APPENDIX C
SUPPLEMENTAL SPECIFICATIONS

PROJECT MANUAL – 8 ½ x 11” - 227 Pages

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STATEMENT OF CLAIM FORM

Claim No. __ for Contractor

1. Name of Contractor: _____

2. Date written claim given:_____.

3. Contractor's representative to contact regarding the claim:

   Name:_____ Title:_____
   Telephone No._____(office) FAX No. _____

   E-mail: _____

4. General description of claim:

_____
_____
_____

5. Contract Documents. If the claim is based upon any part or provision in the Contract Documents, including but not limited to pages in the Drawings and/or paragraphs in the Specifications, Owner-Contractor Agreement, General Conditions or Supplementary General Conditions, state upon which parts or provisions the claim is based:

_____
_____
_____

6. Delay claims:

   6.1 Date delay commenced: _____
   6.2 Duration or expected duration of the delay, if known: _____
   6.3 Apparent cause of the delay and part of critical path affected:

_____
_____
_____

   6.4 Expected impact of the delay and recommendations for minimizing such impact:

_____
_____
_____

7. Additional compensation. Set forth in detail all additional compensation to which the Contractor believes it is entitled with respect to this claim:

_____
_____
_____

8. Instructions for Completing the Statement of Claim Form ("Instructions"). The Instructions are incorporated in this Form.

9. Truth of Claim. By submitting this claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this State of Claim is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

CONTRACTOR: _____

By:_____

Name and Title:_____

Date: _____

CONTRACTOR'S ACKNOWLEDGMENT

State of_____,

County of_____, ss:

_____first being sworn, states that after conscientious and thorough review, the statements made in attached Statement of Claim Form are complete and true to the best of his or her knowledge and belief.

_____

Sworn to before me a notary public by _____on_____, 20__.

_____
Notary Public

WHEN COMPLETED, FORWARD A COPY OF THIS NOTICE AND STATEMENT OF CLAIM FORM TO THE OWNER AND DESIGN PROFESSIONAL.

INSTRUCTIONS FOR COMPLETING THE STATEMENT OF CLAIM FORM

1. Completing the Statement of Claim Form ("Claim Form") is a material term of the Contract. The Claim Form tells the Owner and Design Professional that the Contractor is making a Claim and that they need to act promptly to mitigate the effects of the occurrence giving rise to the Claim. The Claim Form also provides them with information so that they can mitigate such effects. The Contractor acknowledges that constructive knowledge of the conditions giving rise to the Claim through job meetings, correspondence, site observations, etc. is inadequate notice, because knowledge of these conditions does not tell the Owner and Design Professional that the Contractor will be making a Claim and most often is incomplete.

2. If the space provided in the Claim Form is insufficient, the Contractor, as necessary to provide complete and detailed information, must attach pages to the Claim Form with the required information.

3. Paragraph 4. The Contractor must state what it wants, *i.e.*, time and/or compensation, and the reason why it is entitled to time and/or compensation.

4. Paragraph 5. The Contractor must identify the exact provisions of the Contract Documents it is relying on in making its Claim. For example, if the Claim is for a change in the scope of the Contractor's Work, the Contractor must identify the specific provisions of the Specifications, and the Plan sheets and details that provide the basis for the scope change.

5. Paragraph 6. This paragraph applies to delay claims, including delays that the Contractor believes result in constructive acceleration. The Contractor must identify the cause of the delay, party or parties responsible, and what the party did or did not do that caused the delay, *i.e.*, specific work activities. The Contractor acknowledges that general statements are not sufficient, and do not provide the Owner with sufficient information to exercise the remedies available to the Owner or to mitigate the effects of the delay.

   For example, if the Contractor claims a slow response time on submittals caused a delay, the Contractor must identify the specific submittals, all relevant dates, and then show on the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Also for example, if the Contractor claims it was delayed by another Contractor, the Contractor must identify the delaying Contractor, specifically what the delaying Contractor did or did not do that caused the delay, and then show the applicable schedule, by circling or highlighting, the activities immediately affected by the delays. Further by example, if the Contractor seeks an extension of time for unusually severe weather, the Contractor must submit comparative weather data along with a record of the actual weather at the job site and job site conditions.

6. Paragraph 6.4. Time is of the essence under the Contract Documents. If there is a delay, it is important to know what can be done to minimize the impact of the delay. It therefore is important that the Contractor provide specific recommendations on how to do so.

7. Paragraph 7. The Contractor must provide a specific and detailed breakdown of the additional compensation it seeks to recover. For future compensation, the Contractor shall provide its best estimate of such compensation.

8. Paragraph 8 and Acknowledgment. By submitting this Claim, the Contractor and its representative certify that after conscientious and thorough review and to the best of his or her knowledge and belief a) the Contractor has complied fully with the Instructions, b) the information in this Claim Form is accurate, c) the Contractor is entitled to recover the compensation in paragraph 7, and d) the Contractor has not knowingly presented a false or fraudulent claim. The Contractor by its authorized representative must acknowledge this Statement of Claim before a notary public.

End of Instructions

CONTRACTOR'S WAIVER & RELEASE AGREEMENT
("AGREEMENT")

Project:

The undersigned hereby acknowledges receipt of payment from the Owner for all Work on the Project through the date of its prior Application for Payment. The undersigned acknowledges and agrees that the terms in this Agreement shall have the same meaning as in the Contract Documents for the Project.

In return for said payment, and/or pursuant to certain contractual obligations of the undersigned, the undersigned hereby waives and releases any rights it has or may have through the date of its last Application for Payment to any and all Claims and liens related to the Project, including without limitation: Claims of payment, mechanic's liens, liens against funds, surety bond Claims, and Claims for breach of contract or unjust enrichment. The sole exception to this waiver and release is for any Claims the undersigned has made by properly and timely submitting a Statement of Claim form. The undersigned acknowledges and agrees that this wavier and release is intended to be a comprehensive release of all Claims and liens related to the Project, including without limitation all Claims against the Owner, the Design Professional, any Construction Manager, and the employees, board members, agents and representatives of any of the foregoing persons. The undersigned further certifies that this Agreement covers Claims and liens by all persons with which it did business related to the Project, including without limitation subcontractors and suppliers, through the date of its last Application for Payment. The undersigned represents that all such persons have signed an agreement in the form of this Agreement releasing any and all Claims and liens related to the Project, except for any Claims made by properly and timely submitting a Statement of Claim form, a copy of which has been delivered to the Design Professional and the Owner. The undersigned hereby represents and warrants that it has paid any and all welfare, pension, vacation or other contributions required to be paid on account of the employment by the undersigned of any laborers on the Project.

This Agreement is for the benefit of, and may be relied upon by the Owner, Design Professional and any Construction Manager. The undersigned hereby agrees to indemnify, defend and hold harmless each of the foregoing, the Project, work or improvement, and real property from any and all Claims, or liens that are or should have been released in accordance with this Agreement.

_____
Company Name

_____
Authorized Signature (Company Officer)

_____
Title

_____
Date

State of:_____ County of _____

Subscribed and sworn to before me this _____

day of _____

Notary Public: _____

My Commission Expires: _____

SECTION 011000 – 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 THE CONTRACT DOCUMENTS

A. Project Identification: Project consists of the **Grener Sports Complex-Miracle Field.**

1. Owner: **City of Hilliard; 3800 Municipal Way, Hilliard, OH 43026**

B. Architect Identification: The Contract Documents, dated **March 2018**, were prepared for the Project by The Kleingers Group, 6305 Centre Park Drive, West Chester, OH 45069.

1.3 CONTRACT – Grener Sports Complex-Miracle Field

A. The project will be constructed under a Contract to include all related work. A condensed general summary of the scope of work is as follows:

1. Base Bid - Provide all work per the contract documents including but not limited to:
1. Site clearing and demolition. All earthwork and compaction.
2. Installing an asphalt driveway, parking lot and drop-off area.
3. Installing an asphalt walking path.
4. Installing a Miracle League Field, including the surface, fencing, dugouts, base, bleachers and flag pole.
5. Installing a sanitary sewer.
6. Installing a private and public water line.
7. Installing storm sewer.
8. Installing conduit and electric and technology for site and sport lighting and scoreboard.
9. Installing landscaping, plants and seeding per plans.
10. Installing all erosion and sediment control measures per plans.
11. Construct Bid Alternate 1, if chosen by Owner for the listed cost of work.
12. Construct Bid Alternate 2, if chosen by Owner for the listed cost of work.

1.4 SPECIFICATION FORMATS AND CONVENTIONS

A. Specification Format: The Specifications are organized into Divisions and Sections using the 50-division format and CSI/CSC's "MasterFormat" numbering system.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.

    a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION 011000

SECTION 011400 – WORK RESTRICTIONS

1.1 GENERAL

A. Use of Premises: Limit use of premises to work in the areas indicated. Do not disturb portions of site beyond areas in which the Work is indicated.

1. Limits: Confine constructions operations to areas of new work only.

2. Owner Occupancy: Allow for Owner occupancy of site and use by the public.

B. Full Owner Occupancy: Owner and public will occupy site and existing Bo Jackson Facility during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Facility's operations.

1.2 PRODUCTS (Not Used)

1.3 EXECUTION (Not Used)

END OF SECTION 011400

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1:
1. BASE BID: EverTop for Miracle League Fields
2. BID ALTERNATE: PebbleFlex 2.0 Surfacing

B. Alternate No. 2:
1. BASE BID: EverTop for Miracle League Fields
2. BID ALTERNATE: CX140 Miracle League Turf

END OF SECTION 012300

SECTION 013100 – PROJECT MANAGEMENT AND COORDINATION

1.1 GENERAL

A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

    a. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

C. Conservation: Coordinate construction activities to ensure 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 into, the Work.

D. Project Meetings, General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.

E. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Owner, Architect; Contractor

2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Tentative construction schedule.
    b. Phasing.
    c. Procedures for processing field decisions and Change Orders.
    d. Procedures for processing Applications for Payment.
    e. Distribution of the Contract Documents.
    f. Submittal procedures.
    g. Use of the premises.
    h. Security.
    i. Progress cleaning.
    j. Working hours.

F. Progress Meetings: Conduct progress meetings as requested by the Owner, at an interval no often than every other week, or as agreed upon by the Contractor, Architect, and Owner. Coordinate dates of meetings with preparation of payment requests.

1. Attendees: Owner, Architect, and the Contractor. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Progress cleaning.
        4) Change Orders.
        5) Documentation of information for payment requests.

3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.2 PRODUCTS (Not Used)

1.3 EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 – CONSTRUCTION PROGRESS DOCUMENTATION

1.1 GENERAL

A. Submittals: Submit the following:

1. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.
2. Daily Construction Reports: Submit two copies at weekly intervals.
3. Field Condition Reports: Submit two copies at time of discovery of differing conditions.

B. Coordination: Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity with other activities and schedule them in proper sequence.

1.2 PRODUCTS

A. Daily Construction Reports: Prepare a daily construction report recording events at Project site, including list of subcontractors; high and low temperatures and general weather conditions; accidents; stoppages, delays, shortages, and losses; meter readings; orders and requests of authorities having jurisdiction; and equipment or system tests and startups.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

1.3 EXECUTION

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.
4. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
    a. Post copies in Project meeting rooms and temporary field offices.
    b. When revisions are made, distribute updated schedules to the same parties and post in the same locations.

END OF SECTION 013200

SECTION 014000 - QUALITY REQUIREMENTS

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 assurance and quality control.

C. Related Sections include the following:

2. Division 1 Section "Construction Progress Documentation" for developing a schedule of required tests and inspections.
3. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

1.4 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

1.5 SUBMITTALS

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

D. Permits, Licenses, and Certificates: For Owner'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 for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing products 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.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

G. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1. Contractor responsibilities include the following:

a. Provide test specimens and assemblies representative of proposed materials and construction. Provide sizes and configurations of assemblies to adequately demonstrate capability of product to comply with performance requirements.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Fabricate and install test assemblies using installers who will perform the same tasks for Project.
d. When testing is complete, remove assemblies; do not reuse materials on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.

2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 016000 – PRODUCT REQUIREMENTS

1.1 GENERAL

A. Definitions: As follows:

1. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

    a. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
    b. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
    c. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

2. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
3. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
4. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
5. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor acceptance or rejection of proposed substitution within 5 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Acceptance: Change Order.
b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

D. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

E. Product Delivery, Storage, and Handling: Use means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage.

F. Product Warranties: Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. **Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.**

1. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

a. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
b. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
c. Refer to Divisions 2 through 12 Sections for specific content requirements and particular requirements for submitting special warranties.

2. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

1.2 PRODUCTS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures: Procedures for product selection include the following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.

a. Substitutions may be considered, unless otherwise indicated.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.

a. Substitutions may be considered, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

a. Substitutions may be considered, unless otherwise indicated.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

a. Substitutions may be considered, unless otherwise indicated.

5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with

provisions in "Comparable Products" Paragraph to obtain approval for use of an unnamed product.

6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Paragraph to obtain approval for use of an unnamed product.
7. Product Options: Where Specification paragraphs titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide either the specific product or system indicated or a comparable product or system by another manufacturer. Comply with provisions in "Product Substitutions" Paragraph.
8. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Paragraph to obtain approval for use of an unnamed product.

    a. Substitutions may be considered, unless otherwise indicated.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

    a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with provisions of the Contract Documents on "substitutions" for selection of a matching product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

C. Product Substitutions: Architect will consider requests for substitution if received within 15 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

    a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services.
    b. Requested substitution does not require extensive revisions to the Contract Documents.
    c. Requested substitution is consistent with the Contract Documents and will produce indicated results.

d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's Construction Schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.

D. Comparable Products: Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

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 those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, 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 architects and owners, if requested.
5. Samples, if requested.

1.3 EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017000 – EXECUTION REQUIREMENTS

1.1 GENERAL (Not Used)

1.2 PRODUCTS (Not Used)

1.3 EXECUTION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates.

2. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

C. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

D. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

F. Installation: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
3. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

    a. Allow for building movement, including thermal expansion and contraction.

4. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
5. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

G. Progress Cleaning: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
4. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
5. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended.
6. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
7. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. Protection of Installed Construction: Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

I. Correction of the Work: Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

END OF SECTION 017000

SECTION 017310 – CUTTING AND PATCHING

1.1 GENERAL

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include a description of cutting and patching and changes to existing construction, a list of products to be used and firms or entities that will perform the Work, dates when cutting and patching will be performed, and a list of utilities that cutting and patching procedures will disturb or affect.

1. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
2. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

B. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

C. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.

E. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

1.2 PRODUCTS

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

1.3 EXECUTION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

E. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize interruption of services to occupied areas.

F. Performance: Employ skilled workers 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, and subsequently patch as required to restore surfaces to their original condition.

G. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and 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. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
5. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: 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. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

END OF SECTION 017310

SECTION 017700 – CLOSEOUT PROCEDURES

1.1 GENERAL

A. Substantial Completion: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities.
5. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
8. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Substantial Completion Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

C. Final Completion: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner's personnel in maintenance of products and systems.

D. Final Completion Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

E. List of Incomplete Items (Punch List): Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

F. Project Record Documents: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

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

1. Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
2. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
3. Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize into manageable sets; bind each set with durable paper cover sheets. Include identification on cover sheets.

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

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

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

1. Maintenance Data: Include manufacturer's information, list of spare parts, maintenance procedures, maintenance and service schedules for preventive and routine maintenance, and copies of warranties and bonds.
2. Organize maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "MAINTENANCE MANUAL," Project name, and subject matter of contents.

J. Warranties: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

1. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
2. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

1.2 PRODUCTS (Not Used)

1.3 EXECUTION

A. Demonstration and Training: Instruct Owner's personnel to maintain systems.

1. Provide instructors experienced in operation and maintenance procedures.
2. Schedule training with Owner, through Architect, with at least seven days' advance notice.

B. Final Cleaning: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

1. Cleaning: Employ experienced workers for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
2. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
    b. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.
    c. Remove construction equipment and surplus material from Project site.
    d. Clean exposed exterior hard-surfaced finishes to a dirt-free condition, free of stains.
    e. Remove debris and surface dust from limited access spaces.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 107500 - FLAGPOLES

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 ground-mounted flagpoles made from aluminum.

B. Owner-Furnished Material: Flag[**s**].

C. Related Sections:

1. Division 07 Sections for base flashing at roof-mounted flagpoles.
2. Division 26 Section "Exterior Lighting" for site lighting fixtures.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:
1. Wind Loads: For project location, minimum 90 mph.
2. Base flagpole design on flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.

1. Include section, and details of foundation system for ground-mounted flagpoles.

C. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. American Flagpole; a Kearney-National Inc. company.
2. Atlantic Fiberglass Products, Inc.
3. Baartol Company.
4. Concord Industries, Inc.
5. Eder Flag Manufacturing Company, Inc.
6. Ewing Flagpoles.
7. Lingo Inc.; Acme Flagpole Company Division.
8. Millerbernd Manufacturing Company.
9. Morgan-Francis; Division of Original Tractor Cab Co., Inc.
10. PLP Composite Technologies, Inc.
11. Pole-Tech Company Inc.
12. U.S. Flag & Flagpole Supply, LP.
13. USS Manufacturing Inc.

2.2 FLAGPOLES

A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
3. Provide self-aligning, snug-fitting joints.

B. Exposed Height: 25 feet (7.5 m).

C. Aluminum Flagpoles: Provide cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than 0.064-inch- (1.6-mm-) nominal wall thickness. Provide with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.

1. Provide flashing collar of same material and finish as flagpole.

2.3 FITTINGS

A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.

B. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch- (8-mm-) diameter, braided polypropylene halyard and 9-inch (228-mm) cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Provide two halyards and two cleats at each flagpole.
2. Halyard Flag Snaps: Provide two chromium-plated bronze swivel snap hooks per halyard.

a. Provide with neoprene or vinyl covers.

2.4 MISCELLANEOUS MATERIALS

A. Concrete: Comply with requirements of Division 3 Section “Cast-in-place Concrete”.

B. Sand: ASTM C 33, fine aggregate.

C. Elastomeric Joint Sealant: Complying with requirements in Division 07 Section "Joint Sealants".

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Place concrete, as specified in Division 03 Section "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Ground Set: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure. Install flagpole, plumb, in foundation tube.

1. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107500

SECTION 116500 – ATHLETIC & RECREATIONAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following baseball equipment:

1. Single-Tier Dugout Team Bench
2. Cantilever Baseball Dugout
3. Bleachers
4. Scoreboard
5. Top Rail Fence Cover
6. Foul Poles
7. Productive Pads

B. Related Sections include the following:

1. Division 32 Section “Chain Link Fences and Gates” and “Decorative Metal Fences and Gates” for fences at sport fields.
2. Division 32 Section “Concrete Paving” for concrete pads and walks associated with sport fields.

1.3 DEFINITIONS

A. NFHS: The National Federation of State High School Associations.

1.4 SUBMITTALS

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

1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.

B. Structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation including loads, footing and foundation design for football goal posts.

C. Coordination Drawings: Layout plans, drawn to scale, and coordinating locations of all field equipment and space requirements.

D. Samples for Initial Selection: For each type of equipment offering a color selection.

E. Samples for Verification:

1. Actual material sample of material in color(s) selected. Provide sample that is approximately 8-inches square or (for extrusions and linear items) 12-inches long.

F. Product Certificates: For each type of gymnasium equipment, signed by product manufacturer.

G. Qualification Data: For installer.

H. Operation and Maintenance Data: For gymnasium equipment to include in operation and maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of gymnasium equipment through one source from a single manufacturer.

B. Conform to the latest rules and regulations of the NFHS.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify position and elevation of equipment. Coordinate fully with finish grading elevations and finish paving elevations.

B. Install only when other site work is completed to a point that ensures no displacement of installed athletic field equipment.

C. Install equipment only when weather conditions and soil conditions are in a range acceptable to the equipment manufacturer.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of field sport equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extruded Bars, Profiles, and Tubes: ASTM B 221.
2. Cast Aluminum: ASTM B 179.
3. Flat Sheet: ASTM B 209.

B. Steel: Comply with the following:

1. Steel Plates, Shapes, and Bars: ASTM A 36.
2. Steel Tubing: ASTM A 500 or ASTM A 513, cold formed.
3. Steel Sheet: ASTM A 1011.
4. Stainless Steel Sheet, Strip, Plate, and Flat Bar: ASTM A 666.
5. Stainless Steel Bars and Shapes: ASTM A 276

C. Anchors, Fasteners, Fittings and Hardware: Manufacturer's standard corrosion-resistant or noncorrodible units; concealed.

D. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 with minimum strength recommended in writing by equipment manufacturer.

2.2 SPORTS EQUIPMENT

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated as the basis of design or the most comparable product by one of the other named manufacturers. If product number given for the “other named” manufacturers is not the closest possible to the basis of design, advise Architect and submit the product that IS most close to the basis of design.

B. Single-tier team bench:

1. 2 total aluminum benches (1 in each dugout)
2. 20’ long by 18” high seat with backrest
3. Color: per owner’s preference for seat and frame
4. Portable
5. Products:
    1. Basis of Design: Sportsfield Specialties Polyboard Seating & Backrest
    2. UCS # 525-1215
    3. Aluminum Athletic Equipment Co.

C. Cantilever Baseball Dugout
1. Overall Dimensions: 10’-0” Wide x 30’-0” Long
2. Maximum Wind Speed Load: 90 mph
3. Maximum Ground Snow Load: 50 psf
4. Roof Pitch: 3:12
5. Powder Coated Primer and Finish
    1. Color:
6. Roofing Material:
    1. 29 Gauge, Corrugated Metal with J-Channel Drip Cap Installed on Front and Sides
7. Concrete Slab:
    1. Approximately 6” Beyond the Outside of the Perimeter Edge of the Modular Dugout on All Four Sides
    2. 3000 psi Normal Weight Concrete Slab with a Thickness of Approximately 6” with 18” Wide Thickness Edge on All Four Sides
    3. Concrete Slab and/or Concrete Footings to be Verified, Reinforced and/or Poured as Determined by a Licensed Engineer of Record in the State of Project Location Based on Local Building Codes and Soil Conditions
8. Products:
        1) Basis of Design: Sportsfield Specialties Cantilever Modular Baseball/Softball Dugout (LG-CD-08X16-90-OFFSET08)
        2) Peal Steel Buildings

D. Bleachers
1. Capacity: Minimum 50 seats each (18 total)
    1. Minimum 4 Wheelchair Spaces
        1) Must comply with the 2010 ADA Standards for Accessible Design
        2) Wheelchair spaces are not be located on a temporary platform or mother movable structure.
2. All Aluminum System
3. Rise shall be 8 inches.
4. Depth per row shall be 24 inches.
5. Full Depth Footboard Plank for full closure. Angle iron closure is unacceptable.
6. Walkway elevation shall be 40 inches.
7. Walkway width shall be 60 inches.
8. Powder coated risers per owner's preference.
9. Powder coated skirting in front of bleacher aisle, platform and stairs.
10. Handrail will be inset from guardrail 1½" to 3".
11. Guardrails:
    1. Vertical Picket. No chainlink mesh
    2. Galvanized steel frame
12. Hardware:
    1. Bolts used for field installation shall be galvanized.
    2. Primary connections, i.e. seat, cross-brace, handrail (rail and posts) shall be made with minimum of 3/8" diameter hardware.
    3. End Caps - All end caps (seatboard, footboard, and handrail) shall be cast aluminum. All end caps will be friction fit.
13. Products:
    1. NRS 24' 5 Row ADA Bleacher
    2. Alum-A-Stand

E. Scoreboard (Alternate)
1. 4' x 8' Video display board with an all-in-one controller
2. "The Miracle League" logo in 6", 8" and 16" letters
3. 2' x 8' sponsor ad panel
4. Products:
    1. All American Scoreboards-Triple Play (Basis of Design)

F. Top Rail Fence Cover:
1. Chain link top rail fence cover to be installed on all fence rails adjacent to warning track.
    1. Include a 3" W x 4 ½" H x 8' L UV resistant polyethylene cover with a minimum .09" thick wall.
    2. 8" L fasteners to be installed in drilled holes every 24" o.c.
    3. Color: Yellow
    4. 4" diameter corrugated covers are prohibited

G. Foul Pole:

1. 20' above ground at Baseball Quad
2. 30' above ground at Championship Fields
3. 6" diameter aluminum tube.
4. Color: Yellow
5. 1-1/2" aluminum lockcrimp mesh
6. Powder-coated finish.
7. 2 Total
8. Products:

    1. Basis of Design: AAE #AFP-Y (12 foul poles)
    2. Aluminum Athletic Equipment Co.

3. UCS

H. Protective Pads
1. Top Fence Rail Protective Pad: Padding kit shall provide a protective pad for 20'-0" of the top rail of chain-link fencing.
1. Include 3-1/2 inch o.d. x 2 inch o.d. closed cell, weather-resistant, polyethylene shock absorbing type foam, and a red, heat-sealed, polyester reinforced cover with grommets spaced on 6 inch centers, and durable nylon, self-locking type wire ties. Foam section shall be slit longitudinally for installing over top fence rail.

2.3 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for position, elevation and alignment of mounting substrates, installation tolerances, operational clearances and other conditions affecting performance.

1. Verify critical dimensions.
2. Examine supporting structure and subgrades, and footings.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

2.4 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions and competition rules applicable to each type of equipment. Complete equipment field assembly, where required.

B. Unless otherwise indicated, install gymnasium equipment after interfacing final grades and paving have been completed.

C. Permanently Placed Equipment and Components: Rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated on Shop Drawings; in proper relation to adjacent construction; and aligned with filed sport layout.

D. Insert Setting: Position sleeve in oversized, recessed voids in concrete and footings. Clean voids of debris. Fill void around sleeves with grout, mixed and placed to comply with grout manufacturer's written instructions.

E. Anchoring to In-Place Construction: Use anchors and fasteners where necessary for securing built-in and permanently placed gymnasium equipment to structural support and for properly transferring load to in-place construction.

2.5 INSTALLATION

A. Install protective pads in strict accordance with manufacturer's recommendations and as located on the plans.

2.6 ADJUSTING

A. Adjust components to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

2.7 CLEANING

A. After completing equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Replace equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

2.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

END OF SECTION 116500

SECTION 260100 - OPERATION AND MAINTENANCE OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Closeout

1. Operation and Maintenance Manual: For equipment and systems to include in operation and maintenance manuals.

B. Shop Drawings

1. As-Built Drawings: For recording installed conditions that deviate from design documents.

1.2 OPERATION AND MAINTENANCE MANUAL

A. The contents of operating and maintenance manual shall include the following:

1. Project Information Cover: Title of Project; Name and address of Owner, Design Professionals, Contractor of Record and Subcontractor; System name and specification references.
2. Index: Contents of the manual.
3. Warranty Statements: Furnish a warranty statement for each system, reiterating the terms of warranty identified within the Contract Documents, and identifying how the Owner is to obtain warranty service. Clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 1-year parts and labor). Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion. Supply standard out-of-warranty service rates and service contact information.
4. Bill of Materials: List of products supplied, and serial numbers of each product.
5. Product Datasheets and Shop Drawings: Manufacturer datasheets and shop drawings for each product and system supplied.
6. Manufacturer Owner / User Manuals: Manufacturer’s Owner’s or User’s manual for each product, and Manufacturer’s Installation instructions and other documentation supplied with the product.
7. Extra Material Schedule:

    a. Complete spare parts schedule for components of equipment furnished, which are not factory generic information, but accurate for the equipment provided.
    b. Itemized list of each piece of electrical, architectural and Owner equipment having electrical connections with circuit and panelboard locations; also, list related expendable equipment required for each item, such as fuse size and type, pilot lights, catalog numbers of fuses, overloads, etc. as applicable.
    c. Itemized list of each luminaire type with catalog number of replacement lamps, ballasts, boards, drivers, trims, lenses, accessories, etc.

8. Maintenance Procedures: Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; testing, aligning and adjusting instructions.
9. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
10. Function and Operating Descriptions: Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
11. Operating Procedures: Manufacturer's printed operating procedures including start-up, break-in, normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.
12. Include Product Certificates, Source quality-control test reports and Field Quality-Control Reports
13. Test Reports and Checklists: Test reports, checklists, and other forms generated and completed for the Project.
14. Training Information: Copy of training outlines/agendas, training session handouts, training sign-in sheets, and signed delivery receipt for each training session recording; Separate USB drive, labeled, for audio/video-recorded instructions to Owner, for operations and maintenance for each system.
15. As-Built Drawings.
16. Software: Application and operating software documentation; Software licenses; Software service agreements; Manufacturer’s operating specifications; design user’s guide for software and hardware; Editable configuration files for system equipment; Software source code used in supplied products; Compiled versions of configuration files and source code; IP addresses of products configured to have static IP addresses; MAC addresses of products featuring network communication ports (wired and/or wireless); Network device names for products configured for DHCP; Software required for reviewing and editing supplied files.

1.3 AS-BUILT DRAWINGS

A. Obtain two complete sets of electrical prints and use them to provide progress record drawings which are separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed (including routing of conduit and cables). These drawings also serve as work progress report sheets. Make notations, neat and legible thereon daily as work proceeds. Make these drawings available for inspection at all times and keep them at the job at a location designated by the Owner's Representative.

B. Maintain the clean, undamaged set of prints of drawings as well as a set of submittal drawings and coordination drawings. Mark the sets to show the actual installation where the installation varies from the Documents as originally shown. Include locations of underground and concealed items if placed other than shown on the Documents. Where shop drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

C. Show changes in: size, type, capacity, etc., of material, device or piece of equipment, location of device or piece of equipment; location of outlet or source of building service systems; routing of piping, conduit, or other building services. Record location of concealed equipment, electrical service work, conduits and other piping/work by indication of measured dimensions to each line from readily identifiable and accessible walls, column lines or corners of building. Indicate approved substitutions, modifications, and actual equipment and materials installed.

D. Affix near the titleblock on each drawing the Contractor's Company Name(s), signature of Contractor's Representative(s) and current date.

E. For electrical work installed below slabs, pavements, grade, etc., record location of nearby concealed water piping, sewers, wastes, vents, ducts, conduit and other piping, etc. by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building and from adjacent electrical work. Show invert elevation of underground electrical work relative to work installed by other trades.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 INSTRUCTION OF THE OWNER'S PERSONNEL

A. Provide instruction in the proper operation and maintenance of equipment that requires routine servicing. Include the following:

1. Review of operation and maintenance manuals.
2. Required tools.
3. Lubricants.
4. Extra Materials.
5. Cleaning.
6. Hazards.
7. Warranties and maintenance agreements.

B. Demonstrate equipment and systems operation including the following:

1. Start-up.
2. Shut-down.
3. Emergency conditions.
4. Safety procedures.
5. Setpoint and schedule adjustments.
6. Economy and efficiency adjustments.

END OF SECTION 260100

SECTION 260501 - COMMON WORK RESULTS FOR ELECTRIC

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 all sections.

1.2 GENERAL DIRECTION

A. Submittal of a bid indicates that the contractor has examined the drawings, specifications, and had an opportunity to visit the site to be able to provide a comprehensive complete bid.

B. The intent of these specifications and the accompanying drawings is to provide complete and workable systems as shown, specified and required by applicable codes. Interpret these specifications in conjunction with the drawings and provide all work described. If work is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both. Should there be a conflict between the specifications and drawings, provide the greater quantity or better quality. Immediately notify owner's representative and design professional of such conflicts.

C. The drawings that accompany these specifications are diagrammatic and although size and location of equipment is drawn to scale wherever possible make use of submittal data and verify all dimensions on site. They do not show every conduit, offset or pull / junction box which may be required to install work in the space provided and avoid conflicts. The drawings are an outline to indicate the approximate location and arrangement of work. Follow the drawings as closely as is practical and install additional pull / junction boxes and offsets where required by site conditions and codes at no additional cost. Install all new work in such manner as to conform to the structure, avoid obstructions, provide required service clearances and preserve headroom. Do not scale from drawings, all measurements should be taken in the field.

D. Coordinate all new work with all other contractors and installers in addition to existing building obstructions and install accordingly. Refer to coordination drawings of other trades. Comply with requirements of architectural drawings including but not limited to mounting height and locations.

E. Provide all labor and material, tools and equipment necessary to render all systems complete and operational, and ready for turnover to Owner. Work defined within this section applies for all Division 26 work, including work of Division 26 that is provided in support of work of other divisions. Unless specifically indicated otherwise in documents of other construction divisions, products to be installed shall also be furnished under Division 26.

F. Fully research peculiarities and limitations of space available for installation of work with materials being provided. Work around material lead times to not extend project schedule.

G. Branch circuiting shown on drawings is also diagrammatic not intended to be the installation location. For instance, circuiting shown on the exterior of the building connecting building

mounted items shall be installed indoors concealed wherever possible. For circuits remote from the building, provide the work below grade unless otherwise indicated.

H. Complete work, or part(s) thereof, at times as may be designated by the Owner's Representative, so that it can be used for temporary or permanent use. Do not construe such use of the system as an acceptance of it by Owner.

I. During mobilization or construction, if an abnormal condition is uncovered either with existing conditions, equipment loads, submittal data, etc. bring these to the attention of the Design Professional for review.

J. Owner's Representative or Design Professional may relocate fixtures, devices, equipment, etc. prior to installation within a 20-foot limit at no additional charge.

1.3 GENERAL STANDARDS

A. Provide work in compliance with applicable provisions of the following standards. Provide listing and labeling for all electrical materials, marked for respective intended uses, from UL or other Nationally Recognized Testing Laboratory (NRTL) that is acceptable to applicable Authorities Having Jurisdiction (AHJs).

B. Provide materials, installation methods, workmanship, testing, etc., in strict accordance with the latest adopted edition of applicable standards and adopted codes, including (but not limited to) the following.

1. International Building Code
2. State Building Code and applicable amendments
3. State Energy Code
4. Utility company requirements and standards as applicable
5. All provisions and requirements of NFPA (National Fire Protection Association)
6. National Electrical Code (NEC), NFPA 70
7. Life Safety Code, NFPA 101
8. Local governmental and other prevailing codes and ordinances
9. ADA/ADAAG requirements (American with Disabilities Act) including all applicable Standards for Accessible Design.
10. UL (Underwriters Laboratories Inc.)
11. ETL (Intertek Testing Services NA, Inc.)
12. CSA (CSA Group Testing and Certification Inc.)
13. FM (Factory Mutual Insurance Company)
14. ASME (American Society of Mechanical Engineers)
15. NEMA (National Electrical Manufacturers Association.
16. NECA (National Electrical Contractors Association)
17. IP (International Protection Rating / Ingress Protection Rating)

1.4 PERMITS AND REGULATIONS

A. Obtain and pay for permits, fees, certificates of inspection and approval, etc. required for this branch of the work. Furnish Owner with certificates of final inspection and approval prior to final acceptance of this branch of the work.

B. Laws and regulations which bear upon or affect the various branches of this work shall be complied with by this contractor and are hereby made a part of this contract.

1.5 DEFINITIONS

A. Furnish - Procure, supply and deliver to project site, ready for installation, install and warrant (unless indicated otherwise on documents). Include warranty expenses.

B. Install - Assemble, wire and connect loose-shipped components on site. Place in position for service or use, including material, labor, accessories, services, and testing. Wire, connect, and render fully operational for intended use.

C. Provide - Furnish and Install. Similar Terms: "include", "shall", "equip with", "consisting of"

D. Equal or Equivalent - Determination of equivalency to be made by design professional for all products not listed as basis-of-design.

E. Substantial Completion - Where frontend documentation does not define, products and systems must be fully installed as designed, tested, adjusted, labeled, and functionally demonstrated to owner.

F. NRTL: Nationally Recognized Testing Laboratory

G. OCPD: Overcurrent protective device.

H. SCCR: Short-circuit current rating.

1.6 REQUESTS FOR INFORMATION

A. Submit all questions, requests for information (RFIs) and similar queries through the formally-established RFI process for the project that has been accepted by the Owner's Representative, Design Professionals, Prime Contractor and subcontractors. Submit as a PDF file. Do not submit as text in an email.

1.7 AVAILABILITY OF ELECTRONIC DRAWINGS

A. If expressly permitted by the Owner and the terms of the Contract, editable electronic drawings may be made available for the creation of shop and as-built drawings upon request. Drawings will be made available at the discretion of the Engineer.

B. "Request Drawings" form can be accessed, filled out and submitted at http://www.klhengrs.com (right hand side of page - Contractor Resources). Direct access to this form can be found here: http://files.klhengrs.com/requestdrawings.html

1.8 QUALITY ASSURANCE

A. Contractor shall have a minimum five (5) years experience in the installation of systems similar to the systems specified. Contractor if requested shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor's inability to perform.

B. Contactor and all workers trained in electrical safety as required by NFPA 70E.

1.9 WARRANTY / GUARANTEE

A. Provide a warranty/guarantee in written form as part of O&M manual stating that all work, materials, equipment and parts are warranted to be free of defect for a minimum period of one year from the date of Substantial Completion. Warranty period and requirements may be expanded in drawings or subsequent specification sections. Repair or replace (owner's option) any defects or failures at no cost to the owner within the warranty period. Issues arising within warranty period must be attended to in a timely manner and in no case exceed four (4) working days. State this in writing as part of O&M manual. Replace defective items to the satisfaction of the Owner's Representative and the Design Professional.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Provide materials that are new, full weight, of the best quality. Provide similar materials that are of the same type and manufacturer. Provide materials, apparatus and equipment with NRTL listing and label where regularly supplied. Provide only products that are intended for, rated for and suitable for the installed condition.

B. Provide basis of design products or listed products equivalent in quality, performance, aesthetics, and product support (factory and local) to that specified as basis of design. Products not basis of design are subject to review by the Design Professional and possible rejection. Listing of a product manufacturer by name alone as an equivalent manufacturer shall not equate all products offered by that manufacturer to the basis of design.

C. Bear all costs incurred from deviation from basis-of-design materials, methods, labor, services, etc. Use of materials, methods, labor, services, etc. that deviate from the basis-of-design will be considered a statement that capacities, requirements, clearances, arrangements, performance, etc. have been checked, verified, found satisfactory, and align with intent of specified work and applicable codes and regulations.

D. Should deviation from basis of design equipment impact other contractors scope of work it shall be the responsibility of this contractor to coordinate with and cover these costs in addition to their own.

PART 3 - EXECUTION

3.1 GENERAL DIRECTION

A. Unless specifically indicated, provide all specified and drawn work as required to render all equipment and systems fully operational, including all ancillary, accessory, and support work.

B. Install equipment and materials in strict accordance with manufacturer's written instructions. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values.

C. In cases where products / materials are furnished by Owner or others, provide the following services: receive, transport and securely store materials on site; remove materials and components from packaging; assemble all materials and components per factory instructions; install, wire and connect materials and components as recommended by manufacturer for a fully operational installation.

D. Wire and connect electrical equipment furnished under this branch of work, other branches of work and by the Owner. Review documents of other trades to identify electrically operated/controlled equipment that is furnished or installed by the Owner, or by other trades. Provide power connections and local disconnects for same. Provide control wiring (including relays, starters, programming, etc.), as required to render equipment fully operable.

E. Except where otherwise indicated, provide fully-rated or series-rated overcurrent protection (OCP). Provide equipment and OCP rated to meet or exceed the calculated available series-rated fault current at the respective node in the power distribution system. Series-rated breakers/systems are not permitted where prohibited by prevailing codes and standards, including applications involving motor contribution as addressed in Article 240.86(C) of NFPA 70.

F. Remove and replace items that may impede new work installation including but not limited to fencing, doors, gypsum, lift-out panels, and structures to provide pathway for moving equipment into place.

G. Examine surfaces to receive products for suitable mounting conditions and verify compliance with installation tolerances and other conditions affecting performance of the work. Proceed with installation only after unsatisfactory conditions have been corrected.

H. Drawings indicate dimensions for typical equipment configurations including clearances between equipment and adjacent surfaces and other items. Ensure selected products and equals comply with layout provided and required clearances.

3.2 SUPERVISION AND WORKMANSHIP

A. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent and qualified to do all the work required.

B. Furnish the services of an experienced superintendent to be in constant charge of the work at all times.

C. Provisions shall be made for owner's representative or design professional to make rough-in and open ceiling inspections prior to covering up work.

3.3 CHANGE OF WORK

A. In the event of revised scope or work formally issued through Change of Work order, contractor shall provide an itemized breakdown of pricing and receive approval prior to commencing with work.

3.4 COORDINATION

A. Commence with coordination in a timely manner. Subsequent additional compensation, special allowances, additional construction time, etc. will not result from failure to coordinate (including providing related information to other trades for review) in a timely manner. Do not plan, fabricate or install work before consulting with and properly coordinating with other trades so that work will not interfere with that of other trades.

B. Coordinate layout and installation of equipment and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces.

C. Participate in multi-trade coordination efforts prior to commencing with material procurement or installations. Participate in preparation of coordination drawings by other trades, prior to fabrication or installation of equipment, materials, etc. Coordinate actual clearances of installed equipment. Coordinate exact location of electrical outlets, lighting fixtures, conduits, raceways, equipment, cable assemblies, applicable devices, etc. well in advance of installation so there will be no interferences at installation between the various trades.

D. Ensure that required workspace clearances, required clearances for access and maintenance and electrical working clearances of all devices and equipment complies with NEC (NFPA 70) Article 110. This also applies to finalizing locations of disconnects, starters, contactors and other electrically operated equipment that may require testing or maintenance while energized. Layout all affected equipment on paper, and meet with electrical inspector on-site as needed, prior to ordering related materials or commencing with installations, to ensure compliance with NEC Article 110.

E. Coordinate and correct conflicts in equipment and materials prior to installation. If a conflict cannot be resolved, refer the matter to the Owner's Representative for a final decision as to method and material.

3.5 ARCHITECTURAL COORDINATION ITEMS

A. Cutting and Patching:

1. Hold cutting and patching to a minimum by arranging with other trades for sleeves and openings before construction is started.
2. Cut and drill all openings in roofs, walls, and floors required to perform the work. Neatly patch all openings cut. Hold cutting and patching to a minimum by arranging with other contractors for all sleeves and openings before construction is started. When drilling / cutting concrete slabs, utilize ground penetrating radar (GPR) and/or X-ray scanning

equipment to verify the location is free from obstruction, including but not limited to: structural rebar / strands / tendons and electrical conduit / wiring. Repair all damage to structural elements that may occur. Provide temporary partitions, dust barriers, vacuums to keep all dust to a minimum. Allow inspection by owner's rep and inspection by authority having jurisdiction prior to concealing any work or uncover and restore work to allow for observation.

B. Fire Caulking:

1. Fire stopping requirements/locations are not indicated on electrical drawings. Review architectural and other drawings to determine where there will be fire/smoke rated walls, floors, membranes, etc. and rating requirements of same. Provide required fire stopping work associated with electrically related penetrations. Patching through fire rated walls and enclosures shall not diminish the rating of wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch / sealant / pillow / grommet / compound / etc. Clean affected surfaces, joints, etc. immediately before applying fire stopping and only apply under recommended temperature and humidity. Apply primer as required by manufacturer. Properly tool sealants for clean look. Subject to compliance with requirements, provide products by one of the following:

    a. Fire Stop Pillows: Nelson PLW, STI, Hilti, 3M
    b. Fire Stop Putty: Nelson FSP, STI, Hilti, 3M
    c. Latex Intumescent Sealant: Nelson LBS3, STI, Hilti, 3M
    d. Outlet boxes: Nelson FSP, STI, Hilti, 3M

C. Access Panels:

1. Provide all access panels required for proper servicing of equipment or access to junction boxes as a last resort after first searching out locations for equipment and junction boxes in accessible areas. All access panel locations and sizes must be coordinated with and approved by design team and owner's representative. Provide fire rated and smoke rated access panels where required. Provide frame as required for finish. Coordinate installation with General Contractor as they may elect to install access panel. Exact location(s) must be approved by the Architect. Minimum size to be 12" x 12" for junction boxes and 22" x 22" for equipment, units to be 16-gauge steel, primed for paint, door opens beyond 90 degrees and locking device shall be screwdriver cam locks.
2. For equipment or junction boxes above gypsum board or "hard ceilings", provide equipment access panels sized to permit complete holistic removal of the unit in its entirety. Access panel shall also be sized to accommodate removal of the largest piece of equipment in the case where such access panel is used as a removal pathway for multiple pieces of equipment. Subject to compliance with requirements, provide products by one of the following:

    a. Bar-Co., Inc.
    b. J.L. Industries.
    c. Karp Associates, Inc.
    d. Milcor Div. Inryco, Inc.
    e. Nystrom, Inc.

D. Conduit Sleeves:

1. Aboveground, exterior wall penetrations: rigid steel pipe sleeve.
2. Below grade, exterior wall and floor penetrations: schedule 40 cast iron pipe sleeve
3. PVC Pipe Sleeves where allowed: ASTM D 1785, Gray, Schedule 40.

4. Rectangular opening sleeves: Galvanized Sheet Steel, thickness min 0.1 inches.
5. Sleeve Seal Systems: Provide modular sealing device designed for field assembly, EPDM, Nitrile or Silicone based on installation environment with stainless steel bolts and polymer pressure plates. Install type and number recommended by manufacturer for a water tight seal. Provide by one 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.
    f. OZ/Gedney
    g. Link-Seal

6. Sleeve Seal Fittings: Provide manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Install in wall or slab as constructed and grout area around fitting. Provide by one of the following:

    a. Presealed Systems
    b. Bio FireShied
    c. MetaCaulk

7. Sleeves shall be cut flush with both faces of wall. Deburr all sleeves. Floor sleeves shall extend one inch above floor top elevation. Maintain all fire ratings. Use joint compound for around gypsum sleeves. Roof penetrations shall be with flexible boot-type flashing unit or within a pipe curb assembly equal to Pate Co. Curb and flashing per roofing manufacturer's requirements to maintain warranty.

E. Grout:

1. Provide non-shrink grout, recommended for sealing openings in non-fire-rated walls or floors, ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout. Provide 5000-psi strength design mix, premixed and factory packaged.

F. Silicone Sealants:

1. Provide single-component, silicone-based, neutral-curing elastomeric sealant for exterior work. Provide pourable (self-leveling) grade formulation for openings in non-fire rated floors and other horizontal surfaces. Install only in temperature and humidity as recommended by manufacturer. Colors of all visible sealants to be clear or color approved by owner's rep or design team.

G. Acrylic Sealants:

1. Provide one-part, non-sag, mildew-resistant, paintable recommended for exposed applications of interior and protected exterior locations

3.6 PROTECTION OF SURFACES

A. Make every effort to protect roofs, walls and floors from foot traffic, equipment, carts, lifts, etc. Make roof penetrations and install insulated roof curbs and flashing in accordance with roofing

manufacturer's recommendations. Obtain written certification from roofing manufacturer that work has been performed properly and that roof warranty is intact.

3.7 UTILITY VERIFICATION REQUIREMENTS

A. Field verify locations of underground and aboveground utilities, or those otherwise obscured from view, in the vicinity of work prior to commencing work. Utilize "811" call before you dig and hire locating service to identify, locate and mark remaining utilities and private lines. Obtain on-site approval from local utility prior to connecting services. Failure to perform the above shall result in contractor proceeding at their risk and accepting full responsibility for incorrect connections.

3.8 DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Receive, inspect, store and protect all materials required for new work. Do not accept or install any product damaged in any way.

B. Comply with all manufacturer guidelines and requirements for movement, storage, and protection of new work. All new work must be stored in a clean, dry place protected from weather and construction traffic. Maintain acceptable temperature and humidity per manufacturer recommendations. When stored inside or during transport through building, do not exceed structural capacity of the floor.

C. Coordinate and account for sizes of all new work included shipping materials with available openings. Account for rigging of all new work as required and as intended by manufacturer.

D. Do not install work until work area is sufficiently weathertight, all wet work in area is complete and all work above is complete. Provide temporary heating, cooling or humidity control to maintain acceptable conditions for install per manufacturer recommendations until permanent equipment operational.

E. Prior to installation, all products shall have the ability to be returned to the supplier or manufacturer after purchase and charged a reasonable restocking fee equal to a small portion of the cost.

F. Protect all new work through construction from damage. Take safeguards necessary to protect from damage. Items damaged during construction will not be accepted and shall be replaced with new.

G. Remove and replace all materials that have been installed improperly, physically damaged, moisture or water damaged, or mold damaged.

H. Fully remove all packaging materials inside and out prior to startup.

3.9 TEMPORARY SERVICE

A. Provide temporary electrical service.

1. Provide GFCI protection for all work.
2. Provide and maintain power lines (including circuit protection, physical protection, grounding, etc.) to the temporary offices and facilities of trades requiring same, extending from the temporary electrical service. Provide temporary security site lighting to illuminate temporary offices and facilities, material storage areas and other areas as required to prevent theft and injury.
3. Provide sufficient temporary lighting (including lamps) and power complete with wiring and similar equipment, for work on the site and within the affected buildings during the construction period. Provide proper overcurrent and ground fault protection for wiring. Physically protect feeders and lamps along their entire length. Provide temporary branch circuit wiring per NEC in each area with outlets on nominal ten-foot centers for lamps and with receptacles on nominal fifty-foot centers to accommodate extension cords. Provide and maintain a minimum of 10 foot candles of illumination in construction spaces or more if required by NIOSH/OSHA for the duration of the project.
4. Provide necessary specialty temporary power and supplementary light for trades requiring same. At conclusion of the project, remove and take possession of temporary electric materials.
5. Make necessary arrangements with local utility companies for temporary electrical service and pay associated fees for inspections, connections, initiation, etc.

3.10 STARTUP, TESTING AND ADJUSTMENTS

A. Engage a factory-authorized service representative to perform startup service. Perform tests and inspections and prepare reports for submission. Take corrective action for all non-conforming tests.

B. Prior to energizing, test wires and cables for proper phase to phase connections, electrical continuity and short-circuits. Properly reference and resistance test grounding electrode and equipment grounding conductors. Test service voltage and configuration and take corrective action if necessary. Verify circuit voltage at source prior to energizing any feeder or branch circuit. Energize circuitry and demonstrate capability and compliance with requirements. Ensure the direction of rotation of each motor. Adjust controls, remote monitoring, safeties, operations, moving parts, etc. as applicable. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Complete installation and startup checks according to manufacturer's written instructions.

C. Set and document final settings of field-adjustable circuit-breaker overcurrent trip values.

3.11 CLEANING EQUIPMENT AND PREMISES

A. Vacuum, clean and wipe down all new work and equipment inside and out. Exposed parts which are to be painted shall be cleaned of all foreign objects and prepped for paint.

B. During the progress of work, clean up and leave the premises and portions of the building in which work has occurred in a clean and safe condition. Provide this cleaning on a per-shift basis.

3.12 DEMONSTRATION / TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment. Refer to product specific specification for training types and duration.

3.13 PROGRAMMABLE AND SOFTWARE OPERATED EQUIPMENT

A. This subsection applies for systems that incorporate microprocessor based equipment and components. The systems themselves are specified elsewhere within Project Manual.

1. Program software and equipment specifically for phased turnover of spaces based on construction phases. Program, check, and test each system using respective certified factory technician.
2. Room names and numbers may change from architectural drawing names and numbers to actual operational room names and numbers. Contact Design Professionals and Owner to determine actual operating room names, room numbers, etc. and program using actual operational information. Provide interim and permanent programming and configuration work as required to render and maintain systems in full operation.
3. Provide and adapt as necessary the latest release of system software and provide upgrade(s) at final close-out of project.
4. All programming shall be commented in detail and turned over to owner in hard copy printed form and in electronic form on USB drive. This information shall be provided with Operations & Maintenance Manual submission.

END OF SECTION 260501

SECTION 260502 - COMMON ELECTRIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL

A. Mounting Heights: Outlet mounting heights as indicated on the plans are approximate. Determine the exact mounting heights (and locations) of outlets in the field with relation to architectural detail and equipment being served. Coordinate outlet location with equipment, with furniture plans and with architectural elevation plans. Where mounting heights are not detailed or dimensioned, contact the Owner's Representative for direction. Prior to rough-in, coordinate final mounting heights of system outlet boxes in field with Owner's Representative. Install boxes at heights as follows, to center of box, unless directed otherwise in field or otherwise noted on E-series drawings or architectural plans. In cases where using center of box for measurement would result in a switch-height device having an operable component higher than 48 inches above finished floor, install boxes lower as needed so that uppermost part of operable component is no higher than 48 inches. Height of boxes dimensioned from ceiling apply to rooms having ceilings 9' or less; in rooms having higher ceilings, locate these as directed in the field.

Receptacles – Elsewhere: 18”
Disconnects: 46”
Circuit Breaker Panelboards: 72” to top unless code dictates otherwise
Other Outlets/Fixtures/Equipment: As directed by Design Professional

B. Lock-Out Tag-Out Devices: Provide permanently installed lock-out tag-out devices compliant with NFPA 70 and OSHA, with padlocking provisions, at source overcurrent devices for the following applications.

1. Where the normal NFPA 70-compliant location of the disconnecting means is impracticable or introduces additional or increased hazards to persons or property.
2. Where required by NFPA 70.
3. Where required by OSHA.
4. Where required by any other authority having jurisdiction.

C. Electrical Installations:

1. Install conduit, wiring, outlet box and junction box type work in finished areas concealed. Such work installed in unfinished areas may be exposed only at the discretion of the Owner's Representative.
2. All new electrically related work shall be supported directly from building structural members. New electrically related work shall not be supported from ductwork, ductwork hangers, ceiling supports, existing conduit supports, etc. All conduits (and cable assemblies, where applicable) shall be routed parallel to building structural members. Noncompliant work installed by the electrical contractor shall be removed and reinstalled to the satisfaction of the Owner’s Representative and the Design Professionals, at the expense of the electrical contractor.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.
4. Provide systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and

architectural/structural components. Provide factory-furnished filler plates in unused spaces of manufactured equipment.

5. Install electrical equipment to facilitate servicing, maintenance, and repair and replacement of equipment components. Install equipment for ease of disconnecting, with minimum of interference with other installations. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope. Protect the structure, furnishings, finishes, and adjacent materials.
6. Verify dimensions by field measurements. Take measurements and be responsible for exact size and locations of openings required for the installation of work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, follow direction of the Owner's Representative.
7. Provide no wire size smaller than No. 12 for branch circuits unless otherwise noted on plans for control circuits, or otherwise indicated in a Division 26 specification section. Provide larger sizes where required by prevailing codes or indicated on contract documents. Provide neutral conductor for all multi-pole feeders. Provide grounded ("neutral") conductor(s) for all multi-pole feeders and branch circuits unless this contractor determines in field that the affected load(s) will never have need for a neutral conductor and NEC does not mandate otherwise. Provide minimum 3/4" conduit size.
8. Do not install device wall outlets directly back to back, where located on opposite sides of common walls. Offset outlets by at least two feet for applications in fire rated walls and smoke rated walls and applications in acoustically treated walls. Offset outlets by at least one foot for other applications.
9. Provide wires continuous from outlet to outlet and properly splice joints. Provide insulation value for joints 100% greater than that of the wire. Mechanical wire splicers may be used. Where friction and rubber tape is used, provide tape conforming to Federal Specifications HH-T-11 and HH-T-111. Where plastic electrical tape is used, provide Scotch #33, or approved equal. Provide minimum 8" tail for conductors terminating at each wired outlet at their outlet fittings to facilitate installment of devices, luminaires, etc.
10. Use of synthetic or plastic "tie-wraps", "zip ties", "wire ties" and similar products are <u>not</u> permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.
11. If during construction it becomes apparent that some specific minor changes in layout will result in a neater job or better arrangement, make such alterations without additional compensation and without having to offer credit. Obtain Design Professional's review before making such changes. Provide workmanship throughout that conforms to the standards of best practice. Marks, dents and finish scratches are prohibited on exposed materials, luminaires, fittings, etc. Clean inside of panels and equipment boxes.
12. Special Occupancies: Provide all electrical work in Special Occupancies as defined and described in Chapter 5 of NFPA 70 in strict compliance with Chapter 5 of NFPA 70, in addition to compliance with specified and drawn requirements of Division 26.

A. Connectors and Connections:

1. Provide complete assembly of materials for each type of required electrical connection, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.
2. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals, and that are recommended by equipment manufacturer for intended applications. Provide connectors that are specifically UL listed and labeled for the exact splicing/termination application, including for instances where solid conductors are spliced/connected to stranded conductors. Provide electrical

insulating tape, heat-shrinkable insulating tubing and boots, wirenuts, cable ties, etc. as recommended for use by accessories manufacturers for intended applications.

3. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Cover splices with electrical insulating material to achieve insulation at least 100 percent in excess of electrical insulation rating of those conductors being spliced. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Do not "ring" copper conductors while skinning wire.
4. Ground metal frames of portable and stationary direct-wired electrically operated equipment by connecting frames to the circuit equipment grounding conductor and to grounded metal raceway. Provide necessary electrical connections between the specified equipment and junction boxes, disconnect switches, and starters near equipment with flexible metallic conduit and matched connectors. Do not expose flexible conduit in finished areas.
5. Wire and connect electrical equipment furnished under this branch of work, other branches of work and by the Owner. Review documents of other trades to identify electrically operated/controlled equipment that is furnished or installed by the Owner, or by other trades. Provide power connections and local disconnects for same. Provide control wiring (including relays, starters, etc.), as required to render equipment fully operable unless indicated otherwise on drawings or in project manual. Determine exact requirements in field from respective equipment installer.

PART 2 - PRODUCTS (INCLUDED IN PART 1 ABOVE AS APPLICABLE)

PART 3 - EXECUTION (INCLUDED IN PART 1 ABOVE AS APPLICABLE)

END OF SECTION 260502

SECTION 260503 - SUBMITTALS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 GENERAL

A. The contractor is not relieved of responsibility for providing specified or drawn scope of work should any errors or omissions in submittal information not be noted by the Design Professional during submittal reviews or site observations.

B. Submittal requirements of this section apply to all Division 26 sections. Note that some Division 26 sections may also have additional requirements that are unique to the specific section, which would be requirements in addition to those stated in this section. Furnish submittals for each Section that includes one or more of the following elements of work: supply, installation, integration, programming, creation, labeling, and/or contractor-based design or engineering, of one or more products or systems. If a manufacturer is proposed but not listed in a particular specification section, submit as a substitute.

C. Furnish submittals in electronic (PDF) format. Provide electronic submittal files that are compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard. Assemble single PDF file submittals from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked if needed to aid the reviewer in navigating the content. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., 260519-PD-01.pdf).

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Route submittals through established Project channels as identified by the Owner’s Representative. Coordinate, assemble, title, transmit and track Project submittals. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall have the same appearance and organization as those of other Sections. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections may include additional requirements. Design Professional reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis.

B. Furnish submittals for all materials proposed for use for the project, using products compliant with all respective specifications and with information shown on drawings. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. Organize submittals as identified in the Contract Documents. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents. The format for labeling the submittals shall be as follows: Section Number–

Submittal Type Abbreviation–Submittal Iteration (examples: First Product Data Submittal for Section 260519: “260519-PD-00”; revised Product Data Submittal for Section 260519: “260519-PD-01.”).

3.2 SUBMITTAL REQUIREMENTS

A. General:

1. Transmittal: Supply a dedicated transmittal for submittals for each individual Section. Itemize the specific submittals included by Section, submittal type, and iteration.
2. Title Sheet: Include a separate title sheet (including index) with each submittal, of each type. Title sheets for each Section, for each submittal type, shall have the same appearance, 8-1/2 inches x 11 inches for product data submittals. Title sheets for drawings shall be the same size as the associated drawings. Create title sheets with appearance and information identified on the sample title sheet at the end of this Section.
3. Title Blocks: Create drawing submittals on the Contractor’s, manufacturers, or vendor’s own title block, not using those of the Owner, Design Professionals or their Consultants.
4. Legend: Drawing submittals shall include a legend of symbology.
5. Resubmittals: Resubmittals shall include a replica of the reviewer’s comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.
6. Submittal requirements indicated in this section apply for all specification sections with products and materials, and are supplemental to and in addition to submittal requirements that may be included in product and material specification sections.

B. Informational Submittals – Submit this information as part of the Operations and Maintenance Manual.

1. Product Certificates: For each applicable product or system, from manufacturer.
2. Source quality-control test reports.
3. Field Quality-Control Reports:

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Quality Assurance Submittals (QA):

1. Furnish upon request when not expressly requested to be supplied with bid. When requested, furnish to the Design Professional within 2 business days.

    a. Qualification Data for testing agencies, including detailing of scope of services for the project.
    b. Furnish list of Subcontractors to be used on the Project along with a description of the role each shall play on the Project, and the last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value.

D. Product Data Submittals (PD): Submit following contract award or notice of intent to award a contract. Submit and obtain review(s) prior to procurement or fabrication of materials. Provide separate manufacturer datasheets for each product, which shall be manufacturer originals of the manufacturer’s official electronic datasheet. Distributor modified, distributor branded, and/or

html based “web” datasheets are not acceptable. For all materials, equipment, components and ancillary materials, include the following as applicable: voltage; phase; frequency; short circuit ratings; load; dimensions; technical data; enclosure types; required clearances; weights; methods of field assembly and installations; diagrams; configurations; capacities; finishes; construction; overcurrent protection; features; performance; electrical characteristics ratings; finishes; accessories; NRTL listing for series rated devices; time-current coordination curves for each type and rating of overcurrent protective device, including selectable ranges for each; all pertinent technical support data; factory settings; etc. Where manufacturer’s datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or bold visible arrows the models, versions, colors, options, etc. being supplied. Indicate and identify exact catalog numbers. Comply with applicable standards of UL or NRTL.

E. Shop Drawing Submittals (SD): Submit following contract award or notice of intent to award a contract. Submit and obtain review(s) prior to procurement or fabrication of materials. Submit concurrently with section-specific product data submittals where both apply. Draw plans, elevations, sections, elevations and sizes to scale. Show and details, features, characteristics, ratings, factory settings, nameplates, legends, bus structure, capacities, features, accessories, locations of pertinent items, schematics, wiring diagrams, production drawings, etc. Furnish schematic drawings with all information required to install, identify, connect, wire, program, maintain, etc. the system(s). Comply with applicable standards of NRTL.

F. Sample Submittals (SS): Submit concurrent with, or soon after, product data and shop drawings and prior to installation of Work. Furnish physical samples where applicable, in quantities as directed by Owner’s Representative.

G. Training Submittals (TG): Submit thirty (30) days prior to the first training session. Furnish proposed schedule, training agendas for each session, identification of personnel that will conduct training, and handouts proposed for distribution during training. Record all training sessions and include within O&M Manual.

H. Closeout Submittals (CO):

1. Submit following completion of onsite work.
2. Operation and Maintenance Manuals:

    a. Provide on USB drive(s). Provide sub-directories on the drive(s) to label and separate contents for the manual.

3. As-Built Drawings

    a. Provide on USB drive(s).

I. Extra Materials: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Generate report indicating all maintenance materials turned over to owner and obtain signature from owner acknowledging receipt.

3.3 SUBMITTAL RESPONSES

A. Revise and Resubmit: When a submittal is marked “Revise and Resubmit,” the entire submittal shall be reviewed, revised and resubmitted in totality unless specifically indicated otherwise. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of

requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon. Uniquely identify specific portions of each resubmittal that have been modified since the previous version was reviewed. Resubmittals shall include a copy of the reviewer's previous comments, include a written description of the action(s) taken, be labeled chronologically, and be inclusive of all corrective action identified by the previous reviewer.

B. Exceptions Noted: When a submittal is marked "Exceptions Noted," the specific actions identified shall be taken. No further submittal actions required

C. No Exceptions: When a submittal is marked "No Exceptions", no further actions are required.

END OF SECTION 260503

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
260519-PD-00

SECTION TITLE:
Section Name

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name
Address 1
Address 2
City, State Zip
Phone (000) 000-0000
Fax (000) 000-0000
PM Name: Full Name
PM E-Mail: xxxxxxxxx@xxxx.xx

Firm Name
Address 1
Address 2
City, State Zip
Phone (000) 000-0000
Fax (000) 000-0000
PM Name: Full Name
PM E-Mail: xxxxxxxxx@xxxx.xx

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type of conductor and cable.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below, or by an NRTL listed equivalent manufacturer.

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.
7. American Insulated Wire Corp
8. Republic Wire

B. Conductor Insulation and Multiconductor Cables: Comply with NEMA WC 70/ICEA S-95-658. Refer to Part 3 of this section for allowable types specific to this project.

2.2 CONNECTORS AND SPLICES

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide products by one of the manufacturers listed below, or by an NRTL listed equivalent manufacturer.

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.
10. Square D, a Schnieder Electric Company
11. Thomas & Betts
12. Arrow-Hart Div, Crouse-Hinds Co

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

PART 3 - EXECUTION

3.1 APPLICATIONS AND INSTALLATION

A. Feeders: Stranded copper conductors for feeders smaller than No. 1 AWG; stranded copper or stranded aluminum for feeders No. 1 AWG and larger. If aluminum is selected for feeders No. 1 AWG and larger, provide aluminum for all such feeders; do not use copper for some and aluminum for others.

B. Branch Circuits: Stranded copper conductors.

C. Where applicable for electrical equipment connections for aluminum wiring, provide the following supplemental requirements and work regardless of who furnishes the equipment or what type of equipment is affected.

1. Review equipment submittals, installation documents and nameplates to determine if there are any warranty or UL limitations regarding copper versus aluminum wiring connections at equipment.
2. If there are any limitations, provide local non-fused disconnect at or near equipment (external to the equipment) and terminate aluminum conductors to the line side terminals of the disconnect switch. Provide copper conductors from load side terminals of the disconnect switch to the respective equipment factory disconnect or terminals as applicable.
3. Provide UL-Listed AA-8000 series compact-stranded conductors with insulation type compliant with specifications, prevailing codes and end-use equipment manufacturer requirements. Provide appropriately UL-Listed connectors as recommended by conductor manufacturer. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

D. Provide conductor insulation rated at 600VAC and 90 degrees C. Provide wire, cable and connectors suitable for the temperature, conditions and location where installed. Provide THHN/THWN insulation for conductors 500 kcmil and larger, and for conductors # 8 AWG and smaller. Provide THW or THHN/THWN insulation for other sizes as appropriate for the locations where installed. Provide XHHW-2 insulation for wiring below grade and for wiring subject to moisture conditions.

E. Grounded (“Neutral”) Conductors: Provide dedicated parity sized grounded (“neutral”) conductor for each branch circuit phase conductor fed from 15-ampere and 20-ampere branch circuit breakers. Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used. Provide grounded (“neutral”) conductor for all multi-pole feeders. Provide grounded (“neutral”) conductor(s) for all multi-pole feeders and branch circuits unless this contractor determines in field that the affected load(s) will never have need for a grounded (“neutral”) conductor and NEC does not mandate otherwise.

F. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables. Use manufacturer UL 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. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

G. Install wire in raceway unless specifically permitted otherwise in this specification section, under other Division 26 sections, or on electrical drawings. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

H. Do not pull wire until raceways are complete, plastering is complete, and raceways are free of moisture. Install joints and splices only at NEC approved panels, accessible junction boxes, or accessible outlet boxes. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary to prevent damage to conductors. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to wire or cable. Conceal work in finished spaces.

I. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems." Use of synthetic or plastic “tie-wraps”, “zip ties”, “wire ties” and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.

J. Neatly dress work. Install work parallel and perpendicular to surfaces and exposed structural members, and follow surface contours where possible. Keep conductor splices to minimum. Install splice and tap connectors that possess equivalent, or better, mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors that are compatible with conductor material. Install wires continuous from outlet to outlet. Provide insulation value of joints at least 100 percent more than that of the wire insulation. Provide adequate length of conductors within electrical enclosures, and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

K. De-rate cables per NFPA 70 where bundled, where passing through insulation, and where otherwise required to be compliant with NFPA 70 based on field conditions and/or means and methods that will be used. De-rate conductors per NFPA 70 where required based on quantities of conductors within raceways, and where otherwise required to be compliant with NFPA 70 based on field conditions and/or means and methods that will be used.

L. Type MC cable may be utilized only if NEC approved and if approved by local authority having jurisdiction and if included in the limited applications defined below.

1. Provide for final connections to luminaires that are installed in accessible tile ceiling systems (limited to 6' maximum in length and limited to “whips” from building electrical system junction boxes down to luminaires). Do not install Type MC cable from fixture to fixture unless a special properly listed and labeled UL approved system is specifically indicated.
2. Provide only where concealed (install wiring for exposed applications in raceway).
3. Route cables perpendicular and parallel to the building architectural lines, surfaces, and structural members, keeping offsets to a minimum and following surface contours where

possible. Maintain a uniform elevation for cable runs wherever possible. Support and anchor cables at maximum 4-foot intervals and within 12" of box or outlet in a manner that prevents sagging. Install cables in a manner that prevents overheating. Fasten cables directly to the structure using factory clamps and clips specifically designed for the respective cable (Caddy or equal).

3.2 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-486B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Install conductor at each outlet with at least 8 inches of slack.

B. Provide complete assembly of materials for each type of required electrical connection, including but not limited to, pressure connectors, terminal (lugs), electrical insulating tape, heat shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

C. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 90 degrees. Provide factory splice kits (U.L. approved for submersion in water and direct burial) for wire splicing in outdoor grade, or slab on grade, junction boxes and for all other wet locations.

D. Provide electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals, and that are recommended by equipment manufacturer for intended applications. Connect wires #6 AWG and larger to panels and apparatus by means of approved lugs or connectors large enough to enclose all strands of the conductors. Provide solderless type connectors

E. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Cover splices with electrical insulating material to achieve insulation at least 100 percent in excess of electrical insulation rating of those conductors being spliced. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Do not "ring" copper conductors while skinning wire.

F. There may be cases where circuit or feeder conductor sizes are too large or too small to fit into the lugs normally supplied with the power distribution equipment or end-use equipment, due to circumstances such as increasing conductor sizes to offset voltage drop, unusual breaker frame sizes, type of conductors used, etc. In such cases provide appropriate factory lug kits for affected equipment if recommended by manufacturer; elsewhere provide insulated butt-splices with tails sized to fit respective lugs.

G. Ground metal frames of portable and stationary direct-wired electrically operated equipment by connecting frames to the circuit equipment grounding conductor and to grounded metal raceway. Provide necessary electrical connections between the specified equipment and

junction boxes, disconnect switches, and starters near equipment with flexible metallic conduit and matched connectors. Do not expose flexible conduit in finished areas.

3.3 CONDUCTOR SIZING

A. Conductor sizes indicated in Division 26 documents are based on copper unless specifically indicated otherwise on single-line diagram on drawings.

B. Provide minimum #12 AWG conductor size, unless specifically indicated otherwise on drawings.

C. Unless specifically indicated otherwise on drawings, provide grounded (“neutral”) conductors that are at least parity-sized with corresponding phase/line conductors for all applications.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type of ground rod, bar and connection type.

1.2 QUALITY ASSURANCE

A. Provide 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. Comply with UL 467 for grounding and bonding materials and equipment. Comply with ANSI/TIA/EIA-607, “Commercial Building Grounding and Bonding Requirements for Telecommunications. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Except as otherwise indicated, provide copper electrical grounding and bonding systems and materials with assembly of materials including but not limited to cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products that comply with NEC, UL, and IEEE requirements, and with established industry standards for those applications indicated. Utilize compatible metallic materials throughout system to eliminate galvanic action.

B. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide conductors and connectors as specified in Section 260519. Subject to being equivalent and subject to compliance with requirements, provide other grounding related materials by Erico (as a standard of quality), or other equivalent available manufacturers where not otherwise specified in Division 26.

2.2 CONDUCTORS AND CONNECTORS AND ELECTRODES

A. For insulated conductors, provide copper or tinned-copper wire or cable insulated (green-colored) conductors, insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction. For bare copper conductors, provide: Solid Conductors, ASTM B 3; Stranded Conductors, ASTM B 8; Tinned Conductors, ASTM B 33.

B. Provide connectors 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. Provide copper or copper alloy bolted connectors for conductors and pipes, pressure type with at least two bolts. Provide clamp type pipe connectors, sized for pipe.

Use exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Provide copper-clad steel (copper molecularly bonded to nickel-sealed high-strength steel core) ground rods, 3/4 inch in diameter by 10 feet in length (sectional rods may be used when rods are longer than 10 feet). Provide sheet copper plate electrodes that are 20-gage by 36" by 36", made from high-conductivity sheet, with cable attachments (minimum quantity of 2), sized for cables as necessary to fulfill project grounding requirements, where ground rods cannot or should not be used.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Provide green-colored insulation, unless indicated otherwise. Provide solid conductors for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated. Provide bare copper conductors below grade, No. 2/0 AWG minimum. Provide tinned conductors in corrosive areas. Where to be installed underground, bury at least 36 inches below grade.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors as required by NFPA 70 and as otherwise required. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70: all feeders; all branch circuits; expansion couplings; flexible raceway runs.

B. Lighting Poles and Standards Supporting Outdoor Lighting Fixtures: Provide grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit. Bond straps directly to basic structure, taking care not to penetrate any adjacent parts. Install bonding so vibration is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

C. Ground Rods: Drive rods until tops are at least 2 inches (50 mm) below finished floor or final grade unless otherwise indicated. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any. 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. Use driving sleeves or couplings when driving ground rods into the earth.

D. Ground Plates: Provide copper ground plates where ground rods cannot be used. Provide connections to ground electrodes at a point not less than 1 foot below grade level, and not less than 2 feet away from footings and foundations. Weld grounding conductors to underground grounding electrodes where mechanical connections cannot, or should not, be utilized. Interconnect ground plates with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except if otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

F. Service Entrance Grounding Requirements

1. Provide a parity sized insulated grounded conductor (neutral) for each set of service entrance feeder phase/line conductors, terminated and bonded to service equipment (i.e. to each and every service disconnect where applicable). This applies whether or not downstream loads require a neutral conductor. Install these neutral conductors unspliced and unbroken.
2. Ground and bond service entrance neutrals to room ground busbar, to effectively grounded structural steel member, to effectively grounded metallic water pipe, and to grounding electrode system as required per NFPA 70 and as applicable.
3. Provide an enclosed single ground busbar at electrical service entrance locations, bonded to the enclosure, and bonded to service ground with full parity sized green insulated ground conductor (sized same as service ground conductor). Provide quantity and sizes of lugs on busbars as required to accommodate bonding to service grounding electrode system, service neutrals, structural steel, effectively grounded metallic water pipe, and other grounding requirements set forth in project manual and in NFPA 70. Provide UL listed lugs for use with copper and aluminum conductors.
4. Connect grounding electrode conductors to 1-inch diameter, or greater, metallic cold-water pipe at service entrance using a suitably sized ground clamp. Provide connections to flanged piping at street side of flange. Ground electrical service system neutral at service entrance equipment to grounding electrodes. Install braided type bonding jumpers with code-sized ground clamps on water meter piping to electrically bypass water meters and water service entrance valves.
5. Contact AHJ electrical inspector in advance of installing service grounding work. Determine locally approved methods that must be used for re-bar grounding that the AHJ considers compliant with NFPA 70 Article 250.52.

G. Grounding Requirements for Adjoining and Adjacent Structures

1. This subsection applies for any building structure of any kind that adjoins another in any way, including portions of common buildings that “adjoin” via expansion joints, as well as adjacent abutting structures.
2. Bond new concrete columns using minimum #3/0 AWG below-grade copper conductors. For steel construction, bond together every other steel perimeter column to those of adjacent and adjoining structures. Provide minimum surface contact area of eight square inches, welded securely to clean areas of the steel, for structural steel bonding plates (equivalent bolting methods are acceptable only if means and methods are in strict compliance with directives obtained from the project Structural Engineer). Provide minimum #3/0 AWG copper bonding jumper between bonding plates with sufficient slack to allow for building expansion and movement. Install this work above accessible ceilings or in other accessible non-public areas.

3. Provide an earth ground at every other new column in all directions. Adjacent columns may be earth-grounded at one of the columns instead of both, at column groups that are bonded together.

3.4 LABELING

A. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed. The labels or text shall be green. Label Text: "GROUND SYSTEM - If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect, test and adjust components, assemblies, and equipment installations, including connections. 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 continuity of each conductor. Test completed grounding system at service disconnect enclosure grounding terminal/bar, and at each location where a maximum ground-resistance level is specified or as required to verify integrity of grounding electrode system. Make tests at ground rods before any conductors are connected.
4. Measure and report measured ground resistances that exceed 3 ohms. If resistance to ground exceeds specified values, notify Design Professional promptly and include recommendations to reduce ground resistance. After review and comment by Design Professional, take appropriate action to reduce resistance to specified values, by driving additional ground rods or installing additional ground plates or chemically treating adjacent soil, or providing chemical ground rods or combinations thereof. Then retest to demonstrate compliance.
5. Installed components will be considered defective if it does not pass tests and inspections. Correct malfunctioning work on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new work and retest. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL (NOT USED)

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. Construct with 9/16" dia. holes, nominal 2" o.c. on top surface, with standard factory finish, and with the all necessary fittings which mate and match with U-channel. Select channel dimensions for applicable load criteria. Metallic Coatings shall be hot-dip galvanized after fabrication and threading, and applied according to MFMA-4. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allied Tube & Conduit
2. Caddy
3. Cooper B-Line, Inc.; a division of Cooper Industries
4. ERICO International Corporation
5. GS Metals Corporation
6. Hilti
7. Powers
8. Thomas & Betts Corporation
9. Unistrut; Tyco International, Ltd.
10. Wesanco, Inc.
11. Perma-Cote

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

1. Riser clamps for supporting rigid metal conduit; galvanized steel; with 2 bolts and nuts, and 4" ears.
2. Clevis hangers: For supporting rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
3. Galvanized steel clamps; 1/2" rod size.
4. Galvanized steel clamps, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2".
5. One-hole conduit straps for supporting 3/4" rigid metal conduit; galvanized steel.
6. Two-hole conduit straps for supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
7. Offset conduit clamps for supporting rigid metal conduit; galvanized steel.

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. Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Cooper B-Line, Inc.; a division of Cooper Industries.
    b. Empire Tool and Manufacturing Co., Inc.
    c. Hilti, Inc.
    d. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
    e. MKT Fastening, LLC.
    f. Simpson Strong-Tie Co., Inc.

2. Capacities: Provide materials and installed systems with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used, plus 100% safety factor.
3. Adverse and/or Corrosive Environment Areas: Provide stainless steel anchors. Provide hot-dipped galvanized (after fabrication) product and material versions of what is specified in this section for steel hangers, supports, systems, etc. (supported from stainless steel anchors), unless stainless steel is specified or otherwise indicated. Such applications and areas include, but are not limited to:

    a. Outdoors.
    b. Miscellaneous high-humidity or otherwise corrosive environments.

4. Mechanical-Expansion Anchors in Dry Conditioned Areas: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement Provide stainless steel anchors where located in areas subject to moisture or corrosion.
5. Drop-In Anchors: AISI Type 303 stainless steel, drop-in, shell or flush type, equivalent to Hilti HDI series.
6. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
7. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
8. Through Bolts: Steel structural type, hex head, and high strength. Comply with ASTM A 325.
9. Toggle Bolts: All-steel galvanized springhead type, minimum 3/16” x 4”.
10. Hanger Rods: Threaded steel, Galvanized steel rods; 1/2" minimum diameter.
11. Clevis hangers: For supporting rigid metal conduit; galvanized steel; with 1/2" minimum diameter hole for round steel rod.
12. Galvanized steel rod reducing couplings: 1/2" x 5/8” minimum.
13. Galvanized steel clamps: 1/2" minimum rod size; Galvanized steel clamps: Minimum 1-1/4" x 3/16" stock; minimum 3/8" cross bolt; minimum flange width 2".
14. Hexagon nuts: Galvanized steel.
15. Expansion anchors: Minimum 1/2".

PART 3 - EXECUTION

3.1 APPLICATIONS AND INSTALLATION

A. It shall be the responsibility of the electrical contractor to supervise the installation of and pay for all additional members, wood or metal and labor which may be required to support any type of permanent or temporary electrical apparatus employed in the execution of the electrical contractor's work. Provide supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment as required.

B. Coordinate layout and installation of equipment and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Provide supports for multiple raceways capable of supporting combined weight of supported systems and its contents, plus minimum 100% factor of safety. Provide equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components. Provide rated strengths 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.

D. Locate all structural elements within concrete prior to pre-drilling anchors. Contractor is responsible for repairing all damage to structural elements resulting from the scope of this work. Anchor hole dimensions shall be per manufacturer recommendations. Drill and install anchors to depths as recommended by respective anchor manufacturer. Select and apply anchor products based on collective weight being supported, plus 100% factor of safety.

E. Comply with NECA 1 and NECA 101 for application and installation requirements of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

F. All electrically related work shall be supported directly from building structural members. Electrically related work shall not be supported from ductwork, ductwork hangers, ceiling supports, existing conduit supports, etc. Install supports with spacing’s indicated and in compliance with NEC requirements, including all requirements of Article 110.26. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

G. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Field Welding: Comply with AWS D1.1/D1.1M.

H. Touchup Painting: 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. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils. For galvanized surfaces, clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

I. Install equipment and enclosures on walls with tops at uniform height unless otherwise indicated, and by bolting units to structural wall or mounting on structural-steel channels bolted to wall. For equipment and enclosures not at walls, provide freestanding structural-steel channel racks that are anchored to floor structure and overhead structure.

J. Use of synthetic or plastic “tie-wraps”, “zip ties”, “wire ties” and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work. Provide metal clamps, clips, etc. that are manufactured for use for respective applications where they are used. Use of perforated straps is not permitted.

K. Route all conduits, raceways and cables (where applicable) parallel and perpendicular to building structural members. Any and all noncompliant work installed by the electrical contractor shall be removed and reinstalled by the electrical contractor to the satisfaction of the Owner's Representative and the Design Professionals, at the expense of the electrical contractor.

L. All fasteners, hangers and methods of hanging exposed work in finished areas shall be submitted to the Owner's Representative for review before installation. Fasteners shall be zinc-coated, type, grade, and class as required for a neat finished installation.

M. Space supports for conduits and raceways required by NFPA 70 as a minimum. Minimum rod size shall be 1/4 inch in diameter. For multiple raceways or cables, install trapeze-type supports fabricated with steel slotted, sized so capacity can be increased by at least 100 percent in future without exceeding specified design load limits. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps, or single-bolt conduit clamps using spring friction action for retention in support channel as applicable.

N. Coordinate with installation of roof curbs, equipment supports, and roof penetrations as applicable. Install work so that no raceway or cable is within six inches below roof deck(s). Suspend and support overhead electrical work from roof trusses and joists/joist girders only at panel points, at top chord only, unless otherwise indicated.

O. Do not drill any concrete structural members or decks without prior case-by-case written approval of means and methods from Owner and Design Professionals.

P. 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. or 100 percent factor of safety, whichever is greater.

Q. 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. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Install anchor bolts to elevations required for proper attachment to supported equipment. Install anchor bolts according to anchor-bolt manufacturer's written instructions. Provide female expansion anchors, and install studs and nuts after equipment is positioned. Torque bolts and nuts on studs to values recommended by equipment manufacturer. Provide bushings for floor-mounted equipment anchors to allow for resilient media between anchor bolts/studs and mounting hole in

concrete. Provide anchor bolt bushing assemblies for wall-mounted equipment to allow for resilient media where equipment and equipment-mounting channels are attached to wall.

1. To Wood: Fasten with lag screws or through-bolts. Provide Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent. Provide marine grade products where subject to moisture conditions. Provide Simpson Strong Tie (or equal) expansion screw anchors. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads.
2. To Wood Structural Members: Provide bolts installed through members.
3. To New Concrete: Provide channel-type concrete inserts and bolt to inserts, or provide expansion anchors for applications where inserts are not practical.
4. To Existing Concrete: Expansion anchor fasteners.
5. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars and other structural elements. Review proposed means, methods, locations, etc. in advance with Owner and Design Professionals.
6. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
7. To Steel: Welded threaded steel studs complying with AWS D1.1/D1.1M, with lock washers and nuts, or beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, clamped to flanges of beams or on upper truss chords of bar joists.
8. To Light Steel: Sheet metal screws.
9. Items Mounted on Hollow Walls and Nonstructural Building Surfaces in finished areas: Provide blocking between studs behind finished wall surface. Mount equipment, devices and boxes with backs of enclosures flush to front of finished wall surface.
10. Items Mounted on Hollow Walls and Nonstructural Building Surfaces in unfinished areas: Mount equipment on slotted-channel racks attached to substrate.
11. Do not use powder/gas-actuated driven methods.

R. Coordinate all work with all other trades prior to commencement of the work. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.

S. Fabricated Support Devices:

1. Conform to the manufacturer's recommendations for selection and installation of supports.
2. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
3. Support parallel runs of horizontal raceways together on trapeze-type hangers.
4. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners shall be used in lieu of hangers for 1-1/2 inches and smaller raceways above suspended ceilings only.
5. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits.
6. Support exposed and concealed raceway within 1 foot of box and access fittings. In horizontal runs, support at the box and access fittings shall be omitted where box or access

fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.

7. In vertical runs, arrange supports so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on the ends of the raceway.
8. Miscellaneous supports:

    a. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, pull boxes, junction boxes, and other devices.
    b. Support outlet boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
    c. Support junction boxes, pull boxes and other boxes directly from the building structure.

9. Fastening:

    a. Fasten pathway products and associated supporting hardware securely to the building structure.
    b. Fasten by means of wood screws on wood, toggle bolts on hollow masonry units.
    c. Fasten by means of concrete inserts or expansion bolts on concrete or solid masonry.
    d. Fasten by means of bolts with lock washers and nuts, machine screws, welded threaded studs, or clamps on steel (spring-tension where applicable).
    e. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures.
    f. In partitions of light steel construction, use sheet metal screws.
    g. When installing fasteners in concrete or CMU structures, do not cut, drill or damage reinforcing bars or other structural elements.
    h. Ensure that the load applied to any fasteners does not exceed 25-percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.
    i. Raceway supports: Hanger spacing shall be as required for adequate support of the raceway, but in no case shall there be less than one hanger per 8 feet of raceway length.

10. Locate all structural elements within existing concrete prior to pre-drilling or setting anchors. Contractor is responsible for repairing all damage to structural elements resulting from the scope of this work.

3.2 CONCRETE BASES

A. Provide dowel rods to connect concrete bases to concrete floors/slabs/substrates. Unless otherwise indicated, install dowel rods on maximum 18-inch centers around the full perimeter of concrete base.

B. Provide epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor/slab/substrate, unless concrete bases are installed directly on grade. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. 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. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast galvanized or stainless-steel anchor-bolt inserts into bases.

D. Outdoor bases shall be at least 6" thick and shall have straight and finished sides and a 1"-45 degree chamfer at the top perimeter. Perimeter of pads shall extend down below the frostline. Reinforcing steel bars shall be placed in both directions of the bases and a mesh overlay shall be provided. Where required for supplemental support, provide lateral support work to adjacent wall(s). Provide concrete bases/housekeeping pads beneath all electrical power and systems distribution equipment that is slab or grade mounted or mounted within 6" of slab or grade.

E. Unless indicated otherwise in specifications or on drawings, use minimum 3000-psi, 28-day compressive-strength concrete. Size and provide concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.

F. Forms: As required for equipment pads or other special applications in field, provide forms made of steel, wood, or other suitable material of size and strength to resist movement during concrete placement, and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends. Do not remove forms for 24 hours after concrete has been placed. Set forms to required grades and lines, rigidly braced and secured. Provide sufficient quantity of forms to allow continuous progress of work, and so that forms can remain in place at least 24 hours after concrete placement. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage. Form areas that involve termination of spare conduits below grade, or that involve continuation of conduits by others, accordingly to accommodate easy future access to the ends of conduits for future extensions.

G. Reinforcement: Cut bars true to length with ends square and free of burrs. Provide metal expansion caps for one end of each dowel bar in expansion joints. Design caps with one end closed and a minimum length of 3" to allow bars movement of not less than 1", unless otherwise indicated. Provide these for joining applications where continuous pouring cannot be accomplished.

H. Concrete Placement: Remove loose material from subbase surface immediately before placing concrete. Check subbase and forms for line and grade before placing concrete. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Place concrete using methods that prevent segregation of mix. Use splash boards to divert the flow of concrete away from the trench sides, and to avoid dislodging soil and stones. Coordinate with Owner's Representative at least 72 hours prior to placing concrete. Line up concrete trucks as required to achieve one continuous pour where applicable. Do not backfill until a minimum of 48 hours have passed.

I. Concrete Finishing: Smooth surface by screeding after striking-off and consolidating concrete. Provide Class A finishing. Broom finish concrete pads, and aprons around pullboxes and structures. Protect concrete from damage until acceptance of work. Exclude traffic over affected areas for at least 14 days after placement.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For surface raceways, wireways, fittings, boxes, enclosures, and cabinets.

B. Definitions

1. EMT: Electric metallic tubing.
2. FMC: Flexible metallic conduit.
3. GRC/RMC: Galvanized rigid steel conduit.
4. IMC: Intermediate metal conduit.
5. LFMC: Liquid-tight flexible metallic conduit.
6. RNC: Rigid nonmetallic conduit.
7. Conduit/Raceway/Pathway: “Conduit”, “raceway”, “pathway” and similar terms shall be taken to mean “conduit” unless specifically indicated otherwise in project manual documents, or unless specifically directed otherwise in field by Owner or Design Professionals. All such terms shall be considered synonymous for the general purposes of installation means and methods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Metal conduits, tubing, boxes and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Subject to compliance with requirements, manufacturers offering raceway, box and fitting related products that may be incorporated into the Work as applicable include, but are not limited to, the following:

1. Allied
2. Adalet.
3. AFC Cable Systems, Inc.
4. Allied Tube & Conduit; a Tyco International Ltd. Co.
5. Anamet Electrical, Inc.
6. Appleton Electric.
7. Armorcast Products Company
8. Arnco Corporation
9. Baxter
10. Bell Electric.
11. Bowers.
12. Cantex.
13. Carlon.
14. Carson Industries LLC
15. CDR Systems Corporation; Hubbell Power Systems
16. CertainTeed Corp.
17. Condux International, Inc.

18. Cooper
19. Eagle Electric Mfg Co., Inc.
20. Efcor.
21. EGS/Appleton Electric
22. Electri-Flex Company.
23. Erickson Electrical Equipment Company
24. FSR
25. General Electric Company
26. Highline Products
27. Hoffman; a Pentair company.
28. Hubbell.
29. Kraloy.
30. Lamson & Sessions; Carlon Electrical Products
31. LTV.
32. Midland-Ross Corp.
33. Milbank Manufacturing Co.
34. Mono-Systems, Inc.
35. NewBasis
36. Niedax-Kleinhuis USA, Inc.
37. Nordic Fiberglass, Inc
38. Norwalk
39. O-Z/Gedney; a brand of EGS Electrical Group.
40. Oldcastle Precast, Inc.; Christy Concrete Products
41. Panduit
42. Pass and Seymour, Inc.
43. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
44. Quazite
45. RACO
46. Regal.
47. Republic Conduit.
48. Robroy Industries.
49. Siemens/ITE
50. Southwire Company.
51. Spring City Electrical Manufacturing Company
52. Square D; a brand of Schneider Electric.
53. Stahlin Non-Metallic Enclosures; a division of Robroy Industries
54. Steel City.
55. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
56. Tay-Mac
57. Thepitt.
58. Thomas & Betts Corporation.
59. Walker/Wiremold/Legrand
60. Western Tube and Conduit Corporation.
61. Westinghouse/Cutler-Hammer
62. Wheatland Tube Company; a division of John Maneely Company.
63. Wiegmann (Hubbell-Wiegmann)

2.2 METAL CONDUITS, TUBING, AND FITTINGS

A. EMT: Comply with FS WW-C-563, ANSI C80.3 and UL 797.

B. IMC: Comply with ANSI C80.6 and UL 1242.

C. GRC/RMC: Comply with ANSI C80.1 and UL 6. Provide steel conduit, galvanized/fused to inside and outside walls of conduit and fittings after fabrication and after threading.

D. FMC: Comply with FS WW-C-566 and UL 1; zinc-coated steel. Provide flexible metal conduit formed from continuous length of spirally wound, interlocked zinc-coated or galvanized (inside & outside) strip steel. Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type, with insulated throats. Provide Straight Terminal Connectors consisting of one-piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end with locknut. Do not use 45-degree or 90-degree Terminal Angle Connectors for flexible or water-tight flexible metal conduit in locations that will not be fully accessible after completion of construction. Provide full size green insulated ground wire for all applications, regardless of length.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

1. Provide liquid-tight flexible metal conduit formed from continuous length of spirally wound, interlocked, double-wrapped hot-dipped zinc-galvanized (inside & outside) steel core. Provide liquid-tight jacket of flexible polyvinyl chloride (PVC) that is fully weatherproof, flame-retardant, heat resistant, oil resistant, sunlight resistant and that resists heat, oil and chemical breakdown.
2. Provide smooth-wall type jackets (not a corrugated look) for furniture whip (and similar) applications in indoor finished areas.
3. Provide Liquid-Tight Flexible Metal Conduit Fittings compliant with FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat.
4. Provide Straight Terminal Connectors that are one-piece body, female ends with clamps and deep slotted machine screws for securing conduits, and male threaded ends with locknuts.
5. Provide Terminal Angle Connectors that are 45-degree or 90-degree two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut. Do not use 45-degree or 90-degree Terminal Angle Connectors for flexible or water-tight flexible metal conduit in locations that will not be fully accessible after completion of construction.
6. Provide full parity size green insulated ground wire for all applications, regardless of length.
7. Provide installed LFMC systems using materials and installation methods that result in IP67 compliant.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. EMT: Provide steel, galvanized or zinc-coated water/concrete-tight fittings; do not use die-cast fittings. Provide Compression type for outdoor applications, and applications in other wet locations. Provide Compression or set screw type for indoor applications.
2. GRC/RMC: Zinc-Galvanized Steel (after fabrication/factory-threading), threaded (fused-galvanized after threading.)
3. Expansion Fittings: Material to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Provide terminal conduit fittings with insulated throats, or plastic bushings for conduits 2" and larger where insulated throats may not be not readily available.
5. Provide locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening. Provide screw type grounding terminal for metal bushings of standard or insulated type.

6. Provide miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that are specifically designed for their particular application.
7. Provide galvanized cast-metal (steel) conduit bodies of types, shapes and sizes as required to fulfill job requirements and NFPA 70 requirements. Construct conduit bodies with threaded-conduit-entrance ends, with removable covers, either cast or of galvanized steel, and with corrosion-resistant screws.

G. Joint Compound for Threaded Conduit: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.3 NONMETALLIC CONDUITS AND FITTINGS

A. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated. Comply with NEMA TC 3 for fittings; match to conduit or tubing type and material.

1. Provide electrical plastic conduit equal to Carlon Plus 40. Provide heavy wall electrical plastic conduit that is Schedule 40, 90 degrees C rated, constructed of polyvinyl chloride, in conformity with NEMA TC-2, in conformity with NFPA 70 Article 354, and is UL listed and labeled for direct burial, concrete encasement, and above ground use. Provide conduit/duct accessories of types, sizes, and materials, complying with manufacturer's published product information, which mate and match conduit and tubing.
2. Provide Duct Spacers ("chairs") equal to Carlon #S288*L series for base spacers, and #S289*L series for intermediate spacers.
3. Provide horizontal elbows for service entrance conduits that are maximum 45-degree. Provide minimum 24-inch radius. Provide larger minimum radius where indicated on drawings, or if directed in field. Provide multiple units as necessary to obtain required offset (i.e. provide two 45-degree elbows to obtain a 90-degree offset where needed). Provide 90-degree maximum elbows.
4. Provide couplers, adapters, "O" rings, sealing, and other accessory components as required for a complete installation. Provide miscellaneous fittings that have been specifically designed and manufactured for their particular application.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Metal Product Description: Provide sheet metal wireways, complying with UL 870 and NEMA 250, Type 1 for indoor applications and Type 3R for outdoor applications unless otherwise indicated, and sized according to NFPA 70. Include covers, 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.

1. Provide screw-cover type for indoor applications, and flanged-and-gasketed type for outdoor applications unless otherwise indicated. Provide manufacturer's standard enamel finish. Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Provide plate-finished hardware to prevent corrosion. Protect screws installed toward inside of wireway, with spring nuts to prevent wire insulation damage.
2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Provide electrical wireways of types, grades, sizes, and number of channels for each type of applicable service.
3. Provide lay-in wireways with hinged covers in accordance with UL 870, and with components UL-listed, including lengths, connectors, and fittings. Provide units that allow fastening of hinged cover closed without use of parts other than standard lengths,

fittings and connectors. Provide units capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts. Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature. Provide NEMA 3R units where used outdoors or in areas subject to moisture.

B. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be UL listed and labeled for use in wet locations, including cover plates and doors. Boxes, enclosures, and cabinets installed in damp and areas subject to moisture shall be UL listed and labeled for use in damp locations, including cover plates and doors. All other applications shall be UL listed and labeled for the location in which they are installed. Provide galvanized (after fabrication and after threading) boxes with galvanized or stainless-steel accessories, hardware and cover plates.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A. Provide galvanized-coated flat rolled code-gage non-gangable sheet-steel outlet/junction/pull boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes and with cable and conduit-size knockout openings in bottom and sides where applicable. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Provide with stainless steel nuts, bolts, screws and washers.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover. Only use for special applications with prior case-by-case approval from Design Professionals.

D. Luminaire Outlet Boxes: Comply with outlet box specifications above; nonadjustable, designed for attachment of luminaire weight (50 lb, minimum) plus 100 percent factor of safety. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight, including 100 percent factor of safety.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box and shall extend to the finished wall surface.

F. Bushings, knockout closures and locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

G. Device Box Dimensions: 4 inches square by 1-1/2 inches deep or 4 inches square by 2-1/8 inches deep, depending on device depths and wiring fill, with single-gang plaster/”mud” rings where only one device is being installed. Provide wider boxes for applications where more than

two devices will be installed. Provide internal metal dividers where required under NFPA 70 for varying voltages, multiple circuits, etc. Gangable boxes (using multiple single-gang boxes to assemble multi-gang boxes) are prohibited.

H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor applications and Type 3R for outdoor applications with continuous-hinge cover with flush latch unless otherwise indicated, and with steel interior panels that are finished with manufacturer's standard enamel.

1. Metal Enclosures: Stainless steel, or galvanized (after fabrication) steel, finished inside and out with manufacturer's standard enamel.

I. Cabinets:

1. Provide NEMA 250, stainless steel or Type 3R galvanized (after fabrication) steel boxes with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Provide hinged door in front cover with flush stainless-steel latch and concealed stainless-steel hinge. Provide key latch to match panelboards. Provide metal barriers to separate wiring of different systems and voltage. Provide accessory feet where required for freestanding equipment. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, listed by a qualified testing agency, and marked for intended location and application.

J. Weathertight outlet boxes and covers:

1. Provide corrosion-resistant weathertight/raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
2. Provide weatherproof covers that mount on a single gang horizontal or vertical (depending on application) junction box to ensure weather protection for a standard outlet. Provide covers that can mount on indoor or outdoor junction boxes and that include a weatherproof cover/base assembly with gasket, two universal inserts, and mounting hardware. Provide weatherproof cover that provides flexibility in installation. Provide covers that meet or exceed UL requirements for wet locations while in use, that meet requirements of NFPA 70 Article 410-57(b), and are minimum NEMA 3R rated. Provide weatherproof cover constructed of UV stabilized high impact polycarbonate material. Provide clear cover for the part that encloses the cord set, to allow visual inspection. Provide cover that meets agency requirements for cold impact at negative 60 degrees Fahrenheit (negative 51 degrees C). Provide covers with useable inside depth to accommodate plug head. Provide assemblies for outdoor applications, unless indicated otherwise on drawings, and for indoor applications that serve permanent or extended-use cord & plug load connected equipment.
3. Provide minimal profile assemblies that are rated NEMA 3R While In Use and that employ recessed box and cover design, equal to Thomas & Betts “Red Dot” series. Provide trim color(s) to match surrounding finished wall surface.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes: Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a

qualified testing agency, and marked for intended location and application. Provide weatherproof cover, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location. Provide nonskid cover finish, with a minimum coefficient of friction of 0.50, and with molded or embossed lettering to indicate contents.

B. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered Professional Engineer shall certify tests by manufacturer. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

C. Polymer-Concrete Handholes/Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two. Design for flush burial with open bottom unless otherwise indicated.

1. Outdoor junction and pull boxes for branch-circuit-scale applications: Provide flush grade-mounted junction/pull box assemblies, equal to Quazite #PG1212-BG-12, 12 inches deep, with bolted cover and open bottom. Provide larger sizes where required by NFPA 70 based on conduit quantities/sizes and wire fill. Provide assemblies constructed of polymer concrete. Provide assemblies that are unaffected by UV light, moisture, freezing, and sub soil chemicals. Provide assemblies that have minimum 30-year projected life in all climates. Provide enclosures/covers that are gasketed with stainless steel inserts and bolts. Provide covers with factory logo for service type contained within. Provide assemblies that are heavy duty (ANSI Tier 15), and rated for a design load of 22,500 pounds and test load of 33,750 pounds. Provide outdoor mounted junction/pull boxes flush grade/slab mounted (level & plumb), set on a minimum 12” deep bed of pea gravel. Install so that conduits enter the boxes from below. Field verify specific installation requirements with Owner's Representative and Design Professional prior to rough-in of outdoor grade-mounted junction/pull boxes.
2. Outdoor handhole/pull boxes for feeder-scale applications: Provide flush grade mounted junction/pull box assemblies, equal to Quazite #PG2436-BG-24, 24” deep with bolted cover and open bottom. Provide larger sizes where required by NFPA 70 based on conduit quantities/sizes and wire fill. Provide larger sizes where required by NFPA 70 or field conditions. Provide assemblies constructed of polymer concrete. Provide assemblies that are unaffected by UV light, moisture, freezing, and sub soil chemicals. Provide assemblies that have minimum 30-year projected life in all climates. Provide enclosures/covers gasketed with stainless steel inserts and bolts. Provide covers with factory logo for service type contained within. Provide assemblies that are heavy duty (ANSI Tier 15), rated for a design load of 22,500 pounds, and rated for a test load of 33,750 pounds. Provide outdoor mounted junction/pull boxes flush grade/slab mounted (level & plumb), and set on a minimum 12-inch-deep bed of pea gravel. Install so that conduits enter the boxes from below. Field verify specific installation requirements with Owner's Representative and Design Professional prior to rough-in of outdoor grade-mounted junction/pull boxes.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: GRC/RMC or IMC.
2. Exposed and Subject to Physical Damage: GRC/RMC. Raceway locations include the following:

    a. Areas where driven/ridden mechanized equipment is operated

3. Concealed Conduit, Aboveground in Dry and Noncorrosive Locations Not Subject to Physical Damage: EMT.
4. Concealed Conduit, Aboveground in Damp Locations, Wet Locations, Corrosive Locations, Where Not Subject to Physical Damage: IMC.
5. Concealed Conduit, Aboveground in Damp Locations, Wet Locations, Corrosive Locations, Where Subject to Physical Damage: GRC/RMC.
6. Underground Conduit For Services, Feeders and Similar Scale Work : RNC, Type EPC-40-PVC. See details and/or notes on drawings for applications where concrete or other encasement is required.
7. Underground Conduit For Branch Circuit and Similar Scale Work: RNC, Type EPC-40-PVC. See details and/or notes on drawings for applications where concrete or other encasement is required.
8. Connection to Vibrating Equipment or equipment that is subject to any degree of motion in its normal operation (Including But Not Limited To Transformers, Electric Solenoids, and Motor-Driven Equipment): LFMC. Leave sufficient slack in flexible conduit to permit movement from vibration without adversely affecting conduits and connections.
9. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Raceway Fittings: Compatible with (Listed accordingly) raceways and suitable for use and location.

1. EMT: Comply with NEMA FB 2.10 and with requirements of these specifications.
2. GRC/RMC and IMC: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. General Installation.

1. Minimum Raceway Size: 3/4-inch trade size.
2. Install wire in raceway/conduit unless specifically permitted otherwise elsewhere in Division 26 sections, or on drawings.
3. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.
4. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for Conduits and raceways required by NFPA 70 as a minimum.
5. Layout all proposed raceway routing, elevations, installation methods, etc. on coordination drawings and coordinate all proposed raceway routing with all affected trades prior to commencing with work. In addition, review the information with Owner and Design Professionals for all areas where the raceways will be visible after completion of construction, to ensure a neatly organized installation occurs. Where raceways must be exposed in finished/regularly occupied areas, install them in a manner that minimizes detrimental effects on room aesthetics. Install so raceways are as out of site as reasonably possible. For instance, where applicable for exposed work and if so directed by the Design Professionals or the Owner, make drops near corners, window casings,

door casings, etc. Likewise, if a receptacle needs to be installed at the center of a wall, install the raceway down the wall in a corner of the room then transition and run horizontally to the outlet location if so directed by the Design Professional or the Owner. Use compression fittings for EMT applications in these areas. Do not use strut or fasteners that stand off from wall for wall applications in these areas. Install exposed wall-mounted conduits tight to wall using one-hole straps for conduits 1-1/4 inches and smaller, and use two-hole straps for conduits 1-1/2 inches and larger.

6. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
7. Do not install aluminum products in contact with, or near proximity to, concrete or earth.
8. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.
9. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.
10. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
11. Locate all structural elements within concrete prior to pre-drilling anchors. Contractor is responsible for repairing all damage to structural elements resulting from the scope of this work.
12. Provide fittings as needed for a complete installation. Provide locknuts for securing conduit to enclosures with ridged outside circumference for proper fastening. Provide miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that are specifically designed and intended for their particular application.
13. Provide knockout closures to cap unused knockout holes where blanks have been removed.
14. Provide flexible connections or expansion fittings where all conduits cross building expansion joints. Coordinate exact quantity & location with Architectural plans prior to installation of work.
15. Install electrical boxes in those locations that ensure accessibility to enclosed electrical wiring.
16. Do not install boxes back-to-back in walls. Provide not less than 6" (150 mm) separation in general, not less than 16” separation for acoustically rated walls and not less than 24" separation for the following applications: fire walls, fire barriers, smoke barrier walls, and fire partitions. Where outlet boxes are shown back-to-back on common walls, offset accordingly when installed.
17. Fire walls, fire barriers, smoke barrier walls and fire partitions: Steel outlet boxes that do not exceed 16 square inches in area may be used in fire walls, fire barriers, smoke barrier walls, and fire partitions only if the total area of such openings does not exceed 100 square inches for any 100 square feet of wall area. Verify with local authorities having jurisdiction prior to commencing with related rough-in work. Provide outlet boxes, equipment back-boxes, etc. in fire walls, fire barriers, smoke barrier walls, and fire partitions that are of the type tested for use in fire-resistance-rated assemblies. Install in accordance with the tested assembly, and with the instructions included in the listing. Install firestopping at penetrations of fire-rated floor and wall assemblies.
18. Neatly cut openings for boxes so that standard size (not "midway" or "jumbo") cover plates will cover all parts of the opening. Position recessed outlet boxes accurately to allow for surface finish thickness. Do not use round boxes.
19. Fasten electrical boxes firmly and rigidly to substrates and structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry as applicable. Provide box supports that are independent of conduit. Protect boxes from construction debris and damage subsequent to installation of boxes.
20. Use of synthetic or plastic “tie-wraps”, “zip ties”, “wire ties” and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work. Do not use perforated straps.
21. Consider the outlet, junction, and pull box locations indicated on drawings approximate unless there are prevailing codes that require specific spacings or locations. Study the

general construction with relation to spaces and equipment surrounding each outlet, and neatly install outlets accordingly.

22. Install wiring for different power voltages in raceway systems separate from each other. Install wiring for the various electrical systems in raceway systems that are separate from each other.
23. Provide steel conduit and steel fittings for indoor above-slab applications, as specified in this section.
24. Provide conduit fittings with insulated throats. Plastic bushings may be used for conduits 2" and larger where insulated throats may not be readily available.
25. Provide maximum of 40 percent fill for raceways, or a threshold of less if required by NFPA 70 or project conditions.
26. Keep raceways at least 12 inches away from parallel runs of flues, hot-water pipes, and other sources of heat. Install horizontal raceway runs above liquid and steam piping. Where the lines are not insulated, the clearances shall be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature of the installation area.
27. Support risers at each floor level with suitable hangers.
28. Level and square raceway runs, and install at proper elevations and heights.
29. Protect coatings, finishes, and cabinets from damage and deterioration. Repair damage to galvanized finishes with zinc-rich paint or coating, color to match surface, recommended by manufacturer. Make these repairs prior to products receiving finish coats of paint.
30. Pathway Evacuation and Protection: Cap and plug conduit ends with standard accessories as soon as conduit has been permanently installed. Prior to the installation of cable, clean and vacuum boxes, conduits/raceways, supports, etc. Clean inside of conduit before wiring is pulled. Remove solids or other hindrances that could impede its full utilization or that could damage cable during or after installation. Remove liquid and moisture from the raceways. Blow out until raceway is dry, sufficiently that the installed cables will not be subjected to any contact with fluid or moisture. Seal and protect raceways and boxes from moisture infiltration. Provide watertight fittings. Do not begin installation of conductors and cables until electrical raceways are complete and until installation locations (end to end) are in a weatherproof environment.
31. Arrange stub-ups so curved portions of bends are not visible above finished grade or slab.
32. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.
33. Support conduit within 12 inches of enclosures to which attached. Properly support and anchor raceways for their entire length using structural materials. Do not span any space unsupported.
34. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
35. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Fasten conduit terminations in sheet metal enclosures with two locknuts. Install locknuts inside and outside enclosure.
36. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
37. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
38. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean. Field-

bend conduits with benders designed for purpose so as not to distort, nor vary, internal diameters. Bring joints to a shoulder. Provide suitable supports and fasteners for conduit.

39. Conceal conduit and tubing within finished walls, ceilings, and floor cavities unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
40. Install exposed conduits, and extensions from concealed conduit systems, neatly parallel and perpendicular to walls, and plumb on walls. Secure to walls at intervals not exceeding six feet, supported by approved straps and fasteners. Secure to overhead structure at intervals not exceeding six feet. Support conduit by approved straps, fasteners and hangers. Provide hangers suspended from rods. Space wall brackets supporting conduits not more than 4 feet 6 inches on center. Install exposed conduit work so there is no interference with ceiling inserts, lights, or ventilation ducts or outlets.
41. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use, using properly selected and attached manufactured cap (tape of any sort is not permissible). Provide finished wall/cover plate on unused outlet boxes.
42. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.
43. Mount boxes at heights indicated on Drawings and elsewhere in Division 26 specifications. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated. In cases where using center of box for measurement would result in a switch-height device having an operable component higher than 48 inches above finished floor, install boxes lower as needed so that uppermost part of operable component is no higher than 48 inches.
44. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block (do not over-cut), and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
45. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Coordinate all such separations with Design Professional in advance to ensure boxes are located properly for each application.
46. Locate boxes so that cover or plate will not span different building finishes.
47. Support boxes from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
48. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
49. Provide properly wired electrical connections within enclosures. Anchor enclosures ensuring that they are level, and permanently and mechanically secure.
50. Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for applications as needed to render electrical work fully operational.
51. Mechanically fasten together metal conduits, enclosures, and raceways to form continuous electrically conducting equipment grounding path. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly. Conduit shall be continuous between outlets to make a complete installation and to provide a continuous ground.
52. Do not use dissimilar metals throughout the systems to eliminate possibility of electrolysis. Where dissimilar metals will be unavoidably in contact, coat surfaces with corrosion inhibiting compound before assembling.
53. Use rough-in dimensions of electrically operated equipment furnished by equipment installer. Install conduit and boxes for connection to equipment only after reviewing respective equipment and clearance dimensions, and after coordinating with other trades.
54. Do not use electrical "handy/handee" boxes.

55. Do not use running threads at conduit joints and terminations - use 3-piece union, or split coupling.
56. Provide joints made tight with water-tight couplings matching conduit. Install offsets with long radius sweep bends, except conduit sizes 1 inch and over where standard elbows may be used.
57. Where moisture conditions within conduits are encountered above grade, drill a hole at the lowest point in the conduit run so that drainage will not interfere with conditions below.
58. Where conduit is capped at wall for future additions, do not extend more than threads-length past wall (maximum of 3/4-inch past wall for EMT).
59. Where conduits for outlets on waterproof walls must be installed exposed, set anchors for supporting conduit on waterproof wall in waterproof cement.
60. Requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces.
61. Provide a 4-inch reinforced casing of concrete (3000-PSI minimum) around conduits that are installed in cinders or cinder concrete, to protect them.
62. Support raceway components directly from structural building systems, not from ceiling suspensions systems. Provide supplemental supports for junction or pull boxes.
63. Support single conduits 1-1/2 inches and larger by means of rod and ring hangers. Support multiple runs in similar manner or use a common trapeze hanger system.
64. Pinch type hangers similar to Minerallac may only be used at heights greater than 8 feet, and only in unfinished areas where the work could be installed concealed.
65. Protect conduits during construction with temporary plugs or caps. Securely cap conduits until pull string, or cable is installed.
66. Conduit Routing: If specific routing information appears on the Drawings, route and maintain conduits as shown. Should interference or a conflict arise, consult the Design Professional before proceeding with the Work. If specific routing information does not appear on the Drawings, or if routing shown on Drawings is schematic in nature, determine the best route for the conduit in accordance with code and other project guidelines.
67. Conduit bends: Bends shall be made so that the conduit will not be flattened or kinked and so that the internal diameter of the conduit is not reduced. The radius of the curve of the inner edge of any bend shall not be less than indicated by the National Electrical Code and TIA/EIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces. In no case shall any conduit be bent or shall any fabricated elbow be applied to a conduit that will impose less than the minimum allowable bending radius specified by the manufacturer of cable that will be installed within the conduit. When it is necessary to make field bends, use tools manufactured for conduit bending. Heating of metallic conduit to facilitate bending is not permitted. Constructing an outside entrance to a building from buried conduit to penetrate above the ceiling line will allow an exception for a 4 inches LB fitting at one end to allow placement of the conduit flat to the building outside wall; apply this only if conduit could not be concelaed.
68. 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.
69. Install above-ceiling conduits as high as possible, with a minimum of 8 inches above ceiling tiles so as to permit ceiling tile removal.
70. Provide flashing and counter flashing or pitch pockets for waterproofing of raceways, outlets and fittings that must penetrate the roof. Coordinate all related work with roofing installer and provide means and methods based on roofing installers recommendations.
71. Provide sleeves and sleeve seals at penetrations of exterior floor and wall assemblies, at penetrations of abutted perimeter walls for building expansions/additions, and where expansion joints are used at walls. Provide oversized sleeves in forms for new concrete walls, floor slabs, and partitions to allow for the passage of raceways. Provide waterproof sleeved raceways below grade and in areas prone to high moisture and condensation. Provide sleeves in member for conduits passing through structural members.

72. Install each branch of power in separate raceways from each other.
73. Do not install conduit horizontally in concrete slabs on grade. Do not install or embed conduits horizontally within any other slabs.
74. Do not install branch circuit conduits beneath slabs on grade, except where specifically indicated otherwise on drawings, or unless special case by case permission is obtained from Owner's Representative in the field.

B. Pull Boxes and Junction Boxes:

1. Provide each pull box indicated on the Drawings.
2. Provide additional pull boxes: Every 180 degrees of raceway bend; Every 100 feet of raceway; As additionally required by Code.
3. Provide pull and junction boxes in areas that will be accessible after installation. Accessible areas include spaces above removable tile ceilings and behind access doors that are installed expressly for this purpose. Do not install pull-boxes in locations that will not be accessible after construction is complete and is not accessible after permanently installed work is complete.
4. Size boxes in accordance with the NFPA 70 (NEC). Use larger boxes where so specified.
5. Support boxes rigidly. Land conduits on the boxes so that conduits enter and exit across from each other on opposite sides of the box so as to facilitate straight line pulling of cable through the box. Do not use pull boxes in lieu of conduit bends, except as necessary by design or to meet constructability constraints.
6. When directional transition of the cables is necessary through a box, land conduits on the box so that they permit the largest possible bending radius for those cables that will pass through the box.
7. Coordinate all work with all other trades prior to commencement of the work. Do not use access doors unless special prior written permission is granted from the Owner's Representative. Install pull boxes, junction boxes, etc. in areas that are accessible after construction. Do not install pull boxes or junction boxes above gypsum board, plaster or similar ceiling systems, nor above ductwork or equipment that renders them inaccessible.
8. Record junction and pull boxes on record drawings. Permanently mark and label (using methods approved by Owner's Representative) junction/pullboxes as to which types of electrical services are within.

C. Repair and Patching: Holes and other penetrations into building surfaces or structure that are created to facilitate pathway installation but that are not ultimately used shall be filled, repaired, and restored to their original strength, appearance and integrity. Damage to building or property that occurs during the course of pathway installation shall be repaired and restored to its original condition prior to damage. Obtain review and approval of penetration sizes, means and methods from Design Professional and Owner's Representative for all proposed penetrations of structural elements prior to commencing with any related work.

D. Cover Plates: Provide gasketed stainless steel or post-fabrication hot-dipped galvanized steel cover plates over the openings of junction boxes and pull boxes. Provide blank wall plates for unused wall outlet openings, to match style and finish used for active wiring device locations in the same respective area.

E. Seals for Common Conduit and Raceways in Dissimilar Environments: Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points: Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces; Where an underground service raceway enters a building or structure; Where otherwise required by NFPA 70.

F. Insulation for Common Conduit and Raceways in Dissimilar Environments: Provide insulation on the exterior of conduit on the warm side of penetrations between dissimilar environments to prevent condensation from forming. Insulate with 1.5-inch polyisocyanurate closed cell pipe insulation with an overall PVC jacket for a minimum distance of 48” from the penetration. Applications include, but are not limited to, the following: Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces; Where otherwise required by NFPA 70.

G. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement, and for transformers and motors. Use LFMC in damp or wet locations.

H. Expansion-Joint Fittings:

1. Provide UL listed and labeled expansion fittings and appropriate couplings in metal raceways wherever structural expansion joints are crossed, wherever deflection is expected, where environmental temperature change may exceed 100 deg F with straight-run lengths that exceeds 100 feet, and as otherwise required to accommodate similar movement. Provide expansion fittings with ground bonding jumpers that are long enough to accommodate respective expansions and movement.
2. Provide expansion fittings with ground bonding jumpers that are long enough to accommodate respective expansions and movement. Install in each run of aboveground EMT, GRC/RMC and IMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
3. Install type and quantity of fittings that accommodate temperature changes of 155 deg F.
4. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
6. Type LFMC conduit may be used instead of expansion fittings in unfinished areas, using lengths of at least two (2) feet and no more than six (6) feet. Provide bonding jumpers.

3.3 INSTALLATION OF EXPOSED CONDUIT OUTDOORS

A. Only install conduit exposed outdoors when it is impossible to do otherwise, or only if specifically indicated for such installation case-by-case elsewhere in documents. Installation convenience, financial considerations, lack of coordination with other trades and similar rationale are not sufficient reasons for doing so. In cases where conduits must be installed at outdoor locations, de-rate conductors and modify conduit sizes per NFPA 70 (National Electrical Code, NEC). Provide expansion fittings, which are Listed and labeled for the respective applications, at all building expansion joints and at maximum distances of 100 feet. Paint all such conduits with at least two coats of UV-resistant weatherproof paint. Provide colors to match respective surrounding surfaces; submit colors to Design Professional for review in advance of procuring paint.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Coordinate trench locations in reference to other underground utilities. Ensure no other utilities are placed directly above or below, when parallel to conduits.
2. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
3. Excavate trench bottom to provide firm and uniform support for conduit. Also see details and/or notes on drawings for additional trench-related information and for applications where concrete (or other) encasement is required.
4. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
5. Install manufactured RNC duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Provide GRC/RMC for risers, beginning below grade or slab and excluding the 90 degree fittings that connect to horizontal conduits below grade or slab, to above grade and slab except where terminating at utility poles, in utility pad-mounted transformer enclosures and cable pits, and in utility company pedestals. Couple GRC/RMC conduits to RNC ducts with adapters designed for this purpose.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."
7. Provide underground conduits at minimum of 24" below grade, slab or pavement as applicable (deeper where required by local utility company or prevailing codes and regulations), securely mounted on chairs when banked, with base in newly disturbed earth. Properly align ducts on chairs before backfilling. Provide heavy nylon pull-cord/drag-line (200 pound minimum strength) in empty conduits. Do not embed in slabs or pavement. Do not “scratch-in” just below slab or pavement.
8. Make changes in direction of raceway run with proper fittings that match raceway manufacturer.
9. Properly support and anchor raceways for their entire length with factory bases and intermediate spacers. Provide spacers at each coupling location, at each termination location, and at maximum five foot intervals between. Do not span any space unsupported. Provide end bells with rounded pulling surfaces at manholes, pull boxes and other end points of underground raceways.
10. Apply corrosion inhibiting compound before couplings are assembled for applications where metallic raceways are installed underground, in floors below grade, or outside. Draw up couplings and conduits sufficiently tight to ensure water-tightness. Provide steel rigid metallic conduit for applications where metallic conduits are installed below grade or slab.
11. Extend underground conduits that are capped at wall for future additions five feet beyond building.
12. Arrange excavation for exterior conduits so that:

    a. The lines are straight and true
    b. Grades required for drainage are maintained
    c. The tops of buried raceways are not less than 24" below finished grade

13. Seal PVC joints with product equivalent to Carlon Cement. Make solvent cemented joints in accordance with recommendations of manufacturer.
14. Install work in accordance with NFPA 70 and in compliance with local utility practices.
15. Provide full parity size green insulated ground wire in PVC runs, except for those used exclusively for optical fiber cables.
16. Do not field bend raceway sections, unless required radius exceeds that available from manufacturer. Where field bends cannot be avoided, use factory kit to perform the bends and follow factory instructions.

17. Encasement: See details and/or notes on drawings for applications where encasement is required.

3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances. 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. Install so cover surfaces will be flush with finished grade or pavement as applicable. Install service/feeder scale handholes with bottom below frost line below grade. Field-cut openings for conduits in closed-bottom units and in walls of units according to enclosure manufacturer's written instructions. Cut 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.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL – NOT USED

PART 2 - PRODUCTS

2.1 MISCELLANEOUS MATERIALS

A. Backfill and Fill Materials: Use excavated or borrowed material for backfill. Prior to backfilling, remove rock and gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetable matter, and other deleterious matter. Use gravel or stone where so specified on details on drawings, or otherwise included in specifications.

B. Nonshrink, Nonmetallic Grout: Provide premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout, recommended for interior and exterior applications.

C. Subbase: Subbase refers to the compacted layer used in pavement systems between the subgrade and the pavement base course material. Provide subbase consisting of graded mixture of crushed gravel, crushed stone, crushed slag, or sand.

2.2 CONTROLLED LOW STRENGTH MATERIAL (CLSM – “FLOWABLE BACKFILL”)

A. Description: Controlled-Low-Strength-Material (CLSM) is a material that has a specified compressive strength of 1200 pounds per square inch (PSI) at 28 days. This material is not concrete and is in a flowable state at the time of placement.

B. Materials: Provide CLSM mixture consisting of water, Portland Cement (Type I or II conforming to ASTM C-150, Type "F" fly ash, and fine aggregate. If fly ash is not used, provide CLSM using high dosages of an air entraining admixture to help flowability and lower strength for removability. Non-standard materials may be used only after receiving special permission from Owner’s Representative. Provide water used in mixing and curing that is as clean and free of oil, salt, acid, alkali, sugar, vegetable, and other substances injurious to the finished product as possible. Test water in accordance with the requirements to AASHTO T 26. Water known to be of potable quality may be used without testing. Use fine aggregates conforming to ASTM C 33 in CLSM.

C. Mix Design: Provide proportion of materials used in CLSM as follows.

1. Cement: 50-100 pounds (lbs) per cubic yard (cy)
2. Type "F", Fly Ash: 250-300 lbs/cy
3. Sand: 2700-2800 lbs/cy
4. Water: 400-500 lbs/cy
5. Other proportions may be used only after receiving special permission from Owner’s Representative.
6. Conform to the following flowability test: Fill a 3-inch diameter by 6-inch long open-ended cylinder with the mixture, then strike off to level. Remove the cylinder by pulling straight up and ensure the diameter of the CLSM, after spreading, is a minimum of 8-inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Subsurface conditions may have been investigated during the design of the project. If so, review reports of these investigations. Follow recommendations of these reports. Locate existing underground utilities in excavation areas, which are to remain. Support and protect these services during excavation operations. Contact utility owner immediately for instructions if unchartered or incorrectly charted utilities are encountered.

B. General Installation.

1. Coordinate trench locations in reference to other underground utilities. Ensure no other utilities are placed directly above or below, when parallel to conduits.
2. Locate junction and pull boxes so they remain accessible after all construction work is complete. Coordinate all work with all other trades prior to commencement of the work.
3. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.
4. Layout all proposed raceway routing, elevations, installation methods, etc. on coordination drawings and coordinate all proposed raceway routing with all affected trades prior to commencing with work. In addition, review the information with Owner and Design Professionals for all areas where work will be visible after completion of construction, to ensure a neatly organized installation occurs.
5. Use of synthetic or plastic “tie-wraps”, “zip ties”, “wire ties” and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.

C. Pathway Evacuation and Protection: Seal and protect raceways and boxes from moisture infiltration. Provide watertight fittings. Pressure or vacuum test below-grade conduits before and after concealing the conduits to ensure resistance to moisture ingress. Prior to the installation of cable:

1. Clean and vacuum boxes and conduits.
2. Remove solids or other hindrances that could impede its full utilization or that could damage cable during or after installation.
3. Remove liquid and moisture from the raceways. Blow out until raceway is dry, sufficiently that the installed cables will not be subjected to any contact with fluid or moisture.

D. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations. Properly restore streets, sidewalks, concrete and blacktop surfaces that were broken for installing piping.

E. Comply with codes in jurisdiction. Provide sloped sides, and shore and brace as required when trenching to achieve stability. Provide excavation and backfilling required for electrical work and consult with utilities prior to beginning excavation. Remove materials of every nature and description encountered in obtaining required lines and grades. Remove excess excavated earth materials from the site.

F. Where subsidence occurs at electrical installation excavations during a period of 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.2 EXCAVATION

A. Protection: Protect excavated openings with substantial railings, fencing, signage, shoring, and steel roadway plates in strict compliance with OSHA/NIOSH, with local Department of Transportation (DOT) standards, with authorities having jurisdiction, and as directed by Owner's Representative in field. Provide traffic detours per DOT standards during active construction work shift time periods. Provide related barricades, signage, portable flashing lights, etc. (per DOT standards) at specific locations as determined in field. Provide steel roadway plates, properly installed and anchored per DOT standards, over roadway cuts during inactive periods (i.e. between construction work shifts, while concrete is curing, and while flowable backfill is curing). Finish work affecting the roadways, and restore/pave roadway cuts, as quickly as possible after starting those segments of work. Carefully coordinate scheduling for roadway related work to allow adequate time for inspections and curing, while keeping overall related time to a minimum.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation. Remove shoring and bracing when no longer required. Install sediment and erosion control measures in accordance with local codes and ordinances.

C. Dewatering: Prevent surface water, subsurface water, and ground water from flowing into excavations and from flooding project site and surrounding area. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting/run-off areas. Do not use trench excavations as temporary drainage ditches.

D. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees. Remove from site, and legally dispose of, excess excavated materials and materials not acceptable for use as backfill or fill.

E. Trenching: Excavate trenches to the uniform width, sufficiently wide to provide ample working room. Excavate trenches to depth indicated or otherwise necessary to full project requirements. All trench widths indicated on drawings are minimum required widths.

F. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees Fahrenheit.

G. Backfilling and Filling: Place soil materials in layers to required elevations for each area classification listed below, using materials specified in Part 2 of this Section. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, and approval.
2. Recording locations of underground utilities.
3. Removing concrete formwork.
4. Curing of concrete.
5. Removing shoring and bracing, and backfilling of voids.
6. Removing trash and debris.

H. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, that are frozen, that contain frost, or that contain ice. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift. Compact each layer of backfill or fill material to 95 percent standard compaction.

I. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

J. Separately stockpile excavated topsoil adjacent to the excavated areas and trenches and utilize it in the final stage of backfilling operation. Grade exposed earth and other erodible areas to a reasonably uniform, and satisfactory, cross section and slope, as soon as practicable.

K. Excavation for Underground Electrical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and inspections. Excavate by hand areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

3.3 INSTALLATION OF CLSM

A. General: See details and/or notes on drawings for applications where encasement is required for underground conduits/duct banks. Transport product by mixer truck. Provide continuous agitation from mixing to placement. Retain records of all mixes, tests, etc. and include in Operation and Maintenance Manuals. Submit copies during construction if requested.

B. Forms: In general, unless directed otherwise in field or required otherwise by OSHA and/or other prevailing codes, regulations and standards, the sides of the excavated trenches may be used as forms for encasement. Otherwise, provide forms made of steel, wood, or other suitable material of size and strength to resist movement during encasement product placement, and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends. Do not remove forms for at least 48 hours after encasement product has been placed. Set forms to required grades and lines, rigidly braced and secured. Provide sufficient quantity of forms to allow continuous progress of work, and so that forms can remain in place at least 24 hours after

encasement product placement. Clean forms after each use, and coat with form release agent as often as required to ensure separation from encasement product without damage. Form areas that involve termination of spare conduits below grade, or that involve continuation of conduits by others, accordingly to accommodate easy future access to the ends of conduits for future extensions.

C. Expansion Joints: Provide pre-molded joint filler for expansion joints abutting any structure, and as otherwise recommended by concrete supplier.

D. Placement: Remove loose material from subbase surface immediately before placing concrete. Check subbase and forms for line and grade before placing concrete. Moisten subbase if required to provide a uniform dampened condition at time concrete is placed. Place product directly from the truck chute or pump it. Place product using methods that prevent segregation of mix. Use splash boards to divert the flow of product away from the trench sides, and to avoid dislodging soil and stones. Smooth surface by screeding after striking-off and consolidating product. Broom finish aprons around boxes and structures. Coordinate with Owner's Representative at least 72 hours prior to placing product. Line up product trucks as required to achieve one continuous pour for each pathway. Do not backfill until a minimum of 48 hours have passed. Protect product from damage until acceptance of work. Exclude traffic over affected areas for at least 14 days after placement.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 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: Provide black letters on an orange field, and indicate voltage.

C. 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 clear adhesive tape for securing ends of legend label.

D. Vinyl Labels for Empty “Spare” conduits: Provide labels with description of purpose, and location of opposite end, on each end of conduits provided for future.

2.2 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 cable size. Provide black letters on orange field for cables carrying circuits at 600 V and Less, and provide legend that indicates voltage and system or service type.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label. Provide preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 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 cable size.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-

laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (where permitted by NEC for large feeder and sub-feeder conductors).

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed using indelible process.

2.5 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.
4. Provide tape with printing that most accurately indicates respective type of service of buried cable.

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.

2.6 SELF-ADHESIVE LABELS

A. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated, installed level and plumb.

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes, installed level and plumb.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT AND FIELD NAMEPLATE IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting, black letters on a white background for normal applications, minimum letter height shall be 3/8 inch, installed level and plumb. Provide 1/16" thickness for units up to 20 sq. in. or 8" length; provide 1/8" thickness for larger units.

B. Provide white letters on a black background for normal power distribution system equipment.

2.9 FIELD IDENTIFICATION LABELS

A. Identification of Disconnecting Means: Provide pre-printed “as-built” nameplate identification labels at all service equipment to indicate the maximum available fault current. Provide in compliance with Article 110.24 (A) of NFPA 70.

B. Available Fault Current: Provide pre-printed “as-built” nameplate identification labels at each piece of power distribution equipment, each disconnecting means, etc. to indicate its purpose. Provide in compliance with Article 110.22 (A) of NFPA 70.

C. Circuit Directory/Identification: Provide pre-printed “as-built” identification at circuit sources, using directory cards intended for the purpose, for all circuits. Provide in compliance with Article 408.4 (A) of NFPA 70.

D. Source of Supply Identification: Provide pre-printed typewritten “as-built” nameplate identification labels at all electrical power distribution equipment that specifically indicates the exact source of the power supply that serves the respective equipment. Provide in compliance with Article 408.4 (B) of NFPA 70.

E. In addition to other labelling required herein or by NFPA 70, provide pre-printed “as-built” identification of the following at all service entrance equipment.

1. Potential Electric Arc Flash Hazards compliant with Article 110.16(A) of NFPA 70.
2. Nominal System Voltage.
3. Single-Phase, Three-Phase/Three-Wire or Three-Phase/Four-Wire as applicable.
4. Available fault Current at Overcurrent Protective Devices.
5. The Clearing Time of Service Overcurrent Protective Devices based on the available fault current at the service equipment.
6. The Date that the label was applied.

2.10 CABLE TIES

A. UV-Stabilized Cable Ties

1. Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.
2. Minimum Width: 3/16 inch.
3. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
4. Temperature Range: Minus 40 to plus 185 deg F.
5. Color: Black.

B. Plenum-Rated Cable Ties

1. Self -extinguishing, UV stabilized, one piece, self locking.
2. Minimum Width: 3/16 inch.
3. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
4. UL 94 Flame Rating: 94V-0.
5. Temperature Range: Minus 50 to plus 284 deg F.
6. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify final operational and as-built identity of each item before installing identification products. All equipment & system identification nomenclature shown on drawings and listed herein may be shown for general design and installation reference only. Field-verify the actual nomenclature prior to fabrication. Prepare record documents accordingly. Unless determined otherwise in field, provide text matching terminology and numbering of the contract documents.

B. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. No labeling is required for raceways with readily identifiable terminations within the same room.

C. 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.

D. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied. Coordinate installation of identifying devices with location of access panels and doors. Install identifying devices before installing acoustical ceilings and similar concealment.

E. Apply identification devices to surfaces that require finish after finish work is complete. Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors,

at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

H. Cable Ties: For attaching tags. Cut off excess lengths after installing ties. Use general-purpose type, except the following: Outdoors, UV-stabilized nylon; Indoors: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or envelope/encasement exceeds 16 inches overall. Install line marker for every buried cable, regardless of whether direct-buried or installed in conduit.

3.2 IDENTIFICATION DEFINITION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less: Identify with self-adhesive vinyl label. Locate at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas. Do not install in finished occupied areas.

B. Accessible Raceways and Cables within Buildings: Identify raceways, cables. junction and pull boxes of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows: Power.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use color-coding to identify the phase. Color shall be factory applied to conductor insulation or field applied for sizes No. 4 AWG and larger, if authorities having jurisdiction permit. These colors apply for factory-assembled cables as well as for individual insulated conductors. Use colors listed below for conductors.

1. Colors for 208/120-V Circuits:

    a. Phase A: Black
    b. Phase B: Red
    c. Phase C: Blue
    d. Neutral: White

2. Colors for 480/277-V Circuits:

    a. Phase A: Brown
    b. Phase B: Orange
    c. Phase C: Yellow
    d. Neutral: Gray

3. Colors for 120/240-V Circuits:

    a. Phase A: Black
    b. Phase B: Red
    c. Neutral: White

4. Color for Equipment Grounding: Green
5. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 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 signs including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes, or self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor designation.

G. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape. Install underground-line warning tape for both direct-buried cables and cables in raceway. Install detectable tape at trenches containing empty conduits and conduits containing optical fiber cable.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels. Comply with 29 CFR 1910.145. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access. For equipment with multiple power or control sources, apply to door or cover of equipment including.

K. Operating and Warning Instruction Signs: Provide pre-manufactured operating and warning signage if indicated on drawings and where required by NEC or local authority having jurisdiction. Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at applicable equipment.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Equipment: Self-adhesive, engraved, laminated acrylic or melamine label for normal conditioned areas, and mechanically-fastened engraved, laminated acrylic or melamine label for areas with adverse environments (outdoor, unconditioned, high humidity, detrimental vapors, etc.). Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
    b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    c. Select and install mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure. Secure to substrate with stainless steel fasteners on main switchboards and switchgear and in locations where adhesives cannot be expected to work long-term due to environmental conditions

2. Equipment to Be Labeled: (Project may not include all pieces of equipment.)

    a. Equipment Enclosures and Cabinets (including section, and including typewritten directory of circuits in the location provided by equipment manufacturer where applicable, and including clear description of upstream equipment and device from which the power originates).
    b. Access doors and panels for concealed electrical items.
    c. Monitoring and local/remote-controlling devices via engraved nameplates or wall plates as applicable.
    d. Other similar equipment designated by Owner's Representative or Design Professional in field.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For equipment, materials and systems specified in this section. Include product data, descriptive information, technical data, wiring diagrams, load restrictions, etc.

PART 2 - PRODUCTS

2.1 MANUAL LIGHTING CONTROL DEVICES – SEE SECTION 262726.00

2.2 AUTOMATED LIGHTING CONTROL

A. Photocells

1. Provide Tork #2107 (for 120/277 volt applications) and Tork #2104 (for 208/277 volt applications) photocells or equal by Intermatic, 2000W tungsten rated, 1800VA ballast rated, -40 to 140 degree F rated, fail-on, with contacts that remain closed from dusk to dawn (on at 1 to 5fc, off at 3 to 15fc). Provide delay of up to two minutes to prevent false switching due to vehicular lights or lightning. Provide mobile light level selector. Provide gasketed heavy duty die cast zinc housing and base. Determine exact mounting locations and adjustment requirements in field relative to structural and site conditions. Aim northward wherever not conflicting with artificial light sources.

B. Time Based Control - Multi-Purpose Time Clocks (7 Day): Provide Tork #T930I-E multi-purpose time clocks (or equal by Intermatic) with photocell initiation (where applicable) and 7-day/24-hour control with external accessibility of override controls. Provide 3-zone unit (1-timer control only, 1-photocell control only and 1-photocell control on/timer control off). Provide required external contactors, relays, etc. to render the control sequences fully operational. Verify zone control requirements in field prior to rough-in. Provide battery backup extended power carryover and one spare unopened battery.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation: Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.

END OF SECTION 260923

SECTION 262116 - LOW-VOLTAGE UNDERGROUND ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 ELECTRICAL POWER SERVICE

A. The electric service includes utility company transformer as indicated on drawings, furnished by local utility company, with secondary voltage as indicated on drawings.

B. Furnish and install all work in strict compliance with all requirements set forth by the utility company providing electrical service for the project. Procure all needed details and information directly from the utility company as required for complete operational installations. Furnish and install all electrical work accordingly. Such work includes, but is not limited to: Pads, bases, vaults, pits, manholes, metering, supports, conduit, wiring, connections, maintaining clearances, testing, inspections and ancillary work as applicable.

C. Determine available fault current from electric utility company and provide appropriately rated electrical service and distribution equipment to accommodate not only the initial transformer proposed by the utility company, but also a future larger transformer if applicable to allow for full usage of the electrical service capacity.

D. Where indicated in project manual, or where indicated on drawings, or where required by NEC, install ground-fault protection devices complying with electrical winding polarities indicated. Set field-adjustable GFP devices and circuit breakers for pickup and time-current sensitivity ranges as indicated, subsequent to installation of devices and CB's.

E. Provide minimum of two 5-inch empty primary conduits from utility distribution source to the pad. Provide concrete pad. Provide secondary ducts and cable. Provide a minimum of one spare secondary duct. Provide meter base, associated conduit(s), and current transformer cabinet if required. Provide all work per utility company requirements and standards. Utility company will furnish and install the transformer and the primary cables, and will make service transformer connections.

1.2 TELECOMMUNICATIONS SERVICE(S)

A. Provide two (2) 4” empty conduits (privately owned) per service (field-verify quantities and sizes with respective utility company), with drag lines, from the building plywood equipment board demarcation location(s) to the outdoor utility pole(s), as otherwise directed by utility operating company for service entrance(s) to building. Extend conduits at utility pole(s) 4 inches above final grade.

B. Provide a minimum of 12 inches of earth separation between telephone related conduits and other conduits, or minimum of 4" separation where encased in concrete. Provide minimum 200-pound test pull line in conduits. Install conduit at a minimum depth of 24 inches, and a maximum depth of 36 inches. Provide record documentation. Provide long sweeping bends for offsets, with radii not less than ten times the internal diameter of conduit, and with a maximum of 270 degrees of bends between pulling points. Provide flush grade mounted pull box (approved by local telephone company) if required bends exceed 270 degrees. Extend conduit entering the building interior 4 inches above finished floor elevation. Provide one (1) 3-cell fabric innerduct

assembly, equal to MaxCell Style 4G, in each conduit. Provide pre-lubricated incrementally marked lengths, and integral 1,250-pound pull tape (incrementally marked and color coded).

C. Provide a minimum 4 feet wide by 8 feet high by 3/4 inches deep plywood equipment board within building (painted on all sides & edges with 2 coats of nonconductive, fire retardant paint) for each service.

A. Provide two NEMA 5-20R 20A/120V SPD duplex receptacles (equal to Hubbell #5362_S series) for each service, connected to a common dedicated circuit, on the plywood equipment board of each service entrance

B. Provide minimum of one #6 AWG green-insulated ground conductor (in 3/4 inch EMT) from electrical power service entrance ground to each plywood equipment board. Terminate as directed by utility provider that is providing service.

C. Provide related work in compliance with state building codes, with local building codes, with National Electrical Code, with National Electric Safety Code, with EIA/TIA 569 (Commercial Buildings Standard for Telecommunications Pathways and Spaces), and with other codes and authorities having jurisdiction.

PART 2 - PRODUCTS: REFER TO APPLICABLE DIVISION 26 SECTIONS.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate with other electrical work, including utility company wiring, as necessary to interface installation of service entrance equipment work with other work. Provide service entrance conduits with sweep L's. Properly seal conduits, immediately upon installation, to prevent water, moisture, dirt, rodents, insects, etc. from entering ducts.

B. Prior to commencing with any service entrance related work, carefully coordinate installation of service work with affected utility companies, with Owner's Representative, with other trades, with affected entities, and with authorities having jurisdiction.

C. Provide tight system and equipment grounding and bonding connections for service-entrance equipment, and wiring.

END OF SECTION 262116

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type and size include rated nameplate data, capacities, weights, dimensions, minimum clearances, location and size of each connection, performance, etc.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Provide factory-assembled and -tested, air-cooled units for 60-Hz service, grain-oriented, non-aging silicon steel cores, and ratings for continuous operation at respective listed kVA.

B. Provide terminal enclosure, with cover, to accommodate primary and secondary coil wiring connections, and to accommodate electrical supply raceway terminal connectors. Provide terminal leads with connectors installed. Provide wiring connectors suitable for copper or aluminum wiring. Cushion-mount transformers with external vibration isolation supports.

C. Coils: Continuous windings without splices except for taps, one leg per phase, with brazed or pressure type internal coil connections. Provide Aluminum coils.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Taps for Transformers:

1. Smaller Than 3 kVA: One 5 percent tap above normal full capacity.
2. 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

3. 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

C. Features:

1. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150-degree C rise above 40 degree C ambient temperature.
2. Provide transformers with 10kV BIL ratings.
3. Energy Efficiency for Transformers: Complying with DOE 2016 Efficiency standard, and tested according to DOE 10 CFR Part 431: 2016, including Appendix A.
4. Enclosure: Ventilated, NEMA 250 Type 1 for indoor applications and Type 3R for exterior applications. Finish Color: Gray.

D. Low-Sound-Level Requirements: Maximum sound levels, when factory tested according to IEEE C57.12.91, as follows:

1. 9 kVA and Less: 45 dB
2. 30 to 50 kVA: 45 dB
3. 51 to 150 kVA: 50 dB 4. 151 to 300 kVA: 55 dB 5. 301 to 500 kVA: 60 dB 6. 501 to 750 kVA: 62 dB 7. 751 to 1000 kVA: 64 dB

PART 3 - EXECUTION

3.1 INSTALLATION

A. Maximum ground resistance shall be 5 ohms at location of transformer.

B. Construct concrete housekeeping pad bases, and anchor floor-mounting transformers according to manufacturer's written instructions, requirements in Section 26 05 29.00 "Hangers and Supports for Electrical Systems", and other related sections. Cushion-mount transformers with external vibration isolation supports.

C. Transformers locations are shown for schematic purposes. Determine exact location in field based on surrounding building conditions, work of other trades, factory recommendations, ventilation requirements, maintenance access, and requirements of the NFPA 70 (including working clearance requirements).

D. From the time of manufacture, through shipping/storage phases, keep transformers dry, free of condensation, and free of rapid temperature fluctuations. Do not store transformers outdoors. Maintain transformers at temperatures above ambient while in storage.

E. Provide local primary disconnect switch for each transformer, and local secondary overcurrent protection. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems." and in accordance with NFPA 250. Provide flexible metal grounding strap for grounding of core and coils. Provide final connections with an accurate torque wrench, and tighten to factory published torque values, and submit written documentation showing factory recommendations and actual values. Provide final connections to primary and secondary taps as necessary to fulfill project voltage requirements.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections: Provide testing and keep written and dated log for the following

1. “Hi-Pot” or "Megger", at factory at time of shipping.
2. "Megger", at job site, immediately prior to final connections.
3. Phase rotation and turns ratio, at factory at time of shipping.
4. Phase rotation and turns ratio, at job site, immediately prior to final connections.
5. Secondary voltage under no load, after installation.
6. Secondary voltage under full load, after installation.

3.3 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each provide bus configuration, current ratings, voltage ratings, SCCR Ratings, overcurrent protective device(s), surge suppression device(s), accessory, and components indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution
3. Siemens Industry, Inc.
4. Square D; a brand of Schneider Electric

B. Enclosures: Refer to electrical drawings and coordinate with field conditions for cabinet mounting types (i.e. flush, surface, flush and surface).

1. Rate for environmental conditions at installed location.
2. Hinged Front Cover: Entire front trim hinged to box, and with standard door within hinged trim cover. Provide dead front behind standard trim door, bolted in place, to cover bare wiring, lugs, bussing and terminal bars. Provide concealed hinges. Provide concealed hinges, secured with flush latch with tumbler lock and keyed alike.
3. Provide additional features where indicated on drawings or needed due to field or architectural conditions. Such features include, but are not limited to, the following.

    a. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
    b. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.

4. Panel and Trim Finish: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
5. Back Box Finish: Galvanized steel
6. Directory Card: Provide neatly typewritten circuit directory card for each panelboard upon completion of installation work. Include the actual room names/numbers that are selected for interior signage/designation.

C. Incoming Mains Location: Provide incoming main locations (top or bottom, or top and bottom) based on means and methods and conduit/raceway layouts that are planned for installation.

D. Phase, Neutral, and Ground Buses: Refer to electrical drawings, single line diagram and schedules for additional information on requirements for buses, as applicable.

1. Material: Tin-plated copper or aluminum.
2. Grounded (“Neutral”) Bus: Provide 100% rated bus with sufficient lugs to accommodate grounded conductors for all circuits and pole spaces.
3. Equipment Grounding Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box; minimum 50 percent rated. Bond to grounded (“neutral”) bus for service entrance applications only.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Future Devices: Provide all mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Fault Current Ratings

1. Provide electrical distribution related equipment with appropriately braced bussing and properly rated breakers, fuses, etc. for the available fault currents.

H. Provide panelboard branches as scheduled on the drawings. Provide circuit breaker panelboard bus assemblies with distributed (sequence) type bussing throughout, so that any two adjacent single-pole breakers, or spaces, are replaceable by a two-pole internal common trip breaker, and so that any three adjacent single-pole breakers, or spaces, are replaceable by a three-pole internal common trip breaker. This applies for branch breakers sized 15-amp through 70-amp inclusive, without disturbing any other breaker.

I. Provide dead-front safety type panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown. Provide with lug connectors approved for use with copper or aluminum conductors. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, schedules, field conditions, etc.

2.2 PANELBOARDS

A. Provide Distribution Panel construction for panelboard applications where indicated on drawings or where otherwise required based on power distribution requirements. Provide Panelboard construction for branch panelboards.

B. Provide circuit breaker panelboards unless indicated otherwise on drawings.

1. Circuit Breaker Branch Overcurrent Protective Devices: Bolt-on type, replaceable without disturbing adjacent units.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breakers (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Mounting: Designed to be mounted and operated in any physical position, and to be operated in a minimum ambient temperature of 40 degrees C.; with mechanical screw type removable connector lugs, AL/CU rated.
e. Size: Full size, no "tandem" or "split" breakers.
f. Position: All load-side box lugs of each breaker in the same gutter.
g. Common Trip: Common trip for multi-pole breakers so overload on one pole will trip all poles simultaneously. Provide multi-pole breakers with common trip (or with handle-ties, only if needed because breakers are existing) for applications where it is determined that a common disconnecting means is required for multi-wire branch circuits serving, or within, the same enclosure, outlet box, equipment, or device.
h. SWD Type: Provide for 15 and 20 ampere branch circuit breakers (UL Listed).
i. HACR Type: Provide for 15 through 70 ampere branch circuit breakers.
j. Spares: Place all spare circuit breakers in the ‘OFF’ position, provide with breaker locks, and schedule them as “Spare” on directory card.

2.4 ACCESSORIES

A. Provide panelboard accessories and devices including, but not necessarily limited to, overcurrent protection devices, ground-fault protection, etc., as recommended by panelboard manufacturer for ratings and applications indicated. Provide distribution equipment with ground bus bars. Provide a minimum of 20 handle, lock-on devices of the non-padlocking type for life safety, special systems and other essential circuits.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount top of trim 90 inches above finished floor unless top-most breaker handle would end up being above 79 inches in which case the top of trim shall be mounted so that the top-most breaker handle will be below 79 inches. Install overcurrent protective devices and controllers not already factory installed. Set field-adjustable, circuit-breaker trip ranges and other applicable settings. Arrange conductors in gutters into groups. Install filler plates in unused spaces.

B. Provide neatly computer-typed/printed circuit directory card for each panel upon completion of installation work. Include the actual room names/numbers that are selected for interior signage and/or designation. Scheduling shown on drawings is shown to indicate feeder and branch circuiting requirements. Determine exact numbering sequence of circuits in field after performing final balancing.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type include detailed product information, electrical characteristics, outputs, connection protocols, accessory components, enclosures, wiring diagrams, warranty, etc.

B. Training

1. Cover installation, maintenance, troubleshooting, programming, repair and operation of the system.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc. Provide barriers required for separating sections compliant with NFPA 70. Provide nameplates that identify loads/tenants that are compliant with prevailing codes, Owner's standards and utility company requirements.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. General

1. Furnish and install all work in strict compliance with all requirements set forth by the utility company providing electrical service for the project. Procure all needed details and information directly from the utility company as required for complete operational installations. Furnish and install all electrical work accordingly. Such work includes, but is not limited to: CT cabinets (bussed if necessary), meter bases/sockets, supports, conduit, wiring, connections, maintaining clearances, testing and inspections. Coordinate installation and connection of utilities and services, including provision for electricity-metering components. Locate and position meters in locations approved by the utility company, Design Professionals and Owner. Steady-state and short-circuit current ratings shall meet indicated circuit ratings.
2. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc. Meter will be furnished and installed by utility company. Provide metering-related work in strict accordance with utility company requirements.

B. Metering at pad-mounted transformer

1. Current transformers will be provided by the utility company within the secondary compartment of the utility company pad-mounted transformer. Provide (1) 2" empty underground conduit from utility transformer secondary compartment to the adjacent or

remote meter enclosure location. Install meter enclosures compliant with utility company requirements. In cases where the meter enclosures are not mounted to a structural wall, provide support structure for the meter in compliance with utility company requirements including concrete bases, galvanized heavy-wall steel concrete-filled pipe bollards (one 2-inch pipe behind each side of meter), and required ancillary supports and fittings for a complete installation. Install support structures for meters as close to the utility transformer as permitted by the utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide Series Combination Warning Labels, if applicable: Self-adhesive type, with text as required by NFPA 70.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type include electrical characteristics, configurations, ratings, markings, colors, etc.

1.2 GENERAL

A. Information regarding the following is included in other Division 26 specification sections and/or on drawings: weatherproof cover plates, special identification requirements, and occupancy sensors.

B. Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color selections with Owner's Representative.

C. Coordination: Receptacles for Owner-Furnished Equipment: Match plug configurations. Cord and Plug Sets: Match equipment requirements.

D. Definitions:

1. EMI: Electromagnetic interference.
2. GFCI: Ground-fault circuit interrupter.
3. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
4. RFI: Radio-frequency interference.
5. SPD: Surge protection device.
6. Tamper-resistant: This term and “safety type” shall be taken to mean the same thing for receptacles.

PART 2 - PRODUCTS

2.1 GENERAL

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below.

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper)
2. FSR Inc. (FSR)
3. Hubbell Incorporated (Hubbell)
4. Hubbell Incorporated; Wiring Device-Kellems (Hubbell)
5. Hubbell Incorporated; Wiring Device-Bryant (Hubbell)
6. Legrand
7. Leviton Mfg. Company Inc. (Leviton)

8. Lutron Electronics, Inc. (Lutron)
9. Pass & Seymour/Legrand (Pass & Seymour)
10. Wiremold/Legrand (Wiremold)

B. For receptacle circuits protected with 15A breakers, provide NEMA 5-15R equivalents for the devices specified in this section.

C. Provide equivalent quality devices by manufacturers listed in subparagraphs hereafter for cases where voltage, amperage and/or NEMA configurations that are indicated on drawings or, are otherwise required based on project conditions, differ from those specified herein.

D. Provide Weather-Resistant Receptacles with UL “WR” marking, compliant with NEC 406.8, for all applications in wet or damp locations.

E. Where GFI protected receptacles are shown on drawings, provide a separate GFI receptacle for each one shown. Do not feed downstream receptacles from load-side (GFI-protected) terminals of upstream receptacles.

F. Provide corrosion-resistant versions of receptacles specified below for industrial applications and applications in corrosive or potentially-corrosive environments.

G. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions: Connectors shall comply with UL 2459 and shall be made with stranding building wire; connectors are NRTL listed for intended use; connectors comply with the requirements in this Section; connectors are permitted by Authorities Having Jurisdiction.

2.2 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R (20A) or 5-15R (15A), UL 498, and FS W-C-596. Provide duplex and single specification grade receptacles, 2-pole, 3-wire grounding, self-grounding, green grounding screw, ground terminals and poles internally connected to mounting yoke, color coded base, 20-amperes, 125-volts, with metal plaster ears, back & side wiring, NEMA configuration 5-20R. Subject to compliance with requirements, provide one of the following (catalog numbers in subparagraphs below are for 20-A, heavy-duty, specification-grade, nylon-face devices; revise catalog numbers to require other configurations and ratings):

1. Cooper; 5351 (single), CR5362 (duplex)
2. Hubbell; HBL5351 (single), HBL5352 (duplex)
3. Bryant; 5351 (single), 5352A (duplex)
4. Leviton; 5351 (single), 5362 (duplex)
5. Pass & Seymour; 5351 (single), 5362 (duplex)

B. GFCI Receptacles, 125V, 20A: Straight blade, feed-through or non-feed-through type depending on application. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection. Subject to compliance with requirements, provide one of the following:

1. Cooper; VGF20
2. Hubbell; GF20#LA

3. Bryant; GF20#LA
4. Pass & Seymour; 2097
5. Leviton; 6490

2.3 WALL PLATES

A. Single and combination types shall match corresponding wiring devices. Provide metal plate-securing screws with head color to match plate finish. Provide factory markings on faces of receptacles that are controlled for energy management or building automation that are compliant with Article 406.3(E), including symbol and the word “Controlled”. Provide engraved wall plates where required by prevailing codes, indicated on drawings or indicated in Division 26 specifications.

1. Material for Finished Spaces: satin finish stainless steel, equal to Leviton Type 430 series
2. Material for Unfinished Spaces with surface-mounted outlet boxes: Galvanized steel
3. Material for Indoor Damp Locations: Gasketed satin finish stainless steel, equal to Leviton Type 430 series, with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant. Refer to Section 26 05 33.00.

2.4 FINISHES AND INDICATORS

A. Device Color (unless otherwise indicated or required by NFPA 70 or device listing):

1. General Wiring Devices: White.

B. Illuminated Indication: Provide illuminated face or indicator light versions of wiring devices specified herein where indicated as such on drawings and/or where required by prevailing code(s), to indicate that there is power to the device.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination with Other Trades: Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors: Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used. Do not strip insulation from conductors until right before they are spliced or terminated on devices. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire. The length of free conductors at

outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails. Existing Conductors: Cut back and pigtail, or replace all damaged conductors; Straighten conductors that remain and remove corrosion and foreign matter; Pigtailing existing conductors is permitted, provided the outlet box is large enough.

C. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
10. Install wiring devices only in electrical boxes that are clean; free from building materials, dirt, and debris. Install wiring devices after wiring work is completed. Install wall plates only after respective wall surfaces have received their final finish.
11. Consider locations indicated on the drawings to be approximate (unless specifically dimensioned on drawings, or unless spacings must comply with prevailing codes). Study the general construction with relation to spaces and equipment surrounding each outlet.
12. Do not use aluminum products in concrete.
13. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Support boxes independent of conduit.
14. Provide feed-through-type GFCI receptacles where downstream receptacles are fed from the line side of the GFCI receptacle.
15. Adjust locations of outlets, devices, etc. to suit arrangement of partitions and furnishings.
16. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates
17. Receptacle Orientation: Install receptacles so that the ground pin is oriented in a consistent manner throughout the facility, so that the orientation is compliant with all prevailing codes and regulations, and so that the orientation is acceptable to the electrical inspector. Where there is no existing building standard or other project requirement, install receptacles with ground pin down. Where receptacles are installed horizontally, install so that neutral connection faces up. Coordinate with AHJ and Owner.
18. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

3.2 TAMPER-RESISTANT RECEPTACLES

1. Provide tamper-resistant receptacles in compliance with NEC Article 406.12 for all applications. Install in all publicly-accessible spaces.

3.3 FIELD QUALITY CONTROL

A. Tests for Receptacles:

1. Line Voltage (120V): Acceptable range is 105 to 132 V.
2. Test for correct polarity and grounding.
3. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
4. Ground Impedance: Values of up to 2 ohms are acceptable.
5. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
6. Using the test plug, verify that the device and its outlet box are securely mounted.
7. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

B. Installed equipment will be considered defective if it does not pass tests and inspections. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest. Prepare test and inspection reports. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 EXTRA MATERIALS

A. Fuses: Furnish fuses equal to 10% of project quantity not exceeding (10) for each fuse size and type. Furnish no fewer than (2) for single phase applications and (3) for three phase applications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Mersen, Inc.
4. Littelfuse, Inc.

2.2 GENERAL REQUIREMENTS

A. Characteristics:

1. 50 through 60 Hz., with 200,000 RMS symmetrical interrupting current rating.
2. Voltage: Rate based on voltage of protected feeders, circuits and loads.
3. Provide rejection type fuses for fuses 1 ampere through 600 amperes.
4. Provide Hi-Cap, bolt type fuses for fuses 601 amperes through 6000 amperes.
5. Cartridge Fuses: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
6. Provide each fuse with clear factory markings indicating classification, characteristics, ampere ratings, voltage ratings, etc.

PART 3 - EXECUTION

3.1 FUSE APPLICATIONS

A. For protecting transformers, motors, circuit-breakers, service entrances, and distribution feeders above 600 amperes: Provide UL Class L Current-Limiting/Time-Delay Fuses. Provide fuses that are current-limiting, time-delay, dual-element type (with pure silver links), equal to Bussman #KRP-C (low peak).

B. For protecting service entrances, and distribution feeders 600 amperes and below: Provide UL Class RK-1 Current-Limiting/Time-Delay fuses. Provide fuses that are current-limiting, time-delay, dual-element type (with pure silver links), equal to Bussman #LPS-RK1 (600V) or Bussman #LPN-RK-1 (250V) as applicable.

C. For protecting general duty motors: Provide UL Class RK-5 Current-Limiting/Time-Delay fuses. Provide fuses that are time-delay, dual-element type (with pure silver links), equal to Bussman #LPS-RK5 (600V) or Bussman #LPN-RK-5 (250V) as applicable. Provide fuses that are rated 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

3.2 INSTALLATION

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

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse. Provide fuses as required to render related electrical, and electrically operated, equipment fully operational. Do not ship fuses installed in switches. Do not install fuses in equipment until wiring and equipment is ready to be energized, and until fuse sizes have been field-coordinated with wiring and equipment being protected. Field verify recommended fuse size and type from respective equipment installer and/or manufacturer prior to installing fuses for protection of specific equipment, motors, etc. Contact Design Professional if a conflict in fuse size or type arises between manufacturer's recommendations and above specifications.

C. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816.16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes. Include current ratings, voltage ratings, short circuit current ratings, accessories, features, etc.

PART 2 - PRODUCTS

2.1 SWITCHES

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Industry, Inc.
4. Square D; a brand of Schneider Electric.

B. Characteristics:

1. 50 through 60 Hz., with 200,000 RMS symmetrical interrupting current rating.
2. 250VAC rated, for projects with service-entrance line to line voltage not exceeding 240V.
3. 600VAC rated, for projects with service-entrance line to line voltage not exceeding 600V.

C. Type HD, Heavy Duty: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate required fuses where applicable, lockable handle with capability to accept three padlocks, interlocked with cover in closed position, single or double throw as indicated on drawings.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 ENCLOSURES

A. Enclosed Switches: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location. Refer to drawings for NEMA type. Provide the following enclosure types if not noted on drawings, or if not noted otherwise on drawings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: Type 3R.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted units with tops at uniform height unless otherwise indicated, or unless units must be stacked vertically, or unless field conditions otherwise dictate.

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

C. Install fuses in fusible devices.

D. Comply with NECA 1.

E. Install disconnect switches within sight of controller position unless otherwise indicated.

F. Size units according to load being served or as noted on drawings, whichever requirement is larger. Provide units with horsepower ratings suitable to the loads where applicable. Install fuses and accessories as necessary to fulfill requirements of each application as applicable.

G. Subsequent to completion of installation of equipment, energize circuits and demonstrate capability and compliance with requirements. Begin by demonstrating switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure and inspect interiors, inspect mechanical and electrical connections, inspect fuse installations, and verify accuracy of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

H. Provide fuses of types specified in Section 262813.00, and of ratings as indicated on drawings.

END OF SECTION 262816.16

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type include rated capacities, operating characteristics, electrical characteristics, maximum continuous operating voltage, weights and dimensions, wiring requirements, tested values, required OCPD and accessories, warranty, etc.

1.2 RELATED DOCUMENTS

A. See Section 26 27 26.00 “Wiring Devices” for surge protection receptacles if applicable.

1.3 DEFINITIONS:

A. SPD: Surge protective/protection device.

B. SPD Type: Used to describe the intended application location of the SPD, either upstream or downstream of the main overcurrent protective device of the facility.

1. Type 1 SPD – Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service equipment overcurrent device, as well as the load side, including watt-hour meter socket enclosures and intended to be installed without an external overcurrent protective device.
2. Type 2 SPD – Permanently connected SPDs intended for installation on the load side of the service equipment overcurrent device; including SPDs located at a branch panel.
3. Type 4 SPD – Recognized Component SPDs, including discrete components as well as component assemblies, which bear specific conditions of acceptability.

C. Enhanced EMI/RFI Filtering: Voltage independent, dedicated circuitry intended to mitigate the effects of switching or ringing surges that is specifically designed so that it can survive the surge environment. The performance of filtering circuitry is defined by the level to which it mitigates Ring Wave transients and can be demonstrated in the test results of IEEE C62.41.2-2002, Category A Ring Wave (2kV).

D. VPR (Voltage Protection Rating): A rating selected from a list of preferred values as detailed in the latest edition of UL 1449 and assigned to each mode of protection. The value of VPR is determined as the nearest highest value taken from a list of preferred values as detailed in the latest edition of UL 1449 to the measured limiting voltage determined during the transient-voltage surge suppression test using the combination wave generator at a setting of 6 kV, 3 kA.

E. MCOV (Maximum Continuous Operating Voltage): The maximum designated root mean-square (rms) value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.

F. Nominal Discharge Current (In): Peak value of the current, selected by the manufacturer from a list of values specified in the latest edition of UL 1449, through the SPD having a current wave shape of 8/20 where the SPD remains functional after 15 surges using the test procedure described in the latest edition of UL 1449.

G. Modes of Protection: Electrical paths where the SPD offers defense against transient overvoltages. e.g. Each Line to Neutral (L-N), Line to Ground (L-G), Line to Line (L-L) and Neutral to Ground (N-G).

H. Per Phase Ratings: 'Per-Phase' ratings for a three-phase Wye-connected SPD is the total surge current capacity connected to a given phase (Line to Neutral mode plus Line to Ground mode).

I. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

1.4 COORDINATION

A. Coordinate location of field installed SPDs to allow adequate clearances for maintenance and proximity to electrical bus in protected power distribution equipment. SPDs shall be rated for the class and category of service necessary for the application.

1.5 MANUFACTURER'S WARRANTY

A. Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within specified warranty period. Warranty Period: Minimum five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide all SPDs on this project by the same SPD manufacturer to ensure commonality and ease of Owner maintenance. Provide products manufactured by Surge Suppression Incorporated, Emerson Surge Protection or Current Technology (model numbers as specified further below). Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below.

1. Advanced Protection Technologies Inc. (APT)
2. ASCO Power Technologies (APT)
3. Current Technology
4. Eaton Corporation
5. Emerson Surge Protection
6. General Electric
7. LEA International
8. Leviton Manufacturing Co., Inc.
9. Siemens Industry, Inc.
10. Square D
11. Surge Suppression Incorporated

2.2 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application. Comply with latest editions of NFPA 70 and UL 1449.

2.3 SERVICE ENTRANCE SPD'S

A. Basis of Design:

1. Surge Suppression Incorporated, Advantage Series
2. Emerson Surge Protection, 400 Series
3. Current Technology, Current Guard Plus Series

B. SPDs: Listed and labeled UL acceptable to authorities having jurisdiction as complying with UL 1449 Type 1. Comply with UL 1283.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 200 kA. This value shall be independently tested by a 3rd party testing agency.

D. SPD shall have a Nominal Discharge Current Rating of 20 kA per mode for all modes. The Maximum Continuous Operating Voltage (MCOV) shall be at a minimum as follows:

1. 120/208 Wye shall be 150V
2. 277/480 Wye shall be 320V

E. The SPD shall have Voltage Protection Ratings (VPRs) for modes shown above as follows:

1. 120/208 Wye

a. L-N: 700V
b. L-L: 1,200V
c. L-G: 700V
d. N-G: 700V

2. 277/480 Wye

a. L-N: 1,200V
b. L-L: 2,000V
c. L-G: 1,200V
d. N-G: 1,000V

F. SPDs shall be or have the following features and accessories:

1. Indicator light display for power to device and protection status.
2. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
3. Surge counter.
4. Permanently-mounted, parallel connected.

5. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that “crowbar” (e.g. spark gaps, gas tubes, SCR’s, etc.) are not allowed.
6. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
7. The SPD shall be tested and listed by an UL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the protected power distribution equipment, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.
8. SPD system shall provide protection for all modes for a three-phase Wye-connected SPD.

2.4 DISTRIBUTION PANEL SUPPRESSORS (400 AMP AND LARGER)

A. Basis of Design:

1. Surge Suppression Incorporated, Advantage Series
2. Emerson Surge Protection, 400 Series
3. Current Technology, Current Guard Plus Series

B. SPDs: Listed and labeled UL acceptable to authorities having jurisdiction as complying with UL 1449 Type 1 or Type 2. Comply with UL 1283.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 100 kA. This value shall be independently tested by a 3rd party testing agency.

D. SPD shall have a Nominal Discharge Current Rating of 20 kA per mode for all modes. The Maximum Continuous Operating Voltage (MCOV) shall be at a minimum as follows:

1. 120/208 Wye shall be 150V
2. 277/480 Wye shall be 320V

E. The SPD shall have Voltage Protection Ratings (VPRs) for modes shown above as follows:

1. 120/208 Wye

a. L-N: 700V
b. L-L: 1,200V
c. L-G: 700V
d. N-G: 700V

2. 277/480 Wye

a. L-N: 1,200V
b. L-L: 2,000V
c. L-G: 1,200V
d. N-G: 1,000V

F. SPDs shall be or have the following features and accessories:

1. Indicator light display for power to device and protection status.

2. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
3. Permanently-mounted, parallel connected.
4. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that “crowbar” (e.g. spark gaps, gas tubes, SCR’s, etc.) are not allowed.
5. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
6. The SPD shall be tested and listed by an UL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.
7. SPD system shall provide protection for all modes for a three-phase Wye-connected SPD.

2.5 BRANCH PANEL SUPPRESSORS (LESS THAN 400 AMP)

A. Basis of Design

1. Surge Suppression Incorporated, Advantage Series
2. Emerson Surge Protection, 400 Series
3. Current Technology, Current Guard Plus Series

B. SPDs: Listed and labeled UL acceptable to authorities having jurisdiction as complying with UL 1449 type 1 or Type 2. Comply with UL 1283.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per mode shall not be less than 100 kA. This value shall be independently tested by a 3rd party testing agency.

D. SPD shall have a Nominal Discharge Current Rating of 20 kA per mode for all modes. The Maximum Continuous Operating Voltage (MCOV) shall be at a minimum as follows:

1. 120/208 Wye shall be 150V
2. 277/480 Wye shall be 320V

E. The SPD shall have Voltage Protection Ratings (VPRs) for modes shown above as follows:

1. 120/208 Wye

a. L-N: 700V
b. L-L: 1,200V
c. L-G: 700V
d. N-G: 700V

2. 277/480 Wye

a. L-N: 1,200V
b. L-L: 2,000V
c. L-G: 1,200V
d. N-G: 1,000V

F. SPDs shall be or have the following features and accessories:

1. Indicator light display for power to device and protection status.
2. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
3. Permanently-mounted, parallel connected.
4. Solid-state clamping components to limit the surge voltage and divert the surge current. SPD components that “crowbar” (e.g. spark gaps, gas tubes, SCR’s, etc.) are not allowed.
5. Capable of sustaining 115% of nominal RMS voltage continuously without degrading.
6. The SPD shall be tested and listed by an UL as a complete assembly to a symmetrical fault current rating greater than or equal to the available fault current at the location of installation at the connected panel, in accordance with NEC Article 285 and shall be marked with the short circuit current rating (SCCR). If the available fault current is unknown, then the SCCR of the SPD shall be 200 kAIC.
7. Incorporate EMI/RFI filtering based on the results of the Category A (2kV) Ring Wave Measured Limiting Voltages. Products utilizing basic EMI/RFI filter performance or tracking circuits in the L-N mode only are not allowed.

2.6 ENCLOSURES

A. Indoor Enclosures: NEMA 1 or better; Outdoor Enclosures: NEMA 4 or better.

B. Wire SPDs to a disconnecting switch or breaker, rated for minimum 30 amps (higher if/as recommended by equipment manufacturer), in the protected power distribution equipment per manufacturer’s installation instructions to ensure a means of disconnecting the SPD from the power source without de-energizing the protected power distribution equipment or the connected loads. Size circuit breaker rating so that breaker does not open prematurely when removing surge suppression from the circuit. The use of direct bus bar connected SPDs is expressly prohibited and will be rejected unless integral means is included to disconnect and remove SPD without having to de-energize respective protected equipment or upstream equipment.

C. Service Entrance Equipment: Provide externally-mounted units or units integrated within equipment in separately-barriered compartments. Install SPD components to the service entrance equipment as near as possible to the interior connection points; position the related branch breakers accordingly. Provide dual shielded, triple insulated multi-core power conductor from connection lug to SPD to minimize cable impedance.

D. New Power Distribution Equipment Other Than Service Entrance Equipment In Utility Rooms or Similar Unfinished Areas: Provide externally-mounted units or units fully integrated within equipment in separately-barriered or equivalent compartments, connected to power distribution equipment within the equipment protected. For fully integrated units, provide factory-installed integrated SPD units with collective assembly tested and UL Listed accordingly, and with the face of SPD unit (including LED’s, integral switches, etc. as applicable) visible and accessible from inside the door but outside of the dead front; size enclosure heights accordingly. Provide flush mounted enclosures where protecting flush mounted distribution equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install SPDs in strict accordance with manufacturer's instructions and the NEC. Comply with NECA 1.

B. Externally Mounted Units and Similar Applicable Installations: Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer in writing. In the case where the lead length exceeds 18 inches the installer must contact the SPD manufacturer for written installation assistance. Do not bond neutral and ground. Install conductors with direct paths to and from SPD devices avoiding sharp bends, loops and excessive lengths. Install externally mounted SPD components to the boxes of protected equipment as near as possible to the interior connection points; position or reposition the related branch breakers accordingly. Cut factory and field leads as required to minimize cable lengths for externally mounted units.

C. Wiring:

1. Install SPDs at service entrance on load side, with ground lead bonded to service entrance ground.
2. Use crimped connectors and splices only. Wire nuts are unacceptable.
3. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
4. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
5. Provide overcurrent protection (OCP) compliant with NFPA 70 for each SPD. Such OCP's that may be shown on drawings are shown for schematic purposes. Provide OCP's at ratings as recommended by SPD manufacturer for each application.

D. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over. Energize SPDs after power system has been energized, stabilized, and tested.

E. The SPD installation shall be certified by a licensed electrician that the installation is in accordance with the manufacturer's recommendations, NEC requirements and the requirements of the specification above. Any deficiencies noted shall be corrected by the Contractor. Provide written documentation of this inspection as part of the closeout documents/manual.

END OF SECTION 264313

SECTION 265100 - LIGHTING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For each type include detailed product information, light source, color temperature, color rendering index, lumen outputs, life, driver manufacturer, model and type, ceiling connection details, integral controls as applicable, drawings of custom fixtures or components, wiring diagrams, warranty, etc. Arrange luminaire submittals in booklet form with separate sheets for each luminaire, assembled by luminaire "type" in alphabetical order.

1.2 GENERAL

A. Provide all labor, materials, equipment, equipment, programming, services, etc. as required for complete and fully operational lighting and lighting control systems.

B. Definitions:

1. BF: Ballast factor.
2. CCT: Correlated color temperature.
3. CRI: Color-rendering index.
4. LER: Luminaire efficacy rating.
5. Lumen: Measured output of lighting source, luminaire, or both.
6. Luminaire: Complete lighting unit consisting of lighting source or sources, and some or all of the following components: optical control devices, contacts, mechanical components to support or attach the luminaire, and electrical and electronic components to start, operate, dim or control and maintain the operation of lighting source, and driving and transformation components.
7. Lighting Source: LED boards or equivalent LED assembly or, lamp (‘bulb”) for insertion into compatible socket, etc.
8. THD: Total harmonic distortion

1.3 QUALITY ASSURANCE

A. Obtain equipment and components from single manufacturer for luminaires of the same type and “family” style. Drawings indicate dimensions for typical equipment configurations including clearances between equipment and adjacent surfaces and other items. Ensure product complies with the layouts indicated in the drawings. Provide Components, Devices, and Accessories that are listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

A. Products: Subject to compliance with requirements, provide products indicated on Drawings. Provide products of one of the manufacturers listed in this section for products that are not defined on the Luminaire Schedule. Provide specification grade luminaires that comply with minimum requirements as stated therein. If a particular “type” does not include basis of design manufacturer or model number, provide "pre-approved equivalent” manufacturer’s and model numbers compliant with, and equivalent to: quality, performance, dimensions, and aesthetics as the respective basis of design for Design Professional review no less than five business days prior to bid due date.

B. Luminaires designated by letters are defined as indicated on the Luminaire Schedule.

C. Provide luminaires, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient light sources, contacts, reflectors, wiring, etc.. Ship luminaires factory-assembled, with components required for a complete operating installation.

D. Recessed Luminaires:

1. Comply with NEMA LE 4 for ceiling compatibility for recessed luminaires.
2. Provide recessed luminaires with necessary gypsum board, plaster frames, and surface trim.
3. Provide recessed luminaires that are constructed without rolled edges and that are post-painted.
4. Provide door frames on troffer style luminaires with spring latches on door frames.
5. Provide static air function for luminaires unless otherwise noted.
6. Provide luminaires that are non-IC constructed unless otherwise noted.
7. Provide junction boxes and serviceable components (driving and transformation component types, thermal protection devices, fuses, etc.) for recessed luminaires that are accessible for service and replacement from below the ceiling, without removing ceiling components.
8. Where plaster frames are inferred for luminaires (either by narrative, or by catalog number, or by application) interpret the actual function to mean for mounting within gypsum board, wet plaster or similar type inaccessible ceiling system. Field verify related requirements and provide required accessories, such as frames, accordingly.
9. Provide UL approved (listed and labeled) thermal protection per latest edition of NFPA/NEC for recess mounted luminaires.

E. Surface Luminaires: Install surface mounted luminaires with air spaces between luminaire and surface per latest edition of NFPA/NEC. Provide factory luminaire wiring that is per NEC, #16 AWG minimum. Wire luminaires having medium base and mogul base sockets with not smaller than No. 16 or No. 14 wire respectively in accordance with the latest requirements of the National Electric Code.

F. Review drawings and specifications of other trades to verify ceiling types, modules, and suspension systems appropriate to installation.

G. Luminaires: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5, 5A, 5B, etc. as applicable.

H. Metal Parts: Free of burrs and sharp corners and edges.

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

J. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit replacing lighting source(s) without use of tools. Design to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during servicing and when secured in operating position. Fabricate luminaires with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen generated noise.

K. Diffusers and Globes: Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation, UV stabilized. Provide at least 0.125 inch minimum lens thickness unless otherwise indicated. Glass: Annealed crystal glass unless otherwise indicated.

L. Factory-Applied Labels: Comply with UL 1598. Include recommended lighting sources, and driving and transformation components. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lighting sources are in place.

1. Label shall include the following characteristics:

a. "USE ONLY" and include specific lamp type.
b. CCT and CRI for all luminaires.

2.2 LIGHT EMITTING DIODE (LED) SYSTEMS

A. Light Emitting Diode (LED) Systems

1. LED Sources: Provide factory installed LED modules that are specifically designed for, and matched and mated to, the respective luminaire in which they are used. Provide LED modules that can easily be replaced in the field and are readily accessible for replacement. Provide color temperature as indicated in Luminaire Schedule.
2. LED Drivers; Provide factory installed driver(s) for the LED source utilized that are specifically coordinated to the LED source and luminaire in which they are used. Provide driver(s) having specific operating characteristics defined in the Luminaire Schedule. Provide driver(s) that can easily be replaced in the field and are readily accessible for replacement. Provide specification sheet for the specific driver as part of the Luminaire Submittal.
3. Total Harmonic Distortion (THD) Rating: Less than 20 percent. Provide factory-installed integral filtering system to ensure THD does not exceed 20 percent regardless of quantities and/or mixes with other manufactured LED systems.

2.3 LUMINAIRE SUPPORT COMPONENTS

A. Support fixtures in compliance with NEC. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.

C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.

E. For open ceiling spaces where fixtures are suspended and subject to damage or impact, provide an additional air craft cable support securely fastened to luminaire and structure to act as a safety chain providing a redundant support. Select cable based on manufacturer's recommendations, accounting for weight of luminaire assembly, external forces that could be applied, minimum 200% factor of safety, etc. Decorative pendants in finished spaces are exempt from this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Luminaires: Set level, plumb, and square with ceilings and walls unless otherwise indicated. Install lighting sources in each luminaire.

B. Temporary Lighting: If it is deemed necessary, and permitted by Owner's Representative and Design Professionals, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is substantially complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Driving and Transformation Components: Distance between the driving and transformation components and luminaire shall not exceed that recommended by the luminaire and driving and transformation components manufacturer. Verify, with manufacturers, maximum distance between driving and transformation components and luminaire.

D. Lay-in Ceiling Luminaires Supports: Unless required otherwise under other sections or unless project requirements and conditions require otherwise, grid may be used as a support element, subject to coordinating installations with ceiling system installer to ensure the ceiling system installer accounts for the weights of each luminaire and of all luminaires collectively, and installs specially marked and designated ceiling support components.

1. Install ceiling support system rods or wires for each luminaire. Locate not more than 6 inches from luminaire corners.
2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Install surface and recessed ceiling luminaires on grid and tile ceilings to agree with module of ceiling either displacing a tile, or unit on center of tile, or centered on grid lines. Install flush mounted luminaires properly to eliminate light leakage between luminaire frame and finished surface.

G. Do not locate splice or tap within an arm, stem, or chain. Provide wiring continuous from splice in outlet box of the building wiring system to driving and transformation component terminals in luminaires.

H. Provide Type MC Cable or wiring in minimum 1/2” diameter flexible metal conduit (with full parity sized green insulated equipment ground wire) for "drops" from building wiring system junction boxes to suspended ceiling mounted luminaires. Limit the length of these “drops” to 72”. Install "drops" to luminaires in gypsum board, and similar inaccessible ceiling systems, from identified accessible junction boxes.

I. Connect luminaires utilized for emergency egress lighting and exit signage ahead of switching and other controls. The only exceptions to this are photocell-only controls for outdoor emergency egress luminaires.

J. Provide luminaires and luminaire outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Owner's Representative and review by ceiling installer. Anchor luminaires installed in, or on, suspended ceiling systems in strict compliance with NEC, including advance coordination with the ceiling installer. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box luminaire stud. Fasten electrical luminaires and brackets securely to structural supports. Install luminaires level and plumb.

K. Where special mounting conditions are encountered, such as mounting to rounded columns or similar special circumstances, provide special custom factory-fabricated mounting means (i.e., brackets designed to conform with curvature of rounded columns, or to conform with similar special surfaces).

L. Provide stems and chains for luminaires as designated by the Owner's Representative where deemed necessary by the Owner’s Representative to achieve a functional and neat installation. Contact Owner’s Representative to determine pendant, stem, and chain lengths if mounting height is not indicated.

M. Provide plaster frames, or gypsum board frames, or similar kits for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

N. Wear clean white cotton gloves when handling the luminaires reflective and diffusing surfaces. Clean surfaces including dust, finger prints, paint, etc. with a clean dry cheesecloth after interior work has been completed. Remove plastic shipping bags from luminaires only after work in the respective area is complete.

O. Where applicable, verify that measured illuminance values comply with respective isolux (or equivalent) plot diagram values.

P. Provide full assembly for luminaires that are shipped with any loose components, regardless of who furnishes the luminaires.

Q. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to emergency source and retransfer to normal.

R. Burn-in all light sources that require specific aging period to operate properly, prior to occupancy by Owner.

S. Make adjustments and perform settings/programming to lighting controls so that all luminaires are fully operational compliant with design requirements and to the satisfaction of the Owner and Design Professionals.

T. Train Owner's maintenance personnel to adjust, operate, clean, re-lamp and maintain equipment, devices, controls, instrumentation, and accessories.

3.2 LIGHTING STANDARDS AND POST LIGHTS

A. Utilize belt slings or rope (not chain or cable) to protect finishes of poles and standards when raising and setting finished poles and standards. Fasten electrical poles, luminaires and brackets securely to structural supports.

B. Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling where applicable. Separately-fuse luminaires within the pole-base handholes.

C. Provide concrete base for each luminaire standard pole. Provide base that is reinforced, and, unless indicated deeper on drawings, of the depth recommended by the manufacturer. Provide galvanized steel washers, nuts and anchor bolts, in diameters, lengths and classes as directed by pole manufacturer. After ensuring that the poles are plumb, neatly fill the entire space between top of concrete bases and bottom of pole bases with grout. Provide poles with matching factory base covers ("skirts"). This applies even if not specifically indicated on Luminaire Schedule.

END OF SECTION 265100

SECTION 265668 - EXTERIOR ATHLETIC LIGHTING

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. For equipment specified in this section include product data of poles, cages, luminaries, lamps, drivers, lighting control system, lightning protection, structural foundation information, warranty, etc. Include dimensions, materials, weights, loads required clearances, method of field assembly, components, location and size of each field connection, and finish.
2. Complete the “Design Submittal Checklist” located within this specification section and include with submission.
3. Submit as separate submittal (PD) but at same time as Shop Drawings for this section.

B. Shop Drawings

1. Provide detailed scaled drawings of the field(s) with pole location dimensions. Submit as separate submittal (SD) but at same time as Product Data for this section.

C. Training

1. Cover installation, maintenance, troubleshooting, programming, repair and operation of the system.

1.2 GENERAL REQUIREMENTS

A. The purpose of these specifications is to define the performance and design standards for exterior athletic lighting. The manufacturer/contractor(s) shall supply lighting equipment to meet or exceed the standards set forth by the criteria within these specifications. The drawings may or may not include system specific diagrams and details from one of the pre-approved basis of design manufacturers listed below. These details are intended to describe the intent of the system and are not a replacement for actual shop drawings and system details that shall be provided by the manufacturer.

B. Provide all necessary equipment, as detailed on drawings and/or schedules, for a complete exterior athletic lighting and control system, including theatrical luminaires, fixtures and accessories. Provide all labor, materials, equipment, equipment, programming, services, etc. as required for complete and fully operational lighting and lighting control systems. Include the services of a qualified engineer regularly employed by the manufacturer of the system who shall check the installation and ensure its proper operation. No part of the system shall be energized before being checked and tested, and the installation approved by manufacturer.

C. Include all rigging required for mounting of the items specified within this section within the scope of work.

D. Performance Requirements: Playing surfaces shall be lit to an average target light level and uniformity as specified on the drawings. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified on the drawings. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Light levels shall be guaranteed not to drop below desired target values from the first 100 hours of operation for the maximum warranty period in accordance to IES RP-6-15, Maintained Average Illuminance. Hours of usage shall comply with those shown on the drawings.

E. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as shown on the drawings. Higher mounting heights may be required based on photometric report and ability to ensure the top of the beam angle is a minimum of 10 degrees below horizontal.

F. Project Specifics: Refer to drawings for table listing additional, more project specific, requirements associated with this project.

G. The primary goals of this outdoor athletic lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, the lighting system shall be designed such that the light levels are guaranteed for the duration of the warranty period.
2. Environmental Light Control: It is the primary goal of this project to minimize spill light and glare.
3. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, provide a remote on/off control system for the lighting system, including all costs to monitor for duration of warranty. Fields should be proactively monitored to detect fixture outages for duration of warranty. Include all communication costs in the bid.
4. Life-Cycle Cost: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate.

H. Definitions:

1. BF: Ballast factor.
2. CCT: Correlated color temperature.
3. CRI: Color-rendering index.
4. Lamp/Light Source: Lamp or LED board of luminaire as applicable.
5. LER: Luminaire efficacy rating.
6. Lumen: Measured output of lamp, luminaire, or both.
7. Luminaire: Complete lighting unit consisting of lamps or sources, and some or all of the following components: optical control devices, sockets, mechanical components to support or attach the luminaire, and electrical and electronic components to start, operate, dim or control and maintain the operation of lamps or LEDs with drivers.
8. THD: Total harmonic distortion

1.3 QUALITY ASSURANCE

A. Obtain poles, luminaires, lamps, controls, etc. through one source from a single manufacturer. The manufacturer shall have been producing lighting control equipment for at least ten consecutive years. In order to maintain a high standard of quality and service, the manufacturer

of the complete system shall also be the manufacturer of the control and dimming components used in this system.

B. Make ordering of new equipment for expansions, replacements, and spare parts available to end user. Make new replacement parts available for minimum of ten years from date of manufacture.

C. The manufacturer shall warrant their equipment to be free from defects in material and workmanship for a period of 2 years after the manufacturer's checkout of the installation and Owner's acceptance of the installation. Failures include, but are not limited to, the following:

1. Software: Failure of input and output to execute control commands.
2. Failure of modular relays to operate under manual or software commands.
3. Driver failure.
4. Damage of electronic components due to transient voltage surges.

D. The manufacturer shall have been producing exterior athletic lighting equipment and systems for at least ten consecutive years.

E. In order to maintain a high standard of quality and service, the manufacturer of the complete system shall also be the manufacturer of the control components used in this system.

1.4 WARRANTY AND GUARANTEE

A. Warranty: Manufacturer shall supply a signed warranty covering the entire system for a period of 25 years. Warranty shall guarantee light level will not fall below specified levels. A +/- 10% design/testing allowance will not be allowed. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term.

B. Warranty shall also cover lighting control cabinet and all electronics, lamp replacements, system energy consumption, monitoring, maintenance and control services, spill light control, and structural integrity. Warranty may only exclude checking/replacement of fuses, storm damage, vandalism, abuse and unauthorized repairs or alterations.

C. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and lamp outage for the warranty period from the date of equipment shipment. Individual lamp outages shall be repaired when the usage of any field is materially impacted.

D. Lamps/light sources shall be warranted for full replacement cost including labor for the warranty period. Provide as many lamp replacements as necessary to maintain the specified light levels for the entire warranty period without any additional cost to the Owner.

E. The alignment of the luminaire shall be warranted by the manufacturer against movement on the luminaire assembly for the warranty period from the date of installation. Labor and equipment charges for re-aiming during the warranty period shall be the responsibility of the manufacturer. Spill light levels at pre-determined points shall be guaranteed by the manufacturer to be at the level specified for this project for the warranty period.

F. Warranty Period Life Cycle Cost: As part of the submittal information required below in the “Design Submittal Checklist – 26 56 68.00 – Exterior Athletic Lighting” provide a life cycle cost calculation as outlined in the required submittal information.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components shall be listed by UL or equivalent independent testing laboratory acceptable to authorities having jurisdiction. Comply with UL 1598.

B. Provide luminaires, of sizes, types and ratings indicated; complete with, but not limited to, housings, light sources, ballasts/drivers, reflectors, starting components, lenses, hardware, raceway, wiring, controls, etc. for a complete operating installation. Ship luminaires factory-assembled, with components required for a complete operating installation.

C. Metal parts shall be free of burrs and sharp corners and edges. Doors, frames, and other internal accesses shall be smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Design to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Fabricate luminaires with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise

D. Provide fusing for each luminaire.

E. Factory-Applied Labels: Include recommended replacements for components. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place. Label shall include the following characteristics:

1. "USE ONLY" and include specific light source type.
2. CCT and CRI for all luminaires.

2.2 LIGHT EMITTING DIODE (LED) SYSTEMS

A. Light Emitting Diode (LED) Systems

1. LED Source: Provide factory installed LED modules that are specifically designed for, and matched and mated to, the respective luminaire in which they are used. Provide LED modules that can easily be replaced in the field and are readily accessible for replacement. Provide color temperature as indicated in Luminaire Schedule.
2. LED Driver: Provide factory installed driver(s) for the LED source utilized that are specifically coordinated to the LED source and luminaire in which they are used. Provide driver(s) having specific operating characteristics defined in the Luminaire Schedule. Provide driver(s) that can easily be replaced in the field and are readily accessible for replacement. Provide specification sheet for the specific driver as part of the Luminaire Submittal.
3. Total Harmonic Distortion (THD) Rating: Less than 20 percent. Provide factory-installed integral filtering system to ensure THD does not exceed 20 percent regardless of quantities and/or mixes with other manufactured LED systems.

2.3 MANUFACTURERS

A. It is the intent of these specifications that the Sports Field Lighting System and the Sports Field Lighting Control and Monitoring System manufacturer be the same manufacturer in order to have a complete sports field lighting system and control system from a single manufacturer. Such firms shall be regularly engaged in the manufacture of sports lighting equipment and lighting control equipment and ancillary equipment, of types and capacities necessary to provide the required functionality, whose products have been in satisfactory use in similar service for not less than ten (10) years.

B. Basis of Design Manufacturer: Musco Sports Lighting

C. Alternate Manufacturers, submit as substitution:

1. Carolina High Mast
2. Lithonia

D. Pre-Bid approval through a project addendum is required for all substitution requests. A complete submittal package based on “Design Submittal Checklist – 26 56 68.00 – Exterior Athletic Lighting” attached at end of this section shall be used for all substitution requests. This submittal must be furnished to the Design Professionals and Owner at least ten (10) business days in advance of the bid date to allow for proper review. Approved substitutions will be stated as such in the final addendum. Bids received that have not been approved through these guidelines will be rejected.

2.4 ENVIRONMENTAL LIGHT CONTROL

A. Spill Light Control: All fixtures shall utilize maximum spill light and glare control devices including, but not limited to, internal shields, louvers and external shields.

B. Photometric spill scans must be submitted indicating the amount of horizontal spill on the property lines. Maximum spill level is indicated on the drawings. Where not indicated, contact Design Professional to understand calculation requirements.

C. Photometric reports must be provided to demonstrate the capability of achieving the following specified performance. Reports shall be certified by a qualified independent testing laboratory with a minimum of five (5) years’ experience or by a manufacturer’s laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. ITL reports will remain confidential and be returned to the manufacturer after the bid is awarded.

2.5 LIGHTING SYSTEM CONSTRUCTION

A. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross arm assembly. Concrete poles will not be accepted. Direct bury steel poles and steel stub poles will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
2. Pre-stressed concrete base embedded in concrete backfill allowed to cure for 4 days before pole stress is applied. Alternate may be an anchor bolt foundation designed such

that the steel pole and any exposed steel portion of the foundation is located a minimum of 18 inches above final grade. The concrete for anchor bolt foundations shall be allowed to cure for a minimum of 28 days before the pole stress is applied.

3. All luminaires shall be constructed with a die-cast aluminum housing or external hail shroud to protect the luminaire reflector system.
4. Manufacturer will remote all ballasts and supporting electrical equipment in aluminum / stainless steel enclosures mounted approximately 10' above grade. The enclosures shall be touch-safe and include ballast, capacitor and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Safety disconnect per circuit for each pole structure will be located in the enclosure. Integral ballast fixtures will not be accepted.
5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.
6. All luminaires, visors, and crossarm assemblies shall withstand steady 115 mph winds and maintain luminaire aiming alignment
7. Controls and Monitoring Cabinet to provide on-off control and monitoring of the lighting system, constructed of NEMA Type 4 aluminum / stainless steel. Communication method shall be provided by manufacturer. Cabinet shall contain contactors labeled to match field diagrams and electrical design. Manual Off-On-Auto selector switches shall be provided. Refer to drawings as these selector switches may be remote. Where remote, provide a NEMA 4 hinged enclosure.
8. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, ballast and other enclosures shall be factory assembled, aimed, wired and tested.
9. Safety: All system components shall be UL Listed for the appropriate application.

B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the crossarms, pole, or electrical components enclosure.

C. Lightning Protection: Contractor shall provide integrated lightning grounding via concrete encased electrode grounding system as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A. If grounding is not integrated into the structure, the Manufacturer shall supply grounding electrodes, copper down conductors and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be not less than 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

2.6 STRUCTURAL PARAMETERS

A. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, the minimum pole mounting heights from the playing field surface shall be as noted in Section 1.2.B. Higher mounting heights may be required based on photometric performance of manufacturer's luminaires to meet spill and glare requirements.

B. Support Structure Wind Load Strength: Poles and other support structures, brackets, arms, bases, cages, anchorages and foundations shall be determined based on the 2012 edition of the International Building Code, wind speed of 115, exposure category C. Luminaire, visor, and cross arm shall withstand 150 mph winds and maintain luminaire aiming alignment.

C. Structural Design: The stress analysis and safety factor of the poles shall conform to AASHTO 2001 (LTS-4) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

D. Foundation Drawings: Project specific foundation drawings stamped and signed by a licensed registered Structural Engineer in the state where the project is located are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. The foundation design shall be based on soil borings when provided or soils that meet or exceed those of a Class 5 material as defined by 2006 IBC Table 1804.2.

2.7 CONTROLS AND MONITORING

A. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (Manual or Auto) and contactor status (open or closed)

B. Remote Lighting Control System: System shall allow Owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

C. The Owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields, to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

D. Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

E. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of lamp outages, control operation and service scheduling including re-lamping operations completed and scheduled. Mobile application will be provided suitable for IOS, Android and Windows devices.

F. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the Owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility
2. Current lamp hours: shall be tracked separately to reflect the number of hours on the current set of lamps being used, so relamping can be scheduled accurately.
3. Report hours saved by using early off and push buttons by users.

G. Communication Costs: Manufacturer shall include communication costs for operating the controls and monitoring system for the warranty period.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with installation and execution requirements set forth in Section 26 51 00.00 “Lighting”. Set luminaires level, plumb, and square with ceilings and walls unless otherwise indicated. Install light sources/lamps in each luminaire. Do not use theatrical lighting as temporary construction lighting. Distance between the driver and light source shall not exceed that recommended by manufacturer. Verify, with manufacturers, maximum distance between drivers and light sources.

B. Luminaires: Set level, plumb, and square. Install lamps/light sources in each luminaire.

C. Temporary Lighting: If it is necessary, and if permitted by Owner and Design Professionals, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete clean luminaires thoroughly (inside and out), and install new lamps/light sources.

D. Remote Mounting of Ballasts/Drivers: Distance between the ballast/driver and luminaire shall not exceed that recommended by ballast manufacturer; verify distances with manufacturer(s).

E. Do not locate splice or tap within an arm or similar component.

F. Where special mounting conditions are encountered, provide special custom factory-fabricated mounting means.

G. Wear clean white cotton gloves when handling the luminaires reflective and diffusing surfaces. Clean surfaces including dust, finger prints, paint, etc. with a clean dry cheesecloth after work has been completed. Remove plastic shipping bags from luminaires only after work.

H. Verify that measured illuminance values comply with respective isolux (or equivalent) plot diagram values.

I. Provide full assembly for luminaires, components and assemblies that are shipped with any loose components, regardless of who furnishes the luminaires.

J. Utilize belt slings or rope (not chain or cable) to protect finishes of poles and standards when raising and setting finished poles and standards.

K. Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling where applicable.

L. Fasten electrical poles, luminaires and brackets securely to structural supports.

M. Provide concrete base for each luminaire standard pole. Provide base that is reinforced, and, unless indicated larger and/or deeper on drawings, of the size and minimum depth and width/diameter as recommended by the manufacturer. Provide galvanized or stainless steel washers, nuts and anchor bolts, in diameters, lengths and classes as directed by pole manufacturer.

N. After ensuring that the poles are plumb, neatly fill the entire space between top of concrete bases and bottom of pole bases with grout. Provide poles with matching factory base covers ("skirts"). This applies even if not specifically indicated on Luminaire Schedule.

O. Separately-fuse luminaire within the pole-base hand holes, or at other locations pre-approved by Owner's Representative and Design Professionals.

P. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems." Install labels with panel and circuit numbers on inside of covers to junction boxes and similar connection points. Identify system components, wiring, cabling, boxes, cabinets, and terminals. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs. Label each device cable within 6 inches of connection to termination block where applicable. Create a directory to indicate loads served by each circuit; incorporate Owner's final designations. Obtain approval before installing. Use a computer to create directory; handwritten directories are unacceptable. Identify applicable components with device address.

3.2 AIMING AND FOCUS

A. General

1. Prior to scheduling of the vendor's field service representative for the final aiming and focusing of the theatrical lighting, confirm the following conditions:

    a. The Control System has been commissioned and operational and voltage to lighting is operating at factory-recommended levels.
    b. Light sources are operational. (Make available on site 10% or minimum of (4) spare light sources for each type being used for the lighting equipment installed in the event there are premature lamp failures during the aim and focus session. These spare light sources may only be utilized to replace any lamp failures during focus and may not to be taken into consideration as part of the Spare Lamp Stock required as stated in specification section 265113).
    c. Include rental costs and make arrangements to have an appropriate Self-Propelled Elevating Work Platform Vehicle and qualified operator on site and available to the vendor's field service representative prior to scheduling.
    d. Make arrangements for the Owner's Representative to be available on site at the time of the aim and focus session to assist in providing direction for specific aiming desired. Day and time of day shall be at the discretion of the Owner.

2. Additional Services: Where aim and focus sessions are requested by any party, in addition to the final aiming as outlined above, negotiate costs (if any) for these services and have contract acceptance prior to scheduling.

3.3 FIELD QUALITY CONTROL

A. Engage a factory-authorized service representative to perform Tests and Inspections.

B. Delivery Timing Equipment On-Site: The equipment must be on-site 4 to 6 weeks from receipt of approved submittals and receipt of complete order information.

C. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Design Professionals, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.

D. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period.
2. The contractor/manufacturer shall be responsible for an additional inspection one year from the date of commissioning of the lighting system.
3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

E. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed representative, the actual performance levels including foot-candles, uniformity ratios, and maximum kilowatt consumptions are not in conformance with the requirements of the performance specifications and submitted information, the manufacturer shall be liable to any or all of the following:

1. Manufacturer shall at his expense provide and install any necessary additional luminaires to meet the minimum lighting standards as defined here bringing the field condition into compliance. New structural calculations must be performed with the increased wind loading and if not complying with the requirements outlined here, either replace the existing poles or verify by certification by a licensed registered Structural Engineer that the existing poles will withstand the additional wind load.
2. Manufacturer shall minimize the Owner's additional long term fixture maintenance and energy consumption costs created by any additional luminaires by reimbursing the Owner the amount of $1,000.00 up front for each additional fixture required. This amount shall be provided to the Owner at substantial completion and Design Professional shall be notified in writing that this has occurred.
3. If field lighting cannot be brought into compliance, manufacturer shall remove the entire unacceptable lighting system and install a new lighting system to meet these specifications.

3.4 STARTUP SERVICE

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

1. Factory-authorized service representative shall make a minimum of 2 site visits, at night, to ensure proper system installation and operation.
2. Complete installation and startup checks according to manufacturer's written instructions.
3. Activate light fixtures and verify that all lamps are operating at 100 percent.

4. Burn-in all light sources that require specific aging period to operate properly, prior to occupancy by Owner.
5. Confirm correct communications wiring, initiate communications between devices and controls, and program the lighting control system according to approved configuration schedules, scenes, input override assignments, etc.

B. Coordinate with applicable installers and the Owner to facilitate the installation of a dedicated ISP address and data jack. Ensure that data jack is mounted within 12 inches of main panel. Label jack with ISP address. Connect data line from jack to panel.

C. Contact manufacturer at least 10 days before training or turnover of project. Have manufacturer remotely connect to the control system, run diagnostics and confirm system programming. Be available on site at the time of this remote connection to perform any corrections required by manufacturer.

D. Provide 24/7 telephone factory support that is available at no additional cost to the installer and Owner during and after the warranty period. Pre-program the system from the factory per plans and approved submittals, to the extent data is available.

E. Provide system programming including wiring documentation, switch operation, remote overrides. Program and document scenes and schedules.

F. Engage a factory authorized technician to confirm proper installation and operation of lighting control system components. Provide a written statement verifying that the system meets system requirements including the following.

1. Confirm entire system operation and communication to each device.
2. Confirm operation of individual relays, switches, sensors, etc.
3. Confirm system programming, settings, etc.
4. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system. Confirm that sensors are located, installed, and adjusted as intended by the factory and the contract documents.
5. Sensors are operating within the manufacturers specifications.
6. Sensors and controls interact as a complete and operational system to meet the design intent.
7. Engage factory-certified field service engineer to perform a site visit to ensure proper system installation and operation under following parameters:

    a. Qualifications for factory-certified field service engineer:
        1) Minimum experience of 2 years training in the electrical/electronic field.
        2) Certified by the equipment manufacturer on the system installed.

    b. Make a visit upon completion of installation of modular dimming control system:
        1) Verify connection of power feeds and load circuits.
        2) Verify connection and location of controls.
        3) Perform final programming of system data.
        4) Verify proper connection of digital control links.
        5) Verify proper operation of manufacturers interfacing equipment.
        6) Obtain sign-off on system functions.
        7) Train users on system operation.

G. Provide system programming including wiring documentation, switch operation, remote overrides. Program and document scenes and schedules.

3.5 ADJUSTING

A. Make adjustments and perform settings to lighting control systems so that all luminaires are fully operational compliant with design requirements and to the satisfaction of the Owner and Design Professionals. Provide remote connection software at no added cost to system Owner.

B. Provide additional remote programming at no additional cost as required by the installer and Owner for the operational life of the system.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support and programming support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software. Provide at least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, clean, re-lamp and maintain equipment, devices, controls, instrumentation, and accessories, and to use and reprogram lighting control systems as applicable. Provide minimum of eight hours over two days of factory on-site training.

B. Additional Training Visit: System Manufacturer shall provide 1 day additional on-site system training to site personnel.

3.8 SYSTEM COMMISSIONING AND TESTING

A. General: Notify vendor in writing, at least 21days prior to requested startup date, that the system is ready for startup. Bear costs of additional or repeat visits due to delay, lateness, or negligence on the part of the installer. Prior to operational checkout, confirm the following conditions.

1. All controls are installed and terminated per the vendor’s integration drawings.
2. Availability of Owner’s staff for instruction.
3. Space is clear of workmen and may be blacked out for extended periods.
4. Building and equipment feeders are energized.
5. HVAC systems are operational in control booths/areas and Equipment Spaces
6. Luminaries are installed and connected to the control system to confirm that individual controlled circuits are in operational order.
7. All equipment is cleaned and ready for operational check-out.

B. Testing: The vendor’s Field Service Representative shall complete the following.

1. Inspect the installation for conformance to vendor’s instructions.
2. Confirm all wiring runs and termination and make notes as required.
3. Make notes and diagrams as needed for completion of As-Built Documents as specified elsewhere in this section. Make note of any deviations from vendor’s directions.
4. Measure incoming voltages at the dimmer rack and record.
5. Configure equipment, controls and other components for proper operation.
6. Test all control stations, consoles and auxiliary controls for proper operation.
7. Replace any equipment not operating as specified.

C. Training: A knowledgeable representative of the vendor shall instruct the Owner's Staff or Representatives in the operation and maintenance of the system. This instruction session shall be scheduled to last a minimum of four hours. While it may be possible to schedule this instruction session to coincide with the system checkout, such coincidence shall not be assumed.

3.9 MAINTENANCE

A. Manufacturer shall be capable of providing on-site service support within 24 hours anywhere in continental United States (and within 72 hours worldwide except where special visas are required). Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup.

B. System Optimization Visit: System Manufacturer shall visit site 6 months, scheduled at the convenience of the Owner, after system start-up to evaluate system usage and discuss opportunities to make efficiency improvements that will fit with the current use of the facility.

END OF SECTION 265668

DESIGN SUBMITTAL CHECKLIST – 26 56 68.00 – EXTERIOR ATHLETIC LIGHTING
ALL ITEMS LISTED BELOW ARE MANDATORY AND SHALL COMPLY WITH THIS SPECIFICATION. THIS COMPLETED FORM SHALL BE SUBMITTED BY ALL MANUFACTURERS WISHING TO PROVIDE THEIR PRODUCT.

Included	Tab	Item	Description
	A	Letter/ Checklist	A list of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number.
	B	Lamp/Light Source Data Sheet	Manufacturer shall submit lamp data sheet, as outlined in this specification. Lamp manufacturer _____ Lamp life in hours -_____Hours Initial lamp lumen value -_____Lumens Lumen value at end of life -_____Lumens Repeat this table for each lamp type used. Provide a lumen maintenance curve for each lamp used to verify the above number.
	C	Field Lighting Design and Calculations	Lighting design drawings for each field must display the following: a. Field Name, date of design, design prepared by, and any other pertinent data. b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified. c. Pole height, pole foundation above/below field, number of luminaires per pole d. Luminaire information (wattage, lumens, optics). e. Height of light test meter above field surface. f. Calculation summary showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance and uniformity gradient; number of luminaries, total kilowatts, average tilt factor, light loss factor. g. Calculation Note: Calculation summary must use lumen value at end of life with 1.0 Light Loss Factor (LLF) or initial lamp lumens and a 0.65 Light Loss Factor (LLF) for all calculations.
	D	Independent Test Report	Provide an independent test report certifying the system meets the light level requirements throughout system life and verifying the specified field performance.
	E	Warranty & Performance Guarantee	Provide written warranty information including all terms and conditions as outlined in specification. Include performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements as outlined in specification at no expense to the Owner.
	F	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Design must be stamped by a Structural Engineer, licensed and registered in the state of the project.
	G	Control and Monitoring	Manufacturer shall provide written definition and schematics for automated control system including monitoring. Provide examples of system reporting and access for numbers for personal contact to operate the system.
	H	Project References	Manufacturer to provide a list of projects in the state of the project where the technology proposed for this project has been installed.
	I	Product Information	Complete set of product brochures for all components, including parts list and UL Listings.
	J	Non-Compliance	Manufacturer shall list all items in submittal that do not comply with the specification.
	K	Compliance	Manufacturer shall sign off below that all requirements of the specifications have been met and that the manufacturer will be responsible for any future costs incurred to bring their equipment into compliance for all items not meeting specifications and not listed above "Non-Compliance".

	L	Alternate System Energy Cost	Any system other than the basis of design that utilizes additional luminaires falls under above section "Field Quality Control - Correcting Non-Conformance". (_____Number of luminaires above the basis of design) x ($1,200) = $_____ This amount to be paid to Owner outside of bid to compensate the Owner for additional energy and maintenance costs resulting from additional luminaires.			
	M	Life Cycle Cost Calculation	Document life cycle cost calculations as defined in specification. Identify energy costs for operating the luminaires, maintenance cost for the system including spot lamp replacement, and group re-lamping costs. All costs should be based on the warranty period. If lamp replacement interval is greater than 3000 hours, manufacturer shall supply an independent test report with applicable recoverable light loss factor, initial, and end of life lumens. Life Cycle Cost Calculation:			
			Luminaire Energy Consumption (number of luminaires) x (kW demand per luminaire) x ($0.08 kWh rate) x (annual usage hours) x (warranty period)		$	
			Cost for Spot Re-lamping and Maintenance Over Warranty Period Included in bid and warranty / guarantee.	+	$	
			Cost to Re-lamp All Luminaires During Warranty Period Included in bid and warranty / guarantee.	+	$	
			Extra Energy Used Without Base Bid Automated Control System ($ Energy consumption from above) x (10%) if control system not included with the bid.	+	$	
			TOTAL 25-Year Life Cycle Operating Cost	=	$	

Manufacturer: Signature:

Contact Name: Date:_____/_____/_____

SECTION 266001 - ELECTRICAL COORDINATION OF OTHER DIVISION EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Product Data

1. Provide equipment electrical characteristic data for equipment specified under other divisions of this project for an electrical coordination review. Submit each type of equipment submittal as a separate submittal, for example: Pool Equipment, Kitchen Equipment, Gymnasium Equipment, Motorized Shades, etc. Each submittal should be label as 266001-PD-## where ## increments from 00 for each submittal.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 266001

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Protecting existing trees, shrubs, groundcovers, plants, and grass, to remain.
2. Removing existing trees, shrubs, groundcovers, plants, and grass as indicated on drawings.
3. Clearing and grubbing.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and removing site utilities.
6. Temporary erosion and sedimentation control measures.

B. Related Sections include the following:
1. Division 31 Section "Earth Moving" for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

A. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

1.4 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing 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 authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion and sedimentation control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."

1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and in accordance with sediment and erosion control Drawings.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within fenced area.
2. Do not permit vehicles, equipment, or foot traffic within fenced area.

3. Maintain fenced area free of weeds and trash.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Construction Manager's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
4. Use only hand methods for grubbing within tree protection zone.
5. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain to prevent corrosion.

3.7 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

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 Special Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns and grasses, and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks and pavements.

B. Related Sections include the following:

1. Division 31 Section "Site Clearing" for temporary erosion and sedimentation control measures, site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Division 32 Section "Turf and Grasses" for finish grading, including preparing and placing topsoil and planting soil for lawns.
3. Division 32 Section "Plants" for planting bed establishment and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Geotextile.
   2. Controlled low-strength material, including design mixture.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Geotechnical Testing Agency Qualifications: Owner will employ and pay a qualified, independent geotechnical testing laboratory to perform soil testing and inspection services during earthwork operations. Contractor shall be responsible for scheduling and coordination of these services.

C. Preexcavation Conference: Before commencing earthwork, meet with representatives of governing authorities, Owner, Architect, Structural Engineer, consultants, Geotechnical Testing Agency and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three working days prior to convening conference. Record discussions and agreements and furnish a copy to each attendee.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated.

   1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Construction Manager's written permission.
   3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide off-site borrow soil materials when sufficient satisfactory soil materials are not available from on-site excavations.

B. Satisfactory Soils: On site soils satisfactory to testing agency, containing less than 25% pulverized shale fragments, free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, organics, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Silt, highly organic soils, wood, roots, trash, debris, and other soils and materials not acceptable to the testing agency.

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; 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 2940; 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; 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; 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 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 0 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 0 to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33; fine aggregate, natural, or manufactured sand.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; as noted on drawings.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; as noted on the drawings.

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 earthwork operations.

B. Protect and maintain erosion and sedimentation controls during earthwork operations.

C. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. 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 utility trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 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.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

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

3.6 EXCAVATION FOR UTILITY TRENCHES

A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utilities follow below.

B. 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.

C. 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.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 SUBGRADE INSPECTION

A. Notify testing agency when excavations have reached required subgrade.

B. If testing agency determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Construction Manager, without additional compensation.

3.8 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 may be used when approved by Geotechnical Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Construction Manager.

3.9 STORAGE OF SOIL MATERIALS

A. 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.

3.10 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 and 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.

3.11 UTILITY TRENCH BACKFILL

A. For sanitary sewer, storm sewer, and water lines, please see the corresponding spec sections. For other site utility backfill, follow below.

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

C. 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.

D. 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.

E. 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.

F. Place and compact initial backfill material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit in non-paved areas.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the utility pipe or conduit in paved areas.

H. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

I. Place and compact final backfill of satisfactory soil to final subgrade elevation in non-paved areas.

J. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation in paved areas.

3.12 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 in accordance with sections 3.13 and 3.14 and as follows:

1. Under grass and planted areas, use satisfactory soil material or engineered fill.
2. Under walks and pavements, use satisfactory soil material (excluding topsoil) or engineered fill.
3. Under steps and ramps, use satisfactory soil material (excluding topsoil) or engineered fill.
4. Under building slabs, use satisfactory soil material (excluding topsoil) or engineered fill.
5. Under footings and foundations, use satisfactory (excluding topsoil) soil material or engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 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.

3.14 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, including 10 feet beyond all such areas, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
2. Under walkways, compact each layer of backfill or fill soil material at 100 percent maximum dry density.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent maximum dry density.
4. For utility trenches, compact each layer of initial and final backfill soil material at 100 percent maximum dry density.

3.15 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 Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn 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.

3.16 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Division 33 Section "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with 1 layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

3.17 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:

1. Where specified install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Shape subbase and base course to required crown elevations and cross-slope grades.
3. Place subbase 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.
4. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry density.

C. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 100 percent of maximum dry density.

3.18 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place drainage course 6 inches or less in compacted thickness in a single layer.
3. Place drainage 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.
4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. 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 to depth required; recompact and retest until specified compaction is obtained.

3.20 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 Construction Manager; 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.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Transport surplus soil material offsite to a legal disposal site off Owner’s property.

1. Remove waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

B. Excavated pavements shall be considered waste material and shall not be incorporated into fills.

END OF SECTION 312000

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Hot-mix asphalt patching.
2. Hot-mix asphalt paving.
3. Hot-mix asphalt paving overlay.
4. Asphalt surface treatments.
5. Pavement-marking paint.
6. Wheel Stops.

B. Related Sections:

1. Division 02 Section "Structure Demolition" for demolition, removal, and recycling of existing asphalt pavements, and for geotextiles that are not embedded within courses of asphalt paving.
2. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.
3. Division 32 Sections for other paving installed as part of crosswalks in asphalt pavement areas.
4. Division 32 Section "Concrete Paving Joint Sealants" for joint sealants and fillers at paving terminations.

1.3 DEFINITION

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS

A. Material Certificates: For each paving material, from manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Ohio Department of Transportation for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard DOT specifications do not apply to this section.

D. Preinstallation Conference: Conduct conference at Project site.

   1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

      a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
      b. Review condition of subgrade and preparatory work.
      c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
      d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

   1. Prime Coat: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
   2. Tack Coat: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
   3. Asphalt Base Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.
   4. Asphalt Surface Course: Comply with weather limitations as per the Ohio Department of Transportation Construction and Material Specifications.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, and 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

B. Asphalt Cement: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

C. Prime Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications.

D. Tack Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the plans.

E. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Paving Geotextile: As specified on plans.

C. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

D. Pavement-Marking Paint: ODOT Item 642.

1. Color: White, Yellow, & Blue.

E. Wheel Stops: Precast, air-entrained concrete, 3500-psi minimum compressive strength, see drawings for dimensions. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: 2 - Galvanized steel, minimum 1/2-inch diameter.

2.4 MIXES

A. Hot-Mix Asphalt: Use plant-mixed, hot-laid asphalt aggregate mixtures complying with the Ohio Department of Transportation Construction and Materials Specifications as indicated on the plans.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Proof rolling to be performed in presence of Architect or Construction Manager.
   2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of asphalt.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove all soft or unsatisfactory material. Recompact subgrade and any existing unbound- aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting against new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd..

   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

   1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/2 inch.

   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.4 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.5 PAVING GEOTEXTILE INSTALLATION

A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place next portion of the pavement section the same day.

3.6 HOT-MIX ASPHALT PLACING

A. Asphalt shall be placed in accordance with the Ohio Department of Transportation Construction and Material Specifications and as indicated on the plans.

B. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.

3. Spread mix at minimum temperatures as per the Ohio Department of Transportation Construction and Material Specifications.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

C. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints Per ODOT standards.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction within temperature specifications as set in the Ohio Department of Transportation Construction and Materials Specifications.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot- mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (total of all combined base courses).
2. Surface Course: Plus 1/4 inch, no minus.
3. Total Thickness: Where total thickness is of asphalt material is 3” or less, total pavement thickness is to be plus or minus 1/4 inch.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age per manufacturers recommendations before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply per ODOT 642 Specifications to a minimum wet film thickness of 20 mils.

3.11 WHEEL STOPS

A. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels a minimum of 7 inches into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.12 FIELD QUALITY CONTROL

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

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

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 according to ASTM D 979.

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 according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

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.

3.13 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321216

SECTION 321218 – SPECIALTY ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fine tolerance hot-mix asphalt paving as a substrate for sport fields, tennis courts, running tracks and field event areas.

B. Related Sections:

1. Division 31 Section "Earth Moving" for aggregate base courses and for aggregate pavement shoulders.
2. Division 32 Section “Asphalt Paving” for asphalt paving applications other than sport surface areas.
3. Division 32 Section “Synthetic Track Surfacing” for track surface to be applied over the asphalt surface and additional tolerance and repair requirements for the asphalt surface.

1.3 DEFINITION

A. Hot-Mix Asphalt (HMA) Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. Low Volume Asphalt Concrete: Mixture of dense (aka well) graded aggregate and specified type and grade of asphalt binder.

C. Surface Course: The low volume surface / wearing course shall be installed uniformly, to all finished lines and grades, smooth, durable, impervious thus protecting lower layers, and stable. Workmanship of the finished surface course shall be of the highest industry standards (NAPA, AI, ASBA, and NHI references) and applicable to sports surfaces prior to acceptance by the Owner.

D. Leveling Course: The course and location of the recreational area that requires placement of a variable thickness of HMA to ‘true up’ the area prior to placement of the surface course. This course has a Maximum Aggregate Size (MAS) no greater than that of the surface course.

E. Base Course: The lower courses of the pavement structure below the surface and leveling course with a MAS of between ¾” and 1”. Base courses shall not be allowed to remain without the surface course placed over an extended period of time and as approved by the engineer. The base shall be kept clean and must be completely dry before proceeding. If the minimum thicknesses shown above cannot be met then install surface mixture as base course.

F. Tacking / Priming: The process of applying one coat of emulsified asphalt to all horizontal and vertical surfaces of either an existing pavement for an overlay or between lifts while building an improved or new structure (tacking), or upon the aggregate base (priming).

1.4 SUBMITTALS

A. Submit the following **with proposal on Bid Day.**

1. Contractors proposed Asphalt Mixture Design sheets for HMA to be placed for each of the uses anticipated on the project; patching, base, leveling, and/or surface course. Design sheets shall include the following:
   a. All Aggregate Gradations and Quality Measurements
   b. Plot (0.45 power graph) of Final Aggregate Blend
   c. Bulk (dry) Specific Gravity of All Aggregates and Final Blend (Gsb) including worksheets for natural (virgin) as well as reclaimed asphalt pavement (RAP).
   d. Statement of Asphalt Binder (PG) being used in Asphalt Mixture
   e. Optimum % Asphalt Binder (Pb)
   f. Mix Air Voids at Optimum (Va)
   g. Bulk Specific Gravity of Mix at Optimum (Gmb)
   h. Theoretical Maximum Specific Gravity at Optimum (Gmm)
   i. Voids in the Mineral Aggregate (VMA) and Voids Filled with Asphalt (VFA)
   j. Dust to total AC Ratio
   k. All Design Data and associated Design Curves

B. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

C. Statement of understanding and compliance: Statement on contractor's letterhead indicating that the full requirements of the sport surfacing manufacturer and product to be used for this project have been read and fully understood and that all required substrate tolerances and conditions required by the sport surfacing manufacturer will be provided. Attach letter to a copy of the detailed requirements of the sport surfacing manufacturer for the specific product to be installed.

1. Contractor to complete "Test Preparation of Asphalt for Installation of Surface and Release Form" before installation of Miracle Field surface.

D. Asphalt Placement Work Plan including but not limited to paving pass widths, paving directions, site access, and timing/coordination of athletic equipment (tennis net posts, vault boxes, fencing, etc.).

E. Qualification Data: Qualified manufacturer shall provide the following:

1. Approved vendor certificate for the locality (state/county/city, et. al) where work is being performed.
2. Quality Control manual for material production oversight and testing measures being performed both at the asphalt plants as well as on the job site.

F. Qualification Data: For qualified installer including list of contact references. Installer shall provide the following:

1. Quality Control manual for material production oversight and testing measures being performed both at the asphalt plants as well as on the job site.
2. List/Organization chart showing personnel responsible for use of equipment and actions of the crew on the grade while paving and compacting asphalt.

G. Material Certificates: For each paving material, from manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Installer Qualifications: A firm that employs workers trained and experienced in the requirements specific to sport surface installations and who has completed hot-mix asphalt paving for sport surface installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance. Contractor must provide in writing a list of 10 projects of similar scope completed in the last 5 years

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of The Ohio Department of Transportation Construction and Material Specification for asphalt paving work.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt sport paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review condition of subgrade and preparatory work.
c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Grade Control: Establish and maintain required lines and elevations.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the Drawings.

B. Aggregates known to cause rust spots or pop-outs including but not limited to steel slag, iron pyrite, and/or dust balls, are **not** permitted in the asphalt.

C. Course Aggregates: Shall be sound, angular crushed stone or crushed gravel. Shall also have a minimum fraction of 85% / 75% crushed faces.

D. Fine Aggregates: Shall be well graded, moderately sharp to sharp (angular) sands. Shall also have an angularity > 40% with no more than 20% natural sand.

E. Reclaimed Asphalt Pavement (RAP) is **not** permitted in the asphalt.

F. Reclaimed Asphalt Shingles (RAS) is **not** permitted in the asphalt.

G. Recycled concrete is **not** permitted in the asphalt.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the Drawings.

B. Prime Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the Drawings.

C. Tack Coat: Use materials complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the Drawings.

D. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

C. Paving Geotextile: As indicated on Drawings.

D. Joint Sealant: ASTM D 6690 or AASHTO M 324, Type II or III, hot-applied, single-component, polymer-modified bituminous sealant.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixture complying with the Ohio Department of Transportation Construction and Material Specifications as indicated on the Drawings.

B. All HMA mix designs shall meet the following requirements, be less than 24-months old, and be in accordance with the Asphalt Institute Manual Series #2 (MS-2).

C. HMA mix designs shall meet one of the following requirements for compactive effort in the laboratory (Contractor's choice):

1. Marshall, 50-Blow
2. Superpave, 50-Gyration
3. Hveem, Low Volume Mix

4. Alternate Low Volume asphalt mix design may be allowed with the engineer's approval prior to time of bidding.

D. Base mixes shall have a minimum of 45% passing the #4 sieve.

E. Surface and Leveling mixes shall have a minimum of 45% passing the #8 sieve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades. Proof rolling shall be performed in the presence of Owner's Testing Agency.

1. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner's Testing Agency, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove all soft or unsatisfactory material. Recompact subgrade and any existing unbound- aggregate base course to form new subgrade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.25 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

3.4 PAVING GEOTEXTILE INSTALLATION

A. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

1. Protect paving geotextile from traffic and other damage and place aggregate base the same day.

3.5 HOT-MIX ASPHALT PLACING

A. General: Asphalt materials shall be placed in accordance with the Ohio Department of Transportation Construction and Material Specifications as indicated on the Drawings.

B. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature as per the Ohio Department of Transportation Construction and Material Specifications.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

C. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.6 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints per ODOT standards.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.7 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction within temperature specifications as set in the Ohio Department of Transportation Construction and Materials Specifications.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot- mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent nor greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment.

1. Bevel edges while asphalt is still hot; compact all edges thoroughly and without compactor lines using a hand or mechanical tamp.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.8 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (total of all combined base courses).
2. Surface Course: Plus 1/4 inch, no minus.
3. Total Thickness: Where total thickness of asphalt material is 3” or less, total pavement thickness is to be plus or minus 1/4 inch.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Sport Area: On the hot mix surface of the sport playing areas, grades shall be set at least fifteen (15) feet on center both longitudinally and transversely for each lift of HMAP that is placed.

    a. The finish surface shall be tested with a 10 foot straight edge placed on the surface. It shall have no deviation in excess of one-eighth (1/8) inch from the nearest point of contact.
    b. After the final lift is placed, water shall be applied to the hot mix surface and all "bird baths", low areas, depressions, high spots, seams, etc., shall be eliminated prior to the placement of the sport surfacing material and/or its appurtenances.
    c. The Sport Surfacing Sub-contractor shall approve the surface of the hot mix prior to final acceptance and subsequent surfacing material.
    d. All cost of all corrections to the sport surface shall be the responsibility of the asphalt installation contractor.

C. Ponding / Retained surface water: Not acceptable; considered defective pavement.

3.9 FIELD QUALITY CONTROL

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

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
2. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

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 according to ASTM D 979.

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 according to ASTM D 2041, and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

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.

3.10 WASTE DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow milled materials to accumulate on-site.

END OF SECTION 321218

Test Preparation of Asphalt for Installation of Surface

and

Release Form

THIS PROCESS IS TO BE COMPLETED AND SIGNED OFF ON DIRECTLY AFTER ASPHALT IS LAID.

THE ENTIRE PLAYING SURFACE IS TO BE FLOODED WITH WATER. AFTER A 10 MINUTE PERIOD SEE IF ANY WATER REMAINS ON THE FIELD.

IF THERE IS WATER REMAINING ON THE FIELD TAKE THE PAINT CAN SUPPLIED AND MARK THE ENTIRE PUDDLE AREA THAT IS DEEPER THAN 1/8".

IT SHALL BE SUPERVISED BY THE GENERAL CONTRACTOR AND THE LEAGUE D1RECTOR OR A LEAGUE REPRESENATIVE.

THIS RELEASE FORM WILL BE SIGNED BY THE GENERAL CONTRACTOR AND THE LEAGUE REPRESENTATIVE STATING THE TEST WAS COMPLETED AND REPAIRS WERE MADE (IF NECECESSARY) AS PER MANUFACTURES REQUIREMENTS BEFORE THE INSTALLATION OF THE SURFACE WILL BEGIN.

IF THERE ARE AREAS THAT REQUIRE ADDITIONAL ASPHALT WORK, ADDITIONAL CURE TIME WILL BE REQUIRED BEFORE SURFACE CAN BE INSTALLED.

REPRESENATIVE FROM THE SURFACE COMPANY WILL SET UP A TIME TO INSPECT THE ASPHALT AND SCHEDULE AN

BY SIGNING BELOW I AM ATTESTING TO THE FACT THAT

ON _____, THE MIRACLE FIELD LOCATED lN

_____

COMPLETED AN ASPHALT TEST

SIGNED ON _____

BY _____

TITLE _____

BY _____

TITLE _____

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Driveways and roadways.
2. Parking lots.
3. Curbs and gutters.
4. Walkways.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.
2. Division 31 Section "Earth Moving" for subgrade preparation, grading, and subbase course.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.4 SUBMITTALS

A. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

C. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.

4. Applied finish materials.

D. Jointing Plan

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.

C. ACI Publications:
1. Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.
2. Comply with ACI 330, "Guide for Design and Construction of Concrete Parking Lot" unless modified by requirements in the Contract Documents.
3. Comply with ACI 325, " Design of Jointed Concrete Pavements for Streets and Local Roads" unless modified by requirements in the Contract Documents.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete producer.
d. Concrete pavement subcontractor.

1.6 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

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. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

E. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

F. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.

G. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

H. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

I. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

J. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

K. Zinc Repair Material: ASTM A 780.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:

1. Portland Cement: ASTM C 150, Type I., gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material when steel reinforcement is called out in exterior installations.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. Dry, delivered pre-wetted and soaked.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM 1752 Vinyl full depth, with joint sealant.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi, unless otherwise indicated on the drawings.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 3 inches, or up to 5 inches with the use of a water-reducing chemical admixture.

C. 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:
1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements and as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

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; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades
1. Proof rolling to be performed in presence of Architect or Construction Manager.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, Construction Manager, or Geotechnical Engineer, and replace with compacted backfill or fill as directed.

C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain 2” minimum cover to reinforcement.

D. Install welded wire reinforcement 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.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

F. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, or through locations of intended contraction or isolation joints, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

C. Isolation (expansion) Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of not more than 30 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
6. Apply joint sealant / caulk.
7. Doweled Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. For thickness 5 inches or less construct contraction joints for a depth equal to at least one-third of the concrete thickness, for thickness greater than 5 inches construct contraction joints for a depth equal to at least one-quarter of the concrete thickness, as follows or match jointing of existing adjacent concrete pavement:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated, or when construction joint will experience heavy truck traffic . Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint. Dowels to be epoxy coated and sized per ACI 330.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed if plastic shrinkage cracking is of concern.

D. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

E. Comply with ACI 301 and ASTM C94, requirements for measuring, mixing, transporting, and placing concrete.

F. A one time add of water to concrete during delivery or at Project site is permitted but the water to cementitious material ratio must not be violated.

G. Do not add water to fresh concrete after testing.

H. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

I. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms.

Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

J. Screed pavement surfaces with a straightedge and strike off.

K. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

L. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

M. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.

N. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

O. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.

P. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven

floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated prior to placement and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 5000 sq. ft. or fraction thereof of each concrete mix placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

POLSECTION 321323 – SYNTHETIC TRACK SURFACING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes:
1. A porous, paved-in-place basemat track system at running track and field event surfaces applied to hot-mix asphalt or concrete paving.
2. A porous, paved-in-place basemat track system with structural spray coating at running track and field event surfaces applied to hot-mix asphalt or concrete paving.
3. An impermeable, paved-in-place basemat track system with structural spray coating at running track and field event surfaces applied to hot-mix asphalt or concrete paving.
4. An impermeable, paved-in-place basemat track system with a poured-in-place wearing layer at running track and field event surfaces applied to hot-mix asphalt or concrete paving.
5. A full depth, poured-in-place polyurethane synthetic track system with an embedded EPDM broadcast finish at running track and field event surfaces applied to hot-mix asphalt.
6. A full depth, poured-in-place polyurethane layered synthetic track system with an embedded EPDM broadcast finish at running track and field event surfaces applied to hot-mix asphalt.

B. Related Sections include the following:

1. Division 32 Section “Specialty Asphalt Paving” for synthetic track surfacing substrate.

1.3 DEFINITIONS

1.4 SUBMITTALS

A. Submit the following **with proposal on BID Day.**

1. Initial Samples: 3-inch square samples of **full range of colors** available for Architect’s selection

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

C. Standard printed specifications of the synthetic track surfacing system.

D. Installation process and requirements including curing process for hot-mixed asphalt paving base and any conditions of the new base that may limit track surface installation or affect quality of installation.

E. Approvals of the asphalt paving substrate and earth subgrade before the installation of the asphalt and concrete for the field events and track surface areas. **Prior to the beginning of**

installation, the manufacturer/installer of the asphalt / concrete shall inspect the subbase and supply a signed letter of Subbase Acceptance for the purpose of obtaining manufacturer's warranty for the finished synthetic track running surface.

F. Shop Drawings:

1. Dimensioned layout of the Miracle League Field, specific to this project showing pavement layout, pavement spot elevations at an interval adequate to ensure proper grading and slope throughout the running track.
2. Dimensioned layout of all lane markings.
3. Section profiles as necessary.
4. Details as necessary.

G. Maintenance Data: Products to include in maintenance manuals.

H. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

I. Warranty: Sample of manufacturer's standard form.

1.5 QUALITY ASSURANCE

A. Codes and standards follow the current guidelines set forth by the Miracle League Field.

B. The Contractor shall be prepared, at the Owners request, to provide any and all tests, laboratory analysis, maintenance information etc., as may be desired prior to the track surfacing selection.

C. The installer and manufacturer shall each have a minimum of 5 years experience with the installation of the specified system. The installer shall have installed at least 10 track surfaces of the specified system in the past 5 years.

D. The synthetic track surface shall be installed by an authorized factory trained applicator of the approved manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All synthetic surfacing material delivered to the site shall be randomly sampled and independently tested to ensure all materials meet specifications. The Contractor installing the materials shall submit an affidavit attesting to the requirements defined in these specifications prior to the commencement of any work.

B. The contractor installing the material shall be responsible for fully protected storage. Any material stored out doors shall be tested by installer for moisture contamination before installation.

1.7 WARRANTY

A. Upon completion of all line stripping, the Contractor shall submit to the owner a certification of accuracy prepared by a Registered Engineer, that the track striping and layout meets the Miracle League Field requirements and the requirements of the drawings and specifications.

B. All surfacing shall be guaranteed to the extent that the surfacing:

1. Has been manufactured and applied in accordance with these and the manufacturer's specification.
2. Will hold fast and/or adhere to the hot-mixed asphalt paving, edging, filler, and patches or overlay materials.
3. Will perform as specified in these specifications and the specification of the product manufacturer in the current standard product information literature and specification sheets.
4. Will not bubble, blister, fade, crack, or wear excessively during the guarantee period.
5. Warranty Period: Five (5) year manufacturers warranty against workmanship and material.

C. The Contractor shall, in the presence of the Owner, inspect the track and field events surfacing at the end of the first year of the guarantee period and each year thereafter until the end of the five (5) year period, or at any time requested by the Owner. Any defects in workmanship or materials (at no fault of the Owner) shall be repaired at the expense of the Contractor to the satisfaction of the Owner.

PART 2 - PRODUCTS

2.1 Base Bid: EverTop for Miracle League Fields

A. Install the EverTop for Miracle League Fields surface.

1. Manufacturers:

a. SurfaceAmerica

2. Color: As selected by the Owner.
3. Layout and paint all track lines and event markings as required and specified by current Miracle League Field rules.

B. Other provisions shall be as per specific manufacturer’s standard specifications and recommendations as submitted to the Architect. See “3-Part Specification: Evertop for The Miracle League Fields”.

2.2 Alternate 1: PebbleFlex 2.0 Surfacing

A. Install the PebbleFlex 2.0 surface.

1. Manufacturers:

a. Landscape Structures

2. Color: As selected by the Owner.

B. Other provisions shall be as per specific manufacturer's standard specifications and recommendations as submitted to the Architect. See "PebbleFlex 2.0 Surfacing Manufacturer's Specifications".

PART 3 - EXECUTION

3.1 PREPARATION

A. Sub-base requirements
   1. The Synthetic Surfacing System shall be laid on an approved sub-base. The asphalt substrate shall meet the conditions set forth in Specification Section 321218 – Specialty Asphalt Paving.
   2. For Miracle League Field certification the Miracle League Field criteria and regulations must be followed.
   3. The asphalt-paving contractor shall flood the surface per the Specialty Asphalt Specification.
   4. Any oil spills (hydraulic, diesel, motor oil, etc.) must be completely removed, either by chipping out or removing and replacing with new, keyed in asphalt. The minimum depth of any asphalt replacement shall be one inch. The curing time for the asphalt base is 14 days. It shall be the responsibility of the surfacing contractor to determine if the asphalt substrate has cured sufficiently prior to the application of polyurethane surfacing system.
   5. It shall be the responsibility of the synthetic track surfacing contractor to confirm that the asphalt substrate meets all design specifications, i.e. cross slopes, planarity and specific project criteria. After all the above conditions are met, the synthetic surfacing contractor must, in writing, accept the planarity of the asphalt-receiving base, before work can commence.

3.2 INSTALLATION

A. The synthetic surfacing system components shall be processed and installed by specially designed machinery and equipment. A mechanically operated paver with variable regulated speed and thermostatically controlled screed shall be used in the installation of the base mat. The wearing course shall be installed using automatic electronic portioning, which provides continuous mixing and feeding for an accurate, quality controlled installation.

B. No work shall take place when the ambient temperature is not above 50°F or when precipitation is impending. No work shall take place when conditions are not suitable to the installation of the system.

C. No traffic or other trades to be allowed on the finished surfaces for a period of one week following completion.

END OF SECTION 321323

3-Part Specification: **EverTop™ for The Miracle League Fields**

Surface America, Inc. • PO Box 157 • Williamsville, NY 14231
Phone: (800) 999-0555 • Phone: (716) 632-8413 • Fax: (716) 632-8324
info@surfaceamerica.com • www.surfaceamerica.com

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: Recreational and High Traffic Surfacing System for The Miracle League Field.

Specifier Note: Revise paragraph below to suit project requirements. If a reader of this section could reasonably expect to find a product or component specified in this section, but it is actually specified elsewhere, then the related section number(s) should be listed in the paragraph below. Add section numbers and titles per CSI MasterFormat and specifier's practice. In the absence of related sections, delete paragraph below.

Specifier Note: Site materials and methods, drainage, fencing, substrate preparation and similar work are provided by others and are described in other sections. Consult with manufacturer for specific substrate preparation requirements. Edit, retain or delete paragraph below to suit project requirements and specifier practice.

B. Related Sections: Division 2 Sitework Sections: Materials and Methods, Excavation, Asphalt Paving, Concrete Paving, Sub-Drainage, Storm Drainage and Fencing.

Specifier Note: Article below may be omitted when specifying manufacturer's proprietary products and recommended installation. Retain References Article when specifying products and installation by an industry reference standard. If retained, list standard(s) referenced in this section. Indicate issuing authority name, acronym, standard designation and title. Establish policy for indicating edition date of standard referenced. Conditions of the Contract or Division 1 References Section may establish the edition date of standards. This article does not require compliance with standard. It is a listing of all references used in this section.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.

2. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.

3. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.

4. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.

5. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.

6. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

Specifier Note: Article below should be restricted to statements describing design or performance requirements and functional (not dimensional) tolerances of a complete system. Limit descriptions to composite and operational properties required to link components of a system together and to interface with other systems.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide a 1 layer rubber-polyurethane surfacing system that has been designed, manufactured and installed to meet the following criteria:

1. Latex free (verification provided upon request).
2. Flammability (ASTM D2859): Pass.
3. Tensile Strength (ASTM D412): 60 psi (413 kPa).
4. Tear Resistance (ASTM D624): 140%.
5. Water Permeability: 0.4 gal/yd2/second.
6. Accessibility: Comply with requirements of ASTM F1951.

Specifier Note: Article below includes submittal of relevant data to be furnished by Contractor before, during or after construction. Coordinate this article with Architect's and Contractor's duties and responsibilities in Conditions of the Contract and Division 1 Submittal Procedures Section.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product data and installation instructions.

C. Verification Samples: Submit manufacturer's standard verification samples of 9" x 9" (229 x 229 mm) minimum.

D. Quality Assurance/Control Submittals: Submit the following:

1. Certificate of qualifications of the flooring surface installer.

E. Closeout Submittals: Submit the following:

1. Warranty documents specified herein.

Specifier Note: Article below should include statements of prerequisites, standards, limitations and criteria that establish an overall level of quality for products and workmanship for this section. Coordinate article below with Division 1 Quality Assurance Section.

1.05 QUALITY ASSURANCE

A. Qualifications: Utilize an installer approved and trained by the manufacturer of the surfacing system, having experience with other projects of the scope and scale of the work described in this section.

B. Certifications: Certification by manufacturer that installer is an approved applicator of the surfacing system.

Specifier Note: Article below should include specific protection and environmental conditions required during storage. Coordinate article below with Division 1 Product Requirements Section.

1.06 DELIVERY, STORAGE & HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage & Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C). Specifier Note: In article below, state physical or environmental limitations or criteria for installation such as weather, temperature, humidity, ventilation or illumination required for proper installation or application.

1.07 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). Do not install in steady or heavy rain.

Specifier Note: Coordinate article below with Conditions of the Contract and with Division 1 Closeout Submittals (Warranty) Section. Use this article to require special or extended warranty or bond covering the work of this section.

1.08 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

C. Proper drainage is critical to the longevity of the EverTop surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

Specifier Note: Coordinate subparagraph below with manufacturer's warranty requirements.

1. Warranty Period: 7 years from date of completion of work for aliphatic binder system; 5 years from date of completion of work for aromatic binder system.

PART 2 – PRODUCTS

Specifier Note: Retain article below for proprietary method specification. Add product attributes, performance characteristics, material standards and descriptions as applicable. Use of such phrases as "or equal" or "or approved equal" or similar phrases may cause ambiguity in specifications. Such phrases require verification (procedural, legal and regulatory) and assignment of responsibility for determining "or equal" products.

2.01 RECREATIONAL AND HIGH TRAFFIC SURFACING SYSTEM FOR THE MIRACLE LEAGUE FIELDS

Specifier Note: Retain or delete paragraph below per project requirements and specifier's practice.

A. Manufacturer: Ecore International, provided and installed by Surface America Inc.

1. Contact: PO Box 157, Williamsville, NY 14231; Telephone: (800) 999-0555, (716) 632-8413; Fax: (716) 632-8324; E-mail: info@surfaceamerica.com; website: www.surfaceamerica.com.

B. Proprietary Products/Systems. Recreational and High Traffic Surfacing System for The Miracle League Fields, including the following:

1. EverTop Primer:

a. Material: Polyurethane.

2. EverTop Surfacing:

a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) and polyurethane.

b. Thickness: Nominal 1/2" (12.7 mm), minimum 3/8" (9.5 mm), maximum 5/8" (15.9 mm).

c. Color: Miracle League National Recommendations: baseline, coaches’ boxes, pitcher’s mound, catcher area – 100% Terra Cotta; outfield, infield grass area, dugout – 60% Bright Green/40% Hunter Green.

Variations in color are acceptable. Black is commonly added to the color mix to disguise dirt and help reduce cost.

d. Dry Static Coefficient of Friction (ASTM D2047): 1.0.

e. Wet Static Coefficient of Friction (ASTM D2047): 0.9.

f. Dry Skid Resistance (ASTM E303): 89.

g. Wet Skid Resistance (ASTM E303): 57.

Specifier Note: Edit Article below to suit project requirements. If substitutions are permitted, edit text below. Add text to refer to Division 1 Project Requirements (Product Substitutions Procedures) Section.

2.02 PRODUCT SUBSTITUTIONS

A. Substitutions: No substitutions permitted.

Specifier Note: Specify proportions and procedures for site mixing materials. Mixing is the preparation of materials for use and is considered to be part of the manufacturing process.

2.03 MIXES

A. Required mix proportions by weight:

a. Top Surface: 22% polyurethane (ratio: 18% polyurethane divided by 82% rubber). 18% polyurethane, 82% rubber (based on entire rubber & polyurethane mix).

PART 3 – EXECUTION

Specifier Note: Revise article below to suit project requirements and specifier's practice.

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with the instructions and recommendations of the surfacing manufacturer.

Specifier Note: Specify actions to physically determine that conditions are acceptable to receive primary products of the section.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that substrate conditions are suitable for installation of the flooring surface system. New asphalt must be fully cured – up to 30 days. New concrete must be fully cured – up to 7 days.

B. Do not proceed with installation until unsuitable conditions are corrected.

C. Proper drainage is critical to the longevity of the EverTop surfacing system. Inadequate drainage will cause premature breakdown of the poured system in affected areas; and void the warranty.

Specifier Note: Specify actions required to physically prepare the surface, area or site or to incorporate the primary products of the section. Variation in the surfacing substrate, including cracks and surface irregularities, will be telegraphed through to the finish surface. Existing surface should be prepared to ensure an acceptable finish. EverTop is porous. Provide for drainage in applications where exposure to precipitation is expected. Consult Surface America, Inc., for more information on product limitations and recommended and excluded uses.

3.03 PREPARATION

Specifier Note: Retain, edit or delete paragraph below to suit project requirements and specifier practice.

A. Existing Substrate Preparation:

a. Remove from substrate any loose or delaminated material that would be deleterious to application of the new surface.

b. Fill cracks in existing concrete with cementitious patching compound.

B. Surface Preparation: Using a brush or short nap roller, apply primer to the substrate perimeter and

any adjacent vertical barriers, such as curbs or slabs that will contact the surfacing system, at the rate of 300 ft2/gal (7.5 m2/L).

Specifier Note: Coordinate article below with manufacturer's recommended installation requirements.

3.04 INSTALLATION

A. Do not proceed with surfacing installation until all applicable site work, including substrate preparation, fencing and other relevant work, has been completed.

B. Primer Application: Using a brush or short nap roller, apply primer to the substrate perimeter and any adjacent vertical barriers, such as curbs or slabs that will contact the surfacing system, at the rate of 300 ft2/gal (7.5 m2/L).

C. Surfacing Installation:

1. Using a hand trowel, install surfacing at a consistent density of 58 pounds, 9 ounces per cubic foot (938 kg/m3) to a nominal thickness of 1/2" (12.7 mm) or as otherwise specified (minimum thickness 3/8" (9.5 mm).

2. Allow surface to cure for a minimum of 48 hours.

3. At the end of the minimum curing period, verify that the surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.

4. Do not allow foot traffic or use of the surface until it is sufficiently cured.

Specifier Note: Specify provisions for protecting work after installation but prior to acceptance by the owner. Coordinate article below with Division 1 Execution Requirements Section.

3.05 PROTECTION

A. Protect the installed surface from damage resulting from subsequent construction activity on the site.

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PebbleFlex® 2.0 Specifications

PebbleFlex® 2.0 Surfacing Manufacturer's Specifications

1. General

1.1 Scope: These are the manufacturer's specifications for the PebbleFlex® 2.0 surfacing system for playgrounds.

1.2 Description: PebbleFlex 2.0 is a porous thermoplastic aliphatic polyurethane designed to be used as the impact attenuating surface for play areas over concrete, asphalt, and crushed stone aggregate base. It will bond to most surfaces and will resist surface movements. It has been designed to be light-stable and durable.

1.3 Work: Provide all necessary materials, labor, tools, and equipment to perform the work included in section 5 "Installation."

1.4 The installation of the new surface shall be completed by a Surface America Inc. *PebbleFlex 2.0 Certified Installer*. Manufacturer's detailed installation procedures shall be submitted to the architect and made part of the bid specifications.

1.5 Temperature must remain above 50˚ F throughout the installation and curing processes. Surface must be dry, and there should be no rain in the immediate forecast.

1.6 Site must be secured against vandalism during the installation and 72-hour curing processes.

2. Submittals

2.1 Manufacturer's Product Literature and Specification Data.

2.2 ASTM 1028 Skid Resistance Test.

2.3 Manufacturer's written instructions for recommended maintenance practices.

2.4 Color samples for customer verification.

2.5 Written statement on manufacturer's letterhead certifying that the top surface will be light stable for a period of 5 years from date of installation.

2.6 Test results from a Zenon Arc Weatherometer exposure test from a third party shall be submitted by the installer to the requiring agency prior to installation of the surface. The surfacing system (pebbles and binder) shall be tested for a minimum of 10,000 hours and show no less than 15% tensile strength (PSI) degradation.

2.7 Written manufacturer's warranty for playgrounds.

2.8 If requested, provide a product liability insurance certificate showing project owner as certificate holder.

2.9 MSDS and Product data sheets for items in Section 3 "Products."

2.10 ASTM 1292 – If critical fall height is required, impact attenuation test results shall be submitted to the requiring agency prior to installation of the surface. The results shall be submitted on the letterhead of the independent testing lab. Impact attenuation results must comply with ASTM 1292 *Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment* for the critical fall height of the equipment.

3. Products

3.1 Product: PebbleFlex 2.0 surfacing system for Playgrounds.

3.2 Materials:

3.2.1 Top Layer

PebbleFlex 2.0 aliphatic thermoplastic polyurethane Pebbles and PebbleFlex 2.0 aliphatic polyurethane Binder.

The colors shall be as selected from the drawings, submitted as samples, and mixed on site to the ratios in the samples. Black material, if included, must be an aliphatic thermoplastic polyurethane pebble and not a rubber such as EPDM or TPV.

3.2.2 Impact layer

The impact layer is to be made of rubber. The rubber is to be select SBR rubber strands of not more than 1" in length.

3.3 Equal Materials: The PebbleFlex 2.0 pebbles are an aliphatic thermoplastic polyurethane pebble. The system is 100% color throughout. The PebbleFlex 2.0 binder is 100% solids aliphatic. Any equal product must be urethane based, not rubber based such as EPDM or TPV, must include an aliphatic polyurethane binder and must be 100% color throughout. Any black rubber based material is not considered equal.

3.4 Finish Texture: Pebble grain.

3.5 Color: Selected from Manufacturer's color chart by owner prior to bid.

4. Surface Preparation

4.1 New or Existing Concrete: If PebbleFlex 2.0 is being applied directly to concrete, then the concrete must be cured for at least 28 days. If an SBR layer is used between the concrete and PebbleFlex 2.0, then the concrete must be cured a minimum of 14 days. New concrete must be light broom finish and can be prepared simply by acid etching. Add acid slowly to water in clean polyethylene buckets at a ratio of eight parts water to one part acid. Care should be taken to prevent splashing on workers. Protective clothes such as safety glasses, rubber gloves, boots, etc. should be used. The acid solution should be used on the concrete at a rate of 100 square feet per 5 gallons of acid solution. Concrete needs to be damp before applying acid. Using a stiff broom, scrub acid solution into the surface where the solution was poured and continue the process to other areas. Never let the concrete dry with acid on it. After 5 minutes, rinse the concrete with large amounts of clean water to remove all the acid solutions, and then allow the concrete to dry. Old concrete that is contaminated with grease or oil can be cleaned with a power-washer. Use a degreasing agent before power-washing. For concrete where a power-washer cannot be used, a diamond grinder can be used to lightly grind the surface to remove contamination. Concrete shall have a minimum of $^{1}/_{8}$"/ft. slope to a drain to ensure proper drainage.

4. Surface Preparation *(continued)*

4.2 Asphalt Preparation: New asphalt must be 15 days old. Broom scrub using a degreaser to remove any surface oils. Power wash any contaminants off the surface. Allow 24 hours for the surface to dry. PebbleFlex 2.0 CANNOT BE INSTALLED OVER ASPHALT CURED FOR LESS THAN 15 DAYS. Asphalt shall have a minimum of 1/8"/ft. slope to a drain to ensure proper drainage.

4.3 Compacted crushed stone: Minimum depth is 4". Compact the base to 95% proctor. Slope the base at 1/8"—1/4"/ft. to accommodate proper drainage. Surface drains and/or weep holes are required at the top surface of the aggregate per the PebbleFlex 2.0 Aggregate Base Instructions.

4.4 Surface preparation: Concrete or asphalt base must have adequate drains to prevent water from backing up into the surface.

5. Installation

5.1 Thickness: The total depth of the surface shall be installed in strict accordance and conformity to the Manufacturer's drawings and these specification requirements. Surface thickness will vary in the impact layer. The thickness of the impact layer will be installed according to the fall height(s) of the play equipment. These requirements must be verified in the field prior to starting the installation of the impact layer.

5.2 Impact Cushion Layer: The impact layer is to be made of rubber. The SBR rubber is to be a strand of not more than 1" in length.

The manufacturer's minimum depth or greater shall be installed as required by the fall height(s) required by the playground equipment that exists or is to be installed and to meet the test results of the finished surface as expressly required within this specification.

For surrounding curbing, prime the vertical surface of the curb using the SBR Binder. Mix one fifty-pound bag of SBR buffings with 8.14 pounds of aromatic polyurethane binder so that the buffings are covered evenly. Spread the mix and trowel to the appropriate depth. Let cure.

5.3 Top Layer: The overall thickness shall be no less than 3/8" and be composed of PebbleFlex 2.0 material with an aliphatic polyurethane binder supplied by the manufacturer.

PebbleFlex 2.0 Mixing and Finishing
Dry mix 100 pounds of PebbleFlex 2.0 Pebbles (50 large/50 small) in a mortar mixer. After thorough mixing, add 15 pounds of Binder to the dry Pebbles in the mortar mixer. Mix thoroughly so that each pebble is covered evenly. Dump the mix onto the surface and spread it at a minimum thickness of 3/8", keeping the surface as level as possible. Hand or power trowel using a solution of soapy water to spray the surface of the trowel. This will allow easier manipulation of the trowel. Let the surface set for 72 hours.

High Wear Areas: Under all high wear areas, such as under slides and swings increase the PebbleFlex 2.0 layer to 1/2".

5.4 Large Areas: All areas in excess of 1,800 square feet, or areas that require adjacent color pours due to designs, shall have this work done in strict accordance with the manufacturer's installation requirements with adjacent poured layer surfaces being flush throughout. The installer shall employ proper techniques to ensure that no gaps or separation will occur. All cold joints must be coated with binder prior to the application of the adjacent PebbleFlex 2.0 layer.

6. Cleaning

6.1 The contractor should clean the job site and remove any excess materials.

6.2 The contractor shall instruct the owner's personnel on proper maintenance and repair of the PebbleFlex 2.0 surface.

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SECTION 321813 – SYNTHETIC TURF ATHLETIC FIELD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Furnish all labor, materials, tools and equipment necessary to install, in place, all synthetic turf as indicated on the plans and as specified herein, including all related materials not specified under another section but required for the work, whether or not specifically referred to herein. The installation of all new materials shall be performed in strict accordance with the manufacturer's written installation instruction, and in accordance with all approved shop drawings.

B. Related Sections:

1. Division 31 Section "Earth Moving"
2. Division 32 Section "Concrete Paving"
3. Division 33 Section "Storm Drainage"

1.3 DEFINITIONS

A. Contractor: Entity awarded contract to construct the synthetic turf athletic field; acting prime contractor.

B. Installer: Entity to physically construct said portion of the synthetic turf athletic field.

C. Manufacturer: Entity to make material to be sold to the contractor and/or installer.

1.4 SUBMITTALS

A. Submit the following **with proposal on BID Day**.

1. The base contractor (if different from the turf contractor employees) must provide a list of at least five (5) synthetic turf bases completed within the last 3 years, including an owner representative and telephone number.
2. Synthetic Turf – One sample, approximately 12" X 12" filled; and one rag sample (unfilled).
3. Specification sheet of the fiber and carpet system provided in the sample.
4. A statement naming the manufacturer of the grass-like fibers.
5. Yarn manufacturer specification sheet of the specified fiber to be used within the system, per the products section of this specification.
6. Quality assurance information as delineated in paragraphs 1.6A, 1.6B (if applicable), 1.6C, 1.6D, and 1.6E below.
7. A sample of the warranty, noting any exceptions to the warranty information listed in the warranty section of this specification.
8. **If there are items within these specifications that the submitting party cannot comply with, these must be identified in a substitution request submitted to the architect no less than 96 hours prior to bids being due. The architect will then determine if such deviation is approved or denied. Deviations to these**

specifications may at the discretion of the owner be grounds for dismissal of the contractors bid proposal.

B. Prior to order of materials, the Contractor shall submit the following:

1. Signed Certification Letter from the contractor stating that the synthetic turf products to be installed match what was submitted as part of item 1.4A.
2. Shop Drawings

a. Shop drawings shall be prepared at the scale of the construction documents and contain all pertinent information regarding installation. These drawings shall be submitted to the Owner for approval prior to the manufacturing and shipment of materials.
b. Submit drawings for:
I. Seaming plan.
II. Installation details; edge details, methods of attachment, back stop detail, other inserts, method of cutting around backstop and others inserts, etc.
III. Striping plan; layouts showing any field lines, markings and boundaries, and field logos per project drawings.
IV. Other details on construction, especially any details that may deviate from these plans and specifications. Deviations to these plans and specifications may at the discretion owner be grounds for dismissal of the contractors bid proposal.

3. Turf 'rag" samples illustrating range in color selections with details of product matching the specifications described in Part 2 - Products.

C. Prior to the beginning of installation, the contractor (installer) of the synthetic turf shall inspect the subbase and supply a signed letter of Subbase Acceptance for the purpose of obtaining contractor's warranty for the finished synthetic playing surface and base drainage system.

D. Prior to Final Acceptance, the Contractor shall submit the following:

1. Three (3) copies of Maintenance Manuals, which will include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and striping.

a. Provide descriptions of all equipment recommended for maintenance and repair, including both equipment provided by the Contractor, and by the owner.

2. Certified test data indicating the finished field meets the required shock attenuation, as per ASTM F355 (method) and ASTM F1936 (procedure). If the field tests less than the acceptable limit (softer), the contractor can re-test after 90 days of use and weathering, prior to beginning modifications to the infill content.

3. For the carpet installed, submit certified copies of independent (third-party) laboratory reports on the following ASTM tests:

a. Pile Height, Face Weight & Total Fabric Weight – ASTM D418
b. Primary & Secondary Backing Weights – ASTM D418
c. Tuft Bind – ASTM D1335
d. Grab Tear Strength – ASTM D1682

1.5 QUALITY ASSURANCE

A. Synthetic Turf Contractor (Installer)'s Experience:

1. The synthetic turf installer must be pre-approved by the Miracle League Field organization.

B. All contractors must meet the following criteria:

1. Have proper Contractor's license, in good standing, and have never had a license revoked.
2. Have not had a Surety or Bonding company finish work on any contract within the last ten (10) years.
3. Have not been disqualified or barred from performing work for any public Owner or other contracting entity.
4. No current litigation for unacceptable work or non-completion of work.

C. Warranty: The Contractor shall submit its Single Source Warranty that guarantees the usability and playability of the full synthetic turf system for its intended uses for an **eight (8**) year period commencing with the date of Substantial Completion, against all defects in workmanship of the subgrade, drainage, gravel foundation, yarn fibers, and turf surface. The warranty coverage shall not be limited to the amount of the usage.

1. The warranty submitted must have the following characteristics:

a. Must provide full coverage for **eight (8)** years from the date of Substantial Completion.
b. Must warrant materials and workmanship, including but not limited to gravel base stability, drainage rates, seaming materials and adhesives.
c. Must warrant that the finished and accepted playing field elevation shall not vary by more than 0.1' due to instability of the gravel foundation (unrelated to existing, pre-developed subgrade soil conditions) or drainage system and that the field drainage rates will remain at or above design capacityfor the life of the warranty.
d. Must have a provision to either make a cash refund or repair or replace such portions of the installed materials that are no longer serviceable to maintain a serviceable and playable surface.
e. Must be a warranty from a single source covering workmanship and all self-manufactured or procured materials of the turf, turf system, base, and drainage.
f. Warrant that the yarn used to make the grass-like tufts will maintain its UV stability and tensile strength such that the strength of the fiber when measured in accordance with ASTM D-2256 will not decrease by more than 50% during the warranty period due to breakdown of UV stability.

D. Manufacturer Qualifications

1. Must specialize in manufacturing (tufting) the products and fibers specified in this section.
2. Must be experienced in the manufacture of this specific type of infilled synthetic grass system. This includes the tuft fiber, backing(s), and backing coating.
3. Shall have manufactured (tufted) more than fifteen million (15,000,000) square feet of polyethylene tufted turf for sports field use in the past five (5) years.
4. The manufacturer must be a member of the Synthetic Turf Council (STC).

1.6 DELIVERY, STORAGE, AND PROTECTION

A. Deliver products to the site in wrapped, unopened condition.

B. Store products in safe, clean location and in a manor to protect from accidental damage

1.7 EXISTING CONDITONS

A. The contractor shall review and accept existing conditions prior to bidding. The contractor shall again review and accept existing conditions prior to beginning the installation.

B. The contractor shall protect all existing conditions that are not part of the scope of work and repair any damage to existing conditions that occurs during this scope of work.

1.8 LAYOUT

A. See drawings for layout. Contractor shall survey, verify all measurements and submit full field layout as a dimensioned drawing with all proposed graphics included, for owner review/approval, notifying of any conflicts. Provide all field lines and other associated markings as indicated on the drawings.

1.9 TEMPORARY UTILITIES

A. Contractor may connect to the Owner's existing utilities, as available, to supply necessary water, adequate lighting and electricity for installation.

B. Contractor shall supply temporary sanitation facilities, including paying all costs associated therewith.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. A-Turf

2.2 MATERIALS

A. All components and their installation method shall be designed and manufactured for use on outdoor athletic fields. The materials as hereinafter specified, should be able to withstand full climatic exposure in location of installation, be resistant to insect infestation, rot, fungus and mildew; to ultra-violet light and heat degradation.

B. The finished playing surface shall appear as mowed grass with no irregularities or wrinkles and shall afford excellent traction for conventional athletic shoes of all types. The finished surface shall resist abrasion and cutting from normal use. The system shall be ideal for baseball, football, soccer, intramurals and recreational use.

C. Synthetic Turf: Alternate 2

1. CX140 Miracle League Turf with pre-adhered foam pad

PART 3 - EXECUTION

3.1 GENERAL

A. The installation shall be performed in full compliance with approved shop drawings.

B. Only trained technicians skilled in the installation of athletic caliber synthetic turf systems, working under the direct supervision of certified field builder's supervisors, shall undertake the placement of the system.

C. The surface to receive the synthetic turf shall be inspected and certified by the installer as ready for the installation of the synthetic turf system and must be perfectly clean as installation commences and shall be maintained in that condition throughout the process.

3.2 SITE WORK

A. Fine-grade subgrade to elevations required to create final finish turf infill elevation flush with proposed curb surface. Field to be on uniform plane and grade.

B. Drainage: Install drainage according to the plans and specifications and connect the drainage to storm water structures as indicated on the drawings.

C. Drainage Testing: **Contractor must provide drainage testing per Miracle League Field's "Test Preparation of Asphalt for Installation of Surface and Release Form" in Specialty Asphalt Specification.**

3.3 INSTALLATION

A. The Owner reserves the right to inspect the subbase by means of a laser level. Based on the owner's report of the subbase, the Contractor shall fine grade the subbase, including properly rolling and compacting the base, until deemed suitable by the owner.

B. The contractor shall thoroughly inspect all materials delivered to the site, both for quality and quantity, to assure that the entire installation shall have sufficient material to maintain proper sand/rubber ratios.

C. Synthetic turf shall be loose laid across the field, stretched, and attached to the perimeter edge detail. Turf shall be of sufficient length to permit full cross-field installation, from sideline to sideline. Turf must also be attached via a nailer board to the curbs.

D. Seams shall be adhered using reinforcing tape and high-grade outdoor synthetic turf adhesive. Seams may also be sewn at the contractor's choice. Seams shall be flat, tight, and permanent with no separation or fraying.

E. Infill materials must be brought to the site and stockpiled for inspection by the owner. Infill materials must be mixed by an experienced installer. The sand/rubber blend shall be applied in numerous thin lifts using special broadcasting equipment. The turf shall be raked and brushed properly as the mixture is applied. The infill material shall be installed to a depth per above specifications. The mixture can only be applied when dry. (Review by engineer does not relieve contractor of responsibility to ensure that the synthetic turf system meets the specified impact attenuation requirements).

3.4 FIELD MARKINGS AND DECORATIONS

A. Markings are to be per the plan and must comply with all Miracle League guidelines.

3.5 CLEAN UP

A. Contractor shall provide the labor, supplies and equipment as necessary for final cleaning of surfaces and installed items.

B. All usable remnants of new material shall become the property of the Owner.

C. The Contractor shall keep the area clean throughout the project and clear of debris.

D. Surfaces, recesses, enclosures, etc., shall be cleaned, as necessary, to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 321813

SECTION 323113 - CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Chain-Link Fences
2. Gates

B. Related Sections include the following:
1. Division 31 Section "Earth Moving" for site excavation, fill, and backfill where chain-link fences and gates are located.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gates and hardware.
4. Gate operators, including operating instructions.
5. Accessories: Privacy slats.
6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

B. Shop Drawings: Show locations of fences, gates, posts, rails, tension wires, details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. UL Standard: Provide gate operators that comply with UL 325.

C. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Insert height, limited to 12 feet (3.6 m). Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle. Comply with ASTM A 392, CLFMI CLF 2445, and requirements indicated below:

1. Steel Wire Fabric: Polymer-coated wire with a diameter of 0.148 inch (3.76 mm).

    a. Mesh Size: 2 inches (50 mm).
    b. Polymer Coating: ASTM F 668, Class 2b over metallic-coated steel wire.

        1) Color: Black, complying with ASTM F 934.

    c. Coat selvage ends of fabric that is metallic coated before the weaving process with manufacturer's standard clear protective coating.

2. Selvage: Knuckled at both selvages.

2.2 INDUSTRIAL FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, ASTM F 1083 for Group IC round pipe, and the following:

1. Group: IA, round steel pipe, Schedule 40 IC, round steel pipe, yield strength 50,000 psi (345 MPa).
2. Fence Height: As indicated on drawings.
3. Strength Requirement: Heavy industrial according to ASTM F 1043.
4. Post Diameter and Thickness: According to ASTM F 1083.
5. Post Size and Thickness: According to ASTM F 1083.

    a. Top Rail: 1.66 inches.
    b. Steel Line Post:
        1) Height up to and including 6 feet – 1.900 inches
        2) Height over 6 feet – 2.375 inches
    c. Steel End, Corner and Pull Post:
        1) Height up to and including 6 feet – 2.375 inches
        2) Height over 6 feet – 2.875 inches
    d. Swing Gate Post for fabric height up to and including 6 feet:: According to ASTM F 900 and as follows:
        1) Gate leaf width up to and including 4 feet: 2.375 inches OD pipe, 3.11-lb/ft weight
        2) Gate leaf width over 4 feet to 10 feet: 2.875 inches OD pipe, 4.64-lb/ft weight.
    e. Swing Gate Post for fabric height over 6 feet:: According to ASTM F 900 and as follows:
        1) Gate leaf width up to and including 6 feet: 2.875 inches OD pipe, 4.64-lb/ft weight

2) Gate leaf width over 4 feet to 10 feet: 4.000 inches OD pipe, 8.65-lb/ft weight.

6. Coating for Steel Framing:

a. Metallic Coating:

1) Type I Steel Pipe: Type A, consisting of not less than minimum 2.0-oz./sq. ft. (0.61-kg/sq. m) average zinc coating per ASTM A 123/A 123M or 4.0-oz./sq. ft. (1.22-kg/sq. m) zinc coating per ASTM A 653/A 653M.
2) Type II Steel Pipe: Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, of 30 plus or minimum 15 micrograms, and a clear, verifiable polymer film of 0.5 plus 0.2 mils. Type B inside with a minimum of 0.9 oz of zinc per sq.ft.

b. Polymer coating over metallic coating.

2.3 TENSION WIRE

A. General: Provide horizontal tension wire at the following locations:

1. Location: Extended along bottom of fence fabric.

B. Metallic-Coated Steel Wire: 0.177-inch- (4.5-mm-) diameter, marcelled tension wire complying with ASTM A 817, ASTM A 824, and the following:

1. Metallic Coating: Type II, zinc coated (galvanized), with the following minimum coating weight:

a. Class 1: Not less than 0.8 oz./sq. ft. (244 g/sq. m) of uncoated wire surface.
b. Matching chain-link fabric coating weight.

2.4 INDUSTRIAL SWING GATES

A. General: Comply with ASTM F 900 for single and double swing gate types.

1. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1043 and ASTM F 1083 for materials and protective coatings.

B. Frames and Bracing: Fabricate members from round, galvanized steel tubing with outside dimension and weight according to ASTM F 900 and the following:

1. Gate Fabric Height: 2 inches (50 mm) less than adjacent fence height.
2. Leaf Width: As indicated on drawings.
3. Frame Members:

a. Tubular Steel: 1.66 inches (42 mm) round for gate heights up to and including 6 feet; 1.90 inches (48 mm) round for gate heights over 6 feet.

C. Frame Corner Construction:

1. Welded and 5/16-inch- (7.9-mm-) diameter, adjustable truss rods for panels 5 feet (1.52 m) wide or wider.

D. Hardware: Provide galvanized and coated hardware matching the fence specs as necessary and as follows:

1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges foe each leaf over 6-foot nominal height.
2. Latch: Forked type or plunger-bar type to permit operation form either side of gate with padlock eye as integral part of latch.
3. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
4. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

2.5 FITTINGS

A. General: Comply with ASTM F 626.

B. Post and Line Caps: Provide for each post.

1. Line post caps with loop to receive top rail.

C. Rail and Brace Ends: Attach rails securely to each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches (152 mm) long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
   a. Aluminum: ASTM B 211 (ASTM B 211M); Alloy 1350-H19; 0.148-inch- (3.76-mm-) diameter, mill-finished wire.

H. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.

2. Match Fence materials.

2.6 PRIVACY SLATS

A. Material: Polyethylene tubular slats, not less than 0.023 inch (0.58 mm) thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips, and fins for increased privacy factor.

B. Color: Black.

2.7 CAST-IN-PLACE CONCRETE

A. Materials: Portland cement complying with ASTM C 150, Type I aggregates complying with ASTM C 33, and potable water.

1. Concrete Mixes: Normal-weight concrete with not less than 3000-psi (20.7- MPa) compressive strength (28 days), 3-inch (75-mm) slump, and 1-inch (25-mm) maximum size aggregate.

2.8 POLYMER FINISHES

A. Supplemental Color Coating: In addition to specified metallic coatings for steel, provide fence components with polymer coating.

B. Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 2b.

C. Metallic-Coated Steel Framing and Fittings: Comply with ASTM F 626 and ASTM F 1043 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.

1. Polymer Coating: Not less than 10-mil- (0.254-mm-) thick PVC finish.

D. Color: Match chain-link fabric, complying with ASTM F 934.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacing indicated, in firm, undisturbed soil.
   1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
   2. Unless otherwise indicated, excavate hole depths approximately 3 inches lower than the post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

B. Post Setting: Center and align posts in holes 3 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.

   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

      a. Exposed Concrete: Extend 2 inches (50 mm) above grade; shape and smooth to shed water.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

D. Line Posts: Space line posts uniformly at 10 feet (3 m) o.c.

E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts.

   1. Locate horizontal braces at midheight of fabric 6 feet (1.83 m) or higher, on fences with top rail and at 2/3 fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

F. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- (3.05-mm-) diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches (610 mm) o.c. Install tension wire in locations indicated before stretching fabric.

   1. Top Tension Wire: Install tension wire through post cap loops.
   2. Bottom Tension Wire: Install tension wire within 6 inches (150 mm) of bottom of fabric and tie to each post with not less than same diameter and type of wire.

G. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

H. Bottom Rails: Install, spanning between posts.

I. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

J. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches (380 mm) o.c.

K. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at 1 end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

L. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

M. Privacy Slats: Install slats in vertical direction, securely locked in place.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper- resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323113

SECTION 33 11 00 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 QUALITY ASSURANCE

A. **All water linework must be done per City of Columbus, City of Hilliard and Norwich Township Fire Department Requirements for water lines.**

SECTION 333100 – SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure, Piping Pressure Rating: at least equal to system test pressure.

B. ALL SANITARY SEWER WORK MUST BE DONE PER CITY OF COLUMBUS AND CITY OF HILLIARD REQUIREMENTS FOR SANITARY SEWERS CONSTRUCTION.

SECTION 334100 - STORM DRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. **All storm sewer work must be done per City of Columbus and City of Hilliard requirements for storm sewer construction.**