



UNIVERSITY *of* MARYLAND

THE FOUNDING CAMPUS

ADMINISTRATION & FINANCE

OFFICE OF FACILITIES MANAGEMENT

SPECIFICATIONS FOR THE DESIGN OF CAMPUS ELECTRICAL DISTRIBUTION AT THE UNIVERSITY OF MARYLAND

UNIVERSITY PROJECT # 17-317

100% CD SUBMISSION – PHASE 4

VOLUME 1 OF 1: PROJECT SPECIFICATIONS

September 19, 2023

Owner

University of Maryland, Baltimore
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Design and Construction
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Brooke E. Lierman, Comptroller
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SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Project consists of mainly electrical and site distribution work southwest side of the UMB campus between West Lombard Street and Pratt Street. The site utility work includes providing new underground electrical ductbank including excavation, restoration, erosion and sediment control, and traffic control. The electrical work includes providing new 15 kV electrical feeders in a combination of existing and new ductbank from the North Switching Station to the following buildings:

- Lexington Building (620 West Lexington St)
- School of Law & Marshall Law Library (500 West Baltimore St)
- Health Science Library (601 West Lombard St)
- Dentistry Museum (31 South Greene St)
- Pearl Street Garage (622 West Fayette St)
- Saratoga Street Garage (220 North Arch St)
- School of Social Work (525 West Redwood St)
- Plaza Garage (500 West Redwood St)
- University Suites (518 West Fayette St)
- School of Dentistry (650 West Baltimore St)

1. Project Location: University of Maryland, Baltimore

2. Owner: University of Maryland, Baltimore.

- B. Contract Documents, dated December 22, 2022 were prepared for the Project by:

1. RMF Engineering: 5520 Research Park Drive, Baltimore, MD 21228
2. Carroll Engineering, Inc.: 215 Schilling Circle, Hunt Valley, MD 21031.

1.3 CONTRACTOR USE OF PREMISES

- A. General: During the construction period the Contractor shall have full use of the premises for construction operations, including use of the site. The Contractor's use of the premises is limited only by the University's right to perform work or to retain other contractors on portions of the Project.

- B. Use of the Site: Limit use of the premises to work in areas indicated. Confine operations to areas within contract limits indicated. Do not disturb portions of the site beyond the areas in which the Work is indicated.

1. University Occupancy: Allow for University occupancy and use by the public.
2. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to the University, the University's employees, and emergency vehicles at all times.

Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

- C. Use of the Existing Building: Maintain the existing building in a weathertight condition throughout the construction period. Repair damage caused by construction operations. Take all precautions necessary to protect the building and its occupants during the construction period.

1.4 OCCUPANCY REQUIREMENTS

- A. Full University Occupancy: The University will occupy the site and existing building during the entire construction period. Cooperate with the University during construction operations to minimize conflicts and facilitate University usage. Perform the Work so as not to interfere with the University's operations.
 - 1. Off Hours Work: All building outages will need to occur during off hours. This includes all building power switchovers and individual load or equipment outages.

1.5 PROTECTION OF EXISTING CONSTRUCTION AND FURNISHINGS

- A. The Contractor shall take all necessary precautions to protect the University's property and furnishings. The Contractor shall promptly remedy damage and loss to the University's property caused in whole or in part by the Contractor, a Subcontractor, a Sub-Subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01010

SECTION 01027 - APPLICATIONS FOR PAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements governing the Contractor's Applications for Payment.
- B. This Section specifies administrative and procedural requirements governing each prime contractor's Applications for Payment.
 - 1. Coordinate the Schedule of Values and Applications for Payment with the Contractor's Construction Schedule, Submittal Schedule, and List of Subcontracts.
- C. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Schedules: The Contractor's Construction Schedule and Submittal Schedule are specified in Division 1 Section "Submittals."

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of the Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative schedules and forms, including:
 - a. Contractor's Construction Schedule.
 - b. Application for Payment forms, including Continuation Sheets.
 - c. List of subcontractors.
 - d. Schedule of allowances.
 - e. Schedule of alternates.
 - f. List of products.
 - g. List of principal suppliers and fabricators.
 - h. Schedule of submittals.
 - 2. Submit the Schedule of Values to the University at the earliest possible date but no later than 7 days before the date scheduled for submittal of the initial Applications for Payment.
 - 3. Subschedules: Where Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish the format for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. University's Project number.
 - c. Contractor's name and address.
 - d. Date of submittal.
2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - h. Percentage of Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum in sufficient detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Break principal subcontract amounts down into several line items.
4. Round amounts to nearest whole dollar; the total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment, purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include requirements for insurance and bonded warehousing, if required.
6. Provide separate line items on the Schedule of Values for initial cost of the materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Margins of Cost: Show line items for indirect costs and margins on actual costs only when such items are listed individually in Applications for Payment. Each item in the Schedule of Values and Applications for Payment shall be complete. Include the total cost and proportionate share of general overhead and profit margin for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at the Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values prior to the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications for payment as paid for by the University.
 1. The initial Application for Payment, the Application for Payment at time of Substantial Completion, and the final Application for Payment involve additional requirements.
- B. Refer to the University of Maryland Baltimore Standard General Condition of Construction for requirements and procedures governing applications for payment.

C. Initial Application for Payment: Administrative actions and submittals, that must precede or coincide with submittal of the first Application for Payment, include the following:

1. List of subcontractors.
2. List of principal suppliers and fabricators.
3. Schedule of Values.
4. Contractor's Construction Schedule.
5. Schedule of principal products.
6. Schedule of unit prices.
7. Submittal Schedule.
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of authorizations and licenses from governing authorities for performance of the Work.
11. Initial progress report.
12. Report of preconstruction meeting.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire the University's insurance.
16. Initial settlement survey and damage report, if required.

D. Application for Payment at Substantial Completion: Following issuance of the Certificate of Substantial Completion, submit an Application for Payment.

1. This application shall reflect Certificates of Partial Substantial Completion issued previously for University occupancy of designated portions of the Work.
2. Administrative actions and submittals that shall precede or coincide with this application include:
 - a. Warranties (guarantees) and maintenance agreements.
 - b. Test/adjust/balance reports.
 - c. Operation and Maintenance Manuals.
 - d. Meter readings if appropriate.
 - e. Startup performance reports.
 - f. Commissioning Reports.
 - g. Final cleaning.
 - h. Application for reduction of retainage and consent of surety.
 - i. Advice on shifting insurance coverages.
 - j. Final progress photographs.
 - k. List of incomplete Work, recognized as exceptions to University's Certificate of Substantial Completion.

E. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of the final Application for Payment include the following:

1. Completion of Project closeout requirements.
2. Completion of items specified for completion after Substantial Completion.
3. Resolve all previously unsettled claims.
4. Resolve all previously incomplete Work.

5. Transmittal of required Project construction records to the University.
6. Proof that taxes, fees, and similar obligations were paid.
7. Removal of temporary facilities and services.
8. Removal of surplus materials, rubbish, and similar elements.
9. Change of door locks to University's access.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01027

SECTION 01035 - MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. The University will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time.

1.4 CHANGE ORDER PROPOSAL REQUESTS

- A. University Initiated Change Order Proposal Requests: The University will issue a detailed description of proposed changes in the Work that will require adjustment to the Contract Sum or Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal requests issued by the University are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
2. Within a mutually agreed upon time period, submit an estimate of cost necessary to execute the change to the University for review.
 - a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities. Include required labor hours and unit costs, with totals for each labor category. Include all credits for deleted work.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts, for new work and deleted work.
 - c. Include a statement indicating the effect the proposed change in the Work will have on the Contract Time.

- B. Contractor-Initiated Proposals: When latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change to the University.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
2. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities. Include required labor hours and unit costs, with totals for each labor category. Include all credits for deleted work.

3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts, for new work and deleted work.
4. Comply with requirements in Section "Product Substitutions" if the proposed change requires substitution of one product or system for a product or system specified.

C. Proposal Request Form: Use forms provided by the Owner for Change Order Proposals.

1.5 CHANGE ORDER PROCEDURES

- A. Upon the University's approval of a Proposal Request, the University will issue a Change Order Requisition for signatures of the Contractor followed by a Notice to Proceed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01035

SECTION 01040 - COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
 - 1. General project coordination procedures.
 - 2. Conservation.
 - 3. Coordination Drawings.
 - 4. Administrative and supervisory personnel.
 - 5. Cleaning and protection.

1.3 COORDINATION

- A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to assure required minimum accessibility for maintenance, service, and repair.
 - 3. Make provisions to accommodate items scheduled for later installation.
- B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
 - 1. Prepare similar memoranda for the University and sub-contractors where coordination of their work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of CPM schedules.
 2. Installation and removal of temporary facilities.
 3. Delivery and processing of submittals.
 4. Progress meetings.
 5. Work coordination meetings.
 6. Project closeout activities.
- D. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.
1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components. At a minimum, prepare coordination drawings for all mechanical rooms, electrical rooms and substation rooms.
1. Show the relationship of components shown on separate Shop Drawings.
 2. Indicate required installation sequences.
 3. Comply with requirements contained in Section "Submittals."
 4. The coordination drawings shall be comprehensive drawings that show all work by all disciplines for each location on a single drawing. The drawings shall be prepared at a large enough scale to permit legibility and ease of recognition of all work.
- B. Staff Names: Within 15 days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.
1. Post copies of the list in the Project meeting room, the temporary field office, and at each temporary telephone.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

- A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

- B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.2 CLEANING AND PROTECTION

- A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration until Substantial Completion.
- B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.
- C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
 - 1. Excessive static or dynamic loading.
 - 2. Excessive internal or external pressures.
 - 3. Air contamination or pollution.
 - 4. Water or ice.
 - 5. Puncture.
 - 6. Abrasion.
 - 7. Heavy traffic.
 - 8. Soiling, staining, and corrosion.
 - 9. Combustion.
 - 10. Electrical current.
 - 11. Improper lubrication.
 - 12. Unusual wear or other misuse.
 - 13. Contact between incompatible materials.
 - 14. Destructive testing.
 - 15. Misalignment.
 - 16. Excessive weathering.
 - 17. Unprotected storage.
 - 18. Improper shipping or handling.
 - 19. Theft.
 - 20. Vandalism.

END OF SECTION 01040

SECTION 01045 - CUTTING AND PATCHING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for cutting and patching.

1.3 SUBMITTALS

- A. Cutting and Patching Proposal: When unforeseen conditions require cutting and patching of the existing structure and/or related components the CM shall submit a cutting and patching proposal to the university, for review and approval before proceeding with any work. Include the following information, as applicable, in the proposal:
 - 1. Describe the extent of cutting and patching required and indicate why it cannot be avoided. Include changes to the building's appearance and other significant visual elements if applicable.
 - 2. Describe the products to be used.
 - 3. Identify the impact to the project's schedule and budget.
 - 4. Indicate the dates when cutting and patching will be performed.
 - 5. Where cutting and patching involves adding reinforcement to structural elements, the modifications to the structure shall be designed by a registered structural engineer. If the design team does not include a structural engineer the CM shall secure the services of an engineer to perform the required design. The CM shall submit the design drawings, details and engineering calculations showing integration of reinforcement with the original structure to the University.
 - 6. Approval by the University to proceed with cutting and patching does not waive the University's right to later require complete removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Requirements for Structural Work: Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.
 - 1. Obtain hot work permit from the University for cutting, burning, welding, etc.
 - 2. Obtain approval of the cutting and patching proposal before cutting and patching the following structural elements:
 - a. Foundation construction.
 - b. Bearing and retaining walls.
 - c. Structural concrete.
 - d. Structural steel.
 - e. Lintels.
 - f. Timber and primary wood framing.

- g. Structural decking.
 - h. Stair systems.
 - i. Miscellaneous structural metals.
 - j. Exterior curtain-wall construction.
 - k. Equipment supports.
 - l. Piping, ductwork, vessels, and equipment.
 - m. Structural systems of special construction in Division 13 Sections.
- B. Operational Limitations: Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.
- 1. Obtain approval of the cutting and patching proposal from the University before cutting and patching the following operating elements or safety related systems:
 - a. Primary operational systems and equipment.
 - b. Air or smoke barriers.
 - c. Water, moisture, or vapor barriers.
 - d. Membranes and flashings.
 - e. Fire protection systems.
 - f. Noise and vibration control elements and systems.
 - g. Control systems.
 - h. Communication systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
- C. Visual Requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in the University's opinion, reduce the building's aesthetic qualities. Do not cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction cut and patched in a visually unsatisfactory manner when directed by the University.
- 1. If possible, retain the original Installer or fabricator to cut and patch the exposed Work listed below. If it is impossible to engage the original Installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Processed concrete finishes.
 - b. Stonework and stone masonry.
 - c. Ornamental metal.
 - d. Matched-veneer woodwork.
 - e. Preformed metal panels.
 - f. Firestopping.
 - g. Window wall system.
 - h. Stucco and ornamental plaster.
 - i. Acoustical ceilings.
 - j. Terrazzo.
 - k. Finished wood flooring.
 - l. Fluid-applied flooring.
 - m. Carpeting.
 - n. Aggregate wall coating.

- o. Wall covering.
- p. HVAC enclosures, cabinets, or covers.

1.5 WARRANTY

- A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials. Refer to applicable spec sections for materials.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

3.2 PREPARATION

- A. Temporary Support: Provide temporary support of work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.
- C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Avoid cutting existing pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until provisions have been made to bypass them or to take them out of service.

3.3 PERFORMANCE

- A. General: Employ skilled workmen or experienced subcontractors to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.
 - 1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

- B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.
1. In general, when cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
 3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
 4. Comply with requirements of applicable Division 2 Sections where cutting and patching requires excavating and backfilling.
 5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Ensure all services have been de-energized or drained before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.
- C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
 2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat. Prepare entire surface to receive final coat as necessary for proper adhesion.
 4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
- D. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.
1. Unless otherwise indicated, provide 3-coat work.
 2. Finish gypsum plaster to match existing adjacent surfaces. Sand lightly to remove trowel marks and arises.
 3. Cut, patch, point-up, and repair plaster to accommodate other construction.

3.4 LEANING

- A. Areas and spaces where cutting, and patching are performed shall be cleaned. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features

before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01045

SECTION 01095 - REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic contract definitions are included in the Conditions of the Contract.
- B. "Indicated": The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, or other paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. Location is not limited.
- C. "Directed": Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean directed by the University, requested by the University, and similar phrases.
- D. "Approved": The term "approved," when used in conjunction with the University's action on the Contractor's submittals, applications, and requests, is limited to the University's duties and responsibilities as stated in the Conditions of the Contract.
- E. "Regulations": The term "regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": The term "furnish" means supply and deliver to the Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": The term "install" describes operations at the Project Site including the actual unloading, unpacking, assembly, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": The term "provide" means to furnish and install, complete and ready for the intended use.
- I. "Installer": An installer is the Contractor or another entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, or similar operations. Installers are required to be experienced in the operations they are engaged to perform.
 - 1. The term "experienced," when used with the term "installer," means having a minimum of 5 previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of authorities having jurisdiction.
 - 2. Trades: Using terms such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name,

such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespersons of the corresponding generic name.

- J. "Project Site" is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.
- K. "Testing Agencies": A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with the standards in effect as of the date of the Contract Documents.
- C. Conflicting Requirements: Where compliance with 2 or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer to the University before proceeding for a decision on requirements that are different but apparently equal, and where it is uncertain which requirement is the most stringent.
 - 1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum acceptable. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to the University for a decision before proceeding.
- D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.
- E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authorities having jurisdiction, or other entity applicable to the context of the text provision. Refer to Gale Research Co.'s "Encyclopedia of Associations," available in most libraries.

1.4 SUBMITTALS

- A. Permits, Licenses, and Certificates: For the University's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 1 - PRODUCTS (Not Applicable)

PART 2 - EXECUTION (Not Applicable)

END OF SECTION 01095

SECTION 01200 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for project meetings, including, but not limited to, the following:
 - 1. Preconstruction conferences.
 - 2. Progress meetings.

1.3 PRECONSTRUCTION CONFERENCE

- A. The University shall schedule a preconstruction conference before starting construction, at a time convenient to the Contractor and the University, but no later than 15 days after execution of the Agreement. The conference will be held at a site identified by the University.
 - 1. The University will conduct the meeting. Minutes will be recorded and distributed to participants in accordance with contract requirements.
- B. Attendees: Authorized representatives of the University, University, and their consultants; the Contractor and its superintendent; major subcontractors; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
- C. Agenda: Discuss items of significance that could affect progress, including, but not limited to, the following:
 - 1. Tentative construction schedule.
 - 2. Critical work sequencing.
 - 3. Designation of responsible personnel.
 - 4. Procedures for processing field decisions and Change Orders.
 - 5. Procedures for processing Applications for Payment.
 - 6. Procedures for processing Requests for Information (RFI's).
 - 7. Procedures for processing University's Supplemental Instructions and Contract Clarification.
 - 8. Distribution of Contract Documents.
 - 9. Submittal of Shop Drawings, Product Data, and Samples.
 - 10. Preparation of record documents.
 - 11. Use of the premises.
 - 12. Parking availability.
 - 13. Office, work, and storage areas.
 - 14. Equipment deliveries and priorities.
 - 15. Safety procedures.
 - 16. First aid.
 - 17. Security.

18. Housekeeping.
19. Working hours.
20. Utility outages.
21. Testing.

1.4 PROGRESS MEETINGS

- A. The University shall schedule and administer bi-weekly progress meetings throughout the progress of work. The progress meetings will be held at a site identified by the University.
 1. The University will conduct the meeting, record minutes, and distribute copies to participants.
- B. Attendees: In addition to representatives of the University and the University, each subcontractor, or other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.
- C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the status of the Project.
 1. Contractor's CPM Construction Schedule: Review progress since the last meeting. Determine status of each activity in relation to the Contractor's Construction Schedule, whether on time, ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to insure that current and subsequent activities will be completed within the Contract Time. Determine status of tasks on critical path. Identify additional tasks becoming critical due to delays.
 2. Review the present and future needs of each entity present, including, but not limited to, the following:
 - a. Interface requirements.
 - b. Time.
 - c. Sequences.
 - d. Status of submittals.
 - e. Deliveries.
 - f. Off-site fabrication problems.
 - g. Access.
 - h. Site utilization.
 - i. Temporary facilities and services.
 - j. Hours of work.
 - k. Hazards and risks.
 - l. Housekeeping.
 - m. Quality and work standards.
 - n. Change Orders.
 - o. Documentation of information for payment requests.
 - p. Review submittal log.
 - q. Review RFI log.
 - r. Review Change Order log.

- s. Review upcoming outages, testing and inspections.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01200

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for all submittals, required for the installation and completion of the work for the project. Submittals include three (3) types of submittals, Construction Submittals, Administrative Submittals and Quality Control Submittals as defined hereinafter.

B. UM Standard Project Forms:

1. The CM, Contractors, and A/E shall use the following UM Standard Project Submittal Forms for all submissions as follows:
 - a. UM Standard Project Submittal Form
 - b. UM Standard Project RFI Form
2. These forms are included in Part 2 Products for reference and each form's individual electronic file is available at the UM Architecture Engineering and Construction Documents web site at <http://www.umbfm.umaryland.edu> then through the link for AEC and AEC Documents.

1.3 DEFINITIONS

- A. Construction Submittals: Construction Submittals are defined as submittals which include all information related to products, materials, and equipment used for the construction of the project. Unless otherwise indicated all references to "Submittals" in the documents are for Construction Submittals. Construction Submittals: Such submittals shall include, but are not limited to, the following:
1. Contractor's construction schedule.
 2. Submittal schedule.
 3. Daily construction reports.
 4. Shop Drawings.
 5. Product Data.
 6. Samples.
 7. Quality assurance submittals.
 8. Fabrication drawings.
 9. Installation drawings.
 10. Setting diagrams.
 11. Shopwork manufacturing instructions.
 12. Templates and patterns.
 13. Schedules.

14. Coordination drawings.
 15. Requests for Information (RFI's).
- B. Administrative Submittals: Administrative Submittals are defined as submittals which include all information related to administrative documentation for the project. Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals shall include, but are not limited to, the following:
1. Permits.
 2. Applications for Payment.
 3. Performance and payment bonds.
 4. Insurance certificates.
 5. List of subcontractors.
- C. Quality Control Submittals: Quality-control submittals are defined as submittals which include all information related to administrative documentation for the project. Such submittals shall include, but are not limited to, the following:
1. Design data.
 2. Certifications.
 3. Manufacturer's instructions.
 4. Manufacturer's field reports.
- D. Coordination Drawings: Coordination Drawings show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in the space provided or to function as intended.
1. Preparation of Coordination Drawings is specified in Division 1 Section "Coordination" and may include components previously shown in detail on Shop Drawings or Product Data.
- E. Samples: Samples include, but are not limited to, the following:
1. Partial Sections of manufactured or fabricated components.
 2. Small cuts or containers of materials.
 3. Complete units of repetitively used materials.
 4. Swatches showing color, texture, and pattern.
 5. Color range sets.
 6. Components used for independent inspection and testing.
 7. Field samples.
 8. Field mock-ups
- F. Product Data: Product data shall include, but are not limited to, the following:
1. Manufacturer's product specifications.
 2. Manufacturer's installation instructions.
 3. Standard color charts.
 4. Catalog cuts.
 5. Roughing-in diagrams and templates.
 6. Standard wiring diagrams.
 7. Printed performance curves.
 8. Operational range diagrams.

9. Mill reports.
10. Standard product operating and maintenance manuals.
11. Certified capacity and performance data.

1.4 GENERAL SUBMITTAL PROCEDURES

- A. Submissions: UM requires that all construction and administration type submittals be transmitted electronically in “pdf” format for all products, materials, and equipment related to construction and all documentation related to the administration of the project. However UM will accept hard copies (paper copies) of construction and administration type submittals from the Contractor and CM when electronic files cannot be used.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay, and in accordance with the project CPM schedule.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.
 - a. The University reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.
 3. Scheduling: Division 1 Section “Schedules and Reports” includes the Submittal Schedule listing submittals and indicating time requirements for coordination of submittal activity with related construction operations.
 4. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals.
 - a. Allow four (4) weeks for initial review. Allow additional time if the University must delay processing to permit coordination with subsequent submittals.
 - b. If an intermediate submittal is necessary, process the same as the initial submittal.
 - c. Allow four (4) weeks for reprocessing each submittal.
 - d. No extension of Contract Time will be authorized because of failure to transmit submittals to the University sufficiently in advance of the Work to permit processing.
 - e. The Contractor and CM shall conduct an internal review of every submittal to ensure accuracy and completeness prior to submission to the A/E.
- C. Submittal Preparation: The Contractor or CM shall attach the UM Standard Project Submittal Form to the electronic file for each submittal. The contractor or CM shall complete the upper portion of the forms as appropriate.

D. Submittal Transmittal: Include an electronic transmittal with each submittal file for transmittal and handling. Each submittal file shall be transmitted electronically from the Contractor to the CM, then to the A/E. Forward a copy of the electronic transmittal to the UM OFM Project Manager. The A/E and the University will not accept submittals received from sources other than the Contractor or CM.

1. On the transmittal, record relevant project information.
2. Include Contractor's certification that information submitted complies with Contract Document requirements.
3. Transmittal Form: Prepare. Use the UM Standard Submittal Transmittal Form. In the places on the form provide the following information:
 - a. Project name.
 - b. Date.
 - c. Destination (To:).
 - d. Source (From:).
 - e. Names of the subcontractor, manufacturer, and supplier.
 - f. Category and type of submittal.
 - g. Submittal purpose and description.
 - h. Submittal and transmittal distribution record.
 - i. Remarks.
 - j. Signature of transmitter.

E. Requests for Information (RFI's): Use the UM Standard RFI Form for all Requests for Information. The CM or contractor shall submit each RFI to the A/E and copy the UM OFM Project Manager.

F. Contractor's Construction Schedule: Refer To Division 1 Section CPM Schedules

G. Daily Construction Reports

1. Prepare a daily construction report recording the following information concerning events at the site, and submit duplicate copies to the University at weekly intervals:
 - a. List of subcontractors at the site.
 - b. Approximate count of personnel at the site.
 - c. High and low temperatures, general weather conditions.
 - d. Accidents and unusual events.
 - e. Meetings and significant decisions.
 - f. Stoppages, delays, shortages, and losses.
 - g. Meter readings and similar recordings.
 - h. Incident reports with emergency procedures followed.
 - i. Orders and requests of governing authorities.
 - j. Change Orders received, implemented.
 - k. Services connected, disconnected.
 - l. Equipment or system tests and startups.
 - m. Partial Completions, occupancies.
 - n. Substantial Completions authorized.

H. Shop Drawings and Coordinated Drawings

1. In addition to the general submittal procedures, the following requirements apply to shop drawings and coordination drawings:
 - a. Submit newly prepared information drawn accurately to scale. Indicate deviations from the Contract Documents. The CM or contractor shall not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.
2. Shop Drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings. Include the following information:
 - a. Dimensions.
 - b. Identification of products and materials included by sheet and detail number.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
3. Submit Coordination Drawings where required for integration of different construction elements, and in compliance with the requirements of Division 1 Section "Coordination". Show construction sequences and relationships of separate components where necessary to avoid conflicts in utilization of the space available.
4. Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).
5. Hard Copy Submittals: When hard copy submittals are used submit one (1) reproducible drawing for review by the A/E. The A/E will review and make appropriate comments on the reproducible drawing, sign off the UM forms with action taken, make one (1) print for their record, and forward the reproducible drawing to the University. The University will review and make additional comments as necessary, forward their comments to the A/E for their record and information, make one (1) copy for their use and return the reproducible drawing to the Contractor. For submittals requiring resubmission, the process will be repeated until submittals are considered acceptable by the A/E and the University.
6. Electronic Submittals: When shop drawings are transmitted electronically, submit one (1) electronic file for each shop drawing. Each file shall include all required submittal data and the UM Submittal Form for each submittal. The A/E will review and make appropriate comments on the electronic file, sign off the UM forms with action taken, retain one (1) copy for their record, and forward the electronic file to the University. The University will review and make additional comments as necessary; forward their comments to the A/E for their record and information, retain one (1) copy of the electronic file for their use, and return the electronic file to the CM or Contractor. For submittals requiring resubmission, the process will be repeated until submittals are considered acceptable by the A/E and the University.

7. Shop Drawing shall not be used without an appropriate final stamp indicating the action taken.

I. Product Data

1. In addition to the general submittal procedures, the following requirements apply to product data submittals:
 - a. Collect Product Data into a single submittal for each element of construction or system. Product Data shall include printed information, such as manufacturer's general product information, installation instructions, catalog cuts, standard color charts, roughing-in dimensions, diagrams and templates, standard wiring diagrams, and performance data and curves.
 - b. Mark each copy to show applicable choices and options. Where printed product data includes information on several products that are either not required or are optional materials, arrangements or components that require a selection or indicator, mark copies to indicate the applicable information. Include the following information:
 - 1) Manufacturer's printed recommendations.
 - 2) Compliance with trade association standards.
 - 3) Compliance with recognized testing agency standards.
 - 4) Application of testing agency labels and seals.
 - 5) Notation of dimensions verified by field measurement.
 - 6) Notation of coordination requirements.
 - 7) Compliance with contract documents.
 - 8) Specification Section and paragraph.
 - c. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
 - d. Hard Copy Submittals: When hard copy submittals are used submit six (6) copies, plus the number required for the CM and Contractor's use, of each required submittal for review by the A/E. The A/E will review and make appropriate comments on each copy, sign off the UM forms with action taken, retain two (2) copies for their records and forward the remaining submittals to the University. The University will review the submittals, make additional comments as necessary, forward their comments to the A/E for their records, retain one (1) copy of each submittal, and return the remaining submittals to the Contractor. For submittals requiring resubmission, the process will be repeated until submittals are considered acceptable by the A/E and the University.
 - e. Electronic Submittals: When product data submittals are transmitted electronically, submit one (1) electronic file for each shop submittal. Each file shall include all required submittal data and the UM Submittal Form for each submittal. The A/E shall review and make appropriate comments on the electronic file, sign off the UM forms with action taken, retain one (1) copy for their record and forward the electronic file to the University. The University will review and

make additional comments as necessary, sign off the UM forms, retain one (1) copy of the electronic file for their use, forward their comments to the A/E for their record and information, and return the electronic file to the CM or Contractor. For submittal files requiring resubmission, the process will be repeated until submittals are considered acceptable by the A/E and the University.

- f. Distribution: Forward one (1) copy of each approved submittal file to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.
- g. Do not proceed with installation until a copy of approved Product Data is in the Installer's possession.
- h. Do not permit use of unmarked copies of Product Data in connection with construction.
- i. The Contractor shall retain three (3) copies of the final submittals for inclusion in the O&M Manuals.

J. Samples

- 1. In addition to the general submittal procedures, the following requirements apply to samples:
 - a. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product designed and specified. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.
 - b. Mount or display Samples in a manner to facilitate review of qualities indicated. Include the following:
 - 1) Specification Section number and reference.
 - 2) Generic description of the Sample.
 - 3) Sample source.
 - 4) Product name or name of the manufacturer.
 - 5) Compliance with recognized standards.
 - 6) Availability and delivery time.
 - 7) Size limitations.
 - 8) Compliance with governing regulations.
 - c. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

- 1) Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least three (3) multiple units that show approximate limits of the variations.
 - 2) Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, & details of assembly, connections, operation, and similar construction characteristics.
 - 3) Refer to other Sections for Samples to be returned to the Contractor for incorporation in the work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.
 - 4) Samples not incorporated into the work or otherwise designated as the University's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.
- d. Submittals: Submit three (3) sets. The A/E will retain one (1) set and send two (2) sets marked with the action taken to the University. The University will retain one (1) set and return the other set to the CM or Contractor.
- e. Maintain sets of Samples, as returned, at the project Site, for quality comparisons throughout the course of construction.
- 1) Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
 - 2) Approved sample sets will be used by the A/E and the University to determine final acceptance of the construction associated with each set.

K. Quality Assurance Submittals

1. In addition to the general submittal procedures, the following requirements apply to quality assurance submittals:
 - a. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.
 - b. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.
 - c. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.
 - d. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."

L. Architect/Engineer's (A/E) Action

1. The A/E will review each submittal, mark to indicate action taken, and transmit the submittals promptly to the UM OFM Project Manager.
 - a. Compliance with the contract documents is the Contractor's responsibility.
2. Submittal Action: The A/E will fill in the appropriate boxes on the UM Standard Project Submittal Form attached to each submittal and attach their comments as necessary. The University will fill in the lower portion of the form as necessary on each submittal to indicate the University has reviewed the submittals. The A/E's submittal stamp shall not be used on submittals for UM projects.

M. Construction Manager's (CM) or Contractor Action

1. The CM or Contractor shall be responsible for the collection of all project submittals from the suppliers and subcontractors for distribution to the A/E and the University for review. The CM is responsible for the redistribution of the reviewed submittals back to the subcontractors and suppliers for appropriate action based on the A/E and University review comments.
2. Submittal Action: The UM Standard Project Submittal Form will indicate how the CM or Contractor needs to proceed with each submittal as follows:
 - a. Action – “No Exceptions Taken”: Submittals returned to the CM or Contractor as "No Exceptions Taken" indicates the submitted material and equipment appears to comply with requirements of the Contract Documents and therefore the work related to the submittal can proceed. Final payment depends on that compliance.
 - b. Action – "Note Markings/Attachments": Submittals returned to the CM or Contractor as "Note Markings/Attachments" indicates the submitted material and equipment will appear to comply with requirements of the Contract Documents provided the noted comments become a part of the submission and therefore the work related to the submittal can proceed. Final payment depends on that compliance.
 - c. Action – “Amend & Resubmit”: Submittals returned to the CM or Contractor as "Amend & Resubmit" indicates some of the submitted material and equipment does not comply with the requirements of the Contract Documents and therefore the work related to the submittal cannot proceed until the re-submittal process confirms that the material and equipment complies with the requirements of the Contract Documents. Final payment depends on that compliance.
 - d. Action–“Rejected/Resubmit”: Submittals returned to the CM or Contractor as "Rejected/Resubmit" indicates that there are significant and fundamental deficiencies indicated in the submitted material and equipment, and does not comply with the requirements of the Contract Documents. Therefore the work related to the submittal cannot proceed until the re-submittal process confirms that the material and equipment complies with the requirements of the Contract Documents. Final payment depends on that compliance.
3. When the CM or Contractor receives submittals as “Amend & Resubmit” or “Rejected/Resubmit," the CM or Contractor shall not proceed with work covered by these

submittals, including purchasing, fabrication, delivery, or other activity. Revise or prepare new submittals according to the notations; resubmit without delay. Repeat as necessary to obtain acceptance from the A/E and UM.

4. Do not use, or allow others to use, submittals marked "Amend & Resubmit" or "Rejected/Resubmit" at the Project Site or elsewhere where work is in progress.
5. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the University will return the submittal marked "Action Not Required."

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 UM STANDARD PROJECT SUBMITTAL FORM

- A. The electronic file for this form is available at the UM Architecture Engineering and Construction Documents web site.

UMB STANDARD PROJECT SUBMITTAL FORM

UMB PROJECT NAME: _____ UMB PROJECT NUMBER: _____ UM SYSTEM CAMPUS: _____	
CONTRACTOR: Submission is in compliance with contract requirements, including dimensions, quantities and all trade coordination. <input type="checkbox"/> Submitted as specified <input type="checkbox"/> Substitution in accordance with <i>Insert Spec Section Here</i> Date: ___/___/___ By: _____	CM: Submittal No. _____ <i>Insert Submittal # above</i> <input type="checkbox"/> Submission to the University and AE is in accordance with <i>Contract Insert Contract No. Here</i> <input type="checkbox"/> Disapproved Date: ___/___/___ By: _____
PROJECT ARCH: <input type="checkbox"/> No Exceptions Taken <input type="checkbox"/> Note Markings/Attachments <input type="checkbox"/> Amend & Resubmit <input type="checkbox"/> Rejected/Resubmit Review of the submission by the Architect is in accordance with and governed by the Architect Agreement <i>Insert Contract # here</i> . For explanation of the Architect's review comments, refer to Section <i>Insert Spec Section here</i> of the Specifications. Date: ___/___/___ By: _____	ASSOCIATED ARCH: <input type="checkbox"/> No Exceptions Taken <input type="checkbox"/> Note Markings/Attachments <input type="checkbox"/> Amend & Resubmit <input type="checkbox"/> Rejected/Resubmit Date: ___/___/___ By: _____
CIVIL ENGINEER: <input type="checkbox"/> No Exceptions Taken <input type="checkbox"/> Note Markings/Attachments <input type="checkbox"/> Amend & Resubmit <input type="checkbox"/> Rejected/Resubmit Date: ___/___/___ By: _____	STRUCTURAL ENGINEER: <input type="checkbox"/> No Exceptions Taken <input type="checkbox"/> Note Markings/Attachments <input type="checkbox"/> Amend & Resubmit <input type="checkbox"/> Rejected/Resubmit Date: ___/___/___ By: _____
MEP ENGINEER: <input type="checkbox"/> No Exceptions Taken <input type="checkbox"/> Note Markings/Attachments <input type="checkbox"/> Amend & Resubmit <input type="checkbox"/> Rejected/Resubmit Date: ___/___/___ By: _____	CONSULTANT <input type="checkbox"/> No Exceptions Taken <input type="checkbox"/> Note Markings/Attachments <input type="checkbox"/> Amend & Resubmit <input type="checkbox"/> Rejected/Resubmit Date: ___/___/___ By: _____
OWNER: Date: ___/___/___ Regional Review By: _____ Date: ___/___/___ UMB Review By: _____ Owner Comments: _____ _____ _____ Review by Owner does not relieve the CM and/or AE of their obligations under the above noted contracts respectively.	

SECTION 01311 - SCHEDULES AND REPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for schedules, reports, and critical path method scheduling required for proper performance of the Work, including:
 - 1. Submittal schedule.
 - 2. Schedule of inspections and tests.
 - 3. Daily construction reports.
 - 4. Material location reports.
 - 5. Field correction reports.
 - 6. Special reports.
- B. The contractor shall submit a CPM schedule that identifies the overall project construction phasing plan as well as phasing plans for each of the project areas as identified in the document packages A, B, and C sets.

1.3 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of schedules and reports with performance of other construction activities.

1.4 DEFINITIONS

- A. Critical Path Method (CPM): A method of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the Project.
- B. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall project duration.
- C. Network Diagram: A graphic diagram of a network schedule, showing the activities and activity relationships.
- D. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical activities are activities on the critical path.

2. Predecessor activity is an activity that must be completed before a given activity can be started.

E. Event: An event is the starting or ending point of an activity.

F. Milestone: A key or critical point in time for reference or measurement.

G. Float is the measure of leeway in activity performance. Accumulative float time belongs to the University.

1. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.

2. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned project completion date.

1.5 QUALITY ASSURANCE

A. The Contractor's Consultant: Retain a consultant to provide planning, evaluating, and reporting by CPM scheduling.

B. The Consultant shall be a recognized specialist, acceptable to the University, who is an expert in CPM scheduling and reporting.

C. The Consultant shall have computer facilities that are capable of delivering detailed network diagrams within 48 hours of request.

D. In-House Option: The University may waive the requirement to retain a consultant if the Contractor can demonstrate that:

1. The Contractor has the computer equipment required to produce CPM network diagrams.

2. The Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques.

E. Program: Use a computer software program for network analysis that has been developed specifically to manage CPM construction schedules and is acceptable to the University.

F. Standards: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

1.6 RELIMINARY NETWORK DIAGRAM

A. Preliminary Network Diagram: Submit a preliminary network diagram within fourteen (14) days of the Notice to Proceed. The preliminary network diagram shall outline activities for the first sixty (60) days of construction. Include a skeleton diagram for the remainder of the Work with the preliminary diagram.

1. Include each significant construction activity. Coordinate each activity in the network with other activities. Schedule each construction activity in proper sequence.

2. Indicate completion of the Work on the date established for Substantial Completion, unless the University agrees otherwise.
- B. Cash Requirement Prediction: With submittal of the preliminary network diagram, include a preliminary cash requirement prediction based on indicated activities.
- C. Distribution: Distribute the preliminary network diagram to parties involved in construction activities that are scheduled early, including the University and the University.

1.7 CPM SCHEDULE

- A. Prepare the Contractor's Construction Schedule using the network analysis diagram system known as the critical path method (CPM). Follow procedures outlined in AGC's "Construction Planning & Scheduling."
1. Proceed with preparation of the network diagram immediately following Notice to Proceed.
 2. Follow the steps necessary to complete development of the network diagram in sufficient time to submit the CPM Schedule so it can be accepted for use no later than sixty (60) days after commencement of the Work.
 3. Conduct educational workshops to train and inform key project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 4. Establish procedures for monitoring and updating the CPM Schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates. Use "one working day" as the unit of time.
- B. CPM Schedule Preparation: Prepare a list of all activities involved in the Project. Include a list of activities required to complete the Work. No single activity shall exceed fifteen (15) work days. Provide the best data available for generation of the network diagram and the CPM Schedule.
1. Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities.
 2. Indicate estimated times for the following activities to be performed:
 - a. Preparation and processing of submittals.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 3. Treat each story or separate area as a separate numbered activity for principal elements of the Work.
 4. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
- C. Processing: Enter prepared data on the processing system. Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM Schedule within the limitations of Contract Time.

- D. Format: Display the full network on a single sheet of stable transparency, or other reproducible media, of sufficient width to show data clearly for the entire construction period.
1. Mark the critical path. Locate the critical path near the center of the network; locate paths with the most float near the edges.
 2. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Initial Issue: Prepare the initial issue of the CPM Schedule network diagram from a listing of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports to show the following:
1. The Contractor or subcontractor and Work or activity.
 2. Description of the activity.
 3. Principal events of that activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in working days (maximum limit is fifteen (15) work days for construction activity).
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the Schedule of Values).
- F. Value Summaries: Prepare two (2) cumulative value listings, sorted by finish dates.
1. In first listing, tabulate the following:
 - a. Activity number.
 - b. Early finish date.
 - c. Dollar value.
 - d. Cumulative dollar value.
 2. In second listing, tabulate the following:
 - a. Activity number.
 - b. Late finish date.
 - c. Dollar value.
 - d. Cumulative value.
 3. In subsequent issues of both listings, substitute actual finish dates for activities completed as of listing date.
 4. Prepare listing for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary listings, tabulate "actual percent complete," and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts following each regularly scheduled progress meeting.

1.8 CPM SUBMITTALS

- A. Submittal and Distribution: Submit three (3) copies of the initial issue of the tabulations and network to the University for acceptance. When authorized, distribute copies to the separate contractors,

subcontractors and suppliers or fabricators, and others identified by the Contractor with a need-to-know schedule responsibility.

1. Post copies in the Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
3. Submit copies of each computer-produced report to the University.

B. Schedule Updating: Revise the schedule immediately after each meeting or other activity, where revisions have been recognized or made. Issue the updated schedule at each project meeting and submit with application for payment. Requests for payment will not be made without an updated CPM schedule.

1.9 SUBMITTAL SCHEDULE

A. After development and acceptance of the Contractor's CPM Schedule, prepare a complete schedule of submittals. Submit the schedule within ten (10) days of the date required for submittal of the Contractor's CPM Schedule.

1. Coordinate Submittal Schedule with the list of subcontracts, Schedule of Values and the list of products as well as the Contractor's Construction Schedule.

B. Prepare the schedule in chronological order. Provide the following information:

1. Scheduled date for the first submittal.
2. Related Section number.
3. Submittal category.
4. Name of the subcontractor.
5. Description of the part of the Work covered.
6. Latest scheduled date for the University's review/approval.

C. Distribution: Upon final approval of the University, print and distribute copies to the University, University, subcontractors, and other parties required to comply with submittal dates indicated.

1. Post copies in the Project meeting room and temporary field office.
2. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned part of the Work and are no longer involved in construction activities.

D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.10 SCHEDULE OF INSPECTIONS AND TESTS

A. Prepare a schedule of inspections, tests, and similar services required by the Contract Documents. Submit the schedule within thirty (30) days of the date established for commencement of the Work.

B. Form: The schedule shall be in tabular form and shall include, but not be limited to, the following:

1. Specification Section number.
2. Description of the test.
3. Identification of applicable standards.
4. Identification of test methods.
5. Number of tests required.
6. Time schedule or time span for tests.
7. Entity responsible for performing tests.
8. Requirements for taking samples.
9. Unique characteristics of each service.

C. Distribution: Distribute the schedule to the University, and each party involved in performance of portions of the Work where inspections and tests are required.

D. Schedule Updating: Revise the schedule after each meeting or other activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.11 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at the site. Submit duplicate copies to the University at weekly intervals:

1. List of subcontractors at the site.
2. List of separate contractors at the site.
3. Approximate count of personnel at the site.
4. High and low temperatures, general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events (refer to special reports).
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Emergency procedures.
11. Orders and requests of governing authorities.
12. Change Orders received, implemented.
13. Services connected, disconnected.
14. Equipment or system tests and startups.
15. Partial Completions, occupancies.
16. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare a comprehensive list of materials delivered to and stored at the site. The list shall be cumulative, showing materials previously reported plus items recently delivered. Include with the list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from the site. Submit copies of the list to the University at weekly intervals.

1.12 SPECIAL REPORTS

- A. General: Submit special reports directly to the University within one day of an occurrence. Submit a copy to other parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at the site, prepare and submit a special report. List the chain of events, persons participating, response by the Contractor's personnel, an evaluation of the results or effects and similar pertinent information. Advise the University in advance when such events are anticipated or predictable.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01311

SECTION 01380 - CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for construction photographs for the following types of projects:
 - 1. New construction projects.
 - 2. Campus renovation projects.

1.3 CM REQUIREMENTS

- A. The CM shall make arrangements to have a series of construction photographs taken of the construction site utilizing their personnel with a digital camera.
- B. The CM shall maintain an up-to-date electronic file of the photographs in numerical order per month in an XL spread sheet format as follows:
 - 1. The XL spread sheet shall include a header with the UM Project Name and Project Number. Under the header include columns for "Photo #", "Date" "Location on Project Site", "View of the Photo" "Description" and "Photograph". For Example:
 - a. Photo #1
 - b. 6-5-12
 - c. Roof Level
 - d. Looking East
 - e. Roof Flashing at Stair Tower
 - f. Photograph

1.4 SUBMITTALS

- A. Monthly: Submit construction photographs, electronically, in "pdf" file format to the University Project Manager (PM) monthly with the application for payment.
 - 1. Organize the electronic "pdf" files as indicated in paragraph 1.3 above.
 - 2. Pre-construction photographs shall be submitted with the first application for payment.

1.5 PHOTOGRAPHIC REQUIREMENTS

- A. The CM shall take a series of construction photographs to document conditions at the project site and during various stages of construction as follows:

1. Pre-Construction Photographs: Prior to the start of construction take photographs of the project site and adjacent areas as follows:
 - a. New Projects: Take photographs in sufficient number to show existing conditions adjacent to the work areas before starting work. Where applicable, take photographs of existing buildings either on or adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.
 - b. Campus Renovation Projects: Take photographs in sufficient number to show existing conditions adjacent to the work areas, to indicate pre construction damage to existing walls, partitions, insulation, previous work that was not completed, and/or missing materials before starting work.
2. Construction Progress Photographs:
 - a. Take project photographs, in accordance with requirements indicated, to best show the status of construction and progress since taking previous photographs.
 - b. Frequency: Take photographs weekly.
 - c. Vantage Points: Comply with the University's directions concerning desired vantage points for shots.
3. Record Photograph Files:
 - a. At the end of the project submit a complete set of record photographs, organized in XL spread sheets on a CD-R in a full size jewel case to the University. Label the CD-R and the jewel case with the UM project, UM Project Number, contents on the CD, and the submission date.
4. Post Construction Photographs:
 - a. After the project has completed if the A/E, the CM, and/or other contractors would like to have a series of post construction photographs taken of the project site they must submit a written request to the University PM. The PM will contact the appropriate University representatives to gain approval and the set up a time for the photographs to be taken. Post construction photographs will not be allowed without the approval of the end user or their representative.

END OF SECTION 01380

SECTION 01400 - QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality-control services.
- B. Quality-control services include inspections, tests, and related actions, including reports, performed by Contractor, by independent agencies, and by governing authorities. They do not include contract enforcement activities performed by the University.
- C. Inspection and testing services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.

1.3 RESPONSIBILITIES

- A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity, Contractor shall provide inspections, tests, and other quality-control services specified elsewhere in the Contract Documents and required by authorities having jurisdiction. Costs for these services are included in the Contract Sum.
 - 1. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the Contractor's responsibility, the Contractor may perform testing by its own workforce. Otherwise, and as indicated in individual Sections, the Contractor shall employ and pay a qualified independent testing agency to perform quality-control services. Costs for these services are included in the Contract Sum.
 - 2. Where individual Sections specifically indicate that certain inspections, tests, and other quality-control services are the University's responsibility, the University will employ and pay a qualified independent testing agency to perform those services.
 - a. Where the University has engaged a testing agency for testing and inspecting part of the Work, and the Contractor is also required to engage an entity for the same or related element, the Contractor shall not employ the entity engaged by the University, unless agreed to in writing by the University.
- B. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Document requirements, regardless of whether the original test was Contractor's responsibility.
 - 1. The cost of retesting construction, revised or replaced by the Contractor, is the Contractor's responsibility where required tests performed on original construction indicated noncompliance with Contract Document requirements.

- C. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
1. Provide access to the Work.
 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 3. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 4. Provide facilities for storage and curing of test samples.
 5. Deliver samples to testing laboratories.
 6. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 7. Provide security and protection of samples and test equipment at the Project Site.
- D. Duties of the Testing Agency: The independent agency engaged to perform inspections, sampling, and testing of materials and construction specified in individual Sections shall cooperate with the University and the Contractor in performance of the agency's duties. The testing agency shall provide qualified personnel to perform required inspections and tests.
1. The agency shall notify the University and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
 3. The agency shall not perform any duties of the Contractor.
- E. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay. Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections and tests.
1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

1.4 SUBMITTALS

- A. Unless the Contractor is responsible for this service, the independent testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to the University. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of each inspection, test, or similar service through the Contractor.
1. Submit additional copies of each written report directly to the governing authority, when the authority so directs.
 2. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the following:
 - a. Date of issue of report.
 - b. Project title and number.
 - c. Name, address, and telephone number of testing agency.
 - d. Dates and locations of samples and tests or inspections.
 - e. Names of individuals making the inspection or test.
 - f. Designation of the Work and test method.

- g. Identification of product and Specification Section.
- h. Complete inspection or test data.
- i. Test results and an interpretation of test results.
- j. Ambient conditions at the time of sample taking and testing.
- k. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
- l. Name and signature of laboratory inspector.
- m. Recommendations on retesting.

1.5 QUALITY ASSURANCE

- A. Qualifications for Service Agencies: Engage inspection and testing service agencies, including independent testing laboratories, that are prequalified as complying with the American Council of Independent Laboratories' "Recommended Requirements for Independent Laboratory Qualification" and that specialize in the types of inspections and tests to be performed.
 - 1. Each independent inspection and testing agency engaged on the Project shall be authorized by authorities having jurisdiction to operate in the state where the Project is located.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting and Patching."
- B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection, testing, or similar services.

END OF SECTION 01400

SECTION 01500 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for construction facilities and temporary controls, including temporary utilities, support facilities, and security and protection.

Temporary utilities include, but are not limited to, the following:

1. Water service and distribution.
2. Temporary electric power and light.
3. Temporary heat.
4. Ventilation.
5. Telephone service.
6. Sanitary facilities, including drinking water.
7. Storm and sanitary sewer.

Support facilities include, but are not limited to, the following:

1. Field offices and storage sheds.
2. Dewatering facilities and drains.
3. Temporary enclosures.
4. Hoists and temporary elevator use.
5. Temporary project identification signs and bulletin boards.
6. Waste disposal services.
7. Rodent and pest control.
8. Construction aids and miscellaneous services and facilities.

Security and protection facilities include, but are not limited to, the following:

1. Barricades, warning signs, and lights.
2. Sidewalk bridge or enclosure fence for the site.
3. Environmental protection.

1.3 SUBMITTALS

- A. Temporary Utilities: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within 15 days of the date established for commencement of the Work, submit a schedule indicating implementation and termination of each temporary utility.

1.4 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction including, but not limited to, the following:
 - 1. Building code requirements.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, fire department, and rescue squad rules.
 - 5. Environmental protection regulations.
- B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."
 - 1. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."
- C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the University, change over from use of temporary service to use of permanent service.
- B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Relocate temporary services and facilities as the Work progresses. Do not overload facilities or permit them to interfere with progress. Take necessary fire-prevention measures. Do not allow hazardous, dangerous, or unsanitary conditions, or public nuisances to develop or persist on-site.

PART 2 - PRODUCTS

2.1 MATERIALS

General: Provide new materials. If acceptable to the University, the Contractor may use undamaged, previously used materials in serviceable condition. Provide materials suitable for use intended.

- A. Lumber and Plywood:
 - 1. For signs and directory boards, provide exterior-type, Grade B-B high-density concrete form overlay plywood of sizes and thicknesses indicated.
 - 2. For fences and vision barriers, provide minimum 3/8-inch- (9.5-mm-) thick exterior plywood.
 - 3. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch- (16-mm-) thick exterior plywood.
- B. Paint:

1. For sign panels and applying graphics, provide exterior-grade alkyd gloss enamel over exterior primer.
- C. Tarpaulins: Provide waterproof, fire-resistant, UL-labeled tarpaulins with flame-spread rating of fifteen (15) or less. For temporary enclosures, provide translucent, nylon-reinforced, laminated polyethylene or polyvinyl chloride, fire-retardant tarpaulins.
- D. Water: Provide potable water approved by local health authorities.
- E. Open-Mesh Fencing: Provide 0.120-inch- (3-mm-) thick, galvanized 2 inch (50-mm) chain link fabric fencing six (6) feet (2 m) high with galvanized barbed-wire top strand and galvanized steel pipe posts, 1-1/2 inches (38 mm) I.D. for line posts and 2-1/2 inches (64 mm) I.D. for corner posts.

2.2 EQUIPMENT

- A. General: Provide new equipment. If acceptable to the University, the Contractor may use undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.
- B. Water Hoses: Provide 3/4-inch (19-mm), heavy-duty, abrasion-resistant, flexible rubber hoses one hundred (100) feet (30 m) long, with pressure rating greater than the maximum pressure of the water distribution system. Provide adjustable shutoff nozzles at hose discharge.
- C. Electrical Outlets: Provide properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-Volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button, and pilot light for connection of power tools and equipment.
- D. Electrical Power Cords: Provide grounded extension cords. Use hard-service cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered-glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM, or another recognized trade association related to the type of fuel being consumed.
- G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.
- H. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of the chemical, aerated recirculation, or combustion type. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

- I. Fire Extinguishers: Provide hand-carried, portable, UL-rated, Class A fire extinguishers for temporary offices and similar spaces. In other locations, provide hand-carried, portable, UL-rated, Class ABC, dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for the exposures.
 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Coordinate with the University Operations and Maintenance Personnel to install temporary service or connect to existing service. Provide all necessary labor, materials and equipment for connections.
 1. Coordinate with the University for a time when service can be interrupted, if necessary, to make connections for temporary services.
 2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.
 3. Obtain easements to bring temporary utilities to the site where the University's easements cannot be used for that purpose.
 4. Use Charges: Cost or use charges for temporary facilities are not chargeable to the University. The University will not accept cost or use charges as a basis of claims for Change Orders.
- B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.
 1. Sterilization: Sterilize temporary water piping prior to use.
- C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnects, automatic ground-fault interrupters, and main distribution switch gear.
 1. Install electric power service underground, except where overhead service must be used.

2. Power Distribution System: Install wiring overhead and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, ac 20 Ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.
- D. Temporary Lighting: When overhead floor or roof deck has been installed, provide temporary lighting with local switching.
1. Install and operate temporary lighting that will fulfill security and protection requirements without operating the entire system. Provide temporary lighting that will provide adequate illumination for construction operations and traffic conditions.
- E. Temporary Heat: Provide temporary heat required by construction activities for curing or drying of completed installations or for protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.
- F. Heating Facilities: Except where the University authorizes use of the permanent system, provide vented, self-contained, LP-gas or fuel-oil heaters with individual space thermostatic control.
1. Use of gasoline-burning space heaters, open flame, or salamander heating units is prohibited.
- G. Temporary Telephones: Provide temporary telephone service throughout the construction period for all personnel engaged in construction activities. Install telephone on a separate line for each temporary office and first-aid station.
1. Separate Telephone Lines: Provide additional telephone lines for the following:
 - a. Where an office has more than two (2) occupants, install a telephone for each additional occupant or pair of occupants.
 - b. Provide a dedicated telephone line for a fax machine in the field office.
 - c. Provide a separate line for the University's use.
 2. At each telephone, post a list of important telephone numbers.
- H. Sanitary facilities include temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.
- I. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.
1. Provide separate facilities for male and female personnel.

- J. Sewers and Drainage: Provide temporary connections to remove effluent that can be discharged lawfully. If drainage facilities cannot be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
 - 1. Filter out excessive amounts of soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
 - 2. Connect temporary sewers to the municipal system, as directed by Baltimore City sewer department officials.
 - 3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.
- K. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 SUPPORT FACILITIES INSTALLATION

- A. Locate field offices, storage sheds, and other temporary construction and support facilities for easy access.
 - 1. Maintain support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the University.
- B. Field Offices: Provide insulated, weather tight temporary offices of sufficient size to accommodate required office personnel at the Project Site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip offices as follows:
 - 1. Furnish with a desk and chairs, a four (4) drawer file cabinet, plan table, plan rack, and a six (6) shelf bookcase.
 - 2. Equip with a water cooler and include a table and chairs for progress meetings, private toilet complete with water closet, lavatory, and medicine cabinet unit with a mirror.
- C. Storage and Fabrication Trailers: Install storage and fabrication trailers sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility service.
- D. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division 2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations, and construction free of water.
- E. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities.
 - 1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of twenty five (25) sq. ft. (2.3 sq. m) or less with plywood or similar materials.
 3. Close openings through floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
- F. Project Identification and Temporary Signs: Prepare project identification and other signs of size indicated. Install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs.
1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.
 2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.
- G. Temporary Exterior Lighting: Install exterior yard and sign lights so signs are visible when Work is being performed.
- H. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than seven (7) days during normal weather or three (3) days when the temperature is expected to rise above 80°F (27°C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material lawfully.
- I. Rodent and Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Employ this service to perform extermination and control procedures at regular intervals so the Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.
- J. Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate. Cover finished, permanent stairs with a protective covering of plywood or similar material so finishes will be undamaged at the time of acceptance.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer, as requested by the University.
- B. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10 "Standard for Portable Fire Extinguishers" and NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations."
 1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

- Store combustible materials in containers in fire-safe locations.
2. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for fighting fires. Smoking is not permitted anywhere on project sites.
 3. Provide supervision of welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
- C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
- D. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- E. Enclosure Fence: Before excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering the site, except by the entrance gates.
1. Provide open-mesh, chainlink fencing with posts set in a compacted mixture of gravel and earth.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
- G. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways, and subsoil might be contaminated or polluted or that other undesirable effects might result. Avoid use of tools and equipment that produce harmful noise. Restrict use of noise-making tools and equipment to hours that will minimize complaints from persons or firms near the site.
- ### 3.5 OPERATION, TERMINATION, AND REMOVAL
- A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
 - B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a twenty four (24) hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Protection: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Termination and Removal: Unless the University requests that it be maintained longer, remove each temporary facility when the need has ended, when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the Contractor's property. The University reserves the right to take possession of project identification signs.
 2. At Substantial Completion, clean and renovate permanent facilities used during the construction period including, but not limited to, the following:
 - a. Replace air filters and clean inside of ductwork and housings.
 - b. Replace significantly worn parts and parts subject to unusual operating conditions.
 - c. Replace lamps burned out or noticeably dimmed by hours of use.

END OF SECTION 01500

SECTION 01600 - MATERIALS AND EQUIPMENT, DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing the Contractor's selection of products for use in the Project.

1.3 DEFINITIONS

- A. Definitions used in this Article are not intended to change the meaning of other terms used in the Contract Documents, such as "specialties," "systems," "structure," "finishes," "accessories," and similar terms. Such terms are self-explanatory and have well-recognized meanings in the construction industry.

1. "Products" are items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - a. "Named Products" are items identified by the manufacturer's product name, including make or model number or other designation, shown or listed in the manufacturer's published product literature, that is current as of the date of the Contract Documents.
 - b. "Foreign Products," as distinguished from "domestic products," are items substantially manufactured (50 percent or more of value) outside the United States and its possessions. Products produced or supplied by entities substantially owned (more than 50 percent) by persons who are not citizens of, nor living within, the United States and its possessions are also considered to be foreign products.
2. "Materials" are products substantially shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.
3. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections, such as wiring or piping.

1.4 SUBMITTALS:

- A. All submittals shall comply with the requirements in the "SUBMITTALS" section.

1.5 QUALITY ASSURANCE

- A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source.
 1. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the

University to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to the fullest extent possible.

- B. Compatibility of Options: When the Contractor is given the option of selecting between 2 or more products for use on the Project, the product selected shall be compatible with products previously selected, even if previously selected products were also options.
- C. Foreign Product Limitations: Except under one or more of the following conditions, provide domestic products, not foreign products, for inclusion in the Work:
 - 1. No available domestic product complies with the Contract Documents.
 - 2. Domestic products that comply with the Contract Documents are available only at prices or terms substantially higher than foreign products that comply with the Contract Documents.
- D. Nameplates: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on concealed surfaces or, where required for observation after installation, on accessible surfaces that are not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on an easily accessible surface that is inconspicuous in occupied spaces. The nameplate shall contain the following information and other essential operating data:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and loss, including theft.
 - 1. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to the site in an undamaged condition in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 - 5. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.
 - 6. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

7. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION

- A. General Product Requirements: Provide products that comply with Contract Documents that are undamaged and new at time of installation.
 1. Provide products complete with accessories, trim, finish, safety guards, and other devices and details needed for complete installation and intended use and effect.
 2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Where products are accompanied by the term as selected, University will make selection.
 4. Where products are accompanied by the term match sample, sample to be matched is University's.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- A. General Compliance Requirements: Compliance requirements for individual products, as indicated in Contract Documents, are multiple in nature and may include generic descriptions, performance requirements, compliance with reference standards, conformance with graphic details and other similar forms and methods of indicating requirements, all of which must be complied with.
- B. Procedures for Selecting Products: Contractor's options for selecting products are limited by Contract Document requirements, and are not controlled by industry traditions or procedures experienced by Contractor on previous construction projects.
- C. Products specified by Reference Standards, Codes and Regulations: Select from among products which can be shown to comply to referenced documents.
- D. Products specified by Naming Products and Manufacturers: Select from among products listed.
- E. Products specified by Naming One Manufacturer's Product as the Basis-of-Design with Reference to Other Manufacturers: Select either the specified Basis-of-Design product or an approved comparable product by one of the other named manufacturers.
 1. Comply with provisions in Comparable Products Article to obtain approval for use of a comparable product by one of the named manufacturers.
- F. Products specified by Naming One Manufacturer's Product and Indicating Option of Selecting Comparable Products by stating or Approved Equivalent or similar language: Select either the specified product or an approved comparable product.
 1. Comply with provisions in Comparable Products Article to obtain approval for use of an unnamed comparable product by another manufacturer.

- G. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches University's sample. University's decision will be final on whether proposed product matches satisfactorily.
- H. Visual Selection Specification: Where Specifications include the phrase as selected from manufacturer's standard colors, patterns, textures or similar phrase, select a product that complies with other specified requirements. University will select color, pattern, and texture.
 - 1. Standard Range: Where Specifications include the phrase standard range of colors, patterns, textures or similar phrase, University will select color, pattern, or texture from manufacturer's product line that does not include premium items.
 - 2. Full Range: Where Specifications include the phrase full range of colors, patterns, textures or similar phrase, University will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Where Basis-of-Design products are specified by name, submit the following, in addition to other required submittals, to obtain approval of a comparable product by one of the named manufacturers:
 - 1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
 - 2. Detailed comparison of significant qualities of proposed product with the Basis-of-Design product in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, serviceability, visual effect, and specific features and requirements indicated.
 - 3. Evidence that proposed product provides specified warranty.
 - 4. List of similar installations for completed projects with project names and addresses and names and addresses of Universities, if requested.
 - 5. Samples, if requested.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each product securely in place, accurately located and aligned with other Work.
 - 1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- B. Install products in accordance with the execution's sections of the Project Manual.

END OF SECTION 01600

SECTION 01631 - SUBSTITUTIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for handling requests for substitutions made after award of the Contract.
- B. Contractor's submittal and University's acceptance of Shop Drawings, Product Data, or Samples not complying with Contract Documents do not constitute an acceptable or valid request for substitution, nor do they constitute approval. Substitutions not properly authorized may be considered defective.

1.3 DEFINITIONS

- A. Definitions in this Article do not change or modify the meaning of other terms used in the Contract Documents.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction required by the Contract Documents proposed by the Contractor after award of the Contract are considered to be requests for substitutions. The following are not considered to be requests for substitutions:
 - 1. Substitutions requested during the bidding period, and accepted by Addendum prior to award of the Contract, are included in the Contract Documents and are not subject to requirements specified in this Section for substitutions.
 - 2. Revisions to the Contract Documents requested by the University or University.
 - 3. Specified options of products and construction methods included in the Contract Documents.
 - 4. The Contractor's determination of and compliance with governing regulations and orders issued by governing authorities.

1.4 SUBMITTALS

- A. Substitution Request Submittal: The University will consider requests for substitution if received within sixty (60) days after issuance of Notice to Proceed. Requests received more than sixty (60) days after issuance of Notice to Proceed may be considered or rejected at the discretion of the University.
 - 1. Submit three (3) copies of each request for substitution for consideration. Submit requests in the form and according to procedures required for change-order proposals.
 - 2. Identify the product or the fabrication or installation method to be replaced in each request. Include related Specification Section and Drawing numbers.
 - 3. Provide complete documentation showing compliance with the requirements for substitutions, and the following information, as appropriate:

- a. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by the University and separate contractors, that will be necessary to accommodate the proposed substitution.
- b. A detailed comparison of significant qualities of the proposed substitution with those of the Work specified. Significant qualities may include elements, such as performance, weight, size, durability, and visual effect.
- c. Product Data, including Drawings and descriptions of products and fabrication and installation procedures.
- d. Samples, where applicable or requested.
- e. A statement indicating the substitution's effect on the Contractor's CPM Construction Schedule compared to the schedule without approval of the substitution. Indicate the effect of the proposed substitution on overall Contract Time.
- f. Cost information, including a proposal of the net change, if any in the Contract Sum.
- g. The Contractor's certification that the proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- h. The Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of the failure of the substitution to perform adequately.
- i. Confirmation that the same warranty will be furnished for substitute product as for specified product.

1.5 UNIVERSITY'S ACTION

A. University will review and take appropriate action upon Contractor's request for substitutions.

1. University's action will be taken with reasonable promptness, while allowing sufficient time in University's professional judgement to permit adequate review.
2. University shall be entitled to rely upon adequacy, accuracy, and completeness of data, and certifications prepared by Contractor.
3. If necessary, University will request additional information or documentation for evaluation after initial review of receipt of request for substitution.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01631

SECTION 01700 - CONTRACT CLOSEOUT
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Project record document submittal, including the following:
 - 3. Marked-up copies of Contract Drawings.
 - 4. Marked-up copies of Shop Drawings.
 - 5. Newly prepared drawings.
 - 6. Marked-up copies of Specifications, addenda, and Change Orders.
 - 7. Marked-up Product Data submittals.
 - 8. Record Samples.
 - 9. Field records for variable and concealed conditions.
 - 10. Record information on Work that is recorded only schematically.
 - 11. Operation and maintenance manual submittal.
 - 12. Preparing and submitting operation and maintenance manuals for building operating systems and equipment.
 - 13. Preparing and submitting instruction manuals covering the care, preservation, and maintenance of University products and finishes.
 - 14. Instruction of the University's operating personnel in the operation and maintenance of building systems and equipment.
 - 15. Submittal of warranties.
 - 16. Final cleaning.
- B. Closeout requirements for specific construction activities are included in the appropriate Sections the specifications.
- C. Environmental Requirements: Conduct cleaning and waste-disposal operations in compliance with local laws and ordinances. Comply fully with federal and local environmental and antipollution regulations.
 - 1. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains.
 - 2. Burning or burying of debris, rubbish, or other waste material on the premises is not permitted.
- D. Maintenance of Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and Samples available at all times for the University's inspections.

- E. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products. Manufacturer's disclaimers and limitations on product warranties do not relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.3 DEFINITIONS

- A. Standard product warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the University.
- B. Special warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the University.

1.4 WARRANTY REQUIREMENTS

- A. Related Damages and Losses: When correcting failed or damaged warranted construction, remove and replace construction that has been damaged as a result of such failure or must be removed and replaced to provide access for correction of warranted construction.
- B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.
- C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the University has benefited from use of the Work through a portion of its anticipated useful service life.
- D. University's Recourse: Expressed warranties made to the University are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the University can enforce such other duties, obligations, rights, or remedies.
 - 1. Rejection of Warranties: The University reserves the right to reject warranties and to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
- E. Where the Contract Documents require a special warranty, or similar commitment on the Work or part of the Work, the University reserves the right to refuse to accept the Work, until the Contractor presents evidence that entities required to countersign such commitments are willing to do so.

1.5 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete the following. List exceptions in the request.

1. In the Application for Payment that coincides with, or first follows, the date Substantial Completion is claimed, show 100 percent completion for the portion of the Work claimed as substantially complete.
 - a. Include supporting documentation for completion as indicated in these Contract Documents and a statement showing an accounting of changes to the Contract Sum.
 - b. If 100 percent completion cannot be shown, include a list of incomplete items, the value of incomplete construction, and reasons the Work is not complete.
 2. Advise the University of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance agreements, final certifications, and similar documents.
 4. Obtain and submit releases enabling the University unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Submit record drawings, maintenance manuals, final project photographs, damage or settlement surveys, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra stock, and similar items, including inventory list.
 7. Make final changeover of permanent locks and transmit keys to the University. Advise the University's personnel of changeover in security provisions.
 8. Complete startup testing of systems and instruction of the University's operation and maintenance personnel. Discontinue and remove temporary facilities from the site, along with mockups, construction tools, and similar elements.
 9. Complete final cleanup requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred, exposed finishes.
- B. Inspection Procedures: On receipt of a request for inspection, the University will either proceed with inspection or advise the Contractor of unfilled requirements. The University will prepare the Certificate of Substantial Completion following inspection or advise the Contractor of construction that must be completed or corrected before the certificate will be issued.
1. The University will repeat inspection when requested and assured that the Work is substantially complete.
 2. Results of the completed inspection will form the basis of requirements for final acceptance.

1.6 FINAL ACCEPTANCE

- A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete the following. List exceptions in the request.
1. Submit the final payment request with releases and supporting documentation not previously submitted and accepted. Include insurance certificates for products and completed operations where required.
 2. Submit an updated final statement, accounting for final additional changes to the Contract Sum.
 3. Submit a certified copy of the University's final punch list of items to be completed or corrected, endorsed and dated by the University. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance and will be endorsed and dated by the University.

4. Submit final meter readings for utilities, a measured record of stored fuel, and similar data as of the date of Substantial Completion or when the University took possession of and assumed responsibility for corresponding elements of the Work.
 5. Submit consent of surety to final payment.
 6. Submit a final liquidated damages settlement statement.
 7. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
- B. Reinspection Procedure: The University will reinspect the Work upon receipt of notice that the Work, including inspection list items from earlier inspections, has been completed, except for items whose completion is delayed under circumstances acceptable to the University.
1. Upon completion of reinspection, the University will prepare a certificate of final acceptance. If the Work is incomplete, the University will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but are required for final acceptance.
 2. If necessary, reinspection will be repeated.

1.7 QUALITY ASSURANCE

- A. Maintenance Manual Preparation: In preparation of maintenance manuals, use personnel thoroughly trained and experienced in operation and maintenance of equipment or system involved.
1. Where maintenance manuals require written instructions, use personnel skilled in technical writing where necessary for communication of essential data.
 2. Where maintenance manuals require drawings or diagrams, use draftsmen capable of preparing drawings clearly in an understandable format.
- B. Instructions for the University's Personnel: Use experienced instructors thoroughly trained and experienced in operation and maintenance of equipment or system involved to instruct the University's operation and maintenance personnel.

1.8 RECORD DOCUMENT SUBMITTALS

- A. General: Do not use record documents for construction purposes. Protect record documents from deterioration and loss in a secure, fire-resistant location. Provide access to record documents for the University's reference during normal working hours.
- B. Record Drawings (As-Built):
1. Markup Procedure: During construction, maintain a set of blue- or black-line white prints of Contract Drawings and Shop Drawings for Project Record Document (As-Built) purposes.
 - a. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:

- 1) Dimensional changes to the Drawings.
 - 2) Revisions to details shown on the Drawings.
 - 3) Depths of foundations below the first floor.
 - 4) Locations and depths of underground utilities.
 - 5) Revisions to routing of piping and conduits.
 - 6) Revisions to electrical circuitry.
 - 7) Actual equipment locations.
 - 8) Duct size and routing.
 - 9) Locations of concealed internal utilities.
 - 10) Changes made by change order.
 - 11) Changes made following the University's written orders.
 - 12) Details not on original Contract Drawings.
- b. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
 - c. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 - d. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - e. Note change-order numbers, and similar identification.
2. Responsibility for Markup: The individual or entity who obtained record data, whether the individual or entity is the Installer, subcontractor, or similar entity, shall prepare the markup on record drawings.
 - a. Accurately record information in an understandable drawing technique.
 - b. Record data as soon as possible after obtaining it. Record and check the markup prior to enclosing concealed installations.
 - c. At time of Substantial Completion, submit record drawings to the University for the University's records. Organize into sets and bind and label sets for the University's continued use.

C. Record Specifications

1. During the construction period, maintain one copy of the Project Specifications, including addenda and modifications issued, for Project Record Document purposes.
 - a. Mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications and modifications issued. Note related project record drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.
 - 1) In each Specification Section where products, materials, or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
 - 2) Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.
 - 3) Note related record Product Data, where applicable. For each principal product specified, indicate whether record Product Data has been submitted in maintenance manual instead of submitted as record Product Data.

- b. Upon completion of markup, submit record Specifications to the University.
- D. Record Product Data: Maintain one copy of each Product Data submittal. Note related Change Orders and markup of record drawings and Specifications.
1. Mark these documents to show significant variations in actual Work performed in comparison with information submitted. Include variations in products delivered to the site and from the manufacturer's installation instructions and recommendations.
 2. Give particular attention to concealed products and portions of the Work that cannot otherwise be readily discerned later by direct observation.
 3. Upon completion of markup, submit three complete sets of record Product Data to the University for the University's records.
- E. Record Sample Submitted: Immediately prior to Substantial Completion, the Contractor shall meet with the University and the University's personnel at the Project Site to determine which Samples are to be transmitted to the University for record purposes. Comply with the University's instructions regarding delivery to the University's Sample storage area. Dispose of other samples in a manner specified for disposing surplus and waste materials.
- F. Miscellaneous Record Submittals:
1. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the University for the University's records.
 - a. Categories of requirements resulting in miscellaneous records include, but are not limited to, the following:
 - 1) Field records on excavations and foundations.
 - 2) Field records on underground construction and similar work.
 - 3) Survey showing locations and elevations of underground lines.
 - 4) Invert elevations of drainage piping.
 - 5) Surveys establishing building lines and levels.
 - 6) Records of plant treatment.
 - 7) Ambient and substrate condition tests.
 - 8) Certifications received in lieu of labels on bulk products.
 - 9) Batch mixing and bulk delivery records.
 - 10) Testing and qualification of tradesmen.
 - 11) Documented qualification of installation firms.
 - 12) Load and performance testing.
 - 13) Inspections and certifications by governing authorities.
 - 14) Leakage and water-penetration tests.
 - 15) Fire-resistance and flame-spread test results.
 - 16) Final inspection and correction procedures.
 - 17) Pipe leakage test reports.
 - 18) Duct leakage test reports.
 - 19) Air and water balance reports.

G. Operation and Maintenance Manuals:

1. **General Submission Requirements:** The University of Maryland (UM) requires operation and maintenance manuals (O&MM) to be submitted in electronic “pdf” file format, by the CM, before substantial completion to the A/E and the University for review.
2. **Product Data:** All product data and shop drawing “pdf” files submitted during the shop drawing review phase must be complete per the requirements of the bid documents. These files can be either scanned as a “pdf” file or the files can be converted to “pdf” format provided the “pdf” files are clear and readable when either viewed on a computer monitor or printed on 8.5 x 11 or 11 x 17 paper. UM has examples of prints from electronic submittal files that are either acceptable or unacceptable and are available upon request. Contact the University project manager for file examples, if necessary.
3. **General File Description:** The following description outlines the organization of one (1) electronic O&MM file for each discipline such as, Architectural, Structural, Civil, Mechanical, and Electrical including the minimum documentation that shall be included in each O&MM file for each discipline. Each File shall be arranged as a stack file with bookmarks and a tree structure.
4. **Arrangement:** Arrange each O&MM file in a similar manner as a hard bound copy would be set up and submitted. For each discipline O&MM file include:
 - a. **Cover:** Include the University Project Title, University Project Number, and Date.
 - b. **Table of Contents:** Numeric List of each page with page 1 being the Cover Sheet, then each product submittal and shop drawing.
 - c. **Subcontractor List:** List each subcontractor by company name, address, contact name and phone number for each approved product data submittal and/or approved shop drawing included in the file.
 - d. **Supplier List:** List each manufacturer’s company name, address, contact name and phone number for each approved product data submittal and/or approved shop drawing included in the file.
 - e. **Contractor Warranty Statement:** Warranty statement in letter for the project warranty on the letter head of the mechanical contractor.
 - f. **Maintenance Chart:** Include a maintenance chart for each piece of equipment or type of material that requires periodic maintenance. List the equipment and parts requiring the maintenance and the time interval.
 - g. **Warranty and Instruction Information:** Include any warranty information and/or manufacturers operating and maintenance instructions including replacement part’s list with each product. Each product data submittal, shop drawing, warranty data, instructions shall be an individual “pdf” file for said data. Include Approved submittal data only.

5. General File Structure Example: Each discipline file structure shall be arranged using the structure example as follows:
 - a. Table of Contents: Include the following:
 - 1) Cover Sheet
 - 2) Subcontractors List
 - 3) Suppliers List
 - 4) Contractor Warranty
 - 5) Maintenance Charts
 - 6) Discipline Specific Main Folders and Subfolders Content

6. Discipline O&MM Files: Each discipline O&MM files shall be arranged as follows:
 - a. Architectural O&MM file include:
 - 1) Exterior: Include all submittals related to the Exterior.
 - 2) Interior: Include all submittals related to the Interior.
 - 3) Furnishings: Include all submittals related to the Furnishings.
 - 4) Equipment: Include all submittals related to the Equipment.
 - 5) Signage: Include all submittals related to the Signage.

 - b. Structural O&MM file includes:
 - 1) Include all submittals related to Structural

 - c. Civil O&MM file includes:
 - 1) Include all submittals related to Civil

 - d. Mechanical O&MM file includes:
 - 1) Plumbing: Include all submittals related to Plumbing.
 - 2) HVAC: Include all submittals related to HVAC.
 - 3) Fire Protection: Include all submittals related to Fire Protection plus the complete fire protection drawings in “dwg” file format on a CD.

 - e. Electrical O&MM file includes:
 - 1) Lighting: Include all submittals related to Lighting
 - 2) Power: Include all submittals related to Power
 - 3) Fire Alarm: Include all submittals related to the Fire Alarm System plus the complete fire alarm drawings in “dwg” file format on a
 - 4) Security: Include all submittals related to Security plus the complete security drawings in “dwg” file format on a CD.
 - 5) Telecomm: Include all submittals related to telecomm plus the complete telecomm drawings in “dwg” file format on a CD.
 - 6) Audio/visual: Include all submittals related to A/V plus the complete A/V drawings in “dwg” file format on a CD.

7. Discipline System File Name and “pdf” Tree Structure: Each Discipline System file name and “pdf” tree structure including main folders and sub folders shall be arranged as follows:
- a. File Name: Architectural O&MM
 - 1) “PDF” Tree Structure – Main Folders
 - a) Π Cover Sheet
 - b) Π Table of Contents
 - c) Π Subcontractor List
 - d) Π Suppliers List
 - e) Π Contractor Warranty
 - f) Π Maintenance Charts
 - g) Π Exterior
 - h) Π Interior
 - i) Π Furnishings
 - j) Π Equipment
 - k) Π Signage
 - b. “PDF” Tree Structure – Main Topic - Sub Folders Example
 - a) Π Furnishings
 - (1) Π Laboratory Case Work
 - (a) Π Approved Product Submittal File Product Data
 - (b) Π Case Work Drawings
 - (c) Π Manufacturers Warranty
 - (d) Π Repeat Above sub folders for each approved product submittal
 - c. File Name: Mechanical O&MM
 - 1) “PDF” Tree Structure – Main Folders
 - a) Π Cover Sheet
 - b) Π Table of Contents
 - c) Π Subcontractor List
 - d) Π Suppliers List
 - e) Π Contractor Warranty
 - f) Π Maintenance Charts
 - g) Π Plumbing
 - h) Π HVAC
 - i) Π Fire Protection
 - 2) “PDF” Tree Structure – Main Topic - Sub Folders Example
 - a) Π Plumbing
 - (1) Π Domestic Water Booster Pump
 - (a) Π Approved Product Submittal File
 - (b) Π Manufacturers Maintenance Data
 - (c) Π Manufacturers Warranty
 - b) Π Repeat Above sub folders for each approved product submittal
 - d. File Name: Electrical O&MM
 - 1) “PDF” Tree Structure – Main Folders

- a) Π Cover Sheet
 - b) Π Table of Contents
 - c) Π Subcontractor List
 - d) Π Suppliers List
 - e) Π Contractor Warranty
 - f) Π Maintenance Charts
 - g) Π Lighting
 - h) Π Power
 - i) Π Security
 - j) Π Fire Alarm
 - k) Π Telecomm
 - l) Π Audio Visual
- 2) “PDF” Tree Structure – Main Topic - Sub Folders Example
- a) Π Lighting
 - (1) Π 2x4 Light Fixtures
 - (2) Π Approved Product Submittal File Product Data
 - (3) Π Manufacturers Maintenance Data
 - (4) Π Manufacturers Warranty
 - b) Π Repeat Above sub folders for each approved product submittal

1.9 INSTRUCTIONS FOR THE UNIVERSITY’S PERSONNEL

- A. Prior to final inspection, instruct the University's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Provide instruction at mutually agreed upon times.
- 1. For equipment that requires seasonal operation, provide similar instruction during other seasons.
 - 2. Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance.

1.10 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by the manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 2 – PRODUCTS – NOT USED

PART 2 - EXECUTION

3.1 CLOSEOUT PROCEDURES

- A. Operation and Maintenance Instructions: Arrange for each Installer of equipment that requires regular maintenance to meet with the University's personnel to provide instruction in proper operation and maintenance. Provide instruction by manufacturer's representatives if installers are not

experienced in operation and maintenance procedures. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Startup.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

3.2 FINAL CLEANING

A. General: The General Conditions require general cleaning during construction. Regular site cleaning is included in Division 1 Section "Construction Facilities and Temporary Controls."

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal, commercial building cleaning and maintenance program. Comply with manufacturer's instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion.
 - a. Clean the Project Site, yard and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and foreign substances.
 - b. Sweep paved areas broom clean. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - c. Remove petrochemical spills, stains, and other foreign deposits.
 - d. Remove tools, construction equipment, machinery, and surplus material from the site.
 - e. Remove snow and ice to provide safe access to the building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

- h. Broom clean concrete floors in unoccupied spaces.
 - i. Vacuum clean carpet and similar soft surfaces, removing debris and excess nap. Shampoo, if required.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other substances that are noticeable vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent labels.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
 - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - q. Clean food-service equipment to a sanitary condition, ready and acceptable for its intended use.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs and defective and noisy starters in fluorescent and mercury vapor fixtures.
 - s. Leave the Project clean and ready for occupancy.
- C. Removal of Protection: Remove temporary protection and facilities installed for protection of the Work during construction.
- D. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the University's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of lawfully.
- 1. Where extra materials of value remain after completion of associated Work, they become the University's property. Dispose of these materials as directed by the University.

END OF SECTION 01700

SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the administrative requirements related to commissioning and includes the following:
1. Definitions
 2. Coordination
 3. Quality control
 4. Submittals
 5. Design review and documentation
 6. Test equipment
 7. Commissioning process
 8. Commissioning scope meetings
 9. Commissioning plans
 10. Submittal review
 11. Commissioning controls coordination meeting
 12. Startup/Pre functional check lists
 13. Functional performance testing
 14. Issue log
 15. Operations and maintenance training
 16. Final commissioning report
 17. Deferred seasonal testing
 18. Team responsibilities
- B. The Owner, Architect/Engineer, and Commissioning Agent are not responsible for construction means, methods, job safety, or management function related to commissioning on the job site.
1. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.
 2. The mention of a subcontractor is not meant to usurp the Contractor's responsibility to assign the work.
- C. Related Sections:
1. 014000 Quality Requirements
 2. 017700 Closeout Procedures
 3. 017900 Demonstration and Training
 4. 260000 General Requirements Electrical Systems
 5. 260800 Commissioning Electrical System

1.2 DEFINITONS

- A. **Basis of Design (BOD):** The Basis of Design document is a specific Commissioning document that describes the systems, components, conditions and methods chosen by the design engineer to meet the requirements of the project. Some reiteration of the Owner's Project Requirements may be included.
- B. **Commissioning (Cx):** Commissioning is a comprehensive and systematic process to verify that the building systems perform as designed to meet the Owner's requirements. Commissioning during the construction, acceptance and warranty phases is intended to achieve the following specific objectives:
 - 1. Verify and document that the equipment is installed and started per manufacturer's recommendations, industry accepted minimum standards, and the Contract Documents.
 - 2. Verify and document that the equipment and systems receive complete operational checkout by installing contractors.
 - 3. Verify and document equipment and system performance.
 - 4. Verify the completeness of the Operations and Maintenance materials.
 - 5. Ensure that the Owner's operating personnel are adequately trained on the operation and maintenance of building equipment.
 - 6. The commissioning process does not take away from or reduce the responsibility of the systems designers or installing contractors to provide a finished and fully functioning product.
- C. **Commissioning Agent (CxA):** The commissioning agent develops the functional test procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Performance Tests are performed after pre-functional checklists and startup is complete.
- D. **Commissioning Plan:** The commissioning plan is an overall plan that provides the structure, schedule, and coordination planning for the commissioning process.
- E. **Deficiency:** A deficiency is a condition in the installation or function of a component, piece of equipment, or system that is not in compliance with the Contract Documents, does not perform properly, or is not complying with the Owner's Project Requirements.
- F. **Owner's Project Requirements (OPR):** The OPR is a specific Commissioning document that is updated throughout the project that provides the explanation of the ideas, concepts, and criteria that are considered to be very important to the Owner. It is initially the outcome of the programming and conceptual design process.
- G. **Functional Performance Test (FPT):** The FPT is a test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g. the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failure, unoccupied, varying outside air temperatures, fire alarm power failure, and any other operational sequence included in the system design. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TAB's primary work is setting up the system flows and pressures as specified, while

functional testing is verifying that which has already been set up. The CxA develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. Functional Performance Tests are performed after prefunctional checklists and startup is complete.

- H. Prefunctional Checklist: The pre-functional check list is a list of items to inspect and elementary component test to conduct to verify proper installation of equipment, provided by the CxA to the contractor. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g. belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated). However, some prefunctional checklist items entail system testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word “prefunctional” refers to before functional testing. Prefunctional checklists augment and are combined with the manufacturer’s start-up checklist.
- I. Warranty Period: The warranty period is for the entire project, including equipment components. Warranty begins at Substantial Completion and extends for two years, unless specifically noted otherwise in the Contract Documents and accepted submittals.
- J. Abbreviations: The following are common abbreviations used in the Commissioning Specification:
 - 1. A/E - Architect and Engineers
 - 2. CxA - Commissioning Agent
 - 3. CC - Controls Contractor
 - 4. Cx Plan - Commissioning Plan document
 - 5. FPT - Functional Performance Test
 - 6. GC - General Contractor
 - 7. MEP – Mechanical, Electrical, Plumbing
 - 8. PM - Project Manager (University)
 - 9. Subs - Subcontractors to the General Contractor
 - 10. TAB - Test and Balance Contractor

1.3 COORDINATION

- A. The owner will hire a third-party Commissioning Agent (CxA). The contractor and the contractor’s team shall be responsible for assisting the CxA in commissioning activities.
- B. Commissioning Agent (CxA) shall provide overall coordination and management of the commissioning program as specified herein.
- C. Commissioning Team: The commissioning process will require the cooperation of the Contractor, subcontractors, vendors, Architect/Engineer, Commissioning Agent, and Owner. The commissioning team shall be comprised of the following. Team member responsibilities are listed in Part 3 of this section.
 - 1. Commissioning Agent:
 - a. Project Manager

- b. Project Technicians
- 2. Contractor and Sub-contractors as required.
- 3. Owner Representative(s)
- 4. Architect/Engineer:
 - a. Architect
 - b. MEP Engineers
 - c. Specialty Consultant(s)
- D. Progress Meetings: Attend construction job-site meetings, as necessary, to monitor construction and commissioning progress. Coordinate with contractor to address coordination, deficiency resolution, and planning issues.
 - 1. Plan and coordinate additional meetings as needed based on work progress.
- E. Site Observations: Perform site visits as necessary to observe component and system installations.
- F. Functional Testing Coordination:
 - 1. Equipment shall not be “temporarily” started for commissioning.
 - 2. Functional performance testing shall not begin until pre-functional check, start-up, and TAB are completed for a given system.
 - 3. The controls system and equipment controls shall not be functionally tested until all points have been calibrated and pre-functional checklists are complete.

1.4 QUALITY CONTROL

- A. Engage commissioning service personnel that specialize in the types of inspections and tests to be performed.
- B. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems of the systems to be commissioned.

1.5 SUBMITTALS

- A. Cx Meeting Minutes:
 - 1. CxA shall be responsible for preparing meeting minutes and provide to Owner’s PM for distribution.
- B. Commissioning Plan:
 - 1. Contractor shall be responsible for reviewing the Commissioning plan, provided by the CxA, and incorporating into project schedule.

C. Pre-Functional Checklists:

1. Contractor shall be responsible for completing pre-functional checklists (prepared by CxA). The contractor shall allow five days for review of completed PFC's before FPT's are scheduled to begin.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The contractor will make available standard testing equipment required to perform startup, initial checkout and functional performance testing as well as any special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents.
- B. Data Logging equipment and software required to test equipment shall be provided by the Contractor, but shall not become property of the Owner.
- C. Instrumentation shall meet the following standards:
 1. Be of sufficient quality and accuracy to test and measure system performance within the tolerances required to determine adequate performance.
 2. Be calibrated on the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument being used.
 3. Be maintained and in good repair and operational condition throughout the duration of use on this project.
- D. Test Equipment Calibration Requirements: Contractors shall comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired after being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS

- A. The following activities outline the commissioning tasks and the general order in which they occur. The CxA shall coordinate all activities.
 1. Design Review and Documentation:
 - a. Basis of Design and Owner's Project Requirements Review
 - b. Design Document Review
 - c. Controls Coordination Review Meeting
 - d. Construction Document Review

2. Commissioning Scoping Meetings
3. Commissioning Plan
4. Submittal Review:
 - a. General systems to be Commissioned
 - b. Controls Submittal Review
5. Commissioning Controls Coordination Meeting
6. Start-Up / Pre-functional Checklists
7. Functional Performance Testing
8. Issues Log
9. Operations and Maintenance Training
10. Final Commissioning Report
11. Deferred and Seasonal Testing

3.2 COMMISSIONING SCOPE MEETINGS

A. Commissioning Scope Meeting – Design Phase:

1. Attend a scope meeting during the design phase prior to the first design review.
2. Cx Team members who have been hired during the design phase shall be in attendance.
3. Review the Cx process with special attention on the design phase requirements.

B. Commissioning Scope Meeting – Construction Phase:

1. Attend a scoping meeting at the start of construction after the subcontractors have been selected.
2. All Cx Team members shall be in attendance.
3. Review the Cx process with special attention on the construction phase requirements.

3.3 COMMISSIONING CONTROLS COORDINATION MEETING

A. Meeting Attendees:

1. CxA
2. Controls Contractor
3. Engineer of Record
4. Owner's Representatives
5. Contractor
6. Architect

B. After the first controls submittal review is complete, schedule, coordinate and facilitate the Commissioning Controls Coordination Meeting.

C. Review all submittal review comments with the group and, as a group, determine the required resolution for each comment. Controls resubmittal shall be submitted within two (2) weeks of this meeting.

3.4 START-UP / PRE-FUNCTIONAL CHECKLISTS

- A. Start-up/Pre-Functional Checklists: Coordinate start-up plans and documentation formats, including providing contractor with pre-functional checklists to be completed during the start-up process.
 - 1. Manufacturer's start-up checklists and other technical documentation guidelines may be used as the basis for pre-functional checklists. CxA will coordinate with the Contractor to obtain manufacturer data as needed.
- B. Start-up/Pre-Functional Checklists are used to verify that the systems are complete and operational before functional testing is scheduled.

3.5 FUNCTIONAL PERFORMANCE TESTING

- A. Functional Performance Tests (FPT): Test procedures shall fully describe system configuration and steps required for each test; appropriately documented so that the test can be repeated with virtually identical results.
 - 1. Test Methods: Functional performance testing and verification may be achieved using a combination of the following methods to test the complete sequence of operation. The CxA shall determine which method, or combination, is most appropriate:
 - a. Direct manipulation of system inputs (i.e. applying heat or cold to sensors).
 - b. Manipulation of system inputs with the building automation software (i.e. software override of sensor inputs)
 - c. Direct observation of equipment readouts, gauges, and actuators.
 - d. Trend logs of system inputs and outputs using the building automation system
 - e. Short-term monitoring of system inputs and outputs using stand alone data loggers.
 - 2. Setup: Setup each test procedure to be performed under conditions that simulate normal operating conditions as closely as possible. Where equipment requires integral safety devices to stop/prevent equipment operation unless minimum safety standards or conditions are met, functional performance test procedures shall demonstrate the actual performance of safety shutoffs in a real or closely-simulated condition of failure.
 - 3. Sampling: Multiple identical pieces of non-life-safety or non-critical equipment may be functionally tested using a sampling strategy. The sampling strategy shall be developed by the CxA. If, after three attempts at testing the specified sample percentage, failures are still present, then all remaining units shall be tested at the contractor's expense. Sampling may only be used as agreed upon in the Cx contract.
 - 4. Trending: Identify conditions where trend data from the building automation system or data loggers can be used to verify sequence of operation performance. Include trend log requirements in FPT documentation.
- B. Assist CxA in completing FPT's as directed by the CxA.

3.6 ISSUES LOG

- A. Issues are items of non-compliance in materials, installation, or operation observed by the CxA.
- B. The CxA shall notify responsible parties upon observation of deficiencies or issues of non-compliance. CxA shall recommend corrective actions as appropriate. Issues that are not immediately resolved shall be placed on the Issues Log.
- C. The CxA shall update the Issues Log and submit it to the PM for distribution to all members of the Cx Team when changes are made.
- D. Those identified as “Responsible” for a specific issue shall respond within three (3) days of receiving an updated Issues Log with the planned resolution.
 - 1. “Responsible” indicates the party who is responsible for responding to the open issue, it does not imply responsibility for creating the issue. For example, if the issue relates to a temperature set-point, the Owner may be listed as the responsible party for providing the desired value.
 - 2. Any member of the design and construction team may be identified to respond to Cx Issues. Team members are responsible for responding to design and construction questions raised during commissioning work.

3.7 TEAM RESPONSIBILITIES

- A. Owner’s Responsibilities:
 - 1. Owner will hire the third party CxA.
 - 2. Provide the OPR documentation to the CxA and Contractors for use in developing the Cx Plan, testing plans, and checklists.
 - 3. Provide the Basis of Design documents, prepared by the architect and approved by the Owner, for use in developing the Commissioning Plan; testing plans and checklists.
 - 4. Assign operation and maintenance personnel and schedule them to participate in Commissioning Team activities including, but not limited to, the following:
 - a. Commissioning meetings.
 - b. Construction phase coordination meetings.
 - c. Piping and ductwork testing and flushing verification meetings.
 - d. Procedures meeting for testing, adjusting and balancing.
 - e. Testing and demonstration of systems, subsystems and equipment.
 - f. Training in operation and maintenance of systems, subsystems and equipment.
 - g. Final review and acceptance meetings.
 - h. Provide utility services required for the commissioning process.
 - i. Review and approve the commissioning plan.
 - j. Coordinate any seasonal or deferred testing.
 - k. Ensure that any seasonal, deferred testing and/or deficiency issues are addressed.
- B. Architect / Engineer’s Responsibilities:
 - 1. Attend the Commissioning Scoping Meetings, Controls Coordination Meetings, and selected team meetings.

2. Perform submittal review, construction observation, as-built drawing preparation, and other items as contracted.
3. Provide the Basis of Design Document. The design engineers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
4. Participate in the resolution of system deficiencies and issues identified during the commissioning, according to the contract documents.
5. Insure that the CxA's submittal comments are incorporated into the Design Professional's submittal comments prior to sending to CM for distribution.
6. Participate in resolution of design non-conformance and design deficiencies identified during the warranty-period commissioning process.

C. Contractor, and Subcontractor Responsibilities:

1. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following brief overview:
 - a. Facilitate the coordination of commissioning and incorporate commissioning activities into the overall project.
 - b. Provide copies of all applicable submittals as required in the specifications including all changes.
 - c. Provide detailed startup procedures.
 - d. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, perform corrective actions.
 - e. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
 - f. Attend commissioning team meetings held on a scheduled basis.
 - g. Make available a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxA.
 - h. Integrate and coordinate commissioning process activities with construction schedule.
 - i. Review construction checklists provided by the CxA.
 - j. Review commissioning process test procedures provided by the CxA.
 - k. Complete commissioning process test procedures.
 - l. Submit training plan for approval, coordinate training and provide qualified instructors for training of Owner personnel.
 - m. Assist the CxA as necessary in the seasonal testing, deferred testing and deficiency resolution.
 - n. Ensure that subcontractors correct deficiencies and make necessary adjustments to submittals, O&M manuals and red-lined drawings for applicable issues identified during testing.
 - o. Provide as-built controls drawings and sequences of operation for all equipment.
 - p. Provide a written list of all user adjustable set-points and reset schedules with a brief discussion of the purpose of each and the range of reasonable adjustments with energy implications.
2. Equipment Supplier Responsibilities:

- a. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
 - b. Assist in equipment testing per agreements with subcontractors.
 - c. Provide information requested by the CxA regarding equipment sequence of operation and testing procedures.
3. Commissioning Agent Responsibilities:
- a. Roles and Responsibilities:
 - 1) The CxA is not responsible for the design concept, the design criteria, compliance with codes, design or general construction scheduling, cost estimating or construction management.
 - 2) The CxA may assist with problem solving and non-conformance items or deficiencies, but the CxA is not the Engineer of Record, and the commissioning process does not preclude the Engineer of Record of responsibilities for system evaluations, adequacy of systems to meet the OPR, capacities of systems, quality control checks, or any of the other elements and recommended final acceptance of systems to the Owner.
 - 3) The primary role of the CxA is to coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultants with all necessary parties, frequently updated timelines and schedules and technical expertise.
 - b. Commissioning Plan:
 - 1) The CxA shall develop a Commissioning Plan at the start of the project.
 - 2) At the end of the Project, the CxA shall provide the Owner with the Final Commissioning Plan for the Owner's use.
 - c. Document Review:
 - 1) Review the Owner's Project Requirements and Basis of Design developed by the design professionals.
 - 2) Perform two (2) focused reviews of the drawings and specification during design phase.
 - 3) Develop full commissioning specifications for all systems and equipment to be commissioned. The commissioning specifications will be subject to approval of the design team and included in the final construction specifications.
 - 4) Review submittals applicable to systems being commissioned for compliance for commissioning needs, concurrent with the AE's reviews.
 - d. Cx Team Meetings:
 - 1) Lead Cx Meetings during design and construction.
 - e. Coordination and Scheduling:

- 1) Coordinate and direct commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications, and consultations with all necessary parties.
 - 2) Coordinate commissioning work with the CM to ensure that commissioning activities are being scheduled into the master project schedule.
- f. Commissioning Progress:
- 1) Perform site visits, as necessary, to observe component and system installations.
 - 2) Attend selected planning and jobsite meetings to obtain information on construction progress.
 - 3) Review construction meeting minutes for revisions/substitutions relating to the commissioning process.
- g. Pre-Functional Checks:
- 1) Verify proper installation of components, equipment, systems and assemblies.
- h. Equipment and System Startup and Verification:
- 1) Review system startup reports and conduct selected site observation.
 - 2) Perform TAB verification per contract requirements, and review the TAB report prior to functional testing.
 - 3) Functional Performance Testing
 - 4) With assistance from the Contractor, write Functional Performance Test procedures for all components, equipment or systems to be commissioned.
 - 5) With the assistance of the Contractors, coordinate Functional Performance Testing. Witness and approve Functional Performance Testing performed by the Contractors.
- i. With the assistance of the Contractors, coordinate retesting as necessary until satisfactory performance is achieved.
- j. Witness seasonal or deferred Functional Performance Testing as necessary.
4. Issue/Deficiency Logs:
- a. Prepare a formal, ongoing, online record of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process.
 - b. Issues will be recorded in the Issues Log. The AE, CM/GC and Contractors will resolve all issues to the satisfaction of the Owner. Issues will be added by the CxA. Team members are required to respond to issues pertaining to their work. Team members are required to respond to issues added to the list within five (5) working days of issue of an update to the Issues Log.
 - c. When issues are resolved, they will be closed on the Issues Log by the CxA.
5. Operation and Maintenance Data:

- a. The CxA shall review of the documentation submitted by the Contractor as required by the Specifications for completeness and accuracy. This commissioning review supplements, but does not replace, the Architect/Engineer's review.
 - b. Review equipment warranties to ensure that the Owner's responsibilities are clearly defined.
6. Training:
- a. The CM/GC and Contractors will provide all documentation and qualified training personnel for training.
 - b. The CxA will verify through the Contractor's plan and schedule, training agendas, and attendance documentation that proper training procedures were followed on all commissioned systems.
 - c. See specifications for training requirements.
7. Commissioning Final Report:
- a. The CxA shall provide a final report following the completion of all Functional Performance Testing.

END OF SECTION 019100

SECTION 023010 - SUBSURFACE INFORMATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract including General and Supplementary General Conditions and other Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

- A. The pages provided in the Appendix of this document provide information to the Contractor on the subsurface conditions, which are currently known. The subsurface investigation is limited in nature and the Owner does not warrant the completeness or accuracy of the information. The documents include the Utility Test Holes which have been completed and the Geotechnical Report.

PART 2 - PRODUCT (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION 023010

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Demolition and removal of selected portions of a building.
 - 2. Demolition and removal of selected site elements.
 - 3. Repair procedures for selective demolition operations.
- B. Related Sections: This Section is related to any and all Sections with explicit or implicit reference to selective demolition. Specific submittal requirements of these related Sections are not included in this Section.

1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them.
- B. Remove and Salvage: Detach items from existing construction and deliver them to OWNER.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.
- D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Qualification Data: Provide qualifications of persons or firms performing demolition which demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other amplifying in

formation. Qualification data must conform to that required in Division 1 Section "Quality Requirements" for Specialists or Professional Engineers as appropriate to the work.

- B. Proposed noise-control or dust-control measures: Submit statement or drawing to the Contracting Officer for approval at least 14 calendar days prior to the start of demolition that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- C. Submit a proposed Demolition Plan to the Owner indicating the following:
 - 1. Detailed sequence of selective demolition work, with starting and ending dates for each activity.
 - 2. Interruption of utility services.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of temporary partitions and means of egress.
 - 6. Procedures and safety precautions to be used during demolition.
 - 7. Trees and shrub protection.
 - 8. Silt and erosion control handling.
 - 9. Removal, transportation, and reclamation or disposal of removed materials.
 - 10. Types of demolition activities that can be expected to interfere with OWNER operations.
 - 11. Procedures to ensure uninterrupted progress of OWNER operations on-site.
 - 12. Coordination of continuing OWNER occupancy of portions of existing building and of partial occupancy by OWNER of completed work.
- D. Inventory: Items to be removed and salvaged.
- E. Photographs: Before work begins, submit sufficiently detailed photographs showing predemolition existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Requirements for photographs are located in Division 1 Section "Photographic Documentation."

1.6 QUALITY REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction. Comply with all regulatory requirements of those agencies and organizations having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Demolition Plan: The Contractor shall prepare a detailed plan of the demolition work procedures and safety precautions to be used in the identification, demolition, trees and shrub protection, silt and erosion control handling, removal, transportation, and reclamation or disposal of removed materials. The plan shall be submitted to the Owner for review within 14 calendar days after receipt of the Notice to Proceed and at least 14 calendar days before the planned commencement of demolition activities.

1. Review and acceptance by OWNER of the Contractor's demolition plan will not relieve the Contractor of any responsibility regarding damage from any demolition activity.

1.7 PROJECT CONDITIONS

- A. OWNER will occupy portions of the building immediately adjacent to the selective demolition area. Refer to Division 1 Section "Work Restrictions" for additional requirements.
 1. Conduct selective demolition so OWNER operations will not be disrupted.
 2. Provide the Owner with not less than 72 hours notice prior to activities that will affect OWNER operations. Include in the notification the expected demolition activities and expected level and duration of disturbance to OWNER operations.
- B. Safe access to existing walkways, corridors and other adjacent occupied or used facilities must be maintained. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from the Contracting Officer.
- C. OWNER will remove the existing items if indicated on the Drawings.
- D. The Contractor shall remove and salvage the existing items so indicated on the Drawings.
- E. The Contractor shall remove and reinstall the existing items so indicated on the Drawings.
- F. Hazardous Materials: Except where noted, hazardous materials are not expected to be encountered in the work. If any material suspected of containing hazardous materials is encountered, do not disturb the material, immediately notify the Owner. If suspected hazardous material is spilling out or leaking, notify the fire department immediately.
- G. On-site storage or sale of removed items or materials will not be permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
- I. Fire Protection: Maintain fire-protection services during selective demolition operations.
- J. Use of explosives is prohibited. Explosive actuated tools (ex: nailguns, etc) shall not be used or brought to the project site without prior written approval from the Owner. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to the use of such explosives.
- K. Contractor dumpsters will be permitted only if a location for the dumpster is shown on the Contract Drawings.

1.8 WARRANTIES

- A. Existing Special Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials that do not void existing warranties. Verify existence of warranties with the Owner.

PART 2 - PRODUCTS

2.1 REPAIR MATERIALS

- A. Where available and appropriate for use, provide repair materials that are identical to existing materials.
- B. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
- C. Use materials whose installed performance equals or surpasses that of existing materials.
- D. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities to be removed have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled, and items to be removed and salvaged.
- D. When encountering unanticipated mechanical, electrical or structural elements that conflict with the intended function or design, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Owner.

3.2 UTILITY SERVICES

- A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition operations.
- B. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by the Owner. See Division 1 Section "Project Management and Coordination" for additional requirements associated with utility shutdowns.
 - 1. Provide not less than 15 calendar days' notice to the Owner if shutdown of service is required during changeover.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving areas to be selectively demolished.
 - 1. OWNER will arrange to shut off indicated utilities when requested by Contractor.

2. Where utility services are required to be removed, relocated or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
 3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve or plug and seal the remaining portion of pipe or conduit after bypassing.
 4. Do not start selective demolition work until utility disconnection and sealing have been completed and verified.
- D. Smoke Detectors: Request a utility outage for all smoke detectors where demolition work is planned. Do not start work until smoke detectors are shut off.

3.3 PREPARATION

- A. Dangerous Materials: If chemicals, gases, explosives, acids, flammable or other dangerous materials of unknown content or origin are found which are not shown on the drawings, contact the Owner immediately before proceeding with demolition.
- B. Temporary Site Control: Remove debris and conduct demolition operations in a manner to ensure minimum interference with roads, streets, walks, walkways, corridors, and other adjacent occupied or used facilities.
1. Do not close or obstruct streets, walks, walkways, corridors, or other adjacent occupied or used facilities without permission from the Owner.
 2. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

3.4 POLLUTION CONTROLS

- A. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in accordance with applicable safety regulations.
- B. Cleaning: Clean adjacent structures and site improvements of dust, dirt and debris caused by selective demolition operations. Return adjacent areas to condition existing before start of selective demolition.

3.5 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete selective demolition within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically. Conduct work in an order that avoids transporting removed items and debris through areas with completed selective demolition

- work, and that allows for removal of items before supports for those items are removed in another area.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage adjoining construction to remain. Where possible, use hand or small power tools designed for sawing or grinding, not for hammering and chopping, to minimize disturbance of adjacent surfaces. Contractor is to use the correct tool for the work and operate it in accordance with the manufacturers instructions. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations, and maintain adequate ventilation when using cutting torches. See Division 1 Section "Fire Prevention Precautions for Hot Work."
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested and other dangerous or unsuitable materials, and promptly dispose of these materials off-site.
 7. Lower removed structural framing members to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors or framing.
 9. Dispose of demolished items and materials promptly.
 10. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.
- B. Existing Facilities: Comply with all regulations for using and protecting elevators, stairs, walkways, loading docks, building entries and other building facilities during selective demolition operations. Coordinate with the Owner for building-specific requirements.
- C. Removed and Salvaged Items. Comply with the following:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to OWNER.
 4. Delivery to OWNER: Transport the materials and equipment to the area on-site designated by the Contracting Officer or indicated on the drawings.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items. Comply with the following:
1. Clean and repair items to functional condition adequate for intended reuse. Paint damaged or deteriorated painted surfaces of equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Contracting Officer, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations after selective demolition operations are complete.
- F. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

3.6 PATCHING AND REPAIRS

- A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.
- B. Patching: Comply with Division 1 Section "Cutting and Patching."
- C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
 - 1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to the manufacturer's written recommendations.
- D. Finishes: Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.
- E. Floor and Wall Surfaces: Patch and repair floor and wall surfaces in each space where demolished walls or partitions result in extending one finished area into another. Provide a flush and even surface of uniform color, texture and appearance.
 - 1. Closely match texture and finish of existing adjacent surface.
 - 2. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
 - 3. Where patching occurs in a painted surface, apply primer and other specified undercoats. Apply specified intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Remove existing floor and wall coverings and replace with new materials, if necessary to achieve uniform color and appearance.
 - 5. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
- F. Ceilings: Patch, repair or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning of any materials removed during demolition is not permitted on OWNER property.
- C. Disposal: Transport demolished materials off OWNER property and legally dispose of them.

3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing items to remain, be removed and/or be salvaged are indicated on the drawings.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.
- B. Cast-in-place concrete includes the following:
 - 1. Concrete Encased Electric Ductbank

1.3 SUBMITTALS

- A. Concrete Mix Design and Reinforcement Data

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS:

2.1 FORM MATERIALS:

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces.
 - 1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class I.
 - 2. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 REINFORCING MATERIALS:

- A. Reinforcing Bars: ASTM A 615 Grade 60, deformed.
- B. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 - 2. Reinforcing shall be supported on factory made chairs and not on bricks or other miscellaneous devices.

2.3 CONCRETE MATERIALS:

- A. Portland Cement: ASTM C 150, Type I.
 - 1. Use one brand of cement throughout Project unless otherwise acceptable to Engineer and Owner.
- B. Aggregates:
 - 1. Normal-Weight: ASTM C 33, uniformly graded. Provide aggregates from a single source for exposed concrete. Use Normal-Weight aggregates unless noted otherwise.
 - 2. Nominal maximum aggregate size: $\frac{3}{4}$ -inch
 - 3. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
- C. Water: Potable and complying with ASTM C94.

2.4 PROPORTIONING AND DESIGNING MIXES:

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, an independent testing agency is responsible for performing, preparing and reporting proposed mix designs.

B. Submit written reports to the Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been approved by the Engineer.

C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:

1. Below grade concrete: 4000 psi, 28-day compressive strength; water-cement ratio, 0.45 maximum (non-air-entrained).

D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Slabs, footings and sloping surfaces: Not more than 4 inches.

2.5 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, and other related materials with placement of forms and reinforcing steel.

3.2 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures.

3.3 PLACING REINFORCEMENT

- A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports and as specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by the Engineer.
- D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.4 PREPARING FORM SURFACES:

- A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form coating compound before placing reinforcement.
- B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.
 - 1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.5 CONCRETE PLACEMENT:

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete in Forms:
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
- E. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.
 1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.
 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to the Engineer.

3.6 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting; keep continuously moist for not less than 7 days.
- C. Curing Methods: Cure concrete by moist curing, by moisture-retaining cover curing, or by combining these methods. No curing compounds are to be used.

END OF SECTION 033000

SECTION 034100 – PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes structural precast concrete units, plant cast, for the following:
 - 1. Pre-cast Electrical Manholes.

1.3 PERFORMANCE REQUIREMENTS

- A. **Structural Performance:** Engineer, fabricate, and install structural precast concrete units to withstand HS 20 design loadings within limits and under conditions required. Design to be in accordance with ASTM C890 and construction in accordance with ASTM C478.
- B. **Engineering Responsibility:** Engage a fabricator who assumes undivided responsibility for engineering structural precast concrete units by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.

1.4 SUBMITTALS

- A. **General:** Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. **Product data and instructions for manufactured materials and products.**
 - 1. Certification by paint and curing compound manufacturers that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- C. **Signed and Sealed shop drawings and calculations prepared by or under the supervision of a qualified professional engineer detailing fabrication and installation of precast concrete units. Indicate member dimensions and cross-sections; locations, sizes, and types of reinforcement, including special reinforcement; and lifting devices necessary for handling and erection.**
 - 1. Indicate layout and dimensions, and identify each precast concrete unit corresponding to sequence and procedure of installation. Indicate welded connections by AWS standard symbols. Detail loose, cast-in, and field hardware, inserts, connections, and joints, including accessories and construction at openings in precast units.
 - 2. For precast concrete units indicated to comply with design loadings or calculated

fire-resistance requirements, include structural analysis data sealed and signed by the qualified professional engineer responsible for their preparation.

- D. Material certificates signed by fabricator certifying that each material item complies with requirements.

1.5 QUALITY ASSURANCE

- A. **Installer Qualifications:** Engage an experienced Installer who has completed structural precast concrete work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. **Fabricator Qualifications:** Firm experienced in producing structural precast concrete units similar to those indicated for this Project and with a record of successful in-service performance as well as sufficient production capacity to produce required units without delaying the Work.
 - 1. Fabricator must participate in the Precast/Prestressed Concrete Institute's (PCI) Plant Certification Program and be designated a PCI Certified Plant for the following product group and category:
 - 2. Product Group and Category: Group C, Category C2.
- C. **Professional Engineer Qualifications:** A professional engineer legally authorized to practice in the State of Maryland and experienced in providing engineering services of the kind indicated that have resulted in the installation and successful in-service performance of precast concrete units similar to this Project in material, design, and extent.
- D. **Testing Agency Qualifications:** To qualify for acceptance, an independent testing agency must demonstrate to the Owner's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM C 1077 and ASTM E 329, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work. Testing agency is employed and paid by the Owner.
- E. **PCI Design Standard:** Comply with recommendations of PCI MNL-120 "PCI Design Handbook--Precast and Prestressed Concrete" applicable to types of structural precast concrete units indicated.
- F. **PCI Quality-Control Standard:** Comply with requirements of PCI MNL-116 "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products," including manufacturing and testing procedures, quality-control recommendations, and dimensional tolerances for types of units required.
- G. **ACI Publications:** Comply with the following ACI publications applicable to types of structural precast concrete units indicated:
 - 1. ACI 301 "Specifications for Structural Concrete for Buildings."
 - 2. ACI 318 (ACI 318M) "Building Code Requirements for Reinforced Concrete."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver precast concrete units to Project site in such quantities and at such times to ensure continuity of installation. Store units at Project site to prevent cracking, distorting, warping, staining, or other physical damage, and so that markings are visible.
- B. Deliver anchorage items that are to be embedded in other construction before starting such work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 FORMWORK

- A. Forms: Provide forms and, where required, form facing materials of metal, plastic, wood, or another acceptable material that is nonreactive with concrete and will produce required finish surfaces.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60 (ASTM A 615M, Grade 400), deformed.
- B. Steel-Welded Wire Fabric: ASTM A 185, plain, cold drawn.
- C. Supports for Reinforcement: Provide supports for reinforcement, including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations.
 - 1. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are protected with plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III.
 - 1. Use only one brand and type of cement throughout Project, unless otherwise acceptable to the Engineer.
- B. Normal-Weight Aggregates: ASTM C 33, Class 5S. Provide aggregates from a single source.
- C. Water: Potable.
- D. Admixtures, General: Provide admixtures for concrete that contain not more than 0.1 percent chloride ions by mass of portland cement or cementitious material.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

- F. Water-Reducing Admixture: ASTM C 494, Type A.
- G. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
- H. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
- I. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.4 CONNECTION MATERIALS AND FINISHES

- A. Accessories: Provide embedded lifting inserts to facilitate both initial installation and future removal and reinstallation of hollow core plank panels. Insert material shall be stainless steel and installed flush with the top surface of the panel. The insert shall accommodate a threaded rod/eyebolt or other similar device for attaching a crane hook or chain. Provide a plastic or stainless steel threaded lug which can be easily removed for use in protecting the female ends of the lifting insert device while in place. The lug shall be flush with the panel. The size, capacity, spacing and number of inserts shall be determined by the precast manufacturer.

2.5 GROUT MATERIALS

- A. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and a 30-minute working time.

2.6 CONCRETE MIXES

- A. Prepare design mixes for each type of concrete required.
- B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast manufacturing plant personnel at precast fabricator's option.
- C. Normal-Weight Concrete: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1 and ACI 301, using materials to be used on the Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28-Day): 5000 psi (34.5 MPa).
 - 2. Maximum Water-Cement Ratio at Point of Placement: 0.40.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows, with a tolerance of plus or minus 1-1/2 percent:
 - 1. Air Content: 6 percent for 3/4-inch (19-mm) maximum aggregate.
- E. Other Admixtures: Use water-reducing, high-range water-reducing, water-reducing and accelerating, or water-reducing and retarding admixtures according to manufacturer's directions.

- F. Concrete-Mix Adjustments: Concrete-mix design adjustments may be proposed when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

2.7 FABRICATION

- A. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and for pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified in PCI MNL-116.
 - 1. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial-formula, form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.
- B. Reinforcement: Comply with the recommendations of CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.
 - 2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers and hangers, as required.
 - 3. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
 - 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- C. Concrete Mixing: Comply with requirements and with ASTM C 94. Following concrete batching, no additional water may be added.
- D. Concrete Placement: Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast units. Comply with requirements of ACI 304R for measuring, mixing, transporting, and placing concrete.
 - 1. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with ACI 309R.
 - 2. Comply with ACI 306R procedures for cold-weather concrete placement.
 - 3. Comply with ACI 305R procedures for hot-weather concrete placement.
- E. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on final shop drawings. Imprint casting date on each precast unit on a surface that will not show in the finished structure.

- F. Cure concrete according to the requirements of PCI MNL-116 by moisture retention without heat or by accelerated heat curing, using low-pressure live steam or radiant heat and moisture.
- G. Finish formed surfaces of precast concrete as indicated for each type of unit, and as follows:
 - 1. Standard Finish: Normal plant-run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations, and form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.
- H. Finish unformed surfaces by trowel, unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements, including installation tolerances, true and level bearing surfaces, and other conditions affecting performance of precast concrete units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bearing Pads: Install bearing pads as precast concrete units are being erected. Set pads on true, level, and uniform bearing surfaces and maintain in correct position until precast units are placed.
- B. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed units.
- C. Erection Tolerances: Install precast units level, plumb, square, and true, without exceeding the recommended erection tolerances of PCI MNL-127 "Recommended Practice for Erection of Precast Concrete."
- D. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at keyways, connections, and joints as follows:
 - 1. Grout Type: Nonmetallic, nonshrink grout.
 - 2. Provide forms or other acceptable method to retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, plumb, and level with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 CLEANING

- A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.
 - 1. Wash and rinse according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

END OF SECTION 034100

SECTION 071113 – BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cold-applied asphalt dampproofing for precast electric manholes.

1.3 SUBMITTALS

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

1.4 FIELD CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.
- B. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise required.

2.2 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Trowel Coats: ASTM D 1227, Type II, Class 1.

- B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- C. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- D. VOC Content: 30 g/L or less.
- E. Low-Emitting Materials: Dampproofing shall comply with the testing and product requirements of the Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Cut-Back-Asphalt Primer: ASTM D 41.
- C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
 - 1. Primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- E. Patching Compound of type recommended in writing by dampproofing manufacturer.
- F. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 1/2 inch thick.
- G. Protection Course: Smooth-surfaced roll roofing complying with ASTM D 6380, Class S, Type III.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Applicator present, for compliance with requirements for surface smoothness, surface moisture, and other conditions affecting performance of bituminous dampproofing work.
 - 1. Test for surface moisture according to ASTM D 4263.
- B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to the dampproofing work; fill voids, seal joints, and remove bond breakers if any, as recommended in writing by prime material manufacturer.
- C. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless more stringent requirements are indicated.
 - 1. Apply dampproofing to provide continuous plane of protection.
 - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Concrete Manholes: Apply two brush or spray coats at not less than 2 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat. The final thickness of dampproofing shall be 60 mils thick.

3.5 INSTALLATION OF PROTECTION COURSE

- A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing-material and protection-course manufacturers' written instructions for attaching protection course.
 - 1. Support protection course over cured coating with spot application of adhesive type recommended in writing by protection-board manufacturer.

3.6 CLEANING

- A. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071113

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.
 - 2. Penetrations in horizontal assemblies.
 - 3. Penetrations in smoke barriers

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.
- C. Qualification Data: For Installer(s). Provide manufacturer's training certificates for all installers.
- D. Installer Qualifications: For firm. Provide certificate of compliance with FM Approval FM Approval 4991, "Approval Standard for Firestop Contractors," or UL "Qualified Firestop Contractor Program Requirements" approval.
- E. All project penetrations shall be combined into a single Penetration Firestopping submittal. Partial submittals will be rejected.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installation Responsibility: Assign installation of all firestop systems [and fire-resistive joint systems] in project to a single qualified installer.
- B. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes
- B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation

1.8 COORDINATION

- A. EC to coordinate location and sizing of sleeves, openings, and penetrating items to ensure that penetration firestopping systems can be installed according to the approved firestopping system design.
- B. Do not paint or conceal any firestopping system until installation has been approved by the UMB Fire Marshal.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:
 - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
 - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

- 1) UL in its "Fire Resistance Directory."
- 2) Intertek Group in its "Directory of Listed Building Products."
- 3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturer's: Subject to compliance with requirements, provide products by one of the following:
 - a. 3M Fire Protection Products
 - b. Hilti, Inc.
 - c. Tremco, Inc
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
 2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
1. Permanent forming/damming/backing materials.
 2. Substrate primers
 3. Collars.
- E. Fire and Fire/Smoke Dampers: The annular space around fire and fire/smoke dampers shall be sealed according to the manufacturer's installation instructions. Firestopping may or may not be required, as recommended by the damper manufacturer.

2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

- A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:
 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates were recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- C. Install fill materials by proven techniques to produce the following results:
 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "X HOUR FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes. Replace X with 1, 2, or 3 hr fire rating.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 10 feet (4.57 m) from end of wall and at intervals not exceeding 20 feet (9.14 m)
 2. In mechanical equipment rooms, electrical rooms, tele data rooms and utility shaft areas without ceilings, wall identification shall occur at 15 ft intervals at a height of 10 ft above finished floor level.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 4 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. 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:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 2. Firestop contractor's name.
 3. UL Design No. of firestop assembly
 4. Date of installation
 5. Manufacturer's name
 6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.
- D. Contractor shall be responsible for ensuring all penetrations are correctly firestopped prior to requesting the qualified testing agency inspection. Costs for re-inspections and repeat site visits will be at the contractor's expense.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out

and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section and all other Electrical Specification Sections.

1.2 SUMMARY

- A. This Section includes general administrative and procedural requirements, as well as the following basic electrical materials and methods:
 - 1. Submittals.
 - 2. Record documents.
 - 3. Operation and Maintenance manuals.
 - 4. Rough-ins.
 - 5. Electrical installations.
 - 6. Cutting and patching.
 - 7. Access to electrical installations.
- B. Summary of Work:
 - 1. Provide a complete integrated electrical system in accordance with the intent of these specifications and the accompanying drawings.

1.3 REFERENCED ORGANIZATIONS AND CODES

- A. The following list of abbreviations, are utilized within the specifications and are provided as a reference.
- B. All work in Divisions 26, 27, and 28 shall comply with the latest version of following codes and regulations as adopted by the State of Maryland and the State Fire Marshal, unless otherwise specified.
 - 1. NFPA (National Fire Protection Association).
 - 2. NESC (National Electrical Safety Code).
 - 3. ADA (American with Disabilities Act).
 - 4. ANSI (American National Standards Inst.).
 - 5. OSHA (Occupational Safety & Health Act).
 - 6. COMAR (Code of Maryland Regulations).
 - 7. UL (Underwriters Laboratories).
 - 8. IBC (International Building Code).
 - 9. State of Maryland Fire Prevention Code.
 - 10. ANSI/EIA/TIA.
 - 11. NETA (National Electrical Testing Association).
 - 12. NEMA (National Electrical Manufacturer's Association).
 - 13. NECA (National Electrical Contractors Association).

1.4 OUTAGES

- A. For all work requiring an outage, the contractor shall submit an outage request to the UMB Project Manager, using the UMB Standard Request for Outage Form which is available through the UMB Design and Construction Web Site at <http://www.umaryland.edu/designandconstruction/>, under the Documents Link. The existing mechanical/electrical systems shall remain operational unless turned off by University personnel during the construction of the project. For each electrical outage request include a photograph of the panel index schedule for each panel affected by the outage.
- B. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled at least ten days (10) days in advance with the Office of Facilities Management. All such outages shall be performed on other than normal duty hours.
- C. All electrical outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon by the contractor and the Office of Facilities Management.
- D. The contractor shall include in his price the cost of all premium time required for outages and other work which interferes with the normal use of the building, which will be performed, in most cases, during other than normal work time and at the convenience of the University.
- E. The operation of electrical equipment; required to achieve an outage must be accomplished by University personnel only. Prospective subcontractors under this section are cautioned that the unauthorized operation of electrical equipment or other control devices by their personnel can result in extremely serious consequences for which the contractor will be held accountable.

1.5 INSTALLER'S QUALIFICATIONS

- A. Electrical Installer shall submit the following evidence:
 - 1. Five (5) comparable completed projects.
 - 2. Reference letters from minimum of three (3) registered professional engineers, general contractors, building owners, explaining proficiency, quality of work, or other attribute on projects of similar size or substance.
 - 3. Copy of Maryland Master Electrician's License.
 - 4. Local or State license where required.
 - 5. BICSI and NICET certification, where required by these specifications.
- B. The electrical installer shall utilize a full time project foreman in charge of all electrical work.
 - 1. Fully qualified and experienced in such work.
 - 2. Available, on site, at all times during construction.
 - 3. All communication shall be through this person.
- C. Installer of specialized systems such as Fire Alarms, telecommunication systems, etc. shall meet the requirements of the associated spec section(s).

1.6 CUTTING, WELDING, BURNING

- A. Before the contractor and/or any sub-contractor commence's any cutting, welding, and/or burning, the contractor shall obtain a hot work permit from Environmental Health and Safety at extension 1-410-706-3490.
- B. The hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to Environmental Health and Safety.

1.7 WORK PERFORMANCE

- A. All electrical work must comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J, OSHA Part 1910 subpart S and OSHA Part 1910 subpart K in addition to other references required by the contract.
- B. Before initiating any work, a job specific work plan must be developed by the contractor. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, and safety equipment to be used and exit pathways.
- C. Job site and worker safety are the responsibility of the contractor. Compliance with the requirements of NFPA 70E is subject to ongoing inspection by University personnel and failure to comply will result in an immediate Stop Work order being issued and enforced at the contractor's expense.
- D. Energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee performs work any time the employee is within the limited approach boundary or, where an increased risk of injury from an exposure to an arc flash hazard exists.
- E. Outages should be scheduled a minimum of ten (10) days in advance.
- F. Mandatory Requirements: The following requirements are mandatory:
 - 1. Protective Equipment: Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
 - 2. UMB Energized Work Permit: A UMB Energized Work Permit is required for any work on energized circuits or equipment. Permit must be approved by UMB Department of Operations and Maintenance prior to performing energized work. Submit the work permit with the outage request.

1.8 SUBMITTALS

- A. General: Follow the procedures specified in Division 01 Section "Submittals."
- B. Product data as specified in the electrical specifications.
- C. Shop drawings detailing fabrication and installation requirements for electrical equipment.
- D. In addition to the following list, submit other shop drawings as may be requested by UMB.

1. Divisions 26, 27, & 28:
 - a. Compression Wire Connectors
 - b. Fire Resistant Sealant
 - c. Ground Wire
 - d. Surface Raceway
 - e. Wireways
 - f. Raceway, Boxes and Cabinets
 - g. Wires and Cables
 - h. Fire Alarm System: Refer to Division 28 Section “Digital, Addressable Fire Alarm System” for submittal requirements

 - E. In instances of complex field wired systems, including but not limited to: fire alarm system, the contractor shall submit:
 1. Cut sheets of every component such as control panels, fire alarm devices, wire, etc.
 2. The contractor shall submit detailed riser diagrams detailing point-by-point connections. Diagrams shall indicate cable on raceway between points.
 3. Corresponding floor plans showing only this particular system with conduit and wire runs between points.
 4. Both riser and floor plan shall indicate address of devices where applicable.
 5. Calculations for battery capacity and voltage drop.
 6. Preliminary programming information.

 - F. Submittal File Format: File formats for each submittal shall be electronically as follows:
 1. Product Data: “pdf” file format.
 2. Shop Drawings: “pdf” file format.
 3. Coordinated Drawings: “pdf” or “dwg” file formats.
- 1.9 QUALITY ASSURANCE
- A. Comply with NFPA 70 for components and installation.
 - B. Listing and Labeling: Provide products 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.
 - C. Install all components and equipment per manufacturer’s written instructions.
 - D. Provide installation in accordance with recognized trade organizations and standards:
 1. NEMA.
 2. NECA “Standards of Installation”
- 1.10 COORDINATION DRAWINGS

- A. General: When required participate in the preparation of the coordinated drawing effort for the project. See Specification Division 01 for general requirements.
- B. Coordination Drawings: In addition to the requirements of the Specification Division 01 prepare the electric part for the coordination drawing effort. Work with the other trades to ensure the material and equipment installed as part on the electrical system will not be in conflict with the installation of material and equipment by the other trade contractors. Unless otherwise indicated the coordination drawings, including plans, sections, and elevations shall be prepared at a scale of not less than 1/4 inch = 1 foot- 0 inches. At a minimum, prepare coordination drawings for all mechanical rooms, electrical rooms and substation rooms.
- C. File Format: Coordination drawings shall be in a layered structure form as CAD Files or PDF Files for each floor with searchable text as follows:
 - 1. File Structure: The “pdf” or “dwg” files shall have separate layered structure for:
 - a. Building Elements: Indicate each building element on separate layers, such as:
 - 1) Walls.
 - 2) Reflected ceiling plan.
 - 3) Room numbers.
 - b. Systems and Sub Systems: Indicate each system or sub system as warranted by congestion or complexity on separate layers such as:
 - 1) Examples of Systems:
 - a) Lighting System.
 - b) Power Distribution System.
 - c) Control/SCADA System
 - 2) Examples of Sub Systems:
 - a) Normal Power.
 - b) Emergency Power.
 - 2. The layered electronic files shall allow building elements, building systems and sub systems to be viewed in isolation or in combinations that are user selectable when the drawing files are being displayed.
- D. Coordination Effort: This coordination effort shall include detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
 - 1. Indicate the proposed locations of electrical equipment, and materials. Include the following:
 - a. Planned electrical systems layout, including conduit elbow radii and accessories.
 - b. Clearances for servicing and maintaining electrical equipment.
 - c. Exterior wall and foundation penetrations.
 - d. Fire rated wall and floor penetrations.

- e. Sizes and location of required concrete pads and bases.
 - f. Size and location of all electrical panels.
 - g. Access doors.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
 3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all access doors for concealed junction boxes devices.
 4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.

1.11 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 01 Section "Contract Closeout." In addition to the requirements specified in Division 01, indicate the following installed conditions:
 1. Conduit and wire runs between the points
 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 3. Approved substitutions, Contract Modifications, RFI responses and actual equipment and materials installed.

1.12 OPERATION AND MAINTENANCE MANUALS

- A. Electrical O & M Manual File: Provide one (1) electronic file "pdf format" for the projects Electrical Operation and Maintenance Manual for the Material and Equipment installed in the project included in Divisions 26 on a CD-R. The electronic Electrical O & M manual shall include one copy of each approved submittal, any manufacturer's maintenance manuals, all warranty certificates, arranged in file folders for each submittal. Also include the address, phone number and contact person for each supplier. Files shall be stacked and include both a book mark and tree structure for accessing each submittal file as indicated in Division 01 Section "Closeout Procedures".
- B. Alternate O & M File: The CM/General Contractor has the option to include all disciplines in a single O&M Manual file for smaller type renovation projects. The electronic O & M manual shall include one copy of each approved submittal, approved TAB report, any manufacturers maintenance manuals, all warranty certificates, arranged in file folders under each discipline for each submittal. Files shall be stacked and include both a book mark and tree structure for accessing each submittal file The electronic file structure for the single file shall be as follows:
 1. Cover Sheet
 2. Forward
 3. General Information
 4. Subcontractors List
 5. Suppliers List
 6. General Warranty Statement – include the manufacturer's warranty with the equipment submittal in the appropriate discipline.

7. Electrical: group all electrical data under this heading with a tree structure.
8. As Built Drawings: Contractors Markups.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.14 SEQUENCING AND SCHEDULING

- A. Coordinate electrical equipment installation with other building components.
- B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for electrical installations.
- C. Coordinate the installation of required supporting devices and set sleeves in poured in place concrete and other structural components as they are constructed.
- D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.
- E. Coordinate connection of electrical services.
- F. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- G. Coordinate requirements for access panels and doors where electrical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in the Architectural Specifications.
- H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

1.15 VARIANCES

- A. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Engineer shall decide on the item and manner in which the work shall be provided.

1.16 GUARANTEE/WARRANTY:

- A. All materials, equipment, etc. provided by the general contractor and/or his subcontractors shall be guaranteed and warranted to be free from defects in workmanship and materials for a period of two (2) years after date of certificate of completion and acceptance of work by UMB. Any defects in workmanship, materials, or performance which appear within the guarantee period shall be corrected by the contractor without cost to the owner, within a reasonable time, to be specified by UMB. In default thereof, owner may have such work done and charge the cost of same to the

contractor. In addition to the above statement the Guarantee/Warranty Period shall include all labor cost related to all warranty work. For compressorized equipment include an additional three (3) year Guarantee/Warranty Period.

PART 2 - PRODUCTS

2.1 LISTED MANUFACTURERS:

- A. Listed Manufacturers: The listed manufacturers indicated in Part 2 of each specification section as the basis of design represents the minimum level of quality for materials and equipment that is acceptable to UMB. Unless otherwise indicated in each specification section, contractors may submit material and equipment by non listed manufacturers provided said submittals meet the requirements of these specifications. All submitted materials and equipment are subject to approval by the A/E and UMB.
- B. Approved Equal Equipment Layouts: The equipment layouts and the related mechanical and electrical service connections, access space and supports indicated on the construction documents represent equipment provided by the specified basis of design manufacturer and model number. When the successful bidder chooses to provide "or approved equal" equipment by one (1) of the other listed manufacturers in the specifications, the bidder shall be responsible for providing all adjustments and modifications to the services necessary to make connections to the equipment, the bidder shall be responsible for installing the equipment such that all required clear access space is maintained, and the bidder shall be responsible for providing all adjustments and modifications to the equipment mounting and supports. All adjustments and modifications shall be provided by the bidder and appropriate subcontractors at no additional cost to the project.

PART 3 – EXECUTION

3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. For equipment rough-in requirements see specifications for electrical equipment.

3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
 - 1. Coordinate electrical systems, equipment, and materials installation with other building components.
 - 2. Verify all dimensions by field measurements.
 - 3. Install systems, materials, and equipment to conform with approved submittal data, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to UMB.
 - 4. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
 - 5. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement

of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

6. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with Division 1 Section "Cutting and Patching." In addition to the requirements specified in Division 1, the following requirements apply:

1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

- B. Perform cutting, fitting, and patching of electrical equipment and materials required to:

1. Uncover Work to provide for installation of ill timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Disconnect installed work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from UMB, uncover and restore Work to provide for UMB observation of concealed Work.

- C. Cut, remove and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical systems and equipment as indicated on the drawings and specifications and other electrical items made obsolete by the new Work.

- D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 01 Section "Definitions and Standards" for definition of "experienced Installer."
2. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
 - a. Refer to Division 01 Section "Definitions and Standards" for definition of "experienced Installer."

3.4 PROTECTION OF WORK

- A. Protect work, material and equipment from weather and construction operations before and after installation.

- B. Properly store and handle all materials and equipment.
- C. Cover temporary openings for electrical equipment to prevent the entrance of water, dirt, debris, and other foreign matter.

3.5 PROVISIONS FOR ACCESS

- A. Furnish and install adequate access to all electrical components. The following list shall be used as a guide only:
 - 1. Equipment such as transformers, generators, etc.
 - 2. Distribution panels.
 - 3. Switch Gear.
 - 4. Disconnects.
 - 5. Variable frequency drives.
- B. Access shall be as required by code and/or as determined by the Architect and Engineer.
- C. Refer to contract drawings where access panels have been specifically located.
- D. Where access is by means of lift out ceiling tiles or panels mark access each panel using small color coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.6 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of equipment and systems to Owner's personnel a minimum two (2) weeks prior to date of final inspection.
 - 1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
 - 2. Training period shall be performed within one (1), two (2) week period.
- B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.
- C. Demonstrate the following:
 - 1. Start up.
 - 2. Operation.
 - 3. Control.
 - 4. Adjustment.
 - 5. Trouble shooting.
 - 6. Servicing.
 - 7. Maintenance.
 - 8. Shutdown.
- D. Provide at least forty (40) hours straight time instruction to the operating personnel.
 - 1. This instruction period shall consist of not less than five (5) eight (8) hour days.
 - 2. Time of instruction shall be designated by the Owner.

3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in the mechanical specifications.

3.7 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

- A. The Installer of products under Divisions 26, 27, & 28 shall make all system connections required to equipment furnished and installed under another division and by others.
- B. It shall be the responsibility of the Installer to obtain all necessary data from the equipment supplied under other Divisions.

3.8 RECORD DRAWINGS (As Built)

- A. Upon completion of the electrical installations, the Installer shall deliver to the Architect one (1) complete set of marked-up blueprints of the electrical contract drawings.
 1. The mark-ups shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design.
 2. Refer to General Requirements of Division 01 for additional requirements pertaining to Submittals and Record Drawings.

3.9 CLOSEOUT PROCEDURES

- A. Operating and Maintenance Instructions: Submit Complete Package At Least Two (2) Months Prior To Substantial Completion. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:
 1. Maintenance manuals, including a customized list of preventive maintenance items and annual schedule for maintenance.
 2. Record documents.
 3. Complete inventory of spare parts and materials.
 4. Tools.
 5. Identification systems.
 6. Control sequences.
 7. Hazards.
 8. Cleaning.
 9. Warranties and bonds.
 10. Maintenance agreements and similar continuing commitments.
 11. Source code and software.
- B. As part of instruction for operating equipment, demonstrate the following procedures:
 1. Switchgear Sequence of Operations

3.10 INSPECTIONS

- A. Contractor shall:
 1. Schedule, pay for (as applicable) and attend all inspections required by the Authorities Having Jurisdiction.

2. Deliver all certificates to the Owner prior to final acceptance of work.

B. Notify UMB in advance of scheduled inspections.

C. An electrical foreman, superintendent or other supervisor familiar with the project shall be in attendance for all scheduled electrical inspections.

D. Electrical inspection shall be by the third (3rd) Party Inspector approved by the Maryland State Fire Marshall.

E. Schedule the preliminary and rough-in inspections in a timely manner. Any work covered prior to any inspection in a manner which, in the inspector's opinion, precludes a complete inspection shall be uncovered at the installer's cost.

3.11 DEMOLITION:

A. Remove and dispose of all existing materials not required for re-use or re-installation.

B. Deliver on the premises, where directed, existing material and equipment which is to be salvaged and remain property of Owner.

C. All other materials removed shall become the property of the Contractor and shall be removed from the premises.

D. Remove conduit, hangers, supports, etc. to a point below the finished floors or behind finished walls and cap. Cut such items flush with masonry surfaces.

E. Remove wiring and conduit back to source panelboard or switch, or to last remaining device on the circuit. Remove conduit, hangers, supports, etc. unless otherwise noted. Conduit may remain to be reused for new work provided it is of the specified size and type and in condition acceptable to UMB.

F. Any conduit abandoned in concrete slabs, walls, or other inaccessible locations shall be left with a nylon pull wire. Ends shall be capped with push plugs for future use.

3.12 REPAIRS & RESTORATION OF SURFACES AND FINISHES:

A. Restore all finishes, equipment and surfaces to original condition, where affected by the work. Provide the following, where applicable, in accordance with accepted trade standards and to Owner's satisfaction:

1. Replace damaged ceiling tiles.

2. Replace ceiling tiles where removal has left holes or cuts in original tiles.

3. Patch, repair and repaint all walls and surfaces cut, penetrated or otherwise disturbed by the work.

4. Patch holes and penetrations in wood, masonry and plaster.

5. Provide suitable cover plates for all recessed back boxes of equipment removed and not covered by new devices.

6. Provide larger trim or cover plates for new devices, where old back boxes, holes, etc. are not concealed by new work.

3.13 FINAL CLEANING

- A. General: General cleaning during construction is required by the General Conditions and included in Section Temporary Facilities.
- B. Cleaning: Switchgear and electrical equipment shall have a final cleaning within 30 days prior to substantial completion. Such cleaning shall be accomplished by an electrical testing firm experienced in servicing the equipment. Comply with manufacturer's instructions.
- C. Remove all electrical clippings, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

3.14 PROJECT PUNCH OUT

- A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement shall be made by deducting the Architect/Engineer fee from the Contractor's final payment.

END OF SECTION 260000

SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

- A. This Section includes cables and related splices, terminations, accessories and acceptance testing for 15,000 volt electrical distribution systems.

1.3 DEFINITIONS

- A. NETA ATS: Acceptance Testing Specification.

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of cable indicated. Include splices and terminations for cables and cable accessories.
- C. Samples: Sixteen (16) inch lengths of each type of cable indicated.
- D. Qualification Data: For Installer and testing agency. Data submitted shall confirm that the person(s) and firm(s) listed in the "Quality Assurance" Article have demonstrated their capabilities and experience. The data shall include, but limited to a list of completed projects with project names, addresses, names of Architects and UMBs. Additional data includes:
- E. Material Certificates: For each cable and accessory type, signed by manufacturers.
- F. Source quality-control test reports. Certified reports of manufacturer's design and production tests indicating compliance of cable and accessories with reference standards.
- G. Field quality-control test reports. Field test reports indicating and interpreting test results relative to compliance with performance requirements specified. Include certified copies of field test reports.

- H. Installation Manual: Manual shall include all data relative to installing the cables and accessories. Maximum pulling tensions, side wall pressure limitations, type of pulling devices shall all be documented within the manual.
- I. Operation & Maintenance Manual: Include recommendation relating to acceptance and periodic maintenance testing and infrared scanning photometry. Recommendation shall include frequency and type of testing. Operation data shall include data of fault indicators and separable connectors and their accessories.

1.5 QUALITY ASSURANCE

- A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable. Submit the following within 30-days of contract award:

- 1. Name of individual(s) performing splicing/terminating
- 2. Certification of individual performing test with name and date
- 3. Number of years of medium voltage splicing/terminating experience
- 4. Proof of termination/splice of the type to be installed, under supervision of the kit manufacturer, or representative
- 5. Dummy splice/termination successfully tested as follows. Test to be performed by the splice kit supplier.

Test	Minimum Value
Discharge Ext. Value with, 3 pcs.	13-kV
Ac Withstand, 1 minute	35-kV
DC Withstand, 15 minutes	65-kV

- 6. List of three recent jobs within last twelve (12) months where specific splices/terminations were installed. Include splice/termination manufacturer, catalogue number, cable type and the quantity installed.
- B. Manufacturer Qualifications: Firm experienced in manufacturing medium-voltage cable and accessories similar to those indicated for this project, with a ten (10) year record of successful in-service performance
- C. Testing Agency Qualifications: In addition to the requirements specified in Division 1 Section "Quality Control Services," an independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- D. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

- E. 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.
- F. Comply with IEEE C2 "National Electrical Safety Code" and NFPA 70.
- G. Production Tests shall be performed on the cable at time of manufacture.
 - 1. Resistance requirements of ICEA S-68-516, section 2.5.
 - 2. Insulation resistance test shall be performed in accordance with ICEA S-68-516, part 6.28, and shall have an insulation resistance constant of at least 50,000 megohms-1000 feet at 15°C.
 - 3. A high voltage ac and dc test shall be performed in accordance with part 6.27 of ICEA S-68-516. The test voltage shall be as follows:

Insulation Wall	AC kV (5 Minutes)	DC kV (15 minutes)
115	23	45
220	44	80

- 4. The shield resistance shall be measured and recorded from end to end on the complete cable
- 5. The cable shall be corona discharge tested in accordance with Section G of AEIC CS[^]. The maximum allowable discharge is five (5) picocoulombs throughout the entire specified test voltage range.
- 6. Certified test reports shall be furnished to the Engineer, for review, for all cables prior to installation.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by UM or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify UM in writing no fewer than ten (10) days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service without written permission from – UMB PM.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver medium voltage cable on factory reels conforming to NEMA WC 26.
- B. Store cables on reels on elevated platforms in a dry location.
- C. Provide hot-shrink (cold-shrink not permitted) cable end caps for cable stored outside.

1.8 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section “Basic Electrical Requirements’ for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

- 1. Cables:

- a. General Cable Technologies Corporation.
- b. Okonite Company (The).
- c. Prysmian
- d. Southwire Company.

- 2. Cable Splicing and Terminating Products and Accessories:

- a. G&W Electric Company.
- b. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.
- c. RTE Components; Cooper Power Systems, Inc.
- d. Thomas & Betts Corporation/Elastimold.
- e. 3M; Electrical Products Division.
- f. Approved Equal.

- 3. Arc Proofing Products:

- a. 3M/ Scotch Products.
- b. Plymoth Bishop
- c. Thomas and Betts Corporation

2.2 CABLES

- A. Cable Type: MV105, single conductor insulated power cable.
- B. Comply with UL 1072, AEIC CS 8, ICEA S-93-639, and ICEA S-97-682, ASTM B-8 or B-231.
- C. Conductor: Copper.
- D. Conductor Stranding: Compact round, concentric lay, Class B.
- E. Conductor Insulation: Ethylene-propylene rubber (EPR) conforming to NEMA WC74 (ICEA S-68-516 and AEIC CS6).

1. Voltage Rating: 15 kV.
 2. Insulation Thickness: 133 percent insulation level.
- F. Shielding: Copper tape, helically applied over semiconducting insulation shield.
1. 25% tape overlay
- G. Cable Jacket: Sunlight-resistant PVC.

2.3 SPLICE KITS

- A. Connectors and Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.
- B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.
1. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.

2.4 SOLID TERMINATIONS

- A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.
1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
 2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
 3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
 4. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

2.5 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

- C. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- D. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
- E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.
 - 1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
 - 2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
 - 3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
 - 4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.
- F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.
- G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, ground cable set and carrying case.

2.6 FAULT INDICATORS

- A. Indicators: Manually reset fault indicator with inrush restraint feature, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Instrument shall not be affected by heat, moisture, and corrosive conditions and shall be recommended by manufacturer for installation conditions.
- B. Resetting Tool: Designed for use with fault indicators, with moisture-resistant storage and carrying case.

2.7 PROTECTIVE CABLE END CAPS

- A. Protect MV cables from water penetration on job site, before, during and after cable pulling. Seal cable end with heat-shrinkable end cap. This cap will remain in place until the actual time of termination. Sealing compounds and/or taping shall not constitute acceptable environmental protection. End sealing caps shall be as produced by Raychem Corporation, Type ESC, or equal.

2.8 ARC-PROOFING MATERIALS

- A. Tape for First Course on Metal Objects: 10-mil- thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, compatible with cable jacket.
- C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch wide.

2.9 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to ICEA S-97-682, NEMA WC74 before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cables according to manufacturer's written instructions and IEEE 576.
- B. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use NRTL - listed and manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
 - 3. Provide written calculations confirming pulling tensions and side wall pressure limits are within cable manufacturer's recommendations. Submit to Engineer prior to start of work.
- C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- D. Install "buried-cable" warning tape twelve (12) inches above cables.
- E. Install fault indicators on each phase where indicated.
- F. In manholes, hand holes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag.
- G. Install cable splices at pull points and elsewhere as indicated; use standard kits.
- H. Install terminations at ends of conductors with standard kits.
- I. Install separable insulated-connector components as follows:

1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
 2. Portable Feed-Through Accessory: Three.
 3. Standoff Insulator: Three.
- J. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
1. Clean cable sheath.
 2. Wrap metallic cable components with 10-mil pipe-wrapping tape.
 3. Smooth surface contours with electrical insulation putty.
 4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
 5. Band arc-proofing tape with one (1) inch- wide bands of half-lapped, adhesive, glass-cloth tape two (2) inches o.c.
- K. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.
- L. Identify cables according to Division 26 Section "Identification for Electrical Systems."
- M. Prior to installing cables, pull a mandrel sized 1/4" less than conduit ID. Then clean each conduit with a stiff brush to remove debris.
- N. Use pulling means including, fish tape, cable, rope, basket-weave wire/cable grips and pulling eyes that will not damage cable or raceways. Do not use rope hitches for pulling attachments to cable.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections: Engage an independent, testing and inspecting agency to perform the following field tests and inspections and prepare test reports at no additional cost to UM:
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS and in the presence of UM personnel or authorized agent. Certify compliance with test parameters.
 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
 - a. DC high potential at kV and duration approved by the Engineer.
 - b. Shield Continuity
 - c. Provide live phasing test to ensure redundant feeders are phased and synchronized
 - d. If installed cable is being spliced to an existing cable, VLF Hi-Pot test shall be performed prior to it being spliced. Temporary terminations shall be used where appropriate. After splicing is complete, testing shall be performed as indicated above.

3. Perform Partial Discharge test of each existing conductor that is spliced onto or otherwise modified according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.
 4. Infrared Scanning: After Substantial Completion, but not more than sixty (60) days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. The infrared testing shall be performed by minimum Level 1 infrared certified thermographer.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice eleven (11) months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.
- B. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Remove and replace malfunctioning units and retest as specified above, listing all deficiencies and corrective actions.

END OF SECTION 260513

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of product indicated.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports.
- E. Operation and Maintenance materials.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. 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.
- C. Comply with NFPA 70.

1.6 COORDINATION

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

1.7 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 1. Alcan Products Corporation; Alcan Cable Division.
 2. American Insulated Wire Corp.; a Leviton Company.
 3. General Cable Corporation.
 4. Senator Wire & Cable Company.
 5. Southwire Company.
 6. The Okonite Company.
 7. Belden, Inc.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN-2 and XHHW-2.
- D. Multiconductor Cable: Comply with NEMA WC 70 for steel-clad cable, Type MC with ground wire.
 1. Fittings: Steel
- E. Color Coding:

208/120 Volts

480/277 Volts

Phase	Color	Phase	Color
A	Black	A	Brown
B	Red	B	Orange
C	Blue	C	Yellow
Neutral	White	Neutral	Gray
Ground	Green	Ground	Green

2.2 CONNECTORS AND SPLICES

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

2.3 SLEEVES FOR CABLES

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

2.4 SLEEVE SEALS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one (1) of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

1. Sealing Elements: NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

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

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance and conductors #4/0 and larger: Type XHHW-2, single conductors in raceway.
- B. Feeders smaller than #4/0: Type THHN-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- D. Branch Circuits in Cable Tray: Type THHN-THWN-2, single conductors in raceway or steel-clad cable, Type MC.
- E. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.
- F. Class 2 Control Circuits: Type THHN-THWN-2, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

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

- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. MC Cable Installation Requirements:
 - 1. Install in compliance with NFPA 70.
 - 2. Locations: In dry wall partitions and above accessible ceilings. Do not install in masonry partitions or walls.
 - 3. Independently support all MC Cable runs; do not piggy-back on plumbing/HVAC, lighting fixture, and/or ceiling grid supports.
 - 4. Do not bundle more than three (3) runs together for supporting purposes.
 - 5. MC cable shall be installed in a neat and orderly fashion using batwings type supports.
 - 6. Minimum bend radius shall be as recommended by the manufacturer.
 - 7. MC cable run to switches shall have a neutral conductor.
 - 8. Cable larger than #8AWG shall not be permitted.
 - 9. All acceptable homeruns from panels in electrical rooms shall be installed in EMT conduit to a junction box/wire trough outside electrical rooms in accessible ceiling of corridor.
 - 10. Homeruns from panelboard to junction box outside of electrical room: wire in EMT or IMC raceway.
 - 11. Do NOT run MC Cable in exposed locations (e.g. all open ceiling locations, Mechanical and Electrical Equipment Rooms, IT Rooms, etc.).
 - 12. MC cable shall be secured at intervals not exceeding six (6) feet and within twelve (12) inches of every outlet box or fitting. Luminaire whips may be six (6) feet maximum without support.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than fifty (50) inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve rectangle perimeter equal to, or greater than, fifty (50) inches and one (1) or more sides equal to, or greater than, sixteen (16) inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors three (3) inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for one (1) inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for one (1) inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

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

3.7 FIRESTOPPING

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

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
 - a. Switchgear Battery Chargers
 - b. Mechanical HVAC equipment
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than sixty (60) days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. The infrared testing shall be performed by minimum Level 1 infrared certified thermographer.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice eleven (11) months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.
- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

- A. Section includes grounding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
 - 5. Grounding for sensitive electronic equipment, i.e., computer and office equipment.
 - 6. Grounding for UPS', batteries and related equipment.
 - 7. Grounding for Generators, transfer switches and related equipment.
 - 8. Grounding for HVAC, pumps and related equipment.
 - 9. Grounding for Lightning Protection System.
- C. Qualification Data: For qualified testing agency and testing agency's field supervisor.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems shall be based on NFPA 70B.

- a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Independent Testing Agency Qualifications: Member Company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

1.5 WARRANTY/GUARANTEES

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper or Tinned-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. 4 or No. 6 AWG, stranded conductor.
 5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; one and five eighths (1-5/8) inches wide and one sixteenth (1/16) inch thick.
 6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; one and five eighths (1-5/8) inches wide and one sixteenth (1/16) inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, one quarter (1/4) by four (4) inches in cross section, with nine thirty seconds (9/32) inch holes spaced one and one eighth (1-1/8) inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

- A. Listed and labeled by an NRTL 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, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; three quarter (3/4) inch in diameter by ten (10) feet long.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Equipment Grounding Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Electrode Conductors: Install bare tinned copper conductor, No. 2/0 AWG minimum.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers two (2) inches minimum from wall, six (6) inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.
- E. Ground Ring: Install a ground ring around the perimeter of the building or structure. Bond the ring in accordance with the National Electrical Code.
- F. Concrete Encase Electrode: Install a concrete encased electrode as part of the building's or structure's foundation. Bond the electrode in accordance with the National Electrical Code.

G. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so four (4) inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from two (2) inches above to six (6) inches below concrete. Seal floor opening with waterproof, nonshrink grout. Exposed grounding conductors pulled through manholes shall also be bonded to the ground rod in each manhole.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than six (6) inches from the foundation.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components. Ground fault protection is required on heat tracing and anti-frost heating circuits.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.
1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a one quarter (1/4) inch by four (4) inch by twelve (12) inch grounding bus.
 3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode, grounding electrode conductor and a separate insulated equipment grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. Grounding Electrode and Equipment 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 Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are two (2) inches 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.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least twelve (12) inches deep, with cover.
 - 1. Test Wells: Install at least one (1) test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. 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 bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than sixty (60) feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than thirty (30) inches from building's foundation.
- J. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of twenty (20) feet of bare copper conductor not smaller than No. 4 AWG.
1. If concrete foundation is less than twenty (20) feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.5 LABELING

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems" Article for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor to engage a third (3rd) Party qualified independent testing agency approved by the Maryland State Fire Marshall to perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two (2) full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.
7. Maximum ground-resistance value 5 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify UMB promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 WARRANTY/GUARANTEES

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.

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

6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

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

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate

- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

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

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

SUMMARY

- B. Related Sections include the following:

- 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.2 DEFINITIONS

- A. RMC: Rigid metallic conduit.
- B. PVC/RMC: PVC coated rigid metallic conduit.
- C. EMT: Electrical metallic tubing.
- D. EPDM: Ethylene-propylene-diene terpolymer rubber.
- E. LFMC: Liquidtight flexible metal conduit.
- F. NBR: Acrylonitrile-butadiene rubber.
- G. RNC: Rigid nonmetallic conduit.

1.3 SUBMITTALS

- A. Product Data: For raceways, wire ways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets include layout drawings showing components and wiring.

- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Source quality-control test reports.

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 NFPA 70.
- C. Coordinate layout and installation of raceways and boxes with other construction elements to ensure adequate headroom, working clearance, and access and eliminate interference problems.

1.5 WARRANTY/GUARANTEES

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Alflex Inc.
 - 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - 5. Electri-Flex Co.
 - 6. O-Z Gedney; a unit of General Signal.
 - 7. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. EMT: ANSI C80.3.
- D. LFMC: Flexible steel conduit with PVC jacket.

- E. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: Steel [compression] type.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- F. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Arco Corporation.
 - 3. CertainTeed Corp.; Pipe & Plastics Group.
 - 4. Lamson & Sessions; Carlon Electrical Products.
 - 5. Manhattan/CDT/Cole-Flex.
 - 6. RACO; a Hubbell Company.
 - 7. Thomas & Betts Corporation.
- B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
- B. Description: Comply with UL 2024; flexible type, approved for plenum [riser] general-use installation.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:

1. Cooper B-Line, Inc.
 2. Hoffman.
 3. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type. Secured with stainless steel screws.
- E. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 2. EGS/Appleton Electric.
 3. Hoffman.
 4. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 5. O-Z/Gedney; a unit of General Signal.
 6. Robroy Industries, Inc.; Enclosure Division.
 7. Scott Fetzer Co.; Adalet Division.
 8. Spring City Electrical Manufacturing Company.
 9. Thomas & Betts Corporation.
 10. Walker Systems, Inc.; Wiremold Company (The).
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Exterior and Wet locations
1. Cast aluminum or galvanized cast iron type.
 2. Threaded hubs.
 3. Gasket screw-on cover plates
 4. NEMA FB-1
- E. Boxes embedded in concrete
1. NEMA 4X PVC
 - a. Glue-in conduit hubs
 - b. Gasket cover plates
 - c. Sunlight UV resistant
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic finished inside with radio-frequency-resistant paint.
- H. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

2.6 SLEEVES FOR RACEWAYS

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

2.7 SLEEVE SEALS

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

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: PVC/RMC.
 2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R or 4.
- B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Office Space: EMT.
 2. Conduits > 2": Rigid Steel.
 3. All wiring > than 600 volts: Rigid Steel.
 4. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical and Electrical rooms and IT Rooms/Closets.
 5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 7. Damp or Wet Locations: Rigid steel conduit.
 8. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
 9. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 10. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: EMT.
 11. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
- C. Minimum Raceway Size: Three quarter (3/4) inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

- B. Keep raceways at least six (6) inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from RNC to rigid steel conduit before rising above the floor.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least twelve (12) inches of slack at each end of pull wire.
- L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. Three quarter (3/4) Inch Trade Size and Smaller: Install raceways in maximum lengths of fifty (50) feet.
 - 2. One (1) Inch Trade Size and Larger: Install raceways in maximum lengths of seventy five (75) feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

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

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30°F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125°F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155°F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125°F temperature change.
 - d. Attics: 135°F temperature change.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per °F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- O. Flexible Conduit Connections: Use maximum of seventy two (72) inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC in damp or wet locations not subject to severe physical damage.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than fifty (50) inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, fifty (50) inches and one (1) or more sides equal to, or greater than, sixteen (16) inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors two (2) inches above finished floor level.
- H. Size pipe sleeves to provide one quarter (1/4) inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

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

3.5 FIRESTOPPING

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

3.6 PROTECTION

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

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All work performed on Baltimore City Property or Right-of-Ways shall conform to standards of the Baltimore City Department of Public Works.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Conduit, ducts, and duct accessories for direct-buried and concrete-encased duct banks.
 - 2. Handholes and boxes.
 - 3. Manholes.

1.3 DEFINITION

- A. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for manholes, handholes, boxes, and other utility structures.
 - 4. Warning tape.
 - 5. Warning planks.
- B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
 - 1. Duct entry provisions, including locations and duct sizes.
 - 2. Reinforcement details.
 - 3. Frame and cover design and manhole frame support rings.
 - 4. Grounding details.
 - 5. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - 6. Joint details.

7. Submit shop drawings and sketches of proposed manhole design.
- C. Shop Drawings for Factory-Fabricated Handholes and Boxes Other Than Precast Concrete: Include dimensioned plans, sections, and elevations, and fabrication and installation details, including the following:
1. Duct entry provisions, including locations and duct sizes.
 2. Cover design (including cover legend).
 3. Grounding details.
 4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 2. Drawings shall be signed and sealed by a qualified professional engineer.
 3. Maintain copy in field for red-line drawings and as-built purposes.
- B. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.
- C. Qualification Data: For professional engineer and testing agency.
- D. Source quality-control test reports.
- E. Field quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Comply with ANSI C2.
- C. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by UM or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify UM, in writing, no fewer than 10 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without UMB's written permission.

1.9 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

1.10 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.
- B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Rigid Steel Conduit: PVC-Coated Steel. Comply with NEMA RN 1.
 - 1. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- B. RNC: NEMA TC 2, Type EPC-40-PVCUL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

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

2. Beck Manufacturing.
3. Cantex, Inc.
4. CertainTeed Corp.; Pipe & Plastics Group.
5. Condux International, Inc.
6. ElecSys, Inc.
7. Electri-Flex Company.
8. IPEX Inc.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT; a division of Cable Design Technologies.
11. Spiraduct/AFC Cable Systems, Inc.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
 - a. Color: Red dye added to concrete during batching.
 - b. Mark each plank with "ELECTRIC" in 2-inch- high, 3/8-inch- deep letters.

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

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

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

3. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
4. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "UMB ELECTRIC." or "UMB COMMUNICATIONS" or "UMB SPECIAL SYSTEMS." As indicated for each service.
7. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
8. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
 - a. Extension shall provide increased depth of 12 inches.
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
9. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
10. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
11. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Description: Comply with SCTE 77.

1. Color: "GRAY"
 2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 5. Cover Legend: Molded lettering, "UM ELECTRIC." "UM COMMUNICATIONS" or "UM SPECIAL SYSTEMS." As indicated for each service.
 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
 7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 8. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
- C. Fiberglass Handholes and Boxes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. Christy Concrete Products.
 - d. Synertech Moulded Products, Inc.; a division of Oldcastle Precast.
- D. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers of hot-dip galvanized-steel diamond plate.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Nordic Fiberglass, Inc.
- E. High-Density Plastic Boxes: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be hot-dip galvanized-steel diamond plate.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carson Industries LLC.
 - b. Nordic Fiberglass, Inc.
 - c. PenCell Plastics.

2.5 PRECAST MANHOLES

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

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.
4. Oldcastle Precast Group.
5. Riverton Concrete Products; a division of Cretex Companies, Inc.
6. Utility Concrete Products, LLC.
7. Utility Vault Co.
8. Wausau Tile, Inc.
9. Gannett Fleming, Inc.
10. Approved Equal.

- B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod. Provide adequate sleeves for 4 sets of 12-way, 5" ducts with minimum 6" between ducts. Sleeves shall be 7.5" minimum outside diameter (OD). Include 2 pulling irons per manhole face and floor.
- B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.7 UTILITY STRUCTURE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bilco Company (The).
 - 2. Campbell Foundry Company.
 - 3. Carder Concrete Products.
 - 4. Christy Concrete Products.
 - 5. East Jordan Iron Works, Inc.
 - 6. Elmhurst-Chicago Stone Co.
 - 7. McKinley Iron Works, Inc.
 - 8. Neenah Foundry Company.
 - 9. New Basis.
 - 10. Oldcastle Precast Group.
 - 11. Osburn Associates, Inc.
 - 12. Pennsylvania Insert Corporation.
 - 13. Riverton Concrete Products; a division of Cretex Companies, Inc..
 - 14. Strongwell Corporation; Lenoir City Division.
 - 15. Underground Devices, Inc.
 - 16. Utility Concrete Products, LLC.
 - 17. Utility Vault Co.
 - 18. Wausau Tile, Inc.
- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
 - 1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inches.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

- b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "UM ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - b. Legend: "UM ELECTRIC-HV" for duct systems with medium-voltage cables.
 - c. Legend: "UM COMMUNICATIONS" or "UM SPECIAL SYSTEMS" for communications, data, and telephone duct systems.
 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt. Provide two per face.
1. Working Load Embedded in 6-Inch, 4500-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening. Provide two per floor.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.
- F. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- H. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment. Provide minimum two (2) stanchions per manhole wall. Maintain 18" from corner of wall. Provide additional stanchions if spacing exceeds 30".
 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be minimum 8" long with 3 arms per stanchion, with 450-lb minimum capacity to 20 inches with 250-lb

minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.

- I. Duct-Sealing Compound: Non-hardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- J. Fixed Manhole Ladders: Arranged for attachment to roof, wall, and floor of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin
- K. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches. Onerequired.
- L. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater]. Two required.
- M. Duct Identification System: Provide duct tag or sleeve system for numbering individual ducts in accordance with Specification 260533 "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Non-concrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased steel-rebar reinforced duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- C. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank, unless otherwise indicated.

- D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.
- E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, installed in [direct-buried] [concrete-encased] duct bank, unless otherwise indicated.
- F. Underground Ducts Crossing Paved Paths, Walks, Driveways, Roadways, and Railroads: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
 - 2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20.
 - 3. Units Subject to Light-Duty Pedestrian Traffic Only: [Fiberglass-reinforced polyester resin] [High-density plastic], structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Manholes: Precast or cast-in-place concrete.
 - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

- A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses" and "Plants."
- C. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.4 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use 5" 60-degree manufactured long sweep bends with a minimum radius of 25 feet, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at the building wall via metal junction box inside building. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.
- H. Concrete-Encased Ducts: Support ducts on duct separators.
 - 1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than [4] [5] spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 - 2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.
 - 3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of

concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Reinforcement: Provide rebar reinforcement as directed on Drawings. Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
7. Depth: Install bottom of duct bank at 60 inches (1525 mm) below grade and top of duct bank at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
9. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections

- at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and signal ducts.
 7. Depth: Install top of duct bank at least 36 inches below finished grade, unless otherwise indicated.
 8. Set elevation of bottom of duct bank below the frost line.
 9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple PVC-coated steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 10. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete."

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and traffic ways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below the frost line.
4. Handhole Covers: In paved areas and traffic ways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.

5. Where indicated, cast handhole cover frame integrally with handhole structure.
 - D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
 - E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
 1. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.
 - F. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 07 Section "[Elastomeric Sheet Waterproofing] [Thermoplastic Sheet Waterproofing]." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
 - G. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
 - H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
 - I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.
 - J. Install ground rod before placing manhole lid.
- 3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
 - B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
 - C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 - D. Install handholes and boxes with bottom below the frost line.
 - E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

- F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and subject to occasional, non-deliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.
 - 1. Concrete: 4500 psi, 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Install ground rod before placing manhole lid.

3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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 and all other sections of Division 26.

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product specified in this section.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

1.4 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized-steel sheet.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than fifty (50) inches and with no side larger than sixteen (16) inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter fifty (50) inches or more and one or more sides larger than sixteen (16) inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Advance Products & Systems, Inc.
 - b. CALPICO, Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Presealed Systems.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5,000-psi, twenty eight (28) day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Basis of Design: Polywater FST Foam Sealant or approved equal.
 - 2. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 3. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Silicone Foams: Multi-component, silicone-based, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- C. Water pressure: Seal conduit up to 15 psi.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
 - b. Seal space outside of sleeves with mortar, grout or silicone. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide one quarter (1/4) inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. De-burr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors two (2) inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work to maintain any existing warranties
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using PVC or steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install PVC or steel pipe sleeves. Size sleeves to allow for one (1) inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

1.6 WARRANTY/GUARANTEES

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1. LEM Products, Inc.
 - 2. Panduit Corp.
 - 3. Brady
 - 4. Approved Equal

2.2 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on twenty (20) inch centers.

- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: four (4) inch- wide black stripes on ten (10) inch centers diagonally over orange background that extends full length of raceway or duct and is twelve (12) inches wide. Stop stripes at legends.

2.3 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with three (3) inch- high letters on twenty (20) inch centers.
- D. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.4 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colored Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label. Tape shall not be less than 3 mils thick by 1 inch wide.

2.5 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3- mils thick by one (1) to two (2) inches wide.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for "RED"-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
3. Inscriptions for "ORANGE"-Colored Tapes: "TELEPHONE CABLE", "CATV CABLE", "COMMUNICATIONS CABLE", "OPTICAL FIBER CABLE".

C. Tag: Type I:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft.
4. Three (3) Inch Tensile According to ASTM D 882: 30 lbf, and 2,500 psi.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Interior Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. One quarter (1/4) inch grommets in corners for mounting.
3. Nominal size, seven (7) inches by ten (10) inches.

C. Exterior Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. One quarter (1/4) inch grommets in corners for mounting.
3. Nominal size, ten (10) inches by fourteen (14) inches.

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one (1) piece, self locking, Type 6/6 nylon.
1. Minimum Width: Three sixteenth (3/16) inch.
 2. Tensile Strength at 73°F, According to ASTM D 638: 12,000 psi.
 3. Temperature Range: -40°F to + 185°F.
 4. Color: "BLACK" except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two (2) color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at fifty (50) foot maximum intervals in straight runs, and at twenty five (25) foot maximum intervals in congested areas. List typical color codes for systems, i.e. fire alarm, "RED"; security, "BLUE" and "YELLOW"; etc.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at six (6) inches to eight (8) inches below finished grade.

Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds sixteen (16) inches overall.

- I. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, more than 600 V, within Buildings: Tape and stencil four (4) inch wide black stripes on ten (10) inch centers over orange background that extends full length of raceway or duct and is twelve (12) inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with three (3) inch- high black letters on twenty (20) inch centers. Stop stripes at legends. Apply to the following finished surfaces:
 1. Floor surface directly above conduits running beneath and within twelve (12) inches of a floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at ten (10) foot maximum intervals.
- C. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of six (6) inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - c. DC Panelboards

END OF SECTION 260553

SECTION 261300 - MEDIUM-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes Pad Mounted Metal-enclosed Interrupter Switchgear with the following optional components, features, and accessories:
 - 1. Surge arresters.

1.3 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. GFCI: Ground-Fault Circuit Interrupter.

1.4 SUBMITTALS

- A. Product Data: For each type of switchgear and related equipment, include the following:
 - 1. Rated capacities, operating characteristics, furnished specialties, and accessories for individual interrupter switches and fuses.
- B. Shop Drawings: For each type of switchgear and related equipment, include the following:
 - 1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show method of field assembly and location and size of each field connection. Include the following:
 - a. Tabulation of installed devices with features and ratings.
 - b. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
 - c. Drawing of cable termination compartments showing preferred locations for conduits and indicating space available for cable terminations.
 - d. Floor plan drawing showing locations for anchor bolts and leveling channels.
 - e. Current ratings of buses.
 - f. Short-time and short-circuit ratings of switchgear assembly.
 - g. Nameplate legends.
 - h. Metering provisions with approval by Owner.
 - 2. Wiring Diagrams: For each type of switchgear and related equipment, include the following:

- a. Power wiring.
 - b. Diagrams showing connections of component devices and equipment.
- C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around switchgear where piping and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.
- D. Source quality-control test reports.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For switchgear and switchgear components to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of switchgear and associated components through one source from a single manufacturer.
- B. 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.
- C. Comply with IEEE C2.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in sections of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation at indicated ampere ratings for the following conditions:
 - 1. Ambient temperature not exceeding 122°F
 - 2. Altitude not exceeding 6600 feet.
- B. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchgear, including clearances between switchgear and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify UMB no fewer than 10 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of switchgear and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.
- B. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 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. Touchup Paint: One container of paint matching enclosure finish, each 0.5 pint.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MANUFACTURED UNITS

- A. Description: Factory assembled and tested, and complying with IEEE C37.20.1.
- B. Ratings: Suitable for application in 3-phase, 60-Hz, solidly grounded system.
- C. System Voltage: 13.2 kV nominal; 15 kV maximum.

2.3 METAL-ENCLOSED INTERRUPTER SWITCHGEAR

- A. Available Manufacturers:
 1. S&C Electric Company
 2. G&W Electric
 3. Approved Equal

- B. Comply with IEEE C37.20.3.
- C. Design Level of Available-Source Fault Current: Integrated short-circuit rating consistent with value of fault current indicated.
- D. Basis of Design: S & C Electric Co.'s Pad Mounted Gear PMH-9, or comparable from approved manufacturer with the following:
 - 1. Group operated, quick-make, quick-break switch mechanisms.
 - 2. 14.4KV nominal rating, 95KV BIL, 600A continuous.
 - 3. Short-Time and Short-Circuit Interrupting current: 25 kA rms Sym.
 - 4. Switch operating handle compartment cover padlockable to prevent operation of switch operating mechanisms.
 - a. Padlock: Yale/Scovill 7300 Series with hardened steel triple plated shackle, 8 inch brass chain, and two No. 47 keys with each padlock.
 - 5. Switch operating mechanisms key interlocked, to require both switches to be in the open position before access can be gained to compartment, assuring that the compartment is de-energized. Flush mount key interlocks. Padlock type key interlocks not acceptable. Provide additional key for University use.
 - 6. Key interlock between the two high voltage switches so that both switches cannot be placed in the closed position (primary feeders cannot be paralleled). Padlock type key interlocks not acceptable. Provide additional key for University use.
 - 7. Momentary rating of ground studs equal or greater than the pad mounted switch short circuit rating.
 - a. Grounding studs at switch terminals in each switch compartment.
 - b. Ground studs at ground pads in bus compartments.
 - 8. Dual purpose front barriers.
 - 9. Inner doors or bolted inner barrier panels which requires a second access procedure to gain access to exposed live parts.
 - 10. Steel compartmented base spacer to match enclosure, of height required to provide adequate space for cable terminations; include minimum 6" base spacer.
 - 11. Surge (lightning) arrester for each ungrounded conductor, metal-oxide varistor, heavy duty, distribution class (Tested in accordance with ANSI/IEEE C62.11 and IEC 99-4 for heavy duty arresters):
 - a. Porcelain: Cooper Power Systems' VariSTAR Type AZL, or Joslyn Corp.'s ZQ Series.
 - b. Polymer: Joslyn Corp.'s ZHP Series, General Electric Co.'s Tranquell Type 9L23, or Ohio Brass Co.'s Type PDV-100.
 - c. Silicone: Cooper Power Systems' VariSTAR Type UHS.
 - d. Rating: As recommended by arrester manufacturer.
 - 12. Enclosure Integrity: ANSI C57.12.29 1999 Pad Mounted Equipment-Enclosure Integrity for Coastal Environments.
 - a. Modify salt spray test (5.4.1) from 1500 hours to 4000 hours.

13. Roof section undercoating.
14. Window: Permit viewing switchblade positions if door is closed.
15. Fuses:
 - a. Installed on a single mounting frame, de-energized when the switch is open.
 - b. Current-Limiting Fuses: Full-range, fast-replaceable, current-limiting type that will operate without explosive noise or expulsion of gas, vapor, or foreign matter from tube. Sized per contract drawings.
 - c. Indicator integral with each fuse to show when it has blown.
 - d. Spares: Include three fuses in use and three spare fuses in storage clips in each switch.

2.4 IDENTIFICATION

- A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, devices, controls, and wiring.

2.5 SOURCE QUALITY CONTROL

- A. Before shipment of equipment, perform the following tests and prepare test reports:
 1. Production tests on completed switchgear assembly according to IEEE C37.20.2.
- B. Prepare equipment for shipment and ship equipment to jobsite.
 1. Provide suitable crating, blocking, and supports so equipment will withstand expected domestic shipping and handling shocks and vibration.
 2. Weatherproof equipment for shipment. Close connection openings to prevent entrance of foreign material during shipment and storage.

2.6 FACTORY FINISHES

- A. Finish: Manufacturer's standard color finish applied to equipment before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive switchgear for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Anchor switchgear assembly to 4-inch, channel-iron sill embedded in concrete base and attach by bolting.
 1. Concrete Bases: 4 inches high, reinforced, with chamfered edges. Extend base no less

than 3 inches in all directions beyond the maximum dimensions of switchgear, unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Diagram and Instructions:
 - 1. Frame under clear acrylic plastic on front of switchgear.
 - a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
 - 2. Storage for Maintenance: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

3.4 CONNECTIONS

- A. Cable terminations at switchgear are specified in Division 26 Section "Medium-Voltage Cables."
- B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Medium-Voltage Cables."

3.5 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each switchgear bus, component, connecting supply, and feeder.
 - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
 - a. Switchgear.

- C. Remove and replace malfunctioning units and retest as specified above.

3.6 CLEANING

- A. On completion of installation, inspect interior and exterior of switchgear. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair damaged finishes.

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturers stipulated service conditions.

END OF SECTION 261300

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The extent of site demolition work is shown on the drawings, and as specified herein.
- B. Work includes:
 - 1. Complete photo documentation of entire area to be affected by construction.
 - 2. Locate and mark all underground utilities.
 - 3. Remove existing gravel/asphalt/concrete/turf surfaces.
 - 4. Protection of existing structures, utilities, monuments and facilities to remain.
 - 5. Repair of damages caused to adjacent facilities by demolition operations at no additional cost.
 - 6. Maintain existing utilities indicated to remain, keep in service and protect against damage during site preparation operations.
 - 7. Clearing and grubbing.

1.2 RELATED WORK

- A. Documents affecting this work shall include, but are not limited to Bidding Requirements, General Conditions, Supplemental General Conditions, and other Division 1 sections.

1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site clearing operation to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities with permission from authorities having jurisdiction. Protect pedestrians from work areas.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining areas.
 - 2. Restore damaged improvements to their original condition, as acceptable to the Owner.
 - 3. Support and protect all existing utilities in the work area.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavation within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1.4 QUALITY ASSURANCE

- A. Do not disturb existing utilities to remain.
- B. Comply with all Local, State and Federal requirements regarding materials, method of work and disposal of materials.
- C. Protect all existing vegetation to be retained. Do not stockpile construction or excavated materials within drip line of trees or have vehicular traffic traverse area within drip line of trees.

1.5 SUBMITTALS

- A. Schedule: Submit proposed methods and operations of demolition for review prior to the start of work. Include the coordination for shut-off, capping and continuation of utility services as required.

PART 2 - PRODUCTS – NONE INCLUDED

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Limit dust and dirt rising and/or scattering.
- B. Return adjacent areas to condition existing prior to the start of work.
- C. Comply with governing regulations pertaining to environmental protection.
- D. Strip topsoil to its full depth at new pavement areas and all areas to be re-graded.
- E. Clean areas of dust, dirt and debris caused by demolition operations as directed.
- F. Use temporary enclosures of openings as required to protect vehicles and persons from harm during demolition operations. All protection methods to comply with OSHA standards.
- G. Remove grass and soil as required per the drawings and work conditions and dispose off-site.
- H. Clearing and Grubbing: Clear site of shrubs and other vegetation, as indicated on plans.
 - 1. Completely remove stumps, roots, and completely remove other debris protruding through ground surface.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

3.2 DISPOSAL OF DEMOLITION MATERIALS

- A. All demolition materials shall be legally disposed of off-site.
- B. Store materials to be relocated or reused in such a manner that they are protected from dirt and damage.

3.3 PROTECTION OF EXISTING TREES

- A. Protect existing trees and vegetation indicated to remain in place, against unnecessary cutting, breaking, skinning or bruising of roots and bark and smothering of trees by stockpiling construction materials within drip line, vehicular traffic or parking of vehicles within drip line.
- B. Replacement of trees significantly damaged or loss of trees due to lack of adequate protection during work operations shall be at Contractor's expense.
- C. Avoid trenching in vicinity of existing trees to prevent damage of tree roots.

3.4 ADJUST AND CLEAN

- A. Keep premises free of debris and unusable materials. As work progresses, remove waste materials from the site.

END OF SECTION 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Site (rough) grading and filling (embankment) to attain proposed grade elevations, profiles and contours.
 - 2. Subgrade preparation for trench slabs, pavement, roadways, sidewalks and curbs.
 - 3. Structure excavating and backfilling.
 - 4. Trench excavating and backfilling.
 - 5. Providing bedding for utilities.
 - 6. Providing granular base and fill at concrete slabs-on-grade.
 - 7. Providing drainage fill against all proposed foundation walls.
 - 8. Providing topsoil and finish grading.
 - 9. Removing surplus, debris and waste materials.
- B. Related Sections
 - 1. Site Preparation
 - 2. Dewatering
 - 3. Excavation Support

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:
 - 1. Geotextiles.
 - 2. Controlled low-strength material, including design mixture.
 - 3. Warning tapes.
 - 4. On-Site (Native) and Import (Borrow) Material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
 - 1. Classification according to ASTM D 2487.
 - 2. Laboratory compaction curve according to ASTM D 698.

- C. Existing Utilities: Locate all existing underground utilities in areas of work. Perform all required test including vacuum excavated test pits to accurately locate all existing underground utilities prior to any excavations or sheeting and shoring design (in accordance with ASCE 38-02, QL-A). Document and record location of all existing underground utilities in the work area for future use and Owner record. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Support shall be designed by a licensed professional engineer and approved by the Owner.
 - 1. Should incorrectly located piping or other utilities be encountered during excavation, consult the Owner immediately for directions. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of the Owner.
 - 2. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, except when permitted in writing by the Owner. Temporary utility services may be required to meet the contractors' schedule. All cost shall be the responsibility of the contractor.
 - 3. Submit request minimum of two week to the Owner, and receive written notice to proceed before interrupting any utility.

1.5 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.
- B. Perform earthwork in compliance with applicable requirements of governing authorities.
- C. Materials and methods of construction: Comply with Maryland State Highway Administration Construction and Material Specifications, current edition, and as specified.
- D. Testing and Inspection
 - 1. The contractor will provide the services of a professional Geotechnical Testing Agency to perform the initial inspection and testing for earthwork.
 - 2. The inspection agency will have full authority to see that the work is performed in strict accordance with the requirements of the Contract Documents. The inspector shall cooperate with the Contractor so as to cause no delay in the progress of the work.
 - 3. The Contractor shall bear all costs of correcting rejected work.
- E. Reference Standards
 - 1. ASTM: American Society for Testing and Materials.

1.6 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Utility Locator Service: Engage private utility locating service before beginning earth-moving operations.
- C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures are in place.
- D. Protect existing trees, plants, lawns and other features designated to remain as part of the work. Only operate or park equipment and vehicles in designated construction and staging areas. Construction and staging areas need to be clearly sectioned off from adjacent campus grounds. Any use of lawns, and pavements other than areas designated for the project is strictly forbidden and will be enforced.
- E. Protect excavations by shoring, bracing, sheeting, underpinning or other methods, as required to prevent cave-ins or loose dirt from entering excavations. Barricade open excavations and post warning lights at work adjacent to public roadways. Conform to Occupational Safety and Health Administration (OSHA), Safety and Health Standards 29 CFR 1926, Subpart P “Excavations, Trenching and Shoring,” and all local laws, ordinances and regulations.
- F. Promptly repair damage to adjacent facilities caused by earthwork operations. Cost of repair at responsible Contractor’s expense.
- G. Promptly notify Owner of unexpected subsurface conditions.
- H. Protect bottoms of excavation and soil beneath and around foundations from mud, frost, and freezing.
- I. Grade around excavations to prevent surface water draining into excavated areas.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: 40.
 2. Plasticity Index: 15.
- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
- H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.
- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

- A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
 2. Survivability: As follows:
 - a. Grab Tensile Strength: 247 lbf; ASTM D 4632.
 - b. Sewn Seam Strength: 222 lbf; ASTM D 4632.
 - c. Tear Strength: 90 lbf; ASTM D 4533.

- d. Puncture Strength: 90 lbf; ASTM D 4833.
3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Blue: Water systems.
 5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
 2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.
 - 1. Clearance: 12 inches each side of pipe or conduit.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
 - 1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - 2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
 - 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - 4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches 6 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
 - 1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
 - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
 - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.8 SUBGRADE INSPECTION

- A. Notify Owner and Testing Agency when excavations have reached required subgrade.
- B. If Owner and Testing Agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

- C. Proof-roll subgrade to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
 - 1. Completely proof-roll subgrade in one direction.
 - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Owner.
 - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed.

3.10 STORAGE OF SOIL MATERIALS

- A. No on-site stockpiling is permitted. See below for information concerning offsite stockpiling.
- B. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for Record Documents.
 - 3. Testing and inspecting underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring, bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.
- B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.

- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "Cast-in-Place Concrete."
- E. Backfill voids with satisfactory soil while removing shoring and bracing.
- F. Initial Backfill:
 - 1. Soil Backfill: Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
 - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- G. Final Backfill:
 - 1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use engineered fill.
 - 4. Under building slabs, use engineered fill.
 - 5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
 - 1. Turf or Unpaved Areas: Plus or minus 1 inch.
 - 2. Walks: Plus or minus 1 inch.
 - 3. Pavements: Plus or minus 1/2 inch.

- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.17 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
 - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
 - 2. Place base course material over subbase course under hot-mix asphalt pavement.
 - 3. Shape subbase course and base course to required crown elevations and cross-slope grades.
 - 4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
 - 5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
 - 6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.18 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
 - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
 - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
 - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
 - 4. Sub-grade inspections.
 - 5. Compaction and Moisture inspections.
- B. Testing Agency: Engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing

subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.
 - 2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.
 - 3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 312319- DEWATERING

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.
- B. Geotechnical Report

1.2 SUMMARY

- A. This Section includes construction dewatering for tunnel and utility construction.

1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations and permit construction to proceed on dry, stable subgrades.
- B. Surface Water Removal: Design a failsafe temporary surface water removal system to remove all surface rainwater from the site and prevent any surface water from entering any and all excavations. The Contractor shall provide all necessary equipment, piping, pumps, electrical connections, tanks, containers, hoses, barriers, signs, fencing, excavation, and repair of any disrupted existing sewer equipment.

1.4 SUBMITTALS

- A. Shop Drawings for Information: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water. Show electrical power connections.
- B. Qualification Data: For Installer and professional engineer.
- C. Record drawings at Project closeout identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.
- D. Field Test Reports: Before starting excavation, submit test results and computations demonstrating the dewatering system is capable of meeting performance requirements.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of the AHJ.

- B. Pre-installation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing and then only after arranging to provide temporary utility service according to requirements indicated. Contractor must contact Owner and A/E at least two weeks prior to any proposed shutdown.
- B. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damaged caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and storm water controls.
- B. Before excavating below ground-water level, place system into operation to lower water to specified elevation. Operate system continuously until drains, sewers, and structures have been constructed and fill requirements have been placed, or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, storm and sanitary sewers, and other excavations.

1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 3. Accomplish dewatering without damaging existing buildings or other adjacent structures.
 4. Remove dewatering system if no longer needed.
 5. System shall be maintained by the Contractor until deemed not necessary and then removed from the site.
 6. The system shall be completely automatic without any manual intervention to activate.
 7. Electrical requirements shall be provided by the Contractor.
 8. The system may discharge into the existing storm sewer system provided the discharge does not interfere with any adjacent buildings or roadways and the discharge is lawful.
 9. The system shall be coordinated with the excavation of the existing roadway and any excavation that revises the existing grading of the site.
 10. Include a written report outlining control procedures to be adopted if dewatering problems arise.
 11. Include Shop Drawings signed and sealed by the qualified PE responsible for their preparation.
 12. Note locations and capping depth of wells and well points.
 13. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify all parties if changes to elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
 14. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding areas.
 15. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
 16. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 17. Do not permit open-sump pumping that leads to loss of fines, soil piping, softened slope instability.
 18. Maintain piezometric water level a minimum of 24 inches below surface of excavation.
 19. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, damaging portions of work under construction or completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on a continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures, damaged foundation soils, and damaged equipment at no expense.
- G. Damages: Promptly repair damages to adjacent facilities, structures, equipment, landscaping, etc. caused by dewatering operations.

END OF SECTION 312319

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General Conditions, Supplemental General Conditions, and other Division 01 Specification Sections, apply to this Section.
- B. Geotechnical Report.

1.2 SUMMARY

- A. Section includes:
 - 1. Installation of shoring and bracing required for construction of tunnels, piping, vaults, manholes, trenches, miscellaneous utilities, and to support existing structures/utilities.
 - 2. Inspection and acceptance of existing shoring and bracing.
 - 3. Maintenance of shoring and bracing.
 - 4. Removal of shoring and bracing, as required to a minimum of four feet below the surface.
 - 5. Support of existing utilities, manholes, valves, and piping.
 - 6. Monitoring existing structures.
- B. Types of shoring and bracing system include, but are not limited to the following:
 - 1. Steel soldier piles with timber lagging.
 - 2. Trench Boxes
 - 3. Manufactured trenching systems.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Section "Earthwork."

1.4 SUBMITTALS

- A. Prior to starting work, submit for review and approval, calculations, and shop drawings showing each proposed method of supporting adjacent earth and structures; i.e. retention system and other methods of bracing. Include the following:
 - 1. Lists of material to be used, including design mixes.
 - 2. Sequence of operations.
 - 3. Detailed sections clearly illustrating the scope of work.
 - 4. Relationship of piles, lagging, walls, and bracing to new and existing structures and utilities.
 - 5. Location of existing and new utilities and details of support when required.

6. Procedures and details of testing.
 - B. Shop drawings and calculations: Prepared by qualified Licensed Professional Engineers registered in the State of Maryland and bearing their seals and signatures.
 - C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of complete projects with project names and addresses, names and addresses of Owners, and other information specified.
 - D. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by excavation support and protection systems.

1.5 QUALITY ASSURANCE

- A. Comply with the Publications of the following agencies to the extent referenced and applicable:
 1. ASTM - American Society for Testing and Materials.
 2. AISC - American Institute of Steel Construction.
 3. OSHA - Occupational Safety and Health Act.
- B. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing excavation support and protection systems similar to those required for this Project and with a record of successful in-service performance.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of Maryland and who is experienced in providing engineering services for designing excavation support and protection systems that are similar to those indicated for this project in material, design, and extent.
 1. Engineering Responsibility: Engage a qualified professional engineer to prepare or supervise the preparation of data for the excavation support and protection system including drawings and comprehensive engineering analysis that shows the system's compliance with specified requirements.
- D. Do not install excavation support and protection system until successfully reviewed by A/E.

1.6 JOB CONDITIONS

- A. Before starting work, check and verify governing dimensions and elevations. Survey conditions of adjoining surfaces. Photograph existing conditions to record any prior settlement or cracking of structures, pavements, and other deficiencies. Prepare a list of existing damages, verified by dated photographs and signed by the University.
- B. Survey adjacent structures and improvements, establishing exact elevations at fixed points to act as bench marks. Clearly identify benchmarks and record existing elevations. Locate datum level used to establish benchmark elevations.

1.7 EXISTING UTILITIES

- A. The contract drawings indicate the general location of underground utilities. **All** utility locations and elevations in the vicinity of work shall be verified by the contractor prior to the start of project work. Test pits using vacuum excavation methods shall be conducted in areas where conflicts may occur prior to any excavation, heavy equipment loading, drilling and setting the H-piles is performed so as to avoid damaging or interfering with these existing utilities.
- B. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by the respective representative and then only after arranging to provide temporary utility service according to requirements indicated.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- A. Design sheeting and bracing using the following criteria:
 - 1. Design shoring and bracing systems using a safety factor of 2.0 minimum.
 - 2. Select structural steel members on the basis of AISC specifications.
 - 3. Select structural wood members on the basis of Timber Construction Standards of the American Institute of Timber Construction.
 - 4. Existing building, valve vaults, manholes or foundations shall not be used for support of sheeting and shoring load. Sheeting and shoring shall be independent of the adjacent structure.
 - 5. All shoring and bracing work shall comply with the applicable publications, codes standards and regulation of OSHA.

2.2 MATERIALS

- A. General: Provide adequate shoring and bracing materials, which will support loads imposed. Materials need not be new, but should be in serviceable condition.
- B. Structural Steel - ASTM designation A 36 or ASTM A 572 Grade 50.
- C. Timber Lagging: Any species, rough-cut, mixed hardwood, nominal
- D. 75 mm thick, unless otherwise indicated. Maximum 13 mm space between individual pieces.

PART 3 - EXECUTION

3.1 SHORING

- A. The Contractor shall design the sheeting and shoring to minimize disruption to existing utilities. The Contractor will be fully responsible for planning his work and designing the sheeting and shoring to avoid disrupting all utilities not indicated on the plans for relocation.
- B. Prior to completion of backfill, cut and remove the top of shoring to 1200 mm below existing ground.

3.2 BRACING

- A. Provide engineered bracing to support construction activities at the top of the excavation. Bracing shall be designed by an engineer registered in the State of Maryland in accordance with OSHA.
- B. Locate bracing to clear existing and proposed work. If necessary to move a brace, install new bracing prior to removal of original brace.
- C. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
- D. Maintain bracing until structural elements are rebraced by other bracing or until permanent construction is in place. Bracing shall be inspected for its ability to withstand lateral earth and hydrostatic pressure.
- E. Remove sheeting, shoring, and bracing in stages to avoid disturbance to underlying soils and damage to structures, pavements, facilities, and utilities.
- F. Repair or replace, as acceptable to Owner, adjacent work damaged or displaced through the installation or removal of shoring and bracing work.

3.3 PROTECTION OF ADJOINING STRUCTURES

- A. Do not begin any work until drawings and test procedures are approved.
- B. Prior to shoring and bracing operations, take and record initial elevation readings of adjacent utilities, footings, pavements, and structures.
- C. Upon completion of shoring and bracing operations take and record elevation readings in identical location of initial readings. Settlement greater than 13 mm will require the Contractor to take remedial action.
- D. Submit three certified copies of all elevation records for review.
- E. If any of the following conditions occur during shoring and bracing operations, stop the work immediately and revise procedures to prevent further damage. Revised procedures will be subject to approval.
 - 1. New cracking of existing footings, walls, floors, or pavements.
 - 2. Settlement of 6 mm relative to adjoining areas.
 - 3. Total settlement of 13mm.

4. Signs of shifting in adjoining facilities or utilities.

3.4 INSTALLATION

- A. Provide all piling, bracing, shoring, or other applicable form of temporary supports required to stabilize and protect from movement all existing facilities and utilities that are to remain undisturbed during the course of excavation and demolition operations. Comply with the requirements of OSHA for all work.
- B. Perform the work in such a manner to prevent settlement or shifting of adjoining structure or pavement.
- C. Install piles by means of drilling or boring to eliminate vibration and disturbance to adjacent structure. Jetting, vibratory, or impact hammers, or any other method causing vibration shall not be used unless approved by Owner. Voids between sheeting and earth shall be filled with lean concrete.
- D. Where tiebacks are used, test each tieback with loads greater than design loads.
- E. The Contractor shall be responsible for the installation of all shoring, and bracing and shall make good at his expense any damage caused by or due to failure of sheet piling, shoring, and bracing or other protection methods used.
- F. Maintain sheet piling, shoring, and bracing in place until fill has been placed or permanent construction is in position. Remove shoring, and bracing as required in such a manner to avoid disturbance to underlying soils and structures, pavements, facilities and utilities. As a minimum, remove piling, and lagging to 1200 mm below existing, and remove walers, which interfere with wall placement, prior to final construction.

3.5 DEWATERING

- A. Provide equipment to remove excess water as required to permit installation of new work.

END OF SECTION 315000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work includes:
 - 1. Asphalt paving for streets and parking lots.

1.2 REFERENCES

- A. MDSHA Construction and Material Specifications, Current Edition.

1.3 QUALITY ASSURANCE

- A. Materials and Methods: Comply with MDSHA Standard Specifications for Construction and Materials and Addendum.
- B. Provide materials produced by bulk asphalt concrete producer regularly engaged in the production of hot-mix, hot-laid asphalt concrete materials.

1.4 JOB CONDITIONS

- A. Weather Limitations: Do not apply prime, seal, or tack coats over wet base course or when the temperature is 10 degrees C or lower. Apply surface course only when base course is dry and air temperature is 10 degrees C or higher.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide plant-mixed, hot-laid asphalt-aggregate mixture complying with ASTM D 3515 and Maryland State Highway Administration Standard Specification latest edition with Addendum.
- B. Surface Course: Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand meeting Hot Mix Asphalt Superpave 9.5 MM Superpave, PG 64-22, Level 2
- C. Base Course: Sound, angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings meeting Hot Mix Asphalt Superpave 19.0 MM for Base, PG 64-22, Level 2

- D. Lane Marking Paint: Chlorinated rubber-alkyd type, AASHTO M 248 (FS TT-P-115), Type III, color shall match existing or as noted on drawings.
- E. Concrete Curbs: Specified elsewhere.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. When a concrete base exists, examine for conformity with required elevations and verify that paving can be satisfactorily installed.
- B. Establish and maintain required lines and grade elevations for each course, including crown and cross-slope.
- C. Contractor shall saw cut existing pavement a minimum of 150 mm outside the trench limits on both sides prior to excavation. Contractor shall saw cut to a minimum depth of 150 mm. All damaged pavement shall be re-cut prior to placing new asphalt. All joints shall be heat welded and sand sealed with sharp sand.

3.2 SUBGRADE PREPARATION

- A. General: See Earthwork Specification.
- B. Establishment of Grades: Establish grades, and set grade-stakes, make due allowances for existing improvements, proper drainage, and adjoining property rights. No gradient shall be less than one percent, unless otherwise indicated.
- C. Subgrade for Driveways and Parking: Compaction shall be Standard Proctor (ASTM D-698) to at least 95 percent of maximum density at optimum moisture content. Remove spongy and unsuitable material to depth necessary to achieve density and replace with approved material. Loosen exceptionally hard surfaces, and recompact for uniform bearing power. Maintain subgrades and properly drain until paved.

3.3 INSTALLATION OF PAVING

- A. Aggregate Base Course: After subgrade has been brought to the lines and grades indicated and has been consolidated to the degree specified, a stabilized base course shall be constructed to a minimum thickness of 6 inches, unless otherwise indicated. Compact in two layers with a 10 ton roller, until no crease or wave is shown ahead of roller. Hand operated tampers may be used but only in 4" layers.
- A. Prime Coat: Apply over aggregate base course. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

- B. Tack Coat: Apply to contact surfaces of previously constructed asphalt and surfaces abutting or projecting into hot-mixed asphalt pavement. Allow to dry until at proper condition to receive paving. Exercise care in applying bituminous materials to avoid smearing of adjoining surfaces. Remove and clean damaged surfaces.
- C. Bituminous Concrete Binder: Comply with requirements for surface course, except that minimum thickness shall be 1.5 inches as indicated.
- D. Bituminous Concrete Surface Course: Hot-mixed asphalt surface course.
 - 1. Lifts: Place surface course in one lift.
 - 2. Spreading and Rolling: Spread mixture at minimum temperature of 225 deg F. Surface course shall be uniformly spread with a mechanical spreader. When material is spread in restricted areas or quantity is too small to warrant use of such equipment, it may be placed and spread with shovels and raked with hand lutes. Care should be taken to obtain uniform spread and minimize segregation of mix. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Immediately correct surface irregularities in finish course. All excess coarse aggregate appearing at surface shall be removed.
- E. Joints: Make joints between old and new pavements, or between successive days work, to ensure continuous bond between adjoining work. Where new pavement abuts existing bituminous concrete pavement, sawcut existing surface course along straight lines approximately 12 inches from edge; cuts shall be vertical and extend full depth of surface course. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course. Clean contact surfaces and apply tack coat.
- F. Patching of Pavement: Except as otherwise indicated, the patched pavement area shall be the same kind and thickness as previously existed, and shall match and tie into the surrounding pavement in a neat and acceptable manner. Provide a tack coat on the exposed edges of the cold joints and on the bituminous concrete base when provided, and provide a minimum 2-inch thick bituminous concrete surface course. Place in one lift compacted to 95 percent of maximum density. The finished surface shall be uniform in texture and appearance and free of cracks and creases.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
 2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.
 - a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.
- E. Replace and compact hot-mix asphalt where core tests were taken.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.5 PROTECTION

- A. Protect paving from damage due to construction and vehicular traffic.

3.6 ACCEPTANCE

- A. Surfaces shall be smooth within tolerances specified without pockets, and gently sloped to provide drainage of entire pavement.
- B. Cut out water ponding low spots and add additional surface course until proper drainage is achieved, see REPAIRS.

3.7 REPAIRS

- A. Repair abutments to existing pavement and depressions by cutting out the surfacing to a minimum depth of 25 mm with vertical cuts, filling, and rolling the areas. Feathering of patches and abutments to existing pavement is not permitted.

3.8 SCHEDULE

- A. Minimum Compacted Thicknesses: as shown on Drawings.

3.9 SUBMITTALS

- A. Submittals shall be in accordance with Section 504 of MDSHA Standard Specifications for Construction and Materials.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work includes:
 - 1. Concrete Sidewalk.
 - 2. Concrete curb and combination curb and gutter.
- B. REFERENCES
 - 1. MDSHA Standard Specifications for Construction and Material, Current Edition.

1.2 QUALITY ASSURANCE

- A. Work to conform to the following:
 - 1. American Concrete Institute (ACI).
 - 2. MDSHA Standard Specifications for Construction and Material, Current Edition.
- B. Concrete Supplier: It is the Contractor's responsibility to ensure conformance of supplier. Supplier must be capable for furnishing concrete:
 - 1. In the required quantities of mix conforming to the requirements of this Section.
 - 2. Within the time constraints required by the Contractor for his methods of placement.
 - 3. Within time limits required by this Section which include delivery time.

1.3 SUBMITTALS

- A. Submit a mix design for the type of concrete required.
- B. Product Data: Submit catalog cuts for the following:
 - 1. Reinforcing: Indicate types, sizes, strengths, and alloys where applicable.
 - a. Welded wire fabrics and bars.
 - b. Transfer dowels
 - c. Supports
 - 2. Curing compound.
- C. Delivery Tickets: Furnish duplicate delivery tickets, one each for Contractor and A/E, with each load of concrete delivered to project, including the following information:

1. Date, serial number, batch number.
2. Name of ready-mix concrete plant and supplier.
3. Job location
4. Contractor
5. Type and brand name of cement.
6. Mix number and specified cement content in bags per cubic yard of concrete, with indication of 28-day design strength.
7. Content when flash is used.
8. Truck number
9. Time dispatched
10. Amount of concrete load in cubic yards
11. Admixture in concrete, if any
12. Maximum size of aggregate and type of aggregate
13. Water added at job, if any
14. Slump of concrete ordered

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Materials

1. The materials and admixtures used in Portland cement concrete shall be as MDSHA Standard Specifications for Construction and Material, Current Edition.

B. Joint Materials:

1. Pre-Molded Expansion Joint Filler: Self-expanding cork filler, ASTM D 1752, Type 3. Width equal to slab thickness less depth required for sealant.
2. Joint Cap: Two-piece vinyl device with upper \square "+ removable after curing period; width corresponding to joint filler products by Greenstreak Plastic Products, Vinylex Corp., or Vulcan Metal Products.
3. Field Molded joint Sealant: ASTM D 1850.

C. Curing Materials:

1. Curing Compound: Acrylic rubber, non-yellowing, ASTM C 309, Type 1-D or 1, Class B, except moisture loss not to exceed 0.34 kg/sq. m. in 72 hours and 20% solids content minimum fugitive dye or white pigmented coloring. Conforming products by one of the following.
 - a. Euclid
 - b. L & M
 - c. Kaufman
 - d. Sonneborn

D. Form work:

1. Walks: Steel or solid lumber minimum 50 mm nominal thickness.
2. Vehicular Traffic: Steel conforming to applicable MDOT sections.

2.2 CONCRETE MIXES

- A. Portland cement concrete base: Install per MDSHA Standard Specifications for Construction and Material, Current Edition.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that substrate is free of water and ice and is of the required dimensions, meets compaction requirements, and has been approved by Soils Engineer or A/E prior to placing concrete.
- B. Notify the A/E not less than 24 hours in advance of placing concrete.

3.2 PLACING

- A. Reinforcing: In accordance with ACI 301. Place all reinforcing on supports; center in slab thickness unless shown otherwise.
- B. Place concrete for full thickness in one operation, without change in proportions; screed to proper elevations, finish and cure as specified. Dusting of surfaces with cement is prohibited.
 1. Walks installed shall match adjacent existing condition finish. Match direction of finish, if applicable, to adjacent conditions. If no adjacent walk exists the finish is to be broom finish.
- C. Concrete shall be discharged from the hauling truck within one hour after water and cement have been combined except non-agitating truck limited to 3/4 hour. This time may be reduced by the A/E if hot weather or other conditions cause quick setting to occur.
- D. In no case shall the concrete have a free fall sufficient to cause segregation of the aggregate. In general, the limit free fall shall be 1200 mm.
- E. Weather Conditions: Concrete work to comply with the following requirements as applicable:
 1. Hot Weather Concreting, ACI 305.
 2. Cold Weather Concreting, ACI 306.
- F. Temperature: When air temperature during placement is less than 5 degrees C or may be within 24 hours, temperature of concrete as placed to conform to limits specified below. Maintain concrete temperature within these limits for the full curing period.
 1. Sections less than 300 mm thick: Between 12 and 32 degrees C.

2. Sections 12" thick or greater: Between 10 and 32 degrees C.

3.3 CURING AND PROTECTION

- A. Cure Period: Not less than 7 days at required temperatures.
- B. Cover slabs with curing compound in accordance with MDOT. Material shall form effective seal and prevent evaporation of moisture from concrete for full curing period. Application rate to be as recommended by the manufacturer.
- C. Where hand application methods are used, apply in two separate applications, at right angles to each other, using approximately 60 percent of required application rate for each application.
- D. See TEMPERATURE under PLACING above for thermal requirements to be maintained during cure period.

3.4 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed by a Testing Agency retained by the Contractor.

END OF SECTION 321313

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete pavers set in bituminous setting beds.
 - 2. Brick pavers set in bituminous setting beds.

1.3 ACTION SUBMITTALS

- A. Product Data: For all paver materials.
- B. Samples: For each type of unit indicated and the following:
 - 1. Joint materials involving color selection.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
- B. Shop Drawings: Not required.

1.5 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

- B. Weather Limitations for Bituminous Setting Bed: Install bituminous setting bed only when ambient temperature is above 40 deg F and when base is dry.
- C. Weather Limitations for Mortar and Grout:
 - 1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

- A. Concrete Pavers: Solid paving units complying with ASTM C1491, made from lightweight concrete: Hanover Prest Pavers.
 - 1. Thickness: 2-1/4 inches (pedestrian), 3 inch (vehicular zones).
 - 2. Face Size and Shape: 18 inches by 24 inches (nominal), rectangle with beveled edges, to match existing. 12” by 12” units to be used at vehicular zones.
 - 3. Color: is Matrix # 1385
 - 4. Finish: Tudor
 - 5. High density, hydraulically pressed concrete units of minimum 8,500 psi 28-day compressive strength, absorption less than 4%.

2.2 BRICK PAVERS

- A. Paver Brick: Standard size brick units (2-1/4” x 4” x 8”) complying with **ASTMC216**:
 - 1. Manufacturer & Color: Pine Hall “Pathway Red” or Glen-Gery “Rosecroft” at standard brick edge along street curbs. Use Glen-Gery “Cocoa Brown” beveled edge with two 4”x4” squares at all ADA street curb ramps.
 - 2. Finish: wire-cut..
 - 3. Face Size: 4”x 8”, match existing.
 - 4. Thickness: 2-1/4 inches (pedestrian), 3 inch (vehicular zones).

2.3 ACCESSORIES

- A. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.
- B. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.
- C. Joint Sealant

2.4 BITUMINOUS SETTING-BED MATERIALS

- A. Tack Coat: ASTM D2028/D2028M, cutback asphalt, grade as recommended by unit paver manufacturer.
- B. Fine Aggregate for Setting Bed: ASTM D1073, No. 2 or No. 3.
- C. Asphalt Cement: ASTM D3381/D3381M, Viscosity Grade AC-10 or Grade AC-20.
- D. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.
- E. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate unless otherwise indicated. Heat mixture to 300 deg F.

2.5 MORTAR

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.
- B. Sand for joints: Polymeric sand.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance; proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Verify gradients and elevations of base are correct.
 - 2. Beginning of installation means acceptance of substrate.
 - 3. Contractor to stake out all areas of construction prior to beginning work for

verification by owner and architect.

- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures; existing pavers shall be salvaged, cleaned and reused if possible. Mix new and salvaged pavers randomly throughout installation.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
 - 1. Pavers may be cut in the 24” dimension, but preferably not in the 18” dimension. Layout pavers so as to minimize the use of paver slivers or small pieces.
- D. Joint Pattern: Match and continue existing unit paver joint pattern.
- E. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage).
- F. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated. Install joint filler before setting pavers.
- G. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

3.2 BITUMINOUS SETTING-BED APPLICATIONS

- A. Apply tack coat to concrete slab or binder course immediately before placing setting bed.
- B. Prepare for setting-bed placement by locating control bars approximately 11 feet apart and parallel to one another, to serve as guides for striking board. Adjust bars to subgrades required for accurate setting of paving units to finished grades indicated.
- C. Place bituminous setting bed where indicated, in panels, by spreading bituminous material between control bars. Spread mix at a minimum temperature of 250 deg F. Strike setting bed smooth, firm, even, and not less than 3/4 inch thick. Add fresh bituminous material to low, porous spots after each pass of striking board. After each panel is completed, advance first control bar to next position in readiness for striking adjacent panels. Carefully fill depressions that remain after removing depth-control bars.
 - 1. Roll setting bed with power roller to a minimum depth of 3/4 inch. Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades and slopes indicated. Complete rolling before mix temperature cools to 185 deg F.
- D. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling to a uniform thickness of 1/16 inch. Proceed with setting of paving units only after adhesive is tacky and surface is dry to touch.

- E. Place pavers carefully by hand in straight courses, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. Advance protective panels as work progresses but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers. If additional leveling of paving is required, and before treating joints, roll paving with power roller after sufficient heat has built up in the surface from several days of hot weather.

- F. Joint Treatment: Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

END OF SECTION 321400