application indicated.
   3. Waterproof Integrity: Provide factory fabricated edges, cut-outs, and hardware preparations of fiberglass reinforced plastic (FRP); provide cut-outs with joints sealed independently of glazing, louver inserts, or trim.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install fire-rated assemblies in accordance with NFPA 80.

C. Install exterior doors in accordance with ASTM E2112.

END OF SECTION

SECTION 08 71 00

HARDWARE AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

Fiberglass Doors and Frames	Section 08 16 13

1.2 GENERAL REQUIREMENTS

A. Supply all items of finish hardware and related services necessary for the proper functioning of all doors, and for such other requirements as are designated under this Section.

1.3 QUALITY ASSURANCE

A. The hardware supplier shall coordinate all hardware items to be installed in or on fiberglass doors and frames with the supplier of those items to assure proper fit, reinforcing and operation.

1.4 WARRANTY

A. Warranty shall be signed by Manufacturer, Installer, and Prime Contractor, agreeing to replace hardware components which fail in materials or workmanship within time period indicated below. Failure of materials or workmanship includes faulty operation of hardware, deterioration of finish or construction in excess of normal weathering, and defects in hardware and other components of the work.

B. Provide written warranties on all hardware components with standard warranties with durations longer than one year from Substantial Completion Date.

C. Submit warranties in accordance with Section 01 30 00.

1.5 SUBMITTALS

A. Submit Hardware Schedule in accordance with Section 01 30 00. The Hardware Schedule shall list the type, manufacturer's name and number, finish and location. All abbreviations and symbols used on the Schedule shall be explained. No hardware shall be ordered or delivered to the job until approval of the schedule has been received from the Architect. Approval of the schedule does not relieve the hardware supplier of fulfilling all terms of the Specifications.

1.6 SUBMITTAL SEQUENCE

A. Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., doors and frames) that is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by builders of hardware, and other information essential to the coordinated review of hardware schedule.

B. Hardware for installation on doors and frames shall be made to standard templates, and such templates, schedules and other pertinent information shall be delivered to the individual door and frame fabricators within ten days after receipt of the approved Finish Hardware Schedule. All doors and frames shall be reinforced, drilled, and tapped by the fabricator for mortised hardware. Reinforcement for surface-applied hardware shall be by the fabricators. Drilling and tapping shall be done in the field by the hardware installer for surface-applied hardware items.

1.7 PRODUCT HANDLING

A. Package hardware in individual containers on a set-by-set basis with set numbers that correspond to the approved hardware schedule. Each set shall contain each item of hardware required for that set including necessary screws and installation instructions, and installation templates for spotting mortising tools. Two

or more identical sets may be packaged in the same container. Mark each container clearly with hardware set numbers.

PART 2 - PRODUCTS

2.1 HARDWARE

A. Finish hardware shall be as hereinafter specified and scheduled. Provide additional items of hardware which are necessary to make a complete workmanlike installation even though such items are not specified. Such miscellaneous items shall be equal in quality to items which are specified.

B. Brands and models designated in this Section are intended to define the exact standards of quality, function and design required. Substitution will not be permitted unless given written approval by the Architect.

ITEM	SPECIFIED	ACCEPTABLE
Hinges	McKinney	Stanley, Hager
Locks	Best	No substitutions
Overhead Stops	Rixson	ABH, Glynn Johnson
Gasketing	Pemko	Reese

2.2 MISCELLANEOUS

A. Hardware shall have the following U.S. Standard finishes:
1. US15 for all items unless otherwise specified.
2. Similar finishes for all other items unless otherwise noted.

B. Dead stop angles for overhead stops shall be accurately determined to prevent doors from contacting adjoining walls or other doors while still effecting the hold-open point at the greatest possible angle.

PART 3 - EXECUTION

2.1 HARDWARE LOCATIONS

A. Hardware locations (height above finish floor) shall be as follows:
1. Levers 40” to centerline

2.2 INSTALLATION OF HARDWARE

A. Install each hardware item in compliance with the manufacturer's instructions. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Drill, tap and countersink units for surface-applied hardware and other items which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards and manufacturer's recommendations.

2.3 INSTALLATION OF SEALS

A. Provide metal fasteners of type which will not work loose as a result of normal door use, and which are compatible with metal of the stripping, the frame or the door. Provide only smooth exposed fastener heads, which do not constitute a snagging hazard to clothing of building occupants.

B. Set units plumb and level, accurately centered at optimum location for maintaining a permanent seal. Adjust doors, frames and hardware, as necessary, to achieve proper operation of seals and stripping, including achieving an airtight and watertight seal at each opening.

2.4 INSTALLATION OF THRESHOLDS

A. On concrete and similar substrates, install lead-shield anchors, accurately placed to receive machine screw anchors at locations pre-drilled and evenly spaced in threshold units (spaced not more than 12" o.c.).

B. Screw thresholds to substrate with No. 10 or larger flat head machine screws, of the proper type and length, of bronze or stainless steel, which will provide for permanent anchorage and will not corrode in contact with threshold metal or shield anchor.

C. Set threshold units level and accurately aligned with outside edges of frames and door bottom edge, and at proper elevation for door operation and full and positive seal to threshold stop. Shim, if necessary, for full continuous support of threshold at each edge and intermediate legs, if any. Use non-corrosive shims of metal or plastic (no wood), set in adhesive or otherwise anchored against dislocation from impact of traffic upon threshold.

2.5 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace any unit which cannot be adjusted to operate freely and smoothly as intended for the application.

2.6 HARDWARE SCHEDULE

HARDWARE SET NO. 1

3	Each	Hinges	TA2314 5” x 4 ½”	US15
1	Each	Passage	45HON 15J	619
1	Each	Overhead Stop	10 Series	619
1	Each	Threshold	171A	
1	Set	Gasketing	S88BL	
1	Each	Sweep	315CN	

END OF SECTION

SECTION 13 1100 - SWIMMING POOLS

PART 1 - GENERAL

1.01 RELATED DOUCMENTS

A. The BIDDING REQUIREMETNS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY OF WORK (for general guidance-not all inclusive)

A. Introduction

1. Provide all labor, materials, equipment and services necessary to construct the following: a competition pool and (2) a leisure pool. This work shall include the structure(s) and installation of pool finishes as well as all products listed in Part 2 of Section 131100.

B. Work included in this section

1. Provide all electrical conduit, wiring, junction boxes etc. to all low voltage pool equipment within pool filter/chemical rooms per Division 26 - Electrical. (Low voltage is considered less than 110 V.)
2. Provide all necessary piping and valving as shown on the drawings and specified herein.
3. Provide individually sized housekeeping pads for each pool pump. Provide housekeeping pads for pool equipment as required in the drawings.
4. Start, test, calibrate and adjust all mechanical equipment, electrical equipment, recirculation, chemical, and other supplied systems including deck, loose, maintenance, and safety equipment. Instruct the Owner's representative in the systems operation and maintenance as described herein.
5. Furnish and install combination variable frequency drive/motor starters as indicated on plan drawings and specified herein. Power connections shall be provided by Electrical Contractor.

1.03 QUALITY ASSURANCE

A. The specifications and drawings illustrate and detail two swimming pool systems that shall be utilized for both competitive and recreational use. Certain technical aspects of the design are common only to pool systems planned for public use. Understanding these aspects, their functions and interaction through experience is vital to completing a successful operating system. It is a mandatory requirement that all bidders will have achieved such experience as a prerequisite for bidding this project

1.04 REGULATORY AGENCY REQUIREMENTS AND ENGINEERING SERVICES

A. The entire system shall be designed and installed to meet applicable national and local codes and be in compliance with applicable sections of the American National Standards Institute / National Spa and Pool Institute (ANSI /NSPI-1 2003) and the rules and regulations of USA Swimming (USA) and the National Federation of State High School Associations (NFSHSA).

B. The system shall comply with all necessary pre-construction approvals obtained by the Owner and Owner's Consultants from local regulatory agencies governing the design and construction of public swimming pools.

C. The Contractor shall give all necessary notices, obtain all permits and pay all government fees, and other costs in connection with his work, including the filing of all necessary as-built drawings, prepare all documents and obtain all necessary approvals of governmental departments having jurisdiction over their work. The Contractor shall also be responsible for obtaining all required certificates of inspection for his work and deliver same to the Owner and Owner's Consultants before requesting acceptance and final payment for the work.

D. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, services, apparatus or drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.

1.05 COORDINATION AND CLARIFICATION

A. Coordinate with other contractors or subcontractors all work relating to this section.

B. The Contractor must establish with other contractors or subcontractors, having related work in this section, that all work necessary to complete the pool(s) as shown on the drawings and in the specifications is included in the base bid and alternates to the Owner.

C. If in doubt regarding the responsibility for work covered in this section and/or discovery of errors or omissions in the bidding documents, the Contractor shall notify the Architect through channels established by the specifications and request a clarification ten (10) days prior to the bid date.

1.06 ALTERNATES

A. Review the description of the alternates in Division 1 and on the drawings for possible effect upon work in this section. Alternates related to the work in this section are described in this division and on the bid proposal form.

1.07 SUBMITTALS

A. All submittals shall be made in accordance with the requirements of Division 1 - General Requirements and in strict compliance with the following procedures and guidelines.

B. Permits, Receipts and Test Reports

1. Provide the Architect with copies of all permits and receipts for fee payments.
2. Submit a sample format for each test report intended for use. Submit test reports required herein only on approved forms.

1.08 OPERATION AND MAINTENANCE MANUALS AND CLOSE-OUT SUBMITTALS

A. Detailed operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment supplier and/or CONTRACTOR shall prepare an operation and maintenance manual for all equipment. Parts lists and operating and maintenance instructions shall be provided.

B. Each operation and maintenance manual shall include the following:

1. Equipment function and calibration, normal operating characteristics, and limiting conditions.
2. Assembly, installation, alignment, adjustment and checking instructions.
3. Operating instructions for start up, routine and normal operation, regulation and control, shut down and emergency conditions.
4. Operating cycles shall be specifically described in outline format and in referenced detail. A wall-mounted color-coded piping flow diagram shall be provided in the pool equipment room. The diagram shall be engraved on laminated plastic with color-coded piping to match color of coding on piping, and including valves identified with number on tags. The minimum size shall be 11 inch x 17 inch.
5. Include manufacturer recommended maintenance schedule, parts lists, piping diagram (to agree with wall mounted diagram) and trouble-shooting information for all pool mechanical equipment.
6. Using reference to keyed valves and wall diagram, include specific written instructions for procedures to be followed for the following:

    a. Emptying and refilling the pool(s) including de-watering during the period that the pool(s) will be empty;
    b. Water level control adjustment and chemical control operation;
    c. Normal surge tank operation and balancing;
    d. Filter operation and backwashing; and
    e. Super chlorination.

7. Lubrication and maintenance instructions.
8. Guide to “trouble-shooting”.
9. Parts list and predicted life of parts subject to wear.
10. Outline, cross section, and assembly drawings; engineering data and wiring diagrams.
11. Test data and performance curves, where applicable.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver material in manufacturer's original, unopened containers and crates with all labels intact and legible.

B. Deliver materials in sufficient time and quantity to allow continuity of work and compliance with approved construction schedule.

C. Handle materials in a manner to prevent damage.

D. Store all materials on clean raised platforms with weather protective coverings. Provide continuous protection of materials against damage or deterioration.

E. Remove damaged materials from site.

1.10 SYSTEM TRAINING

A. A qualified representative of the CONTRACTOR performing work under this section shall put the equipment into operation and instruct the Owner's representatives in the operation of this equipment to the Owner's satisfaction immediately after project’s substantial completion.

PART 2 - PRODUCTS

2.01 FILTRATION EQUIPMENT

A. Regenerative Media Filters with Pre-Coat in a Closed Loop

1. Filter System

a. Basis of Design: The filter system under this section shall be a Defender Model SP- 27-48-487, or other as detailed on the drawings.
b. It is the intent of these specifications to describe a filter system complete with all accessory items supplied and warranted by one manufacturer.
c. The primary components of the system consist of the main filter tank, flex tube filter elements, element assembly, bump mechanism, vacuum transfer system, sight glass, pressure gauge panel, inspection (viewing) window, valves and automatic filter controller.
d. All components and related subassemblies shall be factory assembled and tested prior to shipment.

2. Filter System Capacity

a. The pool filter system shall have a capacity of filtering 3,000 gallons in less than 6 hours at a rate of 400-540 gallons per minute.

b. The pool filtration system shall consist of one (1) filter tank with a total designed effective filter surface area of see schedule square feet and operate at a rate of 1.4 or less gallons per minute per square foot of filter area.

3. Filter Tanks

a. The filter tanks shall not be less than 34” in diameter, suitable for 50 psi working pressure and hydrostatically tested to 75 psi. Tank shell shall be not less than ¼” thick. Bottom dished head shall be not less than ¼” thick. Top flat head shall be not less than 1 ½”. thick. All material to be Type A-36 carbon steel.
b. All welding shall be performed by qualified operators. Joints shall be butt or fillet welded inside and out by manual or automatic process. Welded joints shall have complete penetration and fusion with little or no reduction of the thickness of the base metal. Welds shall be free of coarse ripples, grooves, overlaps, abrupt ridges or valleys. All welded surfaces shall be chipped and brushed clean, when necessary, leaving no slag or splatter.
c. Tank legs shall be constructed of 6” x 2 ½” channel legs ¼” thick, 24”, 27” and 33’ filters shall have (3) legs. The material shall be Type A-36 carbon steel. Bearing plates shall be 10” x 5” x 1/4” type 304L stainless steel. Each bearing plate shall have (2) 5/8" drilled holes to secure to the floor with the ½" x 4 ½" stainless steel concrete anchors provided. The legs shall be designed with bolted connections to minimize overall tank height for shipping and access into the mechanical room.
d. The tank heads shall be bolted to the shell with 7/8” diameter T304 stainless steel threaded rods and nuts, 9” on center around the tank perimeter.
e. Tanks shall be equipped with a UL listed grounding lug.
f. Tanks shall incorporate connections for filter influent, effluent, drain; 1-1/2" vacuum transfer piping, 4” viewing window, and lift shaft gland. Refer to the drawings for pipe and connection sizes.
g. Tanks shall include brackets for mounting of automatic controller, gauge panel, filter / regulator, vacuum transfer blower and vacuum hose rack.

4. Flexol 3000 Interior Lining

a. All interior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue and primed as soon as is practical on the same day blasting is done.
b. When priming has dried the lining process will begin. If prime coat has cured for over twenty-four hours, a refresher coat will be applied.
c. Flexsol 3000 shall be an elastomeric polyurethane, 100% solid plural component lining. Hardness shall be 70 durometer on the shore D scale. Break tensile strength shall be 2460 psi with elongation of 25-30%.
d. Application of Flexsol 3000 lining shall be done by experienced applicators using a high pressure, high temperature plural component system. All wetted surfaces including flange faces, manway rings and manway covers shall be lined to 120 mils +/- 5 mils DFT.
e. Hardness shall be verified after curing to ASTM D 2240 standard.

f. Flexsol 3000 lining shall meet the NSF toxicity standard unconditionally and shall be approved for use with the NSF approved filter.

5. Exterior Coatings

a. All exterior surfaces shall be grit blasted to white metal condition with a 2-3 mil profile. Blasted surfaces shall be cleaned of all dust or blast residue and primed as soon as is practical on the same day blasting is done.
b. When priming has dried the coating process will begin. If prime has sat for over twenty-four hours, a refresher coat will be applied.
c. Two coats of high solids enamel shall be applied for a total developed film thickness of 5-8 mils.
d. Manufacturer is to supply min.16 oz of high solids enamel touch-up paint.

6. Internal Components

a. The filters shall consist of flex tube elements, filter tube sheet, stainless steel lift shaft and internal flow diversion assembly.
b. The filter elements shall be flexible tubes that provide the support structure for the media. The outer wall of each element shall be fabricated of multi-filament high strength polyester braid. Each element shall have an internal T304 stainless steel spring, which acts a support structure for the braided filament.
c. The filter element tube sheet shall be fabricated of T304 stainless steel and provide both support for the top of the element assembly as well as water tight seal to prevent media from escaping the filter tank.
d. The lifts shaft shall be fabricated from T304 stainless steel and provide the internal connection between the filter element tube sheet and the external bump mechanism.
e. The filter influent connections shall be fitted with a T316 stainless steel flow diversion assembly to eliminate disturbance to the filter elements during operation.
f. All stainless steel wetted fasteners shall be Type 304.

7. Bump Mechanism

a. The bump mechanisms shall include a pneumatically operated tire mounted externally on the filter tank heads. The tire is alternately pressurized then depressurized causing the connected filter element assembly to move in an upward then downward fashion. This movement shall provide the means of dislodging the media and accumulated solids, which then recoat the filter element.

8. Vacuum Transfer System

a. The vacuum transfer systems shall be provided to allow the recharging of media into the filter for either bag or bulk media.
b. The vacuum blowers shall include a 1.5 HP TEFC 115/230v single phase motor 50/60 Hz.

c. In-line filters with dual connections shall be provided to prevent dust and media from being drawn into the blowers.
d. Provide three (3) 1-1/2” SCH 80 PVC ball valves: for the vacuum drain line, the blower inlet and the vacuum hose.
e. Provide 10 feet of 1-1/2” vacuum hose with required fittings.

9. Automatic Controller

a. The automatic controllers shall provide total control of the system's filtration and regeneration cycles, and provide all necessary equipment interlocks and timing mechanisms to execute the filter program.
b. The controllers shall include an adjustable pressure switch, factory set to 50 psi. The switch shall stop the recirculating pump and close the pneumatic valves if air pressure falls to 50 psi.

c. The controllers shall contain a microprocessor that will activate the following functions of the system:

1) Bump cycle / manual or automatic
2) Pre-coating of the filter elements
3) Stopping and starting of the main recirculating pumps
4) Opening and closing of pneumatically operated valving
5) Vacuum transfer system
6) Heater cool down delay
7) Auxiliary contacts to interlock chemical control or other equipment
8) Keyed switch to activate continuous, intermittent bump cycle for flex tube cleaning.

d. The controller panel shall display the following functions:

1) Filter status
2) Pre-coat status
3) Recirculating pump status
4) Vacuum transfer pump status
5) System power

e. The controller enclosure shall be NEMA 12.
f. The RMF automatic controller will provide signal power to the main recirculating pump motor starters. The unit is required to be a device or variable frequency drive (VFD) and is to be installed with control wiring by the electrical contractor.
g. The RMF shall be 120V, 1 phase, 30 amp rated and shall be UL labeled.

10. Flow Meter

a. A digital flow meter shall be included with a 4-20mA 0-10 VDC analog output.
b. The flow meters shall be wired into the VFDs to provide automatic speed control of the filter pump motors.

c. The VFDs shall compensate for varying filter head losses by maintaining the specified flow rate with the 4-20mA output signal of the flow meters.

11. Filter / Regulator

a. Each filter shall include a combination filter / regulator. The regulator shall be adjustable from 0 – 120 PSI. 1/2” F.P.T. connections shall be provided for field installation of air lines.

12. Water Separator

a. One water separator with automatic drain shall be included for each air compressor supplied. 1/2” F.P.T. connections shall be provided for field installation of air lines.

13. Air Compressor

a. The filtration systems will require (1) air compressor per mechanical room. The following is the minimum requirement: 20 gallon tank, 2 HP 120 V, 1 phase, 15 amp,
b. 5.2 CFM @ 90 psi, air pressure gauge, pressure relief valve, belt guard, pressure switch, air filter.

14. Pneumatic Actuators

a. Each filter shall include pneumatic actuators for one (1) influent valve, one (1) effluent valve and one (1) precoat valve.
b. The actuators shall be double acting with valve mounted drilling to ISO 5211.
c. The actuators shall include two (2) 1/4" FPT ports for open / close connections. Flow control valves with quick connect fittings shall be provided at each port to allow speed control adjustment for the open / close function of the actuators.
d. Materials of Construction

1) Body: aluminum alloy, extruded acc. to ASTM 6063, anodized acc. To UNI 4522
2) Ends: Die-cast in aluminum alloy acc. To ASTM B179, epoxy-polyester coated
3) Pistons: Die-cast in aluminum alloy acc. To ASTM B179
4) Pinion: Nickel-plated steel
5) Slideways: Acetal resin (LAT LUB 731320T)
6) Fasteners: AISI 304 Stainless steel
7) Springs: Epoxy coated steel, pre-compressed
8) Seals: NBR Nitrile rubber
9) Lubricant: MoS2

e. The actuators shall be factory lubricated to allow for 1,000,000 maneuvers.
f. The actuators shall have adjustable travel stops for both directions.

g. Working temperature limits: 4ºF to 186ºF.

15. Fiberglass Eccentric Reducing Flanged Precoat Tees

a. Eccentric reducing precoat tees shall be constructed of fiberglass with flanged connections. The tee shall be equipped with influent, effluent connections as well as a precoat line branch connection sized in accordance with the drawings.
b. Flanged connections shall be ANSI 125# dimensions.
c. Reducing tees shall include a 4” F.P.T. gauge connection.
d. Reducing tees shall be designed for 50 psi operating pressure as manufactured by Neptune-Benson.

16. Solenoid Valves

a. Each filter shall include four-(4) single solenoid, 4-way valves mounted on a multi-station manifold for operation of the pneumatic actuators and bump mechanism.
b. The solenoids valves shall include lighted DIN connectors.
c. The solenoid valves shall be factory lubricated and shall not require any field lubrication.
d. The solenoid valves with multi-station manifold shall be located on the bottom of the automatic controller, factory wired and include quick connect fittings for attachment to the pneumatic actuators and bump mechanism.
e. The solenoid valves shall be SMC Series SY 7000.

17. Valves

a. All valves 3" – 12” shall be constructed with cast aluminum ASTM S12A housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and T304 stainless steel shaft. Valves 14" and larger shall be constructed with cast iron housing fully coated with nylon and with nylon coated ductile iron disc.
b. Valves shall be butterfly valves and shall be provided for the influent, effluent and precoat lines.

18. Drain Requirements (By Others)

a. A sump pit or stand pipe is required for dumping spent media and rinsing tube elements.
b. To prevent overflow the sump or stand pipe drain piping shall be sized for 300 GPM capacity.
c. If drain piping cannot be sized for 300 GPM, or if the sewer is at an elevation higher than the filter tank drain, use the following minimum sump sizes:

1) Model SP-33: 250 gallons
2) Model SP-41: 450 gallons

d. Use a sump pump to transfer waste to sewer.

19. Packaging

    a. For loading and unloading, filter tank diameters 24” – 41” shall be bolted to individual wooden pallets. All tanks shall be shrink wrapped to prevent damage during transport.
    b. The components shall be carefully packaged in a totally enclosed wooden crate to prevent damage during transport.

20. Media

    a. Media shall be expanded perlite with a median particle size of 37 microns. Percentage retained on a +150 Tyler Mesh shall not be less than 8% or more than 25%. Darcy permeability shall be at least 3.25 and have a maximum float of 5%.
    b. The media shall contain no more than 1 tenth of one percent (.001) of crystalline silicate.
    c. The media shall be certified by the manufacturer for use in the filter. The media shall be NSF listed in Standard 61 and Standard 50.
    d. The media shall be Celaperl 1000 as supplied by EP Minerals, or approved equal.
    e. Each Defender filter shall be provided with six (6) charges of perlite media.

21. Quality Assurance

    a. The Contractor shall have documented at least three (3) completed installations of the proposed filtration system or a qualified manufacturer’s representative shall be required for on-site installation supervision.

22. Filter Piping - External (Face)

    a. External face piping shall be Schedule 80 PVC pipe and fittings. Flanges shall be located so as to allow for easy dismantling of face piping. All fittings shall be solvent cemented.
    b. Piping shall be drilled and tapped where necessary to accommodate gauge tubing connectors.
    c. All valves 3" and larger shall be constructed with cast aluminum S12A alloy (as defined by ASTM B275) housing and fully coated with Rilsan on all interior and exterior surfaces. Internal components include EPDM resilient lining, Rilsan coated ductile iron disc and 316L stainless steel shaft. Valves shall be rated for 150 psi bubble tight shutoff. Unless otherwise specified, all nuts and bolts shall be stainless steel with stainless steel washers to be used when secured to PVC flanges. Systems incorporating solenoid, pneumatic, pressure amplified, hydraulic or multi-directional valves shall not be acceptable.
    d. Standard accessory items shall include sight glass rated for 50 psi with polycarbonate glass, remote mounted gauge panel with two 4½" diameter pressure gauges, ¼" petcocks, ¼" poly vent tubing with PVC compression adapters.

23. Backwash Control

    a. The filter manifold face piping shall be designed to allow for one (1) filter tank to be backwashed at a time while the recirculation system is operating. A semi-automatic backwashing system shall be provided with the filter system.
    b. Semi-Automatic Backwashing System

        1) The semi-automatic backwash system shall be capable of operating the entire backwash filter sequence for its respective pool with one push of the button.

    c. Water connection to backwash system and booster pump system

        1) A 3/8” minimum protected water connection shall be provided to the backwash controller. Coordinate with manufacturer.
        2) A booster pump system (BPS) shall be provided by the filter system manufacturer for the purpose of maintaining a consistent, adjustable water pressure for hydraulic actuation of the backwash control valves. The BPS shall include a centrifugal pump, pressure sustaining tank, adjustable pressure switch, valves, required tubing / connectors and all fittings and appurtenances for a complete and operable system.

24. Automatic Air Relief Valve

    a. A 1” valve shall be provided to automatically and continuously release air in the filter. The valve shall be fabricated of plastic with Buna-N seals. A plumbing kit shall be provided with two (2) PVC ball valves to allow manual air relief and isolation of the automatic valve. Valves fabricated of cast iron, bronze or stainless steel valves will not be accepted.

25. Filter Size

    a. Filters have been sized based on a maximum allowable filtration rate of 12.5 GPM/SF:

	Units	Bryan Middle School	Burke High School	McMillan Middle School	Monroe Pool
Volume	Gallons				
Flow Rate	GPM	450	450	450	450
Filter Model					
Filter Size	Sq. Ft.				
Turnover Rate	Hours	6	6	6	6
Filtration Rate	GPM/ Sq.Ft.	1.4	1.4	1.4	1.4

2.02 PIPING SYSTEMS

A. General

1. Provide all recirculating piping between the pool(s) and the filter room, fill receptor and all interconnecting piping to and from the chemical feed systems and chemical controller.
2. Provide all necessary pipe supports and support systems required to support all associated piping and valves.
3. Provide all other tubing, conduit, or piping associated with equipment specified herein. Coordinate with other trades.

B. Pipes

1. Pipe routing as shown and detailed on the contract drawings is diagrammatic only and is not intended to show minor details or exact locations of piping systems. Installation is required to be adjusted to accommodate interference and adjustments anticipated and encountered. Pipe sizes on plans refer to nominal inside diameter of the pipe.
2. All PVC swimming pool piping shall be NSF approved and conform to the requirements of ASTM D-1785.
3. All PVC pipes shall be the product of one manufacturer. Approved manufacturers of PVC piping are Eslon, Harvel, and Chemtrol or approved equal.
4. Swimming pool piping above the floor or deck in the filter room shall be Schedule 80 PVC.
5. Swimming pool piping below the filter room floor or deck shall be NSF approved, Schedule 80 PVC.
6. All swimming pool piping under the pool floor shall be NSF approved, Schedule 40 PVC and concrete encased or Schedule 80 PVC backfilled within a 3/4” minus fine crushed aggregate conforming to ASTM C136, and per recommendations indicated in the project geotechnical report. Fill material shall be submitted to the Architect for review and approval prior to placement of any below grade pool pipe. All transitions between Schedule 40 and Schedule 80 shall be encased in concrete.
7. All below grade swimming pool piping not located beneath the pool floor can be backfilled with native granular material free of ice, clay, debris, organic matter, and rocks larger than 4" across their greatest dimension, and per recommendations indicated in the project geotechnical report.
8. The influent and effluent lines to the heat exchanger unit shall be CPVC. Connections between metallic piping and/or equipment and PVC shall be flanged.
9. All PVC and CPVC fittings shall be the product of one manufacturer. Molded fittings shall be as manufactured by Asahi, Eslon, Chemtrol, Harvel, Spear, Lasco or acceptable substitute. Fabricated fittings shall be as manufactured by Harrison Machine, Plastinetics, or acceptable substitute.
10. Vertical sight sump piping shall be NSF approved, Schedule 40 PVC. Horizontal sight sump piping shall be NSF approved, Schedule 40 PVC that is perforated and wrapped with fabric and have 3/8” diameter holes located top and bottom on 4 ft centers. Horizontal sight sump piping shall extend 1 ft minimum beyond the main drain.
11. Chemical feed lines from chemical feeders to recirculation piping shall be Schedule 80 PVC piping. Piping shall be hard piped into the recirculation plumbing. All required

valves shall be of all PVC construction.

12. All flanged plumbing connection hardware shall be stainless steel.
13. All materials shall be installed by workmen thoroughly skilled in their trades and all work shall present a neat and mechanical appearance when complete. The CONTRACTOR, at
14. no additional expense to the Owner, shall replace or correct any work not judged acceptable by the Architect, Owner's testing agency, or their consultants.
15. All support hardware, brackets, fasteners, hangers, etc. installed in the surge tank shall be 316L stainless steel.
16. No installation shall be made that will provide a cross-connection or interconnection between a distributing supply for drinking purposes and the swimming pool, or between the pool and a sanitary or storm water sewer system that will permit a backflow of water into the pool water system.
17. All piping shall be hydrostatically (water) pressure tested for leaks before and after backfilling to guarantee water tightness. Pneumatic (air) pressure test not allowed.
18. The CONTRACTOR shall provide 1/4" PVC water stops for this work for watertight penetration of concrete walls. Water stops shall be round and the O.D. shall be sized to 150% of the O.D. of the pipe. The water stops shall be thermo-welded to the pipe from both sides and shall be located at the centerline of the wall being penetrated prior to placing the concrete to assure a watertight seal.
19. CONTRACTOR must adhere to all the applicable provisions in Division 22 - Plumbing, "General Provisions" and "Basic Materials and Methods" for installation of piping system.
20. All mechanical equipment to be connected into the recirculation piping system shall be done so using flanged or union connections.
21. Provisions shall be made to purge all pipes in the system.
22. Concentric reducers shall be fiberglass by MerMade Filter, Inc., or equivalent reducers of schedule 80 PVC construction.

C. Pipe Hangers and Supports

1. Manufacturer

a. Subject to compliance with these specifications, pipe hanger and support systems shall be manufactured by Cooper B-line (basis of design), Inc, TOLCO, and Anvil International or approved equal.

2. Hangers

a. Pipes 2 inches and smaller

1) Adjustable steel clevis hanger, B-Line models B3100 or B3104.
2) Adjustable steel swivel ring (band type) hanger, B-Line model B3170.

b. Pipes 2-1/2 inches and larger

1) Adjustable steel clevis hanger, B-Line model B3100.
2) Adjustable steel yoke pipe roll, B-Line model B3114.

3. Multiple or Trapeze Hangers

    a. Trapeze hangers shall be constructed from 12 gauge roll formed ASTM A1011 SS, Grade 33 structural steel channel, 1-5/8 by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
    b. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B- Line B-2000 series.

4. Wall Supports

    a. Pipes 2-1/2 inches and smaller

        1) Steel offset “J” hook hanger, B-Line model B3600.

    b. Pipes 3 inches and larger

        1) Welded strut bracket and pipe straps, B-Line models B3064 and B2000 series.
        2) Welded steel bracket B-Line model B3066 or B3067 with roller chair or adjustable steel yoke pipe roll. B-Line model B3120 or B3110.

5. Floor Supports

    a. Electroplated carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line model B3093 and B3088T or B3090 and B8088. Pipe saddle shall be screwed or welded to appropriate base stand.

6. Vertical Supports

    a. Steel riser clamp sized to outside diameter of pipe, B-Line model B3373.

7. Plastic Pipe Supports

    a. V-Bottom clevis hangers with galvanized 18-gauge continuous support channel, B-Line models B3106 and B3106V, to form a continuous support system for all plastic pipes smaller than 1 inch or flexible tubing.
    b. A vented and sloped continuous PVC Schedule 40 pipe no smaller than 1-1/2 inch outside diameter will be used to route flexible tubing with the appropriate pipe supports.

8. Supplementary Structural Supports - Design and fabricate supports using structural quality steel bolted framing materials. Channels shall be roll formed, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch or greater as required by loading conditions. Submit design for pipe tunnels, pipe galleries etc. for approval. Use clamps and fittings designed for use with the strut system.

D. Hanger Attachments

1. Upper Attachments

a. Beam Clamps

1) Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
2) C-Clamps shall be locknuts and cup point set screws similar to B-Line model B351L or B3036L. Top flange c-clamps shall be used when attaching a hanger rod to the flange of structural steel, B-Line model B3034 or B3033 or approved equal. Refer to manufacturers recommendations for set screw torque. Retaining straps shall be used to maintain the clamp position on the beam where required.
3) Center load beam clamps shall be used where specified. Steel clamps shall be B-Line models B3050 or B3055. Forged steel beam clamps with cross bolt shall be B-Line B3291-B3297 series or approved equal as required to fit beams.

b. Concrete Inserts

1) Cast in place spot concrete inserts shall be used applicable, either steel or malleable iron body, B-line B2500 or B3014 or approved equal. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rods sizes, B-line models N2500 or B3014N series.
2) Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 Grade 33 structural quality carbon steel, complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs/ft. in concrete, B-Line models B22I, 32I, or 52I or approved equal. Select channel nuts suitable for strut and rod sizes.

E. Hanger Accessories:

1. Hanger rods shall be threaded on both ends or continuously threaded rods of circular cross section. Use adjustable lock nuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

F. Hanger Finish

1. Indoor Finishes

a. Hangers shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish.
b. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade

33 G90 OR shall have an electro-deposited green epoxy finish.

c. Zinc Plated hardware is not acceptable for use in chemical rooms.

G. Valves

1. Valves 3 inches and larger shall be butterfly type valves, with PVC body, 150# SWP with stainless steel shaft, polypropylene disc and replaceable resilient seat bonded to a rigid shaft and guaranteed for bubble tight shutoff from 27 inch vacuum to 150 PSI. Extended neck 2 inch beyond flanges for any insulated piping shall be provided with handle for manual operation. All valve components shall be suitable for swimming pool chlorinated
2. water service. Butterfly valves shall be Georg Fischer Type 563, Asahi/America Type SP Pool-Pro, Chemtrol Model-B, Simtech VP series, Colonial Valve 411 Series, or approved equal.
3. Valves smaller than 3 inches shall be PVC true union ball valves, full port, three-piece construction, blowout-proof stem, Viton seal with socket end connectors.
4. Check valves shall be a quick closing non-slam type, either self-aligning wafer or flanged type, of corrosion resistant materials suitable for use in a swimming pool environment. Install check valves in accordance with the manufacturer's recommendations. Locate check valves at least 5 pipe diameters from pumps and fittings. Provide check valves as indicated, on water feature or water play equipment systems where water is being pumped significantly above the source pool water level. Check valves shall be either by Technocheck Corp., model 5050, with epoxy coated cast iron body and bronze swing plates on a stainless steel spring; or approved equal, for installation between 150 lb flanges.
5. Modulating float valve in the surge tank(s) shall have PVC body and stainless steel wafer disc. All hardware shall be non-corrodible. The float-operated valves shall be provided horizontally on the main drain lines in the surge tank(s). Valve shall consist of all non- corrosion components including shaft, float arm, pins and floats. Valve shall be suitable for mounting on a 125E class standard PVC flange. The float arm leverage weight and pivot lengths shall be adjustable to obtain desired ratio of surge tank level change to pool gutter overflow level change. Two floats and stabilizer required. Valve shall be Model FV-D XWB (Extra Weight Ball) as manufactured by MerMade Filter, Inc. or approved equal manufactured by EPD.

PART 3 - PART 3 EXECUTION

3.01 EXISTING CONDITIONS, INSPECTION AND PREPARATION

A.

A. Carefully examine all of the contract documents for requirements that affect the work of this section. Prior to starting any work, notify the General Contractor of defects requiring correction. Do not start work until conditions are satisfactory.

B. Verify that all work by others, related to this section, has been completed. This includes all earthwork, concrete work, and mechanical, electrical and plumbing connections.

C. Protect all materials and work completed by others from damage while completing the work in this section.

3.02 FIELD MEASUREMENTS

A. Verify benchmark and pool location prior to layout.

B. If field measurements differ from the construction drawing dimensions, notification shall be given to the Architect prior to proceeding with work.

3.03 PIPING INSTALLATION

A. General

1. a. Provide and erect, according to the best practices of the trade, all piping shown on the drawings and required for the complete installation of these systems. The piping shown on the drawings shall be considered as diagrammatic in indicating the general run and connections, and may or may not in all parts be shown in its true position. The piping may have to be off set, lowered or raised as required or as directed at the site. This does not relieve the CONTRACTOR from responsibility for the proper erection of the systems or piping in every respect suitable for the work intended as described in the specifications and approved by the Architect. In the erection of all piping, it shall be properly supported and proper provisions shall be made for expansion, contraction and anchoring of piping. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure
2. to facilitate installation will not be permitted. All pipes shall have burrs and/or cutting slag removed by reaming or other cleaning methods in strict accordance with the manufacturer's instructions. All changes in direction shall be made with fittings. All open ends of pipes and equipment shall be properly capped or plugged to keep dirt and other foreign materials out of the systems. Plugs of rags, wool, cotton waste or similar materials will not be used in plugging. All piping shall be arranged so as not to interfere with removal and maintenance of equipment, filters or devices, and so as not to block access to manholes, access openings, etc. Flanges or unions as applicable for the type of piping specified shall be provided in the piping at connections to all items of equipment. All piping shall be installed to ensure noiseless circulation. All valves and specialties shall be so placed to permit easy operation and access.

B. Pipe Hangers and Supports

1. Pipes shall be adequately supported by pipe hangers and supports specified in Paragraph
2. 2.05 Pipe, Hangers, and Valves.

3. Horizontal PVC Schedule 80 piping shall be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 120 degree F and as listed below:

Nominal Pipe Size (I	Hanger Support Spacir (Feet)	Minimum Rod Siz Single Rod Hanger
1-1/4" and les	5	3/8"
1-1/2" to 3"	6	1/2"
4" to 6"	8	5/8"
8" to 12"	10	7/8"
Greater than 1	12	1"

4. Horizontal CPVC Schedule 80 piping shall be supported in accordance with the manufacturer's recommendations for fluid temperature not exceeding 140 degree F and as listed below:

Nominal Pipe Size	Hanger Support Sp (Feet)	Minimum Rod Size for Rod Hanger (Inch
½" and less	4	3/8"
¾" to 2"	6	3/8"
2-1/2" to 3'	7	1/2"
4" to 8"	8	7/8"
Greater than	10	1"

C. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non adhesive isolation tape.

D. Install hangers to provide a minimum of 1 inch space between finished covering and adjacent work.

E. Place a hanger within 12 inches of each horizontal elbow.

F. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

G. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.05.C.3. Trapeze hangers shall be spaced according to the smallest pipe size, or install intermediate supports according to the support spacing schedules.

H. Do not support piping from other pipes, ductwork or other equipment that is not building structure. Do not modify building structure for hanger installation.

I. Concrete Inserts

1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
2. Where concrete slabs form finished ceilings, provide inserts to be flush with the slab surface.

J. Pipe Hangers and Supports

1. All piping shall be rigidly supported from the building structure by means of hanger assemblies properly selected and sized for the application in accordance with the manufacturer's recommendations and specifications.
2. All piping in a service tunnel, if required shall be supported by a structure of the CONTRACTOR'S design. The structure shall be non-corrodible and shall be of a size and configuration to rigidly support all the piping as shown in the plans at a minimum spacing as shown below.
3. Piping hangers shall be spaced per the below schedule and shall have hangers not more than one foot on each side of every change in direction. The piping systems shall be installed in an approved manner and shall not overload the building structural frame. The CONTRACTOR shall provide additional hangers and miscellaneous steel supports as required to distribute the piping system load over several structural members where required or directed. Maximum allowable spacing for piping shall be as follows:

PVC Piping	Maximum Spacing
3/4" thru 2"	5'-0"
2 1/2" thru 4"	6'-0"
6" thru 10"	9'-0"
12" thru 14"	12'-0"

4. Round rods supporting the pipe hangers shall be of the following dimensions:

1/2" to 2" pipe	-3/8" rod
2-1/2" to 3" pipe	-1/2" rod
4" to 5" pipe	-5/8" rod
6" pipe	-3/4" rod

5. Hanger rods shall be galvanized steel. Provide for controlling level and slope by turn buckles or other approved means of adjustment and incorporate lock nuts.

6. Where piping is installed side by side, the CONTRACTOR will support the piping by utilizing trapeze type hanger assemblies. Horizontal trapeze member shall be non-metallic channel. The CONTRACTOR shall provide heavier members as required for the load to be supported for the entire span distance. Hanger rods shall be as specified above and properly sized for the load supported, but not less than 5/8 inches diameter.
7. The use of pipe hooks, chains, or perforated iron for pipe hanger supports will not be permitted.
8. Attachment of piping hangers to the building structure shall be provided in a manner approved by the Architect. The CONTRACTOR shall provide concrete inserts to be installed by the General Contractor in the building construction at the time the concrete is poured and hangers shall be attached to these inserts.

K. Piping Installation

1. Trench bottoms shall be smooth and free of rocks and debris. If the trench is dug in ledge rock, hardpan or where large boulders are not removed, place 3 inches of sand or compacted fine-grained soil below pipe. Pipe must be supported over its entire length with firm, stable material. Blocking will not be used to change pipe grade or provide intermittent support over low sections in the trench. Surround the pipe with backfill meeting the requirements of Section 312000 with a particle size of 1-1/2 inch or less and in accordance with the project geotechnical report. Compact in layers not to exceed 6-inches with vibratory method. Follow installation methods of ASTM D2774 "Underground Installation of Thermoplastic Pressure Piping".
2. Installations are to be installed in a straight run of pipe, with a minimum 10 pipe diameters upstream and minimum 5 pipe diameters downstream of any pipe fitting.

L. Flushing, Draining and Cleaning Pipe Systems

1. The CONTRACTOR shall flush out all water systems with water before placing them in operation. Other systems shall be cleaned by using compressed air or nitrogen. After systems are in operation and during the test period, all strainer screens shall be removed and thoroughly cleaned.

M. Expansion and Contraction

1. The CONTRACTOR shall make all necessary provisions for expansion and contraction of piping with offsets, loops, flexible connections and anchors as required to prevent undue strain. The CONTRACTOR shall provide shop drawings for proposed method and arrangement for control of expansion and contraction of piping.

N. Testing

1. All piping installation and pressure testing shall be reviewed by the Owner’s testing agency before commencement of backfilling. A minimum notice of one (1) week is required prior to review. Results of review shall be documented.
2. All pool related piping, shall be hydraulically pressure tested (with water, not air) to a pressure of not less than 50 PSI for a period of no less than two (2) hours.

3. Contractor is responsible for the maintenance of a sustained 20 PSI pressure on all pool related piping throughout the course of construction.

3.04 EQUIPMENT AND SYSTEMS INSTALLATION

A. The CONTRACTOR shall assemble and install all equipment, special parts and accessories as shown on pool drawings, specifications and shop drawings of the equipment suppliers.

B. The CONTRACTOR shall install all equipment and systems in accordance with manufacturer's directions. Equipment shall all be assembled and in place for final observation.

C. All items necessary to complete this section are shown on the plans or described in the specifications including items that may be purchased by the Owner. Items are detailed and specified as a guide for dimensional purposes. The CONTRACTOR must make provisions accordingly and submit shop drawings and submittals based on that data.

3.05 START-UP AND INSTRUCTION

A. The CONTRACTOR shall deliver three (3) complete sets of operating and maintenance instructions for the swimming pool, structures, finishes and all component equipment.

B. Written reports of each of these visits outlining the pool's operation, competence and performance of the pool's operation personnel, and other pertinent comments shall be submitted to the Owner and Architect/Engineer within one (1) week after each visit.

END OF SECTION 13 11 00

SECTION 238416.16 - INDOOR, MECHANICAL DEHUMIDIFICATION 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.

1.2 SUMMARY

A. Section includes packaged, factory-assembled and -tested, refrigerant-type, indoor, mechanical dehumidification units designed for indoor installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of indoor, mechanical dehumidification unit.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each indoor, mechanical dehumidification unit.

1. Include plans, elevations, sections and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of dehumidification units.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
5. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For indoor, mechanical dehumidification units.

1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates for indoor, mechanical dehumidification units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Test Reports: For each indoor, mechanical dehumidification unit, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dehumidification units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set of each type of filter specified.
2. Fan Belts: One set for each belt-drive fan.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of indoor, mechanical dehumidification units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Refrigerant Coils: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR, MECHANICAL DEHUMIDIFICATION UNIT MANUFACTURERS

A. Basis-of-Design Product Pool Pak: Subject to compliance with requirements, provide the product indicated on Drawing or a comparable product.

2.2 PERFORMANCE REQUIREMENTS

A. 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.

B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."

D. ASHRAE 15 Compliance: "Safety Standard for Refrigeration Systems."

E. Capacities and Characteristics:
   a. See Schedules on Drawings

2.3 CASINGS

A. Casing: Double-wall construction with interior corrosion-resistant coating, steel or aluminum, stainless-steel fasteners, knockouts for electrical and piping connections, condensate drain connection, and lifting lugs.

1. Access: Hinged access doors with neoprene compression gaskets and cam latches.
2. Insulation: Minimum 2-inch- (50-mm-) thick, glass-fiber-insulation fill or closed cell foam, with thermal breaks.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Drain Pan and Connection: Stainless steel; insulated.

2.4 FANS

A. Supply Fans:

1. Blades: Forward curved.

2. Type: Unhoused plenum type, centrifugal.
3. Blade and Housing Material: Galvanized steel with powder-coated finish.
4. Drive: Direct-driven with keyed motor shaft.

B. Exhaust Fans:

1. Blades: Forward curved.
2. Type: Housed or Unhoused plenum type, centrifugal.
3. Blade and Housing Material: Galvanized steel with powder-coated finish.
4. Drive: Direct-driven with keyed motor shaft.

C. Variable-Frequency Motor Controller:

1. Manufactured Units: Pulse-width modulated; inverter-duty motors.
2. Output Rating: Three phase; 10 to 66 Hz, with torque constant as speed changes]; maximum voltage equals input voltage.
3. Unit Operating Requirements:

a. Internal Adjustability:

1) Minimum Speed: 5 to 25 percent of maximum rpm.
2) Maximum Speed: 80 to 100 percent of maximum rpm.
3) Current Limit: 30 to minimum of 150 percent of maximum rating.

b. Self-Protection and Reliability Features:

1) Surge suppression.
2) Loss of input signal protection.
3) Under- and overvoltage trips.
4) Variable-frequency controller and motor-overload/overtemperature protection.
5) Critical frequency rejection.
6) Loss-of-phase protection.
7) Reverse-phase protection.
8) Motor-overtemperature fault.

c. Bidirectional autospeed search.
d. Torque boost.
e. Motor temperature compensation at slow speeds.

1) Panel-mounted operator station.
2) Historical logging information and displays.
3) Digital indicating devices.

f. Control Signal Interfaces: Electric.
g. Proportional-integral-derivative control interface.
h. DDC system for HVAC Protocols for Network Communications.

4. Line Conditioning:

    a. Input line conditioning.
    b. Output filtering.
    c. EMI/RFI filtering.

5. Bypass Systems:

    a. Bypass Mode: Manual operation only

2.5 FILTERS

A. Pleated:

1. Thickness: 2 inches (50 mm.
2. MERV Rating: MERV 13, according to ASHRAE 52.2.

2.6 REFRIGERATION SYSTEM

A. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IES 90.1.

B. Refrigerant Coils with Multiple Refrigerant Circuits:

1. Tubes: Copper.
2. Fins:

    a. Material: Aluminum.
    b. Fin Spacing: Maximum 12 fins per inch (mm).

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Stainless-steel frame.
6. Coatings: Corrosion-resistant coating.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.
8. Source Quality Control: Factory test to minimum 450-psig (3105-kPa) internal pressure and to minimum 300-psig (2070-kPa) internal pressure while underwater.

C. Compressors: Hermetic, scroll compressors with integral vibration isolators and crankcase heaters that de-energize during compressor operation; with thermal-expansion valves, filter-dryers, sight glasses, compressor service valves, and liquid- and suction-line service valves.

1. Minimum Number of Refrigerant Circuits: Two for compressor capacities of more than 7-1/2 tons (26.4 kW).
2. Capacity Control:

    a. Hot-gas bypass valve and piping on one compressor.
    b. Cycle compressor.

3. Low-Pressure Cutout: Manual reset after three automatic-reset failures.

4. High-Pressure Cutout: Manual reset.
5. Compressor Motor Overload Protection: Manual reset.
6. Antirecycling Timing Device: Prevent compressor restart for five minutes after shutdown.
7. Defrost Cycle: Adjustable timer shuts off supply fan. Compressor cycles until suction-line temperature confirms thawed evaporator coil.

D. Energy Recovery Heat Exchanger (Pool Heater): Cupronickel, coaxial, vented, double-wall construction for potable-water service.

2.7 REMOTE-MOUNTED, AIR-COOLED CONDENSER UNIT

A. Casing: Steel, baked-enamel finish; with access doors or removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Refrigerant Coil:

1. Copper tube with mechanically bonded aluminum fins; with liquid subcooler.

C. Fan: Aluminum-propeller type, directly connected to permanently lubricated motor with integral thermal-overload protection.

D. Adjustable, Low Ambient Head-Pressure Control: Designed to operate at temperatures as low as 0 deg F (minus 18 deg C) by cycling condenser fans and controlling speed of last fan of each circuit.

2.8 HEATING COILS

A. Hot-Water Coil: Continuous circuit coil.

1. Tubes: Copper.
2. Fins:

   a. Material: Aluminum.
   b. Fin Spacing: Maximum 12 fins per inch.

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Cast iron or Copper with drain and air vent tappings.
5. Frames: Galvanized-steel channel, minimum 0.052 inch (1.3 mm).
6. Coatings: None.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

   a. Working-Pressure Ratings: Minimum 200 psig (1380 kPa), 325 deg F (163 deg C).

8. Source Quality Control: Test to minimum 300 psig (2070 kPa) internal pressure.

B. Steam Coil: Distribution header coil fabricated according to AHRI 410, with threaded steam supply and condensate connections.

1. Tubes: Copper.
2. Fins:

a. Material: Aluminum.
b. Fin Spacing: Maximum 12.

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Cast iron with drain and air vent tappings.
5. Frames: Galvanized-steel channel, minimum 0.052 inch (1.3 mm).
6. Coatings: None.
7. Ratings: Designed, tested, and rated according to ASHRAE 33 and AHRI 410.

a. Working-Pressure Ratings: Minimum 100 psig (690 kPa), 400 deg F (205 deg C).

8. Source Quality Control: Test to 200-psig (1380-kPa) internal pressure.

2.9 DAMPERS

A. Outdoor-Air Dampers: Opposed-blade, dampers with [zinc-plated-steel] <Insert material> operating rod rotating in sintered bronze or nylon bearings. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod. Size for 0 to 25 percent outdoor air, with motorized operator and filter.

B. Outdoor-, Return-, and Exhaust-Air Dampers:

1. Low-leakage, double-skin, airfoil-blade, aluminum dampers.
2. Compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement.
3. Zinc-plated-steel operating rods rotating in stainless-steel sleeve bearings mounted in a single aluminum frame.
4. Operating rods connected with a common linkage.
5. Leakage rate shall not exceed 5 cfm/sq. ft. (0.22 L/s per sq. m) at 1-inch wg (250 Pa) and 9 cfm/sq. ft. (0.4 L/s per sq. m) at 4-inch wg (1.0 MPa).

C. Damper Operator: 24 V ac, close coupled, with gear train sealed in oil and with spring return.

2.10 CONTROLS

A. Control Panel: Integral service compartment containing fan-motor thermal and overload cutouts, compressor thermal and overload cutouts, 115-V control transformer if required, magnetic contactors for fan and compressor motors, and a nonfused factory-mounted and -wired disconnect switch for single external electrical power connection.

B. Interface with DDC System for HVAC: Factory-installed hardware and software to enable the DDC system for HVAC to monitor, control, and display status and alarms.

C. Operating Control: Space humidistat cycles the compressor. Humidistat shall incorporate fan on-off-auto switch.

D. Operating Control: Factory-installed microprocessor controller, capable of being remotely mounted.

1. Display the following on the face of controller:

a. System on.
b. System dehumidifying mode.
c. System air-conditioning mode.
d. System outdoor-air (economizer) mode.
e. System heating pool water.
f. Auxiliary space heat is operating.
g. Unit requires service.
h. Return-air (space) temperature.
i. Return-air (space) humidity.
j. Pool-water temperature.
k. Outdoor-air temperature.

2. Indicate the following sensor failures on panel:

a. Airflow: Dirty air filter, blocked airflow, and fan failure.
b. Refrigerant high and low pressure.
c. High water temperature.
d. High and low evaporator temperature.
e. Low water flow.
f. Communication fault.
g. System off.
h. Antishort cycle delay.
i. Power failure.

3. Provide access to the following set points on panel:

a. Space temperature.
b. Space relative humidity.
c. Outdoor ventilation/air-conditioning changeover temperature.
d. Airflow alarm.

4. Provide the following displays on panel:

a. Space temperature.
b. Space relative humidity.
c. Outdoor-air temperature.
d. Supply-air temperature.
e. Return-air temperature.
f. Airflow rating.
g. Air-off evaporator temperature.
h. Return-air relative humidity.
i. Service codes.

5. Provide the following controls on panel:

    a. System on-off, fan continues to run.
    b. Fan on-off.
    c. Service code access.
    d. System dehumidifying mode.
    e. System air-conditioning mode.
    f. System outdoor-air (economizer) mode.
    g. Auxiliary space heat is operating.
    h. Outdoor-air-temperature, conditioned-space-temperature, and control set-point-temperature digital display.
    i. Outdoor enthalpy digital display.
    j. Filter pressure drop digital display.
    k. Status: Airflow, fans, system, unit operation, and operating mode.
    l. Alarm digital display.

E. Operating Control: Factory-installed microprocessor controller.

1. Factory-installed operator panel with backlit display, capable of being remotely mounted, allows menu-driven display for navigation and control of unit.
2. Integral clock.
3. Personal computer interface.
4. Integral LAN for direct connection to BACnet.
5. Factory programmed.
6. Unit-Mounted Sensors:

    a. Airflow switch.
    b. Compressor-discharge temperature.
    c. Evaporator-air temperature.
    d. Pool-water-out temperature.
    e. Pool-water-in temperature.
    f. Relative humidity.
    g. Return-air temperature.
    h. Supply-air temperature.

7. Integral diagnostics.
8. Nonvolatile memory.
9. IP or SI display.
10. Provide the following status and alarm functions:

    a. System: On-off.
    b. Power failure.
    c. Fan: Off, overload.
    d. Compressor: On, turned off, overload, high pressure, low pressure, overheat, oil failure, and pumpdown.
    e. Evaporator damper closed.
    f. Pool: Low water flow, heating on.
    g. Dehumidification: Call for, on.
    h. Air Conditioning: Call for, on.
    i. System outdoor-air (economizer) mode.

j. Auxiliary space heat on.
k. Alarms: Firestat, freezestat, and filters.

11. Provide the following controls via operator panel:

a. Compressor auto-off.
b. Fan auto-off.
c. Set-Point Adjustments: Relative humidity, temperatures, deadbands, and differentials.
d. Sensor calibration.

2.11 ACCESSORIES

A. Water-Cooling Heat Exchanger: Coaxial, vented, double-wall construction; with three-way refrigerant control valve.

B. Smoke Detectors: Photoelectric detector located in return-air plenum, to de-energize unit.

1. Operating Voltage: 24 V dc, nominal.
2. Self-Restoring: Detectors do not require resetting or readjusting after actuation to restore them to normal operation.
3. Plug-in Arrangement: Detector and associated electronic components mounted in module with tamper-resistant connection to fixed base with twist-locking plug. Terminals in fixed base accept building wiring.
4. Integral Visual-Indicating Light: Digital-display type indicating detector operation.
5. Sensitivity can be tested and adjusted in-place after installation.
6. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the fire-alarm control panel.
7. Sensor: Digital display or infrared light source with matching silicon-cell receiver.
8. Detector Sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) of smoke obscuration when tested according to UL 268A.
9. Integral Thermal Detector: Fixed-temperature type with 135 deg F (57 deg C) setting.

C. Electrical Convenience Outlet: 115 V ac fused, duplex, straight-blade receptacles, separately fused and located inside control panel.

2.12 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.

F. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3,000-hour salt-spray test according to ASTM B117.

1. Standards:

a. ASTM B117 for salt spray.
b. ASTM D2794 for minimum impact resistance of 100 in/lb (11.3 N/m).
c. ASTM B3359 for cross hatch adhesion of 5B.

2. Application: Immersion.
3. Thickness: 1 mil (0.025 mm).
4. Gloss: Minimum gloss of 60 on a 60-degree meter.

2.13 SOURCE QUALITY CONTROL

A. Verification of Performance: Factory test and rate dehumidification units according to AHRI 910.

B. Sound-Power-Level Ratings: Factory test and rate dehumidification units according to AHRI 575.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for hot-water, steam, refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where dehumidification units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install dehumidification units on cast-in-place concrete equipment base(s).

3.3 PIPING CONNECTIONS

A. Where piping is installed adjacent to dehumidification units, allow space for service and maintenance of dehumidification units.

B. Connect piping to dehumidification units mounted on vibration isolators with flexible connectors.

C. Connect condensate drain pans using minimum NPS 1-1/4 (DN 32) copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan, and install cleanout at changes in direction.

3.4 ELECTRICAL CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.
   2. Locate nameplate where easily visible.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring between control devices.

C. Connect smoke detector to fire alarm system.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks. Repair leaks and retest until no leaks exist.
   2. Charge refrigerant coils with refrigerant and test for leaks. Repair leaks and retest until no leaks exist.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Dehumidification unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.7 CLEANING

A. Clean dehumidification units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils' entering-air face.

B. After completing system installation, testing, and startup service of dehumidification units, clean filter housings and install new filters.

3.8 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust initial temperature and humidity set points.

3.9 STARTUP SERVICE

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

1. Complete installation and startup checks according to manufacturer's written instructions.

B. Perform the following final checks before startup:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify free fan wheel rotation and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.
5. Check lubrication of bearings, pulleys, belts, and other moving parts.
6. Set outside- and return-air mixing dampers to minimum outside-air setting.
7. Install clean filters.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

C. Starting procedures for dehumidification units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace malfunctioning motors, bearings, and fan wheels.
2. Measure and record motor's electrical values for voltage and amperage.
3. Manually operate dampers from fully closed to fully open position and record fan performance.

D. Startup Report: Report findings during startup. Identify startup steps, corrective measures taken, and final results.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain dehumidification units.

END OF SECTION 23 84 16.16

SECTION 260100 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

B. Project closeout procedures shall follow the requirements of Section 01 70 00.

1.2 SUMMARY

A. This Section includes general electrical requirements and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1.3 WARRANTIES

A. All materials, workmanship and equipment shall be warranted against defects or against injury from proper and usual wear for a period of one year after the date of substantial completion. Certain equipment shall be warranted beginning at the time of final acceptance or for longer periods of time as specified in those sections of the Project Manual. Any item which becomes defective within the warranty period shall be repaired or replaced, at no additional cost to the Owner.

B. All manufactures warranties shall run to the benefit of the Owner. No manufacturer's warranties shall be voided or impaired.

C. Warranty shall include repair of faulty workmanship.

1.4 ALTERNATES

A. Alternates, if required, shall be as described in the "Alternates" section of this specification, as described on the proposal form or as indicated on the drawings.

1.5 INTERPRETATION OF DOCUMENTS

A. Any questions regarding the meaning of any portion of the contract documents shall be submitted to the Architect/Engineer for interpretation. Addenda or supplemental information will publish definitive interpretations or clarification. Verbal interpretation not issued by addendum or supplemental information shall not be considered part of the contract documents.

B. The Architect/Engineer shall be the sole judge of interpretations of discrepancies within the contract documents.

C. If ambiguities should appear in the contract documents, the Contractor shall request clarification from the Architect/Engineer before proceeding with the work. If the Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out the work in a manner satisfactory to the Architect/Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work unless a written clarification from the Architect/Engineer was requested and obtained before submission of proposed methods or materials.

1.6 DEFINITIONS ABREVIATIONS

A. The following shall apply throughout the contract documents

1.	Code	All applicable national state and local codes
2.	Furnish	Supply and deliver to site ready for installation
3.	Indicated	Noted, scheduled or specified
4.	Provide Owner	Furnish, install and connect complete and ready for final use by
5.	ADA	Americans with Disabilities Act
6.	ANSI	American National Standards Institute
7.	ASTM	American Society for Testing and Materials
8.	FM	Factory Mutual System
9.	IRI	HSB Industrial Risk Insurers
10.	NEC	National Electric Code (NFPA 70)
11.	NEMA	National Electrical Manufacturers Association
12.	NFPA	National Fire Protection Association
13.	UL	Underwriters Laboratories Inc.

1.7 CODES AND STANDARDS

A. All work shall be performed by competent craftsmen skilled in the trade involved and shall be done in a manner consistent with normal industry standards.

B. Design shall adhere to the following:

1. Safety and Health Regulations for Construction.

2. Occupational Safety and Health Standards (OSHA), National Consensus Standards and Established Federal Standards.

3. National Electrical Code (NEC), Latest Edition.

4. American National Standards Institute (ANSI).

5. National Electrical Manufacturer's Association (NEMA).

6. Institute of Electrical and Electronics Engineers (IEEE).

7. National Fire Protection Association (NFPA).

8. Insulated Power Cable Engineers Association (IPCEA).

9. American Society for Testing Materials (ASTM).

10. Life Safety Code (NFPA 101).

11. Underwriter's Laboratories, Inc. Standards (UL).

12. Independent Testing Laboratories (ITL).

13. Electrical Testing Laboratories (ETL).

14. National Electrical Safety Code (NESC).

15. Factory Mutual Engineering Corporation or other recognized national laboratories.

16. Uniform Building Code (UBC).

17. State and local codes.

C. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified shall not be substituted.

1.8 PERMITS

A. Contractor shall become familiar and comply with all requirements regarding permits, fees, licenses, etc. All permits, licenses, inspections and arrangements required for the work shall be obtained by Contractor’s effort and expense. All utilities shall be installed in accordance with the local rules and regulations and all charges shall be paid by the Contractor. Capital facilities fees will be paid by Owner.

1.9 SUBMITTALS

A. Division 1 section “Submittals” shall be adhered to if more stringent than this section.

B. Shop drawings shall be submitted to Architect/Engineer for review when required by other sections of this specification and for all equipment scheduled or specified on drawings.

1. A letter of transmittal shall accompany each submittal. Submittals shall be numbered consecutively and list products covered.

2. Unless otherwise noted, submit a minimum of six (6) copies of shop drawing and product data for review.

C. Shop Drawings

1. Shop drawings include fabrication and installation drawings, diagrams, schedules of other data specifically prepared for the project. Include dimensions and notations showing compliance with specified standards.

2. Drawing sheet size shall be at least 8 ½” x 11” and no longer than 30” x 42”. For sheets larger than 11” x 17”, submit one sheet of reproducible media and one blue-line or photocopy print. Architect/Engineer action will be returned on reproducible media.

D. Product Data

1. Product data includes printed information, such as manufacturer’s installation instructions, catalog cuts, standard color charts, rough-in diagrams, wiring diagrams and performance curves.

2. Each copy shall clearly indicate conformance with specified capacities, characteristics, dimensions and details. Mark all equipment with same item number as used on drawings. Mark each copy to clearly indicate applicable choices and options.

E. Architect/Engineer will review or take appropriate action for submittals. Review is only to determine general conformance with design shown in contract documents.

F. Architect/Engineer review of submittals shall not relieve contractor of responsibility for deviation from requirements of the contract documents or from errors or omissions within submittals.

G. No portion of the work requiring submittals shall be commenced until the Architect/Engineer has reviewed the submittal.

H. Electronic Floor Plan Drawings may be requested for use in preparation of shop drawings. Indicate the project name, and floor plan sheets requested. The use of these drawings is intended solely for preparation of drawings required by this specification. Copyright law prohibits any other use. The user of the electronic files assumes full responsibility for the accuracy and scale of the drawings.

I. See “Submittal Schedule” at the end of Section 260100 – General Electrical Requirements.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete PDF set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:
   a. Emergency instructions and procedures.
   b. System, subsystem, and equipment descriptions, including operating standards.
   c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
   d. Description of controls and sequence of operations.
   e. Piping and wiring diagrams.

2. Maintenance Data:
   a. Manufacturer's information, including list of spare parts.
   b. Name, address, and telephone number of installer or supplier.
   c. Maintenance procedures.
   d. Maintenance and service schedules for preventive and routine maintenance.
   e. Maintenance record forms.
   f. Sources of spare parts and maintenance materials.
   g. Copies of maintenance service agreements.
   h. Copies of warranties and bonds.

1.11 PROJECT RECORD DOCUMENTS

A. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. Mark Record Prints to show the actual installation where installation varies from that shown originally.

2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

3. Mark important additional information that was either shown schematically or omitted from original Drawings.

4. Note Construction Change Directive numbers, Change Order numbers, alternate numbers, and similar identification where applicable.

5. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1.12 Project Closeout

A. Project closeout procedures shall follow the requirements of Section 01 70 00.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials and equipment used in the construction of the project shall be new unused and undamaged unless otherwise specified. Materials and equipment shall be of latest design standards of manufacturer specified.

B. Materials and equipment are limited by the requirements of the contract documents. Material and equipment shall be provided in accordance with the following:

1. Basis of Design Products: Basis of Design Products are those products around which the project was designed in terms of capacity, performance, physical size and quality. Basis of Design Products shall be provided unless substitutions are made in accordance with this specification.

2. Substitutions: Substitutions are product of manufacturers other than listed as Basis of Design. Substitutions shall meet each of the following requirements and shall be subject to prior approval. Submissions requesting prior approval shall be received by the engineer no less than ten (10) days prior to project bid date.
   a. The product shall be manufactured by one of the acceptable manufacturers listed in the contract documents.
   b. The product shall meet or exceed the requirements of the contract documents in terms of quality, performance, suitability, appearance and characteristics.
   c. The contractor providing the substitution shall bear the total cost of all changes due to substitutions. These may include but are not limited to redesign costs and increased work by other contractors or the Owner.
   d. The Architect/Engineer shall be the sole judge of the suitability of the substitution items.

C. Verify installation details and requirements for materials and equipment furnished by others and installed under this contract.

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system. Provide 4 hours training in up to two separate sessions.

1. Provide instructors experienced in operation and maintenance procedures.

2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.

3. Schedule training with Owner and Architect/Engineer with at least seven days' advance notice.

3.2 STARTING AND ADJUSTING

A. Start and test all equipment and operating components to confirm proper operation. Test and adjust all systems to achieve designed capacity and performance.

B. Provide three (3) copies of all test report to the Architect/Engineer for review prior to date of substantial completion.

C. All equipment and systems discrepancies shall be corrected prior to final acceptance.

3.3 TEMPORARY POWER AND LIGHTING

A. Electric Power Service: Provide temporary electric power from Owners electric system without payment of use charges.

B. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and construction equipment.

C. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.

ELECTRICAL SUBMITTAL SCHEDULE

Section #	Section Name	Shop Drwgs	Product Data	Samples	Warranty	Other
260100	General Electrical Requirements	√	√			
260500	Basic Electrical Materials and Methods	√	√			
260600	Grounding and Bonding		√			
262726	Wiring Devices	√	√			
262813	Fuses		√			

262816	Disconnect Switches and Circuit Breakers		√			
265100	Lighting	√	√		√	
265200	Lighting Control	√	√		√	

END OF SECTION 26 01 00

SECTION 26 05 01 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1. Conduits.
2. Building wire and connectors.
3. Supporting devices for electrical components.
4. Outlet boxes.
5. Electrical identification.
6. Electrical demolition.
7. Work in existing buildings.
8. Cutting and patching for electrical construction.
9. Fire Stopping.
10. Touchup painting.

1.3 MATERIAL 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.

1.4 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing of electrical materials and equipment with other trades.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

D. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

E. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

F. Motors, equipment, controls, etc. shall be furnished, mounted and connected according to the following schedule unless otherwise noted (E =Electrical Contractor, M =Mechanical Contractor):

Item	**Furnished By**	Set in place or mounted by	Power wiring and connection by	Control Wiring and connection by
1) Equipment Motors	M	M	E	M
2) Magnetic Motor Starters:				
a) Automatically controlled, with or without n HOA switches.	E	E	E	M
b) Automatically controlled, with or without HOA switches and furnished as part of factory-wired mechanical equipment	M	M	E	M
c) Manually controlled	E	E	E	---
d) Manually controlled and furnished as part of factory-wired mechanical equipment	M	M	E	---
3) Variable Frequency Drives	M	E	E	M
4) Disconnect switches, thermal overload switches, manual operating switches				
a) Furnished as part of factory wired mechanical equipment	M	M	E	--

b) Loose mounted	E	E	E	--
5) Transformers				
a) Serving 120 Volt and higher loads	E	E	E	--
b) Serving 24 Volt control power	M(1)	M	E	M
6) Contactors	E	E	E	E
7) Push-button stations, pilot lights	E	E	E	E
8) Multi-speed switches				
a) Furnished with equipment	M	E	E	M
b) Loose mounted	E	E	E	M
9) Line voltage thermostats and time clocks.	M	E	E	E
10) Low voltage controls and thermostats	M	M	M	M (2)
11) Motorized valves, and float controls for tanks and sumps	M	M	E	M
12) Temperature control panels	M	M	E	M
13) Motorized control valves, damper motors, solenoid valves, etc.				
a) Line Voltage	M	M	E	M
b) Low Voltage	M	M	M	M
14) Factory pre-wired control/power panels including remote sensing devices	M	M	E	M(3)
15) Heat tape	E	E	E	E
16) Electric wall and unit heaters	M	E	E	E
17) Fire protection controls	M	M	E	E
18) Fire Smoke Dampers				
a) At air handling unit (24 Volt)	M	M	M	M
b) In space (120 Volt)	M	M	E	E(4)
19) Fire and smoke detectors including relays for fan shutdown	E	E	E	E(5)
20) Boiler and water heater controls, boiler burner control panels	M	M	E	M

G. Notes:

1. When control power is not available, mechanical contractor shall provide control transformers as required to power all valves, dampers, etc.

2. Conduit rough-in for thermostats by electrical contractor.

3. Fan coil units, electric duct heaters, chillers, remote condensers, remote condensing units and heat pumps control wiring including wiring of remote sensors by mechanical. Control circuit feeders by mechanical unless shown otherwise.

4. Smoke dampers will be specified as 115 volt with wiring by Electrical Contractor and control from the fire alarm panel. Smoke detectors furnished by electrical contractor are required to make dampers operate.

5. Wiring from alarm contacts to alarm system by Electrical; control function wiring by Mechanical.

6. Engine supplier provided.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.

B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION

A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Not less than 6 inches wide by 4 mils thick.

2. Compounded for permanent direct-burial service.

3. Embedded continuous metallic strip or core.

4. Printed legend that indicates type of underground line.

B. Tape markers for wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

C. Engraved-plastic labels, signs, and instruction plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

2.2 ACCESS DOORS

A. Prime coated 14 gauge steel, flush, with screw driver operated cam lock. Frame to accommodate construction type; size as indicated.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.

B. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.

C. Inspect installed components for damage and faulty work, including the following:

1. Conduits.

2. Building wire and connectors.

3. Supporting devices for electrical components.

4. Electrical identification.

5. Concrete bases.

6. Cutting and patching for electrical construction.

7. Touchup painting.

D. Headroom maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

E. Materials and components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

G. Right of way: Give to conduits and piping systems installed at a required slope.

3.2 ELECTRICAL IDENTIFICATION

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

E. Install warning markers directly above power and communication lines during trench backfilling for underground power, control, signal, and communication lines. Locate marker 6 to 8 inches below finished grade unless required otherwise by NEC. Markers shall be continuous and detectable with a metal detector from above ground after backfilling. Provide one strip of marker for each 16 inches of width if multiple lines are installed in a common trench or concrete envelope.

3.3 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly and to resist passage of smoke and other gases. Products designed to achieve a fire or smoke resistance rating shall not be used in locations where such ratings are not required by AHJ. Coordinate location requirements with other disciplines and AHJ prior to installation.

1. Limit air leakage to 5.0cfm per square foot tested in accordance with UL 1479.

2. Materials labeled by a qualified testing agency acceptable to AHJ.

3. Comply with manufacturer's written installation instructions and published drawings

4. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   b. Contractor's name, address, and phone number.
   c. Designation of applicable testing and inspecting agency.
   d. Date of installation.

e. Manufacturer's name.
f. Installer's name.

B. All firestopping assemblies shall be from one manufacturer. Match manufacturer used by other trades or as directed by general contractor.

C. Where electrical outlets are to be installed in fire rated walls, provide FlameSafe FSP1077 putty pads or equal to maintain adequate fire rating.

D. Where lighting fixtures or other electrical devices are to be installed in fire rated ceilings, provide Tenmat Fire Rated Light Covers or equal to maintain adequate fire rating.

3.4 Housekeeping Pads

A. Provide a 3-1/2 inch tall concrete housekeeping pad for all floor mounted interior electrical equipment as follows:

1. Pad shall extend 4-6” beyond all sides of equipment, except in the back for switchboards mounted tight against the wall.

2. Constructed of 3000 psi concrete.

3. Provide 6” x 6” #4 welded wire mesh.

4. Securely bond pad to floor by roughing the floor and coating with cement grout.

3.5 DEMOLITION

A. Disconnect, demolish, and remove construction indicated in specifications and drawings.

B. The Owner shall have first salvage rights to all fixtures, devices and equipment removed. Present removed materials to owner’s representative. Materials not retained by owner’s representative shall be removed from project site.

C. If equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

D. Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

E. Remove all accessible conduit unless otherwise noted.

F. Remove branch circuit conductors and low voltage cable in area of demolition not reused in new work or planned for future use. Where left for future use, label wire at both ends and at each junction box.

G. Power to existing areas not being remodeled shall be maintained at all times except for short term outages necessary for reconnection of existing circuits. Coordinate and schedule outages with owner.

H. Coordinate demolition with the work of other trades. Provide temporary power as required to allow the work of other trades to proceed or as required to allow the owner to occupy the space.

I. See architectural plans to determine project phasing requirements. Electrical circuits serving areas not under construction shall remain active until those areas are turned over to the contractor for construction.

J. Work abandoned in place: Cut and remove underground conduit a minimum of 2 inches beyond face of adjacent construction. Cap and patch surface to match existing finish.

3.6 WORK IN EXISTING BUILDINGS

A. Full Owner Occupancy: The Owner will occupy the site and existing building during the construction period. Cooperate with the Owner to minimize conflicts with the Owner's operations.

B. Schedule all work in advance with the owner. Do not proceed with work without the Owner’s written approval.

C. Notify Owner of noisy operations and schedule in advance.

D. The Owner shall have the right to direct work to secure safe and proper progress and quality of work.

E. Do not interrupt utilities without Owner’s written approval of time and duration. Interruptions shall be the minimum required for completion of work and performed during the hours of 10:00 PM-6:00 AM Monday through Friday or 6:00 PM Saturday through 6:00 AM Monday.

F. The existing fire alarm system shall remain functional throughout the project. The Owner and the Fire Marshall shall approve required outages.

G. The Owner shall be notified before starting welding or cutting. Fire extinguishers shall be immediately accessible when welding or cutting with an open flame or arc. Welding or cutting with an open flame or arc shall be stopped not less than one hour before leaving the premises.

H. Existing electrical items that interfere with the proper installation to new work shall be removed or relocated as required or as directed by the Architect/Engineer.

I. Maintain downstream circuit continuity to equipment to remain active.

J. Where breakers are indicated to be installed in existing panelboards, remove panel covers and verify all connection details prior to ordering of breakers. Provide all required hardware for installation of breakers in existing panels.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.8 CONSTRUCTION LAYOUT

A. Layout work in advance of installation using data and measurements from the site, the appropriate architectural and structural drawings and shop drawings.

B. Confirm adequate clearance for installation, operation, maintenance and code required clearance including items installed by other contractors.

C. If layout to provide clearance is not possible, promptly notify Architect/Engineer for clarification.

3.9 DATA AND MEASUREMENTS

A. The data given herein and on the drawings is as accurate as could be secured. The existence and location of construction as indicated is not guaranteed. Before beginning work investigate and verify the existence and location of items affecting work. Obtain exact locations, measurements, levels, etc., at the site and adapt work to actual conditions.

B. Only Architectural drawings, measurements may be utilized in calculations. Mechanical and electrical drawings are diagrammatic or schematic.

3.10 REFINISHING AND TOUCHUP PAINTING

A. Refinish and touch up paint.

1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.

2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.11 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 00

SECTION 26 05 13 - WIRE AND CABLE (600V)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1. Building wire and connectors.
2. Electrical identification.

1.3 MATERIAL 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.

B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Conductors and conductor insulation: Comply with NEMA WC 70.

B. Conductors, No. 10 AWG and Smaller: Stranded copper.

C. Conductors, larger than No. 10 AWG: Stranded copper.

D. Insulation: thermoplastic, rated at 75 deg C minimum.

1. Feeders: Type THHN/THWN insulated conductors in conduit.
2. Underground and damp location Feeders and Branch Circuits: Type XHHW in conduit.
3. Branch Circuits: Type THHN/THWN insulated conductors in conduit.
4. Circuits over 100 feet from GFCI devices and all circuits from line isolation panels: Low-leakage XHHW in conduit.

E. Wire connectors and splices: Units of size, ampacity rating, material, type, and class suitable for service indicated.

F. Unless otherwise indicated on the drawings, circuits are to be 20 amps with #12 AWG wire.

G. A green ground shall be installed with all branch and feeder circuits. Unless otherwise indicated on the drawings, ground wires are to be #12 AWG.

H. Provide a dedicated neutral conductor for each 120V and 277V branch circuit unless otherwise indicated on drawings.

2.2 ELECTRICAL IDENTIFICATION

A. Tape markers for wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

B. Engraved-plastic labels, signs, and instruction plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.

B. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.

C. Inspect installed components for damage and faulty work, including the following:
1. Building wire and connectors.
2. Electrical identification.

3.2 WIRING INSTALLATION

A. Install splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

B. Install wiring at outlets with at least 12 inches of slack conductor at each outlet.

C. Connect outlet and component connections to wiring systems and to ground. Tighten electrical connectors and terminals, according to manufacturer's published torque-tightening values.

3.3 ELECTRICAL IDENTIFICATION

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

E. Color-code 208/120-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black.
2. Phase B: Red.
3. Phase C: Blue.
4. Neutral: White.
5. Ground: Green.

F. Color-code 480/277-V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Brown
2. Phase B: Orange
3. Phase C: Yellow
4. Neutral: White with a colored stripe or gray
5. Ground: Green.

END OF SECTION 26 05 13

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For grounding, 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 Conductor: 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.
2. Bus Bars: Compression type, two hole.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, 5/8” diameter by 120 inches.

B. Ufer Ground (Concrete-Encased Grounding Electrode): #3/0 bare copper in 25’ of concrete footing.

C. Grounding bushings shall be O. Z. Gedney type "BLG" or equivalent.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors
3. Connections to Ground Rods: Bolted connectors.
4. Connections to Conduits: Insulated grounding bushings

5. Connections to Busbars: Bolted connections.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. All feeders and branch circuits, including:

a. Feeders and branch circuits.
b. Lighting circuits.
c. Receptacle circuits.
d. Single-phase motor and appliance branch circuits.
e. Three-phase motor and appliance branch circuits.
f. Flexible raceway runs.
g. Armored and metal-clad cable or fiber optic cable runs.

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. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

D. Bonding for Metal Enclosed Panelboards: Provide insulated grounding bushings and #4 AWG jumper on conduit that does not terminate in panelboard enclosure bottom plate.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

END OF SECTION 26 05 26

SECTION 26 05 29 - ELECTRICAL SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1. Supporting devices for electrical components.

1.3 MATERIAL 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.

1.4 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing of electrical materials and equipment with other trades.

C. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

D. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.

B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. U-Channel Systems – B-Line Systems, Inc.; Unistrut Diversified Products; or Allied Tube and Conduit.

B. Conduit Sealing Bushings – O. Z. Gedneg; Killark Electric Manufacturing Co.; or Thomas and Betts Corp.

2.2 SUPPORTING DEVICES

A. Material: Cold-formed steel, with corrosion-resistant coating acceptable to authorities having jurisdiction.

B. Metal items for use outdoors or in damp locations: Hot-dip galvanized steel.

C. Slotted-steel channel supports: Flange edges turned toward web, and 9/16-inch- diameter slotted holes at a maximum of 2 inches o.c., in webs.

D. Conduit and cable supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

1. In general, use the following support methods for outdoor conduit installations:

a. Individual exposed conduit: 1” and smaller; 2 hole straps.
b. Individual exposed conduit: 1-1/4” and larger; Minerallac.
c. Paired individual exposed conduit: Minerallac.
d. Rack exposed conduit: Unistrut with strut straps.
e. Concealed in concrete pour: Approved iron tie wire.

2. In general, use the following support methods for indoor conduit installations:

a. Individual exposed conduit: 1” and smaller; 2 hole straps.
b. Individual exposed conduit: 1-1/4” and larger; Minerallac.
c. Individual lighting and power above lay-in ceilings: Dedicated ceiling wire with Caddy clips.
d. Racked exposed or concealed conduit: Unistrut with strut straps.

E. Pipe sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

F. Expansion anchors: Carbon-steel wedge or sleeve type.

G. Toggle bolts: All-steel springhead type.

H. Powder-driven threaded studs: Heat-treated steel.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.

B. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.

C. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.

D. Materials and components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.2 CONDUIT SUPPORT INSTALLATION

A. Install support devices to securely and permanently fasten and support electrical components.

B. Install individual and multiple conduit hangers and riser clamps to support conduits. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.

C. Size supports for multiple conduits so capacity can be increased by a 25 percent minimum in the future.

D. Install 1/4-inch diameter or larger threaded steel hanger rods, unless otherwise indicated.

E. Simultaneously install vertical conductor supports with conductors.

F. Separately support cast boxes that are threaded to conduits and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to conduits on opposite sides of the box and support the conduit with an approved fastener not more than 24 inches from the box.

G. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength. Use factory hardware for all connections and assemblies including 45 and 90 degree attachment hardware.

H. Install sleeves for cable and conduit penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and conduit penetrations of masonry and fire-rated gypsum walls and of all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

I. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:

1. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
2. New concrete: Concrete inserts with machine screws and bolts.
3. Light steel: Sheet-metal screws.
4. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

3.3 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 29

SECTION 26 05 33 – BOXES AND FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1. Outlet boxes.
2. Cutting and patching for electrical construction.

1.3 MATERIAL 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.

1.4 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing of electrical materials and equipment with other trades.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.

B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Fittings shall be manufactured by O. Z. Gedney, Thomas & Betts, Raco, or equivalent.

B. Boxes shall be manufactured by Raco, Steel City, or equivalent.

2.2 BOXES

A. Hollow wall and ceiling spaces: Outlet boxes for concealed applications shall be 4” square with single or multiple gang plaster ring in round or square configuration to match the device or fixture being installed. Depth of ring shall be selected so that face of ring is recessed back from face of finished surface by approximately 1/8”.

B. Masonry walls: Outlet boxes in masonry walls shall be 4” square with single or multiple gang masonry rings with square edges. Masonry boxes may also be used where 4” square boxes are impractical. Slush boxes in place to prevent movement within walls. Flush mounted boxes and conduit are to be used unless otherwise indicated.

C. Exposed exterior boxes: Where exposed boxes are required, they shall be the FS or FSA cast type with threaded hubs and gasketed covers. Use of these boxes is by approval only. Flush mounted boxes and conduit are to be used unless otherwise indicated.

D. Interior junction boxes: Interior junction boxes shall be 4” square minimum with knock outs as required. Larger boxes may be required and shall be sized per NEC. Boxes shall be hot-dipped galvanized steel. Provide a flat steel coverplate.

E. Specialty junction boxes larger than 4 11/16”: Junction and pull boxes shall be sized per NEC and arranged to facilitate pulling or splicing. Boxes shall be steel without knock outs, with hinged or screw on cover plates.

2.3 FITTINGS

A. Electrical metallic tubing (EMT): Steel set-screw or compression type fittings. Die cast are not allowed.

B. Intermediate metal conduit (IMC) and rigid steel conduit (RGS): Threaded fittings.

C. Liquidtight flexible metal conduit (LFMC): Flexible steel conduit with PVC jacket and complying with UL 360.

D. Rigid nonmetallic conduit (RNC): NEMA TC3 fittings.

E. Conduit fittings: Specifically designed for the conduit type with which used. Comply with NEMA FB 1 and UL 514B.

2.4 ELECTRICAL IDENTIFICATION

A. System Idendification: Junction box covers shall be painted with enamel spray paint using the following system:

a. Fire Alarm – Red.
b. Power – Silver.
c. Security – Orange.
d. Communications – Blue.
e. Emergency Power – Yellow
f. Optional Standby Generator – Green

B. All junction box covers shall be marked with the panel and circuit.

C. Engraved-plastic labels, signs, and instruction plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Junction boxes shall be mounted so they are easily accessed for maintenance. Cover shall face down (preferred) or sideways only where side access is available.

B. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.

C. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.

D. Inspect installed components for damage and faulty work, including the following:

1. Supporting devices for electrical components.
2. Electrical identification.
3. Cutting and patching for electrical construction.

E. Materials and components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

3.2 ELECTRICAL IDENTIFICATION

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

3.3 FIRESTOPPING

A. Where electrical outlets are to be installed in fire rated walls, provide FlameSafe FSP1077 putty pads or equal to maintain adequate fire rating.

3.4 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 33

SECTION 26 05 34 – CONDUIT RACEWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following basic electrical materials and methods and shall apply to all phases of the work specified, indicated on the drawings or required to provide for complete installation of electrical systems.

1. Conduits.

1.3 MATERIAL 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Each contractor shall make provisions for delivery and safe storage of materials. Materials shall be delivered in a timely manner to expedite the work.

B. Protect stored piping, supplies and equipment from cold, moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.5 MANUFACTURERS

A. Metallic conduit – Allied Tube and Conduit Corporation or equivalent.

B. Non-metallic conduit – Carlon or equivalent.

C. Flexible metal conduit – American Brass "Sealtite" or equivalent.

PART 2 - PRODUCTS

2.1 CONDUITS

A. Minimum Size

1. Power branch circuits: 3/4”
2. Control Wiring: 1/2”

B. Electrical metallic tubing (EMT): ANSI C80.3 and UL 797, zinc-coated steel

1. Color coded exterior for system identification:

a. Fire Alarm – Red.
b. Power – Silver.
c. Security – Orange.
d. Communications – Blue.
e. Emergency Power – Yellow
f. Optional Standby Generator – Green

C. Flexible metal conduit (FMC): UL 1, Zinc-coated steel.

D. Intermediate metal conduit (IMC): ANSI C80.6 and UL 1242, zinc-coated steel, with threaded fittings.

E. Liquidtight flexible metal conduit (LFMC): Flexible steel conduit with PVC jacket and complying with UL 360.

F. Rigid nonmetallic conduit (RNC): NEMA TC 2 and UL 651, EPC-40 (schedule 40) PVC.

G. Installation location shall determine conduit type permitted.

1. For indoor installations:

a. Exposed: EMT.
b. Concealed: EMT.
c. Connection to vibrating equipment: FMC; except in wet or damp locations, use LFMC.
d. Flex metal and/or liquid tight flex metal shall not exceed 2’ in length except in light fixture applications where up to 6’ is allowed.

2. Use the following conduits for outdoor installations:

a. Exposed: RGS
b. Underground: RNC.

3. At motors:

a. Connect motors and equipment subject to vibration, noise transmission, or movement with FMC of 72-inch maximum length.
b. Damp locations: LFMC.

PART 3 - EXECUTION

3.1 ELECTRICAL EQUIPMENT INSTALLATION

A. Quality of workmanship: A neat and workmanlike installation shall be provided as defined in the National Electrical Installation Standards (NEIS) established by the National Electrical Contractors Association (NECA). NEIS standards shall be followed for all work including that which is concealed by construction.

B. Neatness and craftsmanship shall be a priority. Installations shall be subject to regular observations performed by the Engineer or the Engineer's Representative. If an installation is deemed unsatisfactory by the Engineer or the Engineer's Representative due to quality of workmanship, code conflicts or deviations from the Construction Drawings or Specifications, the Contractor shall remedy the installation to the satisfaction of the Engineer.

C. Inspect installed components for damage and faulty work, including the following:

1. Conduits.

D. Headroom maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.

E. Materials and components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

G. Right of way: Give to conduits and piping systems installed at a required slope.

3.2 CONDUIT INSTALLATION

A. Conceal conduit, unless otherwise indicated, within finished walls, ceilings, and floors.

B. Install conduit at least 6 inches away from parallel runs of flues or hot-water pipes. Locate horizontal conduit runs above water piping.

C. Use temporary conduit caps to prevent foreign matter from entering.

D. Make conduit bends and offsets so ID is not reduced. Keep legs of bends in the same plane and straight legs of offsets parallel, unless otherwise indicated.

E. Use conduit fittings compatible with conduit and cables and suitable for use and location.

F. Conduits may be installed embedded in concrete under the following conditions:

1. Contractor shall receive approval from a structural engineer if conduit is to be located in structural concrete.
2. Leave at least 2-inch concrete cover.

3. Do not displace more than 1/3 of the concrete thickness of the slab. For example, if the slab thickness is 3", maximum conduit size is to be 1" OD.
4. Secure conduit to reinforcing rods to prevent sagging or shifting during concrete placement.
5. Where multiple conduits are run in an area, space conduit laterally to prevent voids in concrete. Fan out conduit runs for a minimum spacing of no less than 3 times the diameter of the larger conduit in a group. Do not place conduits within 12" of supporting beams, walls and columns.
6. Install conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. Where conduit is at right angles to reinforcement, place conduit close to slab support.
7. Where floor finish is to be exposed concrete, avoid excessive underfloor conduits and maximize cover over conduits to avoid floor cracking.
8. Transition from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above floor.

G. Make bends in exposed parallel or banked runs from same centerline to make bends parallel. Use factory elbows where elbows can be installed parallel; otherwise, provide field bends for exposed parallel conduits.

H. Install pull wires in empty conduits. Use No. 14 AWG zinc-coated steel or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of the pull wire.

I. Install interior telephone and signal system conduits in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.

J. Install exterior telephone and signal system conduits in maximum lengths of 500 feet and with a minimal number of 90-degree bends.

K. Utilize sweep elbows for all telephone and signal system conduits 2" and larger.

L. All conduits routed through unfinished spaces shall be routed as high as allowable to avoid future conflicts with build out.

M. Route conduits parallel to building structural members in a neat and orderly manner.

3.3 ELECTRICAL IDENTIFICATION

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Install warning markers directly above power and communication lines during trench backfilling for underground power, control, signal, and communication lines. Locate marker 6 to 8 inches below finished grade unless required otherwise by NEC. Markers shall be continuous and detectable with a metal detector from above ground after backfilling. Provide one strip of marker for each 16 inches of width if multiple lines are installed in a common trench or concrete envelope.

3.4 FIRESTOPPING

A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly and to resist passage of smoke and other gases. Products designed to achieve a fire or smoke resistance rating shall not be used in locations where such ratings are not required by AHJ. Coordinate location requirements with other disciplines and AHJ prior to installation.

1. Limit air leakage to 5.0cfm per square foot tested in accordance with UL 1479.
2. Materials labeled by a qualified testing agency acceptable to AHJ.
3. Comply with manufacturer's written installation instructions and published drawings
4. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

    a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
    b. Contractor's name, address, and phone number.
    c. Designation of applicable testing and inspecting agency.
    d. Date of installation.
    e. Manufacturer's name.
    f. Installer's name.

B. All firestopping assemblies shall be from one manufacturer. Match manufacturer used by other trades or as directed by general contractor.

3.5 CLEANING AND PROTECTION

A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.

B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 26 05 34

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes receptacles, connectors, switches, and finish plates.

B. This Section includes floor boxes and poke-thru floor fittings.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. DL: Damp location as defined in NFPA 70, Article 100.

C. WP: Weatherproof for wet locations as defined in NFPA 70, Article 100.

1.4 SUBMITTALS

A. Product Data: For each product specified.

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.

B. Comply with NEMA WD 1.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Wallbox Dimmers

   a. Leviton
   b. Lutron

2. Other Wiring Devices

   a. Bryant Electric, Inc.
   b. Cooper Wiring Devices.
   c. Hubbell, Inc.; Wiring Devices Div.
   d. Leviton Manufacturing Co., Inc.
   e. Pass & Seymour/Legrand; Wiring Devices Div.

2.2 RECEPTACLES

A. Description: Impact-resistant nylon face with finder groove, thermoplastic back body, and one-piece triple-wipe power contacts. Side and back wired, back wire terminals use screw pressure plates.

B. Tamper Resistant Receptacles: Specification grade; 20 ampere, 125 volt rated.

1. Tamper resistant with thermoplastic shutter. Shutter in closed position covers access to contacts, insertion of object into any one side of outlet does not open shutter. Two-bladed plug or grounding plug compresses spring and simultaneously opens both shutters.
2. Equal to: Pass & Seymour #TR5352.

C. High Abuse Tamper Resistant Receptacles: Specification grade; 20 ampere, 125 volt rated.

1. Tamper resistant with thermoplastic shutter. Shutter in closed position covers access to contacts, insertion of object into any one side of outlet does not open shutter. Two-bladed plug or grounding plug compresses spring and simultaneously opens both shutters.
2. Equal to: Pass & Seymour #TR8300.

D. Simplex Straight-Blade Receptacles: Specification grade; 20 ampere, 125 volt rated.

1. Equal to: Pass & Seymour #TR5351.

E. GFCI Receptacles: Design units for installation in a 2-3/4-inch deep outlet box without an adapter.

1. Equal to: Pass & Seymour #TR2097.

F. Dryer Receptacle: Specification grade; 30 ampere, 3 pole, 4 wire, 125/250 volt rated.

1. Verify plug configuration.
2. Equal to: Pass & Seymour #3864.

G. Range Receptacle: Specification grade; 50 ampere, 3 pole, 4 wire, 125/250 volt rated.

1. Verify plug configuration of installed equipment.
2. Equal to: Pass & Seymour #3894.

2.3 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with type SOW-A jacket. Green-insulated grounding conductor, and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.4 SWITCHES

A. Snap Switches: Specification grade; 20 ampere, 120/277 volt rated; side and back wired; quiet type.

1. Poles: Provide switches in single-pole, double-pole, three-way, and four-way configurations as indicated on the drawings.
2. Equal to: Pass & Seymour #20AC

B. Keyed Switches: Specification grade; 20 ampere, 120/277 volt rated; side and back wired; quiet type.

1. Poles: Provide switches in single-pole, double-pole, three-way, and four-way configurations as indicated on the drawings.
2. Pass & Seymour #20ACX-L (alternate manufacturers not allowed for keyed switches)

2.5 WALLBOX DIMMERS

A. Description: Slider with preset suitable for operation of connected load.

1. Capacity: As indicated on the drawings.
2. Compatibility: Match connected loads.
3. Faceplate: Standard decorator faceplate.

4. Derating: Observe derating restrictions for ganged devices.
5. Equal to: Commercial grade Lutron Nova T Series Dimmer.

2.6 WALL PLATES

A. Single and combination types match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.04-inch thick, Type 302, satin-finished stainless steel.

    a. Ceiling mounted wall plates to match ceiling color.

3. Material for Unfinished Spaces: Galvanized steel.
4. Heavy Duty Weatherproof Cast Aluminum while-in-use plates in wet locations (WP): Self-closing cast aluminum lockable cover and cast aluminum base, the integrity of the assembly is not affected when the attachment plug cap is inserted. Equal to Intermatic WP1010HMC, WP1010MC, or WP1030MC. Select model coordinated with number of gangs and device orientation of indicated location.

2.7 FINISHES

A. Color:

1. Gray, unless otherwise indicated for normal circuits.

    a. Ceiling mounted devices to match ceiling color.

    b. Verify with existing devices prior to ordering.

2. Red, unless otherwise indicated for generator power circuits.

2.8 CIRCUIT LABELS FOR RECEPTACLES

A. Brother PC clear adhesive with Arial #14 black lettering for normal circuits.

B. Brother PC clear adhesive with Arial #14 red lettering for emergency circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

D. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

E. Do not share neutral conductor on load side of dimmers.

F. Protect devices and assemblies during painting.

G. Provide a GFCI receptacle for each device indicated on the drawings. Do not connect GFCI receptacles to protect downstream devices.

H. Provide full-capacity external conduit connections between all compartments of multi-service floor boxes. All compartments shall be capable of installed devices regardless of internal wire tunneling arrangement of floor box.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Basic Electrical Materials and Methods."

1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify serving panelboard and circuit number on faceplate of all receptacles.
3. Conductors Serving Receptacles: Identify serving panelboard and circuit number. Use durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity.

B. Test GFCI operation with fault simulations according to manufacturer's written instructions.

C. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION 26 27 26

SECTION 26 28 16 - DISCONNECT SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes enclosed individually mounted switches and circuit breakers used for the following:

1. Feeder and equipment disconnect switches.
2. Feeder branch-circuit protection.
3. Motor disconnect switches.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 26 Section "Wiring Devices" for attachment plugs and receptacles, and snap switches used for disconnect switches.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes. Include data for overcurrent protective device coordination:

1. Descriptive data and time-current curves.
2. Let-through current curves for overcurrent protective devices with current-limiting characteristics.
3. Coordination charts and tables and related data.

C. Shop Drawings: For each switch, circuit breaker, and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices and accessories, equipment features, and ratings. Include the following:

a. Enclosure types and details.
b. Bus materials, configuration, current, and voltage ratings.
c. Short-circuit current rating of switches and circuit breakers.

d. Descriptive documentation of options or accessories such as auxiliary devices, controls, interlocks, etc.
e. UL listing for series rating of installed devices.
f. Features, characteristics, ratings, and factory settings of overcurrent protective devices and auxiliary components.
g. Fuse product data for fusible devices.

2. Wiring Diagrams: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.

D. Field test results indicating and interpreting test results.

E. Maintenance Data: For switches and circuit breakers to include in operation and maintenance manuals specified in Division 1. In addition to requirements specified in Division 1 Section "Contract Closeout," include the following:

1. Routine maintenance requirements for switches, circuit breakers, and all installed components.
2. Manufacturer's written instructions for testing and adjusting switches and overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain switches and circuit breakers from one source and by a single manufacturer.

B. Comply with NFPA 70 for components and installation.

C. Listing and Labeling: Provide switches and circuit breakers specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide switches and circuit breakers by one of the following:

1. Enclosed Disconnect Switches, Enclosed Molded Case Switches, and Enclosed Molded Case Circuit Breakers:

a. General Electric Co.; Electrical Distribution and Control Division.

b. Siemens Energy & Automation, Inc.
c. Square D Co.

2.2 ENCLOSURES

A. Enclosure: NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.

1. Outdoor Locations: Type 3R.

a. Pool/Kitchen Areas: Type 4X, stainless steel.
b. Other Wet or Damp Indoor Locations: Type 4.
c. Hazardous Areas Indicated on Drawings: Type 7C.

2.3 ENCLOSED DISCONNECT SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD Heavy Duty, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD Heavy Duty, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in CLOSED position.

C. Features and Accessories:

1. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.

2.4 ENCLOSED CIRCUIT BREAKERS

A. Enclosed, Molded-Case Thermal-Magnetic Circuit Breaker: NEMA AB 1, with lockable handle. Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

B. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated. Fully rated interrupting rating to meet available fault current.

C. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.

D. Circuit Breakers, 200 A and Larger: Trip units interchangeable within frame size.

E. Circuit Breakers, 400 A and Larger: Field-adjustable, short-time and continuous-current settings.

F. Electronic Trip Unit Circuit Breakers for breaker frame sizes 800 A and larger: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

G. Current-Limiting Trips: Where indicated, let-through ratings less than NEMA FU 1, Class RK-5.

H. Current Limiters: Where indicated, integral fuse listed for circuit breaker.

I. Features and Accessories:

1. Lugs: Mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
2. Shunt Trip: 120-V trip coil energized from separate circuit.
3. Auxiliary Switch: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b"contacts operate in reverse of circuit-breaker contacts.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

J. Arc Energy Reducing Maintenance Switch: For each circuit breaker rated 1200A or higher, provide a selector switch to switch the circuit breaker instantaneous tripping characteristics to an alternate setting temporarily during maintenance activity. Switch shall be lockable in either the OFF or ON (maintenance mode) position. Provide with an LED indicator light to indicate that switch is in maintenance mode. Provide with NO and NC contact for connection to building management or alarm system.

2.5 FUSES

A. Fuses shall be dual element time delay Bussman Low Peak Class RK-1 or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All disconnect switches shall be fused type unless otherwise indicated on the drawings.

B. Install switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.

C. Install switches and circuit breakers level and plumb.

D. Install wiring between switches and circuit breakers, control, accessories, and indication devices.

E. Connect switches, circuit breakers, and components to wiring system and to ground as indicated and instructed by manufacturer.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Basic Electrical Materials and Methods."

B. Switch and Circuit-Breaker Nameplates: Label each switch and circuit breaker with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 FIELD QUALITY CONTROL

A. Testing: After installing switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for disconnect switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.

B. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

3.4 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.5 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

END OF SECTION 26 28 16

SECTION 26 51 00 –LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes lighting fixtures, lighting controls, lamps, drivers, emergency lighting units, and accessories.

1.3 SUBMITTALS

A. Product Data: For each lighting fixture type, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Emergency lighting unit battery and charger.
3. LED Driver.
4. Types of LEDs.

B. Maintenance Data: For lighting fixtures to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Fixtures, Emergency Lighting Units, Emergency Power Supply Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Fixtures, Mounting Hardware, and Trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

A. Emergency Battery Warranty: 3-year pro-rated warranty.

B. LED Driver/ Light System Warranty: 5-year replacement warranty.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED Driver/System: Furnish one of each type of LED board and driver. Do not supply entire replacement fixtures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Lighting Fixture Schedules on the drawings.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens Thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

2.3 LED DRIVERS

A. General Requirements: Unless otherwise indicated, features include the following:

1. 0-10V Dimming
2. Total Harmonic Distortion Rating: Less than 20 percent.
3. Ambient temperature rating: -40° to +55° C
4. Power Factor (100% output): >0.95

B. Flickering: LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Submit % flicker in 1% increments for full range of dimming starting at 500 mA for full output reading. Systems that do not meet IEEE P1789 will not be considered.

2.4 EXIT SIGNS

A. General Requirements: Comply with UL 924 and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.

2.5 EMERGENCY LIGHTING UNITS

A. General Requirements: Self-contained units, wall or ceiling mounted. Comply with UL 924. Units include the following features:

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 5-year nominal life and warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.6 LED LIGHT MODULE

A. General Requirements: Unless otherwise indicated, features include the following:

1. L70 (70% light output) life rating: minimum 50,000 hours, as defined by IES LM80 and TM21
2. Minimum Color-Rendering Index: 80 CRI

2.7 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Twin-Stem Hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

C. Rod Hangers: 3/8-inch minimum diameter, cadmium-plated, threaded steel rod.

2.8 EMERGENCY LIGHTING INVERTERS

A. Fast-Transfer Central Battery Equipment: Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 50ms or less from normal supply to battery-inverter supply.

B. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.

C. Output Voltage Waveform: Pure sine wave with maximum 3 percent TDD throughout battery operating-voltage range, for 100 percent linear load.

D. Maintenance Bypass Mode: Manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator selection at central battery equipment. Bypass Overload Capability shall be 1.5 times the base load current.

E. Integral Output Disconnecting Means and OCPDs: Thermal-magnetic circuit breakers, complying with UL 489; voltage rating matching unit output voltage rating; 20 A, single pole.

F. Capacity as indicated on the drawings. Manufacturer to verify capacity based on loads served by device and overload capacity of inverter.

2.9 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

D. Burn-In: Continuously illuminate (burn-in) lamps and fixtures per lamp manufacturer’s recommendations.

3.2 CONNECTIONS

A. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Provide instruments to make and record test results.

C. Tests: As follows:

1. Verify normal operation of each fixture after installation.
2. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation.
3. Verify normal transfer to battery source and retransfer to normal.

D. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION 26 51 00