CITY OF WORCESTER

Department of Public Works and Parks

INDIAN HILL PARK IMPROVEMENTS

PHASE II

TABLE OF CONTENTS

PART II - TECHNICAL SPECIFICATIONS

SECTION 116813
PLAYGROUND EQUIPMENT – ADD ALTERNATE # 1

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Forms, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 WORK INCLUDED

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this section as indicated in the drawings and as specified herein, which shall include, but is not limited to, furnishing and installing the following:

1. Playground Equipment – from one of the approved **single-source** manufacturers listed herein, provide all detailed plans and components required to install the playground equipment structures, as approved.

2. Foundations for the required Playground Equipment.

1.03 RELATED SECTIONS

A. Section 31 00 00 – Earthwork
B. Article 40 – Poured-In-Place Playground Surfacing **ADD ALTERNATE #1**
C. Article 38 – Cast-In-Place Concrete

1.04 REFERENCE SAFETY GUIDELINES AND STANDARDS

A. All playground design, layout, materials, equipment, and installation shall comply with the current issue of the "*Handbook for Public Playground Safety*" published by the Consumer Product Safety Commission (CPSC) and ASTM standard F1487. The manufacturer shall be responsible for correcting any product or equipment in violation of the CPSC Guidelines or ASTM F1487 to the satisfaction of the Owner, should such be found within 1 year after installation.

B. ADA Accessibility Guidelines (ADAAG) Section 15.6 Play Areas.

C. American Standard for Testing Materials (ASTM), standards indicated here-in. D.MAAB -

Massachusetts Architectural Access Board.

E. Requirements not specifically set forth herein, but required by the agencies listed above, shall be the applicable standards for quality and safety. Any conflict between the agency standards and the contract documents shall be brought to the attention of the Owners Representative, and unless otherwise directed in writing, the agency standards shall be the minimum requirement to be followed.

1.05 PLAYGROUND EQUIPMENT MANUFACTURERS/ INSTALLERS

A. Playground Equipment shall be manufactured and supplied by one of the following companies, or an approved equal:

1. LANDSCAPE STRUCTURES INC.
M.E. O'Brien & Sons, Inc.
Atten: Andrew Kimball
17 Trotter Drive PO Box 718
Medway, MA 02053
www.obrienandsons.com

2. GAME TIME
2130 Route 35
Building B, Suite 222
Sea Girt, NJ 08750
Phone: (800) 252-2440.
MRC@gametime.com

3. MIRACLE RECREATION EQUIPMENT
Miracle Recreation
878 E Highway 60
Monett, MO 65708
Phone: 888-458-2752
Sales repetitive - Site Specifics, LLC, PO Box 325, Rochester, MA 02770
www.sitespecifics.net

4. PLAYWORLD SYSTEMS
UltiPlay Parks & Playgrounds, Inc.
Massachusetts / Main Office
43 Main Street, Blackstone, MA 01504
Tel: 866-575-PLAY
Fax: 508-634-6949
www.ultiplayus.com

1.06 SUBMITTALS

A. Based on the Contract Documents and drawings, (CAD drawing of playground layout is available upon request) program requirements and specifications here-in, the Contractor/Manufacturer shall prepare and submit a Playground Equipment Proposal, which shall include:

1. scaled plan layout of playground equipment with identification and/or listing of all proposed elements, components, and parts;

2. elevations or perspective views of the equipment depicting what the playground will look like from at least two (2) vantage points;

B. In the submittal, the Contractor/Manufacturer's Representative shall include the following: play capacity of each component, scaled drawings of each specified component, full

product specifications, 3-d color images, color charts, erection drawings, installation details, parts list, and technical data for correct assembly of all components, clamp details, and anchoring details.

C. Contractor/Manufacturer to submit Quote for fabricating, delivering, and installing the complete Playground Equipment proposal in conformance with these specifications, naming the installer, and indicating the estimated lead time for delivery and installation.

D. Contractor/Manufacturer shall submit proof of Manufacturer's International Play Equipment Manufacturers Association (IPEMA) certification.

E. Warranty/Guarantee: The Contractor/Manufacturer's Representative shall provide information on the equipment manufacturer's warranty/guarantee with proposal.

Note: Submittals A. – E. required above are to be delivered by the Contractor to the Owners Representative(s) for their review and approval at the earliest possible time during the Bidding and/or Construction of the Indian Hill Park Improvements project.

F. During construction of the park improvements surrounding the playground, namely the: rain shelter, plaza, sidewalk, concrete curb, light poles, etc., the Contractor/ manufacturer shall update the Playground Equipment plan as necessary due to adjustments or field changes in the locations of the surrounding improvements. This updated playground equipment plan shall be submitted to the Owner Representative for review and approval, prior to ordering any play equipment.

G. Following construction, the Contractor shall submit a Written Report from an approved Certified Playground Safety Inspector (CPSI), that the playground equipment, as installed, meets the Reference Safety Guidelines and Standards cited herein.

H. Following construction, the Contractor/Manufacturer shall submit a repair kit, with tools for adjusting hardware and touch up paints, and written maintenance instructions to the Owner.

1.07 QUALITY ASSURANCE

A. The Contractor/Manufacturer's Representative furnishing the play equipment and structures must have a minimum of 10 years' experience in the manufacturing of play equipment with the personnel, facilities, and equipment adequate for providing the products approved, and shall produce written proof of such.

B. Certification by Manufacturer that the Installer is an approved playground equipment installer of the approved playground product(s) and shall produce written proof of such.

C. The equipment shall be International Play Equipment Manufacturers Association (IPEMA) certified.

D. The Contractor/Manufacturer's Representative shall provide inspection and written report from approved Certified Playground Safety Inspector (CPSI) as verification that materials and installation conforms to Section 1.04 – Reference Safety Guidelines and Standards.

PART 2 - PRODUCTS

2.01 GENERAL – SITE SPECIFICITY OF DESIGN

A. Equipment selection is based on specific program requirements and physical constraints within the site. Equipment must be a commercially produced product ***(not custom fabricated)*** that is designed for the specific recreational purposes required by DPW & Parks as outlined in these specifications.

B. Program requirement: Playground shall have three main features, each with defined safety zones, as shown in the drawings, including:

1. a swing structure with at least 4 swing seats

2. a distinct play structure assembly (min. play experience should include– climbing, hanging, jumping, and spinning etc.) suitable for children ages 5 – 12.

C. Physical constraints: the play equipment components shall be selected and installed in a manner that is compatible with the following limitations:

1. Within the playground site, below the ground, exists a large drain line and a sewer line, each running north-south. The swing, as positioned in the drawings, has been located so its footings may avoid conflict with these existing sub-surface utilities. The Contractor shall field-verify the locations of these utilities, and include this information in the Playground Equipment Proposal, required under Submittals here-in.

2. The safety zones shown in the drawing are schematic and shall be updated by the Contractor/Manufacturer for the specific component assemblies in their Playground Equipment Proposal. The updated safety zones shall stay within the limits imposed by surrounding concrete curb, ornamental fence, trees pits, light poles, and other site improvements, but shall ***maximize*** the number and combination of play structure components within the available safety zone.

D. General equipment requirements that shall be met include:

1. All Composite play structures and swings shall be in-ground installation, anchored into footings.

2. Footing of all playground posts shall be concrete, to the manufacturer's standard diameter and to a depth of 48 inches below finished grade. Top of concrete footing shall be flush with bottom of safety surfacing layer.

3. Minimum depths of safety surfacing – as specified in Article 40
Poured in place safety surfacing.

4. No talk tubes, or tube/enclosed slides.

5. Provide a choice of up to three premium color combinations for composite play equipment components.

6. Vandal Resistance - due to the urban location of the playground, play equipment

composed primarily of metal (i.e.: steel, stainless steel, aluminum etc.) is required.

2.02 MINIMUM REQUIREMENTS FOR EQUIPMENT STRUCTURES & COMPONENTS A.

Material:

All materials shall be structurally sound and suitable for safe play.
Durability shall be ensured on all steel parts by the use of time-tested coatings such as zinc plating, zinc-nickel plating, powder-coating, TenderTuff coating, etc.

1. Colors shall be approved by the Owner. B. Posts:
Primary posts shall be 5” O.D., with a minimum wall thickness of .120”, corrosion resistant galvanized steel, due to the durability required of the product aluminum posts will not be accepted. All posts shall be powder coated in a color selected by the owner. All posts shall feature securely mounted factory installed caps.

C. Decks:
Decks shall be constructed of 11-gauge steel minimum and feature a maximum 5/16” diameter holes on the standing surface and PVC coated or
approved equal. Decks shall generally be flush-mounted to posts.

D. Fasteners:
Primary fasteners shall be socketed and pinned tamperproof in design (or approved equal) stainless steel (SST) per ASTM F 879. All primary fasteners shall include a locking patch type material that will meet the minimum torque requirements of IFI-
125. Manufacturer to provide a full set of the necessary tools for pinned tamperproof fasteners.

E. Finishes:
1. Polyester (Powder) Coating - The polyester coating shall be uniformly applied by the electrostatic method to a thickness of three to five mils. Promptly after application of the powder, the coating shall be oven-cured at 400 degrees Fahrenheit. The color(s) of the polyester coating shall be as selected by Owner.

2. Vinyl - The vinyl coating shall be oven-cured poly-vinyl chloride plastisol with a minimum thickness of 1/8". The coating shall contain ultraviolet inhibitors and mold resistors. The color(s) of the vinyl coating shall be as selected by Owner.

3. Galvanized Finish - All components calling for a galvanized finish shall be hot- dipped galvanized to the manufacturer's standard after fabrication. All galvanized surfaces shall be free of burs, splinters, and sharp edges.

2.03 PLAY EQUIPMENT

A. Specific Play Equipment shall be as proposed by the Contractor/Manufacturer, in compliance with specifications herein, and as approved by the Owners Representative.

1. The Contractor shall not order any products or materials for the work under this section until receiving written approval of the proposed manufacturer, play equipment list, and proposed installer, from the Owners Representative.

B. Swing Structure – to be similar and at least equal to that depicted in the drawings. To be of

size necessary to avoid conflict with sub-surface utilities; and, to have 2 belt seats and 2 full bucket seats

C. 5-12 Year Old Play Structure – to be similar and at least equal to that depicted in the drawings.

2.04 FOUNDATIONS FOR PLAY EQUIPMENT

A. Contractor/Installer shall provide concrete foundations for each play structure, in accordance with the Manufacturers requirements and in compliance with Section Article 38 Cast-in-Place Concrete.

2.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials and equipment shall be delivered and/or stored in accordance with the Manufacturer's recommendations.

2.06 ADDITIONAL HARDWARE AND REPAIR SUPPLIES

A. Hardware shall be provided in sufficient quantity to complete the assembly of the play equipment. All hardware shall be stainless steel or non-ferrous.

B. Contractor/Manufacturer shall provide the Owner with maintenance and repair supplies, installation manuals, tool kits and materials that were shipped with each product, for the Owner's Inventory.

PART 3 - EXECUTION

3.01 COORDINATION WITH RELATED SITE IMPROVEMENTS & SITE CONDITIONS

A. Play equipment shall be installed after locations for site improvements directly surrounding the playground, (eg. concrete curb for fence, rain shelter, concrete sidewalk, shade trees, and light poles) have been confirmed by in-field survey layout, and after installation of cast-in-place concrete foundations associated with these site improvements, unless arranged for otherwise with the Owners Representative.

B. Play Equipment posts, anchor bolts, and concrete foundations shall be installed in compliance with Manufacturer's requirements, on structurally sound subsoil and compacted base, and in compliance with Section 033000 Cast-in-Place Concrete. Do not place foundation on frozen or excessively damp substrate. Top of foundations are to be no higher than bottom of impact attenuation safety surfacing layers.

1. Contractor shall notify Owners Representative when excavating for foundations in proximity of the existing subsurface utilities – sewer, water, and drainage lines.

C. Contractor shall install crushed stone sub-surface and sub-drainage around play equipment foundations in accordance with Section 321816.13 Playground Surfacing and shall bring compacted sub-base to required sub-grade, prior to assembling the remainder of the play equipment structures.

D. Contractor shall review poured-in-place scheduling and timing for playground equipment

assembly with Owners Representative. Delivery date for equipment shall be approved by Owners Representative and coordinated with Sub- Contractor/installer responsible for installation of equipment.

3.02 ASSEMBLY OF PLAY EQUIPMENT STRUCTURES

A. Installation and assembly of the approved Play Equipment structures shall be executed in accordance with the Manufacturers final layout plan and requirements, as reviewed and approved by the Owners Representative, by an installer that the Manufacturer certifies as being qualified to undertake the installation.

B. Once the equipment assembly has commenced, the Contractor/installer shall work on consecutive business days to complete the installation expeditiously and without interruption in progress.

C. Defective, discolored, or dysfunctional parts will not be accepted; use only fully intact equipment components for assembly.

3.03 CLEAN UP, ADJUSTMENTS, TOUCH-UP, INSPECTION, AND ACCEPTANCE

A. Clean-up: All debris or left-over parts from the play equipment assembly work shall be removed from the site and properly disposed of by the Installer/Contractor. Smudges of concrete or other blemishes on the play equipment components shall be promptly cleaned by the installers. Sharp edges or burrs on hardware shall be made smooth.

B. Adjustments: Installer shall make all play equipment components fit together and operate smoothly as specified by the Manufacturer.

C. Touch-up: Any imperfections or scrapes in the finish surfaces of the play equipment shall be either replaced or touched up by the installer, using the appropriate paint touch- up product and color provided by the Manufacturer.

D. Inspections:

1. The Contractor/Manufacturer shall have the completed work inspected by a Certified Playground Safety Inspector (CPSI) to evaluate compliance of the completed playground equipment to the Reference Safety Guideline Standards cited in Section 1.04 of these specifications. The CPSI Report from this inspection shall be provided to the Owner.
2. The Contractor/Manufacturer, Installer, and Owners Representative shall inspect the completed installation. Any deficiencies identified shall be corrected at no additional cost to the Owner.

E. Acceptance: Contractor/Manufacturer shall provide a repair kit and instructions to the Owner for care of the completed work.

END OF SECTION

SECTION 260001

ELECTRICAL WORK

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 DESCRIPTION OF WORK

A. The work of this section is work of a Publicly Bid Electrical Subcontractor and includes the following requirements:

1. Specification requirements for ELECTRICAL include all of the following listed Specification Sections in their entirety:
   a. 260001 ELECTRICAL WORK
   b. 260500 COMMON WORK RESULTS FOR ELECTRICAL
   c. 260519 ELECTRICAL POWER CONDUCTORS AND CABLES
   d. 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
   e. 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
   f. 260533 RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
   g. 260548 VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
   h. 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS
   i. 260573 OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY
   j. 262220 LOW-VOLTAGE TRANSFORMERS
   k. 262416 PANELBOARDS
   l. 262726 WIRING DEVICES
   m. 262813 FUSES
   n. 262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS
   o. 264313 SURGE PROTECTIVE DEVICES
   p. 265668 EXTERIOR ATHLETIC FIELD LIGHTING
   q. 271000 COMMUNICATIONS CABLING SYSTEMS
   r. 274100 AUDIO VISUAL COMMUNICATIONS

2. Drawings for ELECTRICAL include all of the following listed:
   a. E-101, E-102, E-201, E-202, E-203, E-301, E-401, E-402, E-403, E-404, E-405.

B. Alternates: Not Applicable.

C. Items to Be Installed Only: Install the following items as furnished by the designated Sections:
1. Not Applicable

D. Items to Be Furnished Only: Furnish the following items for installation by the designated Sections:
1. Section 033000 - CAST-IN-PLACE CONCRETE:
   a. Lintels, sleeves, anchors, inserts, plates and similar items for electrical systems.

E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 033000 - CAST-IN-PLACE CONCRETE for interior concrete equipment pads and installation of backboxes and conduit for electrical devices and light fixtures.
2. Section 312000 – EARTH MOVING for excavation and backfilling for underground work.

F. The Electrical Subcontractor shall be responsible for filing all documents, payment of all fees, and securing of all inspections and approvals necessary for the electrical work.

G. The Electrical Subcontractor shall carry in the bid price all Utility Company and Municipal back charges for all materials furnished and work performed by them in conjunction with this Contract and pay same to the respective agency upon demand. The Electrical Subcontractor shall not be entitled to additional compensation after the submittal of his bid price should he fail, for any reason, to obtain the total back charge costs to be incurred by the local utility companies or municipal agencies.

H. The Electrical Subcontractor shall comply with the adopted version of NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations. The Electrical Subcontractor shall prepare and submit all documentation required to comply with NFPA 241.

1.03 SUBMITTALS

A. Comply with requirements specified in Section 013300 – SUBMITTAL REQUIREMENTS.

B. Shop Drawing: Shop drawings shall include, but not be limited to, the following:
1. Electrical Service, Site lighting and Power
2. Common Work Results for Electrical
3. Electrical Power Conductors and Cables
4. Grounding and Bonding for Electrical Systems
5. Hangers and Supports for Electrical Systems
6. Raceway and Boxes for Electrical Systems
7. Vibration and Seismic Controls for Electrical Systems
8. Identification for Electrical Systems
9. Overcurrent Protective Device Coordination Study
10. Low-Voltage Transformers
11. Panelboards
12. Wiring Devices
13. Fuses
14. Enclosed Switches and Circuit Breakers
15. Surge Protective Devices
16. Exterior Athletic Field Lighting
17. Communications Cabling Systems
18. Audio Video Communications

1.04 REFERENCES

A. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the drawings or specifications for electrical work carries with it the instruction to furnish, install and connect the item as part of the electrical work, regardless of whether or not this instruction is explicitly stated.

B. It shall be understood that the specifications and drawings for electrical work are complimentary and are to be taken together for a complete interpretation of the electrical work except that indications on the drawings, which refer to an individual element of work, take precedence over the specifications where they conflict with same.

1.05 REGULATORY REQUIREMENTS

A. Comply with all applicable federal and state laws, and all local codes, by-laws and ordinances.

B. Where provisions of the Contract Documents conflict with any codes, rules or regulations, the latter shall govern. Where the contract requirements are in excess of applicable codes, rules or regulations, the contract provisions shall govern unless the Designer rules otherwise.

C. Request inspections from authorities having jurisdiction, obtain all permits and pay for all fees and inspection certificates as applicable and/or required. All permits and certificates shall be turned over to the Owner's Project Manager s at the completion of the work. Copies of permits shall be given to the resident engineer prior to the start of work.

D. Unless otherwise specified or indicated, materials and workmanship and equipment performance shall conform with the latest edition of the following standards, codes, specifications, requirements and regulations:
1. State Building Code
2. State Electrical Code
3. National Fire Protection Association (NFPA)
4. Local Town Regulations and By-laws
5. Underwriter's Laboratories, Inc. (UL)
6. National Electrical Manufacturer's Association (NEMA)
7. American National Standards Institute (ANSI)

E. All electrical work shall meet or exceed any other state and local codes and/or authorities having jurisdiction including all other standards indicated herein.

F. Electrical Subcontractor to be present for all pre-testing, testing and inspections with Fire Department and Building Department, as requested by Construction Manager (CM).

1.06 SURVEYS AND MEASUREMENTS

A. Base all required measurements, both horizontal and vertical, on reference points established by the Construction Manager and be responsible for the correct laying out of the electrical work. In the event of a discrepancy between actual measurements and those indicated, notify the Construction Manager in writing, and do not proceed with the work required until written instructions have been issued by the Construction Manager.

1.07 COORDINATION

A. Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet architectural requirements.
1. Grounding: Plans showing dimensioned locations of grounding features specified including test wells, ground rods. ground rings. grounding arrangements and connections for separately derived systems.

B. Work shall be performed in cooperation with other trades on the project and so scheduled as to allow speedy and efficient completion of the work.

C. Furnish to other trades advance information on locations and sizes of all frames, boxes, sleeves and openings needed for their work, and also furnish information and shop drawings necessary to permit trades affected by the work to install same properly and without delay.

D. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Designer. Where the electrical work shall interfere with the work of other trades, assist in working out the space conditions to make satisfactory adjustments before installation. Without extra cost to the Owner, make reasonable modifications to the work as required by normal structural interferences. Pay the Construction Manager for additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

E. If any electrical work has been installed before coordination with other trades so as to cause interference with the work of such trades, all necessary adjustments and corrections shall be made by the electrical trades involved without extra cost to the Owner.

F. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Designer for review and approval.

G. Protect all materials and work of other trades from damage which may be caused by the electrical work, and repair all damages without extra cost to the Owner.

1.08 INSTALLATION REQUIREMENTS

A. The arrangement of all electrical work shown on the drawings is diagrammatic only and indicates the minimum requirements of the work. Conditions at the building including actual measurements shall determine the details of the installation. All work shall be laid out and installed so as to require the least amount of cutting and patching.

B. Check the architectural plans and specifications before ordering any material and equipment. Any discrepancies shall be brought to the attention of the Designer for his determination prior to proceeding with the work.

1.09 TYPICAL DETAILS

A. Typical details where shown on the drawings shall apply to each and every item of the project where such items are applicable. They are not repeated in full on the drawings, which in many cases are diagrammatic only, but with the intention that such details shall be incorporated in full. Any alternate method proposed for use by the Contractor shall have the prior approval of the Designer.

1.10 SLEEVES, INSERTS

A. Furnish and install all sleeves, inserts, anchor bolts and similar items to be set into masonry or concrete, as required for mechanical and electrical work. Internal diameter of sleeve shall be 2" larger than the outside diameter of the pipe or insulation covered line passing through it.

1.11 ACCESSIBILITY

A. Install all work such that parts requiring periodic inspection, operation, maintenance and repair are readily accessible.

B. Furnish all access panels appropriate to particular conditions, to be installed by trades having responsibility for the construction of actual walls, floors or ceilings at required locations.

1.12 SUPPLEMENTARY SUPPORTING STEEL

A. Provide all supplementary steelwork required for mounting or supporting equipment and materials.

B. Steelwork shall be firmly connected to building construction as required.

C. Steelwork shall be of sufficient strength to allow only minimum deflection in conformity with manufacturer's published requirements.

D. All supplementary steelwork shall be installed in a neat and workmanlike manner parallel to floor, wall and ceiling construction; all turns shall be made at forty-five and ninety degrees, and/or as dictated by construction and installation conditions.

E. All manufactured steel parts and fittings shall be galvanized.

1.13 TOOLS AND EQUIPMENT

A. Provide all tools and equipment required for the fabrication and installation of the mechanical and electrical equipment at the site.

1.14 PORTABLE AND DETACHABLE PARTS

A. Contractors shall retain in their possession all portable and/or detachable parts and portions of materials, devices, equipment etc. necessary for the proper operation and maintenance of the mechanical and electrical systems until final completion of the work, at which time they shall be handed over to Owner's Project Manager.

1.15 RECORD DRAWINGS, PROJECT CLOSEOUT

A. Comply with requirements specified in Section 017700 – CONTRACT CLOSEOUT.

B. This trade shall submit the record set for approval by the fire and building departments in a form acceptable to the departments, when required by the jurisdiction.

C. Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.16 GUARANTEE/WARRANTY

A. Guarantee Work of this Section in writing for one year from the date of Certificate of Agency Use and Occupancy. Guarantees or warranties that start at the date of shipment from the factory, or from the completion date of an individual portion of the project, are not acceptable. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Designer's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 01 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in User Agency's name.
   1. Upon receipt of notice from Owner's Project Manager of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by this Contractor without any reimbursement.
   2. At nine months into the one-year guarantee period, the contractor shall perform a 100% test of all installed equipment. Any device and/or part found to be defective shall be repaired and/or replaced at no cost to the Owner. The Contractor shall notify the fire department one month in advance of the 100% test.
   3. Replace material and equipment that require excessive service during guarantee period as defined and as directed by Designer.
   4. Provide 24 hour service beginning on the date the project is accepted by the Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this contractor or a separate service organization. Choice of service organization shall be subject to Designer and Owner's Project Manager's approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.
   5. Submit copies of equipment and material warranties to Designer before final payment.
   6. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to User Agency.
   7. This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.
   8. Part 2 Paragraphs of this Specification may specify warranty requirements that exceed those of this Paragraph. Those paragraphs will govern.

9. Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of work by Owner's Project Manager, and shall not initiate the guarantee period.
10. Non-durable items, such as electric lamps, shall be replaced up to the date of acceptance, such that they shall have had no more than 100 hours use prior to this date.
11. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to Owner's Project Manager's satisfaction, advise Designer in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Designer will direct course of action.

1.17 OPERATING, INSTRUCTION AND MAINTENANCE MANUALS

A. Comply with requirements specified in Section 017700 – CONTRACT CLOSEOUT, including CAMIS spreadsheet data collection for Equipment Template and PM Procedure tabs.

B. Each copy of the approved operating and maintenance manual shall contain copies of approved shop drawings, equipment literature, cuts, bulletins, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed. Each manual shall have the following minimum contents:
   1. TABLE OF CONTENTS
   2. Introduction
      a. Explanation of manual and its purpose and use.
      b. Description of the electrical systems.
      c. Safety precautions necessary for equipment.
      d. Illustrations, schematics and diagrams.
      e. Installation drawing.
   3. Maintenance
      a. Maintenance and lubricating instructions.
      b. Replacement charts.
      c. Trouble shooting charts for equipment components.
      d. Testing instructions for each typical component.
      e. Two typed sets of instructions for ordering spare parts. Each set shall include name, price, telephone number and address of where they may be obtained.
   4. Manufacturer's Literature
      a. The equipment for which shop drawings have been submitted and approved.
      b. Power Monitoring: Software and Firmware Operational Documentation:
         1) Software operating and upgrade manuals.
         2) Software licenses.
         3) Software service agreement.
         4) PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Provide separately for each PC.
         5) Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on compact disk or portable storage device with a USB interface of the hard-copy submittal.
         6) Program Software Backup: On compact disk or portable storage device with a USB interface, complete with data files.
         7) Device address list.
         8) Printout of software application and graphic screens.

1.18 SERVICE CHARACTERISTICS

A. Primary Utility Voltage: 13.8kV

B. Secondary Building Voltage - High Level: 480/277V

C. Secondary Building Voltage - Low Level: 208/120V

D. All equipment and wiring shall be suitable for the applied voltage.

1.19 QUALITY ASSURANCE

A. The requirements of the State Building Code and local regulations establish the minimum acceptable quality of workmanship and materials, and all work shall conform thereto unless more stringent requirements are indicated or specified herein.

B. All work shall comply with the latest editions of the codes as referenced herein.

C. Follow manufacturer's directions for articles furnished, in addition to directions shown on drawings or specified herein.

D. Protect all work, materials, and equipment from damage during process of work. Replace all damaged or defective work, materials and equipment without additional cost to the Owner.

E. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

F. Equipment and materials shall:
1. Where normally subject to Underwriters Laboratory Inc. listing or labeling services, be so listed or labeled.
2. Be without blemish or defect.
3. Not be used for temporary light and power purposes.
4. Be in accordance with the latest applicable NEMA standards.
5. Be products which will meet with the acceptance of all authorities having jurisdiction over the work. Where such acceptance is contingent upon having the products examined, tested and certified by Underwriters or other recognized testing laboratory, the product shall be so examined, tested and certified.

G. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material of one generic type shall be the product of one manufacturer throughout.

H. For items which are to be installed but not purchased as part of the electrical work, the electrical work shall include:
1. The coordination of their delivery.
2. Their unloading from delivery trucks driven into any point on the property line at grade level.
3. Their safe handling and field storage up to the time of permanent placement in the project.
4. The correction of any damage, defacement or corrosion to which they may have been subjected. Replacement if necessary shall be coordinated with Contractor who originally purchased the item.
5. Their field make up and internal wiring as may be necessary for their proper operation.
6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
7. Their connection to building wiring including the purchase and installation of all termination junction boxes necessary to adapt and connect them to this wiring. Included also shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the building wiring as called for and to the connection methods set forth in these specifications.

I. Items which are to be installed but not purchased as part of the electric work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The electric work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.20 DELIVERY, STORAGE AND HANDLING

A. All materials for the work of this section shall be delivered, stored and handled so as to preclude damage of any nature. Manufactured materials shall be delivered and stored in their original containers, plainly marked with the products' and manufacturer's name. Materials in broken containers or in packages showing watermarks or other evidence of damage, shall not be used and shall be removed from the site.

B. Transformers: On receipt, inspect for and note any shipping damage to packaging and transformer.
   1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
   2. Store in a warm, dry, and temperature-stable location in original shipping packaging.
   3. Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
   4. Follow manufacturer's instructions for lifting and transporting transformers.

1.21 TEMPORARY POWER AND LIGHTING

A. The Electrical Subcontractor shall furnish and install feeders of sufficient size from the Utility Company's power lines for the electric light and power requirements for the building while under construction and until the permanent feeders and related equipment have been installed and are in operation. Temporary lighting shall be based on a minimum of one watt per square foot covering each and every square foot of floor area in the building. Sufficient wiring, lamps, and outlets shall be installed to insure proper lighting in all rooms, space, stairwells, and corridors. Minimum sized lamp used shall be 100 watt. Where higher lighting intensities are required by Federal or State Standards of Laws or otherwise specified, the above specified wattage shall be increased to provide these increased intensities.

B. All necessary transformers, meters, cables, panelboards, switches, temporary lamp replacements and accessories required for the temporary light and power installation shall be provided by the Electrical Subcontractor.

C. The Electrical Subcontractor shall provide and maintain on each floor of the building, a feeder or feeders of sufficient capacity for the requirements of the entire floor and he shall provide a sufficient number of outlets, located at convenient points, so that extension cords of not over 50 ft. in length will reach all work requiring temporary light or power.

D. The Electrical Subcontractor shall install and maintain the wiring and accessories for the offices of the Construction Manager and Owner’s Project Manager as specified in the contract form.

E. All temporary electrical work shall meet the requirements of the National Electrical Code Article 305 Temporary Wiring, the Local Utility Company, and all Federal Standards and Laws.

F. All temporary wiring and accessories thereto installed by the Electrical Subcontractor shall be removed after their purposes have been served.

G. The Construction Manager will pay for the cost of electric energy consumed by himself and by all of his Trade Contractors, unless otherwise indicated.

H. All lamps installed in permanent lighting fixtures and used for lighting during construction shall be replaced by the Electrical Subcontractor just prior to date of Use and Occupancy or Final Acceptance.

I. Provide all temporary lighting and power required above during the normal working hours of the project or a total of twelve (12) hours per normal working day; Saturdays, Sundays and legal holidays are excluded. The twelve hours per day shall include manning the temporary power and lighting 2 hour before and 2 hour after a normal eight (8) hour working day. In addition to the above, provide and maintain, to the satisfaction of the local authorities having jurisdiction, all temporary lighting and power that may be required for safety purposes. The Electrical Subcontractor will be compensated by the Construction

Manager for any additional standby time, materials or equipment required by the Construction Manager or other Subcontractors beyond the normal working hours, as defined above.

1.22 STAGING AND SCAFFOLDING

A. Refer to requirements specified hereinabove.

1.23 EXTRA MATERIALS

A. Furnish extra materials described in following product specification sections that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1.24 PHASING, DEMOLITION AND MAINTAINING EXISTING SERVICES

A. During the execution of the work, required relocation, etc., of existing equipment and systems in the existing building areas where new work is to be installed or new connections are scheduled to be made, shall be performed by the Electrical Subcontractor, as required by job conditions and as determined by the Designer in the field, to facilitate the installation of the new system, while demolition, relocation work or new tie ins will be performed. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the User Agency's designated representative, for specified, mutually agreeable periods of time, after each of which the interruption shall cease and the service shall be restored. This procedure shall be repeated to suit the User Agency's working schedule, as many times as required until all work is completed. Any outages of service shall be approved by M's Project Manager, prior to commencing the work. No outages or shutdowns of service shall occur without the written authorization of the Owner's Project Manager prior to commencing the work. Give notice of any scheduled shutdowns, a minimum of weeks in advance. User Agency shall make their best efforts to meet this request without adversely affecting the electric service to the existing building.

B. Prior to any deactivation and relocation or demolition work, consult the drawings and arrange a conference with the Designer and the Owner's Project Manager in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused or to remain in operation and be integrated with the new systems.

C. All deactivation, relocation and temporary tie ins of electrical systems and equipment shall be provided by the Electrical Subcontractor. All demolition and removal of electrical systems and equipment designed to be demolished shall be provided by the Electrical Subcontractor. Place all demolished electrical materials except hazardous materials (PCB lighting ballasts, fluorescent lamps, etc.) As determined by the Authority having jurisdiction in Construction Managers provided dumpster. All hazardous electrical materials shall be legally disposed by the Electrical Subcontractor.

D. Owner's Project Manager reserves the right to inspect the material scheduled for removal and salvage any items he deems usable as spare parts.

E. Phasing:
1. The Electrical Subcontractor shall construct the subject project in phases as directed by the Designer to suit the project progress schedule, as well as the completion date of the project.
2. For additional information related to phasing, review the General Conditions and Supplementary Conditions and the architectural drawings.

PART 2 - PRODUCTS

(Not Used)

PART 3 - EXECUTION

(Not Used)

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

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

1.03 SUBMITTALS

A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

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

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers
a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Or approved equal.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

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

2.04 raceway seals

A. Where a raceway enters a building or structure from outside, it shall be sealed. Spare or unused raceways shall also be sealed. Sealants shall be identified for use with cable insulation, conductor insulation, bare conductor, shield, or other components.

B. Where a service raceway enters a building or structure from an underground distribution system, it shall be sealed in accordance with the NEC. Spare or unused raceways shall also be sealed. Sealants shall be identified for use with the cable insulation, shield, or other components.

C. Conduits or raceways through which moisture may contact live parts shall be sealed or plugged at either or both ends. Spare or unused raceways shall also be sealed. Sealants shall be identified for use with the cable insulation, conductor insulation, bare conductor, shield, or other components.

D. Where portions of a raceway or sleeve are known to be problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway or sleeve shall be filled with an approved material to prevent the circulation of warm air to a colder section of the raceway or sleeve.

E. Cap empty conduits during construction to avoid water ingress into the building.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".

J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

L. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

M. Sleeves shall be installed and properly secured at all points where pipes pass though masonry, concrete or wood. Do not cut the steel decking before the slab is poured. Provide core drilling after slab is poured and cured. Core openings shall have Link-Seal fire rated penetration closures.

3.03 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

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

END OF SECTION

SECTION 260519

ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following:
1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.03 SUBMITTALS

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

B. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 manufacturers

A. Acceptable Manufacturers – Conductors and Cables
1. AFC Cable Systems, Inc.
2. Southwire.
3. Genera Cable.
4. Or approved equal.

B. Acceptable Manufacturers – Connectors and Splices
1. AFC Cable Systems, Inc.
2. 3M; Electrical Products Division.
3. Tyco Electronics Corp.
4. Or approved equal.

2.02 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70.

B. Conductor Insulation: 90 degree rated; Comply with NEMA WC 70 for THHN, THWN-2 and XHHW-2.

C. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

D. Emergency System Feeders: Emergency System Feeders: Mineral-insulated, metal-sheathed cable, Type MI.

2.03 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.04 METAL CLAD (MC) CABLE ASSEMBLY

A. Description
1. Metal clad cable assemblies shall consist of 2 or more insulated, current carrying copper conductors. The Metal-Clad Cable shall be UL Classified as a Through-Penetrating Product (XHLY) for use in One, Two or Three-Hour Through-Penetration Firestop Systems {XHEZ). Assembly shall be suitable for use in cable trays in accordance with the NEC.
2. Current-Carrying Conductors: Soft annealed copper in compliance with the latest edition of ASTM B3 and/or B8.
3. Each separate circuit conductor shall have its own dedicated neutral conductor. The dedicated neutral conductor shall be white/grey with a continuous color stripe matching the color of its dedicated circuit conductor. Multi-wire branch circuits are not allowed.
4. Grounding/Bonding Conductor: Full sized bare aluminum bonding/grounding conductor, sized in accordance with Table 6,1 of UL1569, working in combination with the armor to create a low resistance ground path. Aluminum bonding/grounding conductor shall be cabled with the current-carrying conductors and shall be in intimate contact with the metal armor.
5. Insulated Equipment Grounding Conductor: The equipment ground shall be full-sized in accordance with Table 6.1 of UL 1569 and shall be soft-annealed copper in compliance with the latest edition of ASTM B3 and/or B8.
6. Insulated Conductor: The insulated conductor shall be Type THHN 90°C DRY with an extruded polypropylene protective covering. The Type THHN Insulated Conductor with protective covering shall be manufactured and tested in accordance with UL 83 and UL 1569.
7. Armor: A zinc coated galvanized steel armor shall be applied over the cabled wire assembly with an interlock in compliance with Section 13 of UL 1569.

B. Fittings
1. Fittings shall be UL listed and identified for use with metal clad interlocking armor ground.
2. Connectors shall be of steel or malleable iron and shall have saddle clamp to insure a tight termination of MC Cable to box.

2.05 MINERAL INSULATE (MI) CABLE 2-HOUR RATED

A. Description
1. The wiring cable shall be 2-hour fire-rated.
2. The wiring cable shall be listed in the UL Fire Resistance Directory.
3. Mineral Insulated wiring Type MI cable shall have:
   a. Description: ANSI/NFPA 70, Type MI
   b. Conductor: solid high conductivity copper
   c. Insulation Voltage Rating: 600 volts
   d. Cable Temperature Rating: 90 degrees C
   e. Termination Temperature Rating: 90 degrees C
   f. Insulation Material: magnesium oxide
   g. Sheath Material: seamless soft-drawn copper

h. Fire Rating: complete cable system shall have a 2-hour fire rating as listed and classified by Underwriters Laboratories, Inc.

4. Contractor shall have a minimum of 10 years of experience in the installation of such systems.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

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

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

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN-2, single conductors in raceway.

C. Emergency System Feeders in non-corrosive copper or brass environments: Mineral-insulated, metal-sheathed cable, Type MI.

D. Emergency System Feeders direct-buried: Mineral-insulated, metal-sheathed cable, Type MI with an extruded outer polyolefin jacket to provide additional protection.

E. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN-2, single conductors in raceway.

F. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in raceway.

G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway; Metal-clad cable, Type MC.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN-2, in raceway; Metal-clad cable, Type MC.

M. Fire Alarm Circuits:

1. Initiating and signaling circuits originating and serving an evacuation zone: manufacturer recommended cabling in minimum 3/4” EMT raceway.
2. Initiating and signaling circuits originating outside an evacuation zone: mineral-insulated, metal-sheathed cable, Type MI to the first device in the evacuation zone; and manufacturer recommended cabling in minimum 3/4” EMT raceway thereafter.
3. Riser cables: mineral-insulated, metal-sheathed cable, Type MI.
4. Initiating and signaling circuits for stair and stair pressurization system devices: mineral-insulated, metal-sheathed cable, Type MI.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Sections "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

I. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.04 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

B. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

C. Cut sleeves to length for mounting flush with both wall surfaces.

D. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

E. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

F. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

G. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations.

H. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

I. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

J. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.05 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

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

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

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

1.03 SUBMITTALS

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

B. Field quality-control test reports.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with UL 467 for grounding and bonding materials and equipment.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. Approved Manufacturers
1. Harger Lightning and Grounding
2. Burndy; Part of Hubbell Electrical Systems
3. ERICO International Corporation
4. Or approved equal

2.02 Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

A. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.03 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
1. Pipe Connectors: Clamp type, sized for pipe.

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

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad; 3/4-inch by10 feet (19 mm by 3 m) in diameter.

PART 3 - EXECUTION

3.01 APPLICATIONS

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

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.

C. Conductor Terminations and Connections:

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

3.02 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
   2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.03 INSTALLATION

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

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
   2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

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

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Lightning Protection System: Install 3/0 AWG copper grounding conductor, in conduit, to the building's main service ground busbar.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
   a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

B. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.

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

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

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

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.04 SUBMITTALS

A. Product Data: For steel slotted support systems.

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

C. Welding certificates.

1.05 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Approved Manufacturers
      a. Cooper B-Line, Inc.; a division of Cooper Industries.
      b. Thomas & Betts Corporation.
      c. Unistrut; Tyco International, Ltd.
      d. Or approved equal.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   5. Channel Dimensions: Selected for applicable load criteria.

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

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

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Approved Manufacturers
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Or approved equal.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Approved Manufacturers
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) Or approved equal.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

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

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb. (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

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

F. The electrical trade contractor shall install all hangers and supports for electrical systems prior to fireproofing.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Concrete bases shall be provided by the electrical trade contractor.

B. The electrical trade contractor shall coordinate the anchor-bolt pattern for all light fixtures.

C. The electrical trade contractor shall provide to the respective subcontractor the layout of conduit and other materials that penetrate the equipment pads.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

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

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

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

B. See Division 26 for exterior duct banks and manholes, and underground handholes, boxes, and utility construction.

1.03 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.

B. EMT: ANSI C80.3.

C. FMC: Zinc-coated steel.

D. LFMC: Flexible steel conduit with PVC jacket.

E. Fittings for Conduit (Including all Types and Flexible and Liquid tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
   2. Fittings for EMT: Steel, set-screw or compression type.

2.02 NONMETALLIC CONDUIT AND TUBING

A. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

B. LFNC: UL 1660.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

D. Fittings for LFNC: UL 514B.

2.03 METAL WIREWAYS

A. Approved Manufacturers
   1. Cooper B-Line, Inc.
   2. Hoffman.
   3. Square D; Schneider Electric.
   4. Or approved equal.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1 and Type 3R (exterior) unless otherwise indicated.

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

D. Wireway Covers: Hinged type.

E. Finish: Manufacturer's standard enamel finish.

2.04 NONMETALLIC WIREWAYS

A. Approved Manufacturers
   1. Hoffman.
   2. Lamson & Sessions.
   3. Carlon Electrical Products.
   4. Or approved equal.

B. Description: PVC plastic, extruded and fabricated to size and shape indicated, with Snap-On cover and mechanically coupled connections with plastic fasteners.

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

2.05 SURFACE RACEWAYS

A. Provide surface raceway systems for branch circuit and data network voice, video and other low-voltage wiring. Surface raceway system shall consist of raceway bases, covers, pre-divided raceway bases, appropriate fittings and device mounting plates necessary for a complete installation.

B. Surface Metal Raceways: Galvanized steel with Snap-On covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Approved Manufacturers
   a. Thomas & Betts Corporation.
   b. Walker Systems, Inc.; Wiremold Company (The).
   c. Wiremold Company (The); Electrical Sales Division.
   d. Or approved equal.

C. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
1. Approved Manufacturers
   a. Panduit Corp.
   b. Walker Systems, Inc.; Wiremold Company (The).
   c. Wiremold Company (The); Electrical Sales Division.
   d. Or approved equal.

D. Raceway shall have the following features:
1. 4” x 2” minimum dimensions.
2. Tamper resistant.
3. 2" (51mm) bend radius compliant fittings.
4. Pre-punched mounting holes.
5. UL and cUL Listed component raceways.

2.06 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.

E. Nonmetallic Floor Boxes: Nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

I. Cabinets:
1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
1. Exposed Conduit: Rigid steel conduit.

2. Concealed Conduit, Above ground: Rigid steel conduit; EMT.
3. Underground Conduit outside the foundation wall: RNC, Schedule 80 PVC, direct buried. Convert nonmetallic conduit to rigid steel conduit before rising through earth.
4. Underground Conduit within building confines: RMC, direct buried or RNC, Schedule 80 PVC, direct buried. Convert nonmetallic conduit to rigid steel conduit before rising through earth.
5. Exposed or underground conduit to sewage ejector pump chamber: PVC coated rigid steel conduit.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
   d. Fire pump room.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable: EMT or plenum rated inner duct.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
9. Exposed or underground conduit to sewage ejector pump chamber: PVC coated rigid steel conduit.
10. Exposed or underground conduit to acid neutralization chamber: PVC coated rigid steel conduit.

C. Fire Pump Room:
1. All equipment shall be suitable for use in locations subject to a moderate degree of moisture.
2. All equipment shall be minimally rated for NEMA Type 2, dripproof or with an ingress protection (IP) rating of IP31.
3. Comply with NFPA 20 for junction boxes located within the fire pump room and serving the fire pump controller (e.g., transition from 2-hour MI cable to standard cable) and raceway terminations into the fire pump controller. NFPA 20 prohibits the installation of such components in a manner which violates the integrity of the fire pump controller enclosure type rating.
4. Comply with NEMA Standards Publication ICS 14-2015 Application Guide for Electric Fire Pump Controllers, which states that all “top-entry conduit fittings into the fire pump controller should be, as a minimum, watertight”; and side-entry conduit fittings into the fire pump controller “should be suitable for the environment and enclosure type”.
5. Comply with Article 695 of NFPA 70 National Electrical Code for fire pump installations.
6. Where fire pump controller enclosures are listed for a greater level of protection than NEMA Type 2, the higher degree of protection against water infiltration shall be extended to the associated and connected junction boxes, conduits and other connections located within the fire pump room.

D. Minimum Raceway Size: 1/2-inch (16-mm) trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

F. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.02 INSTALLATION

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

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

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

H. Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits under floor slab as if exposed.

I. Restrictions Applicable to EMT
   1. Do not use in areas subject to severe physical damage.
   2. Do not use in fire pump rooms.

J. Restrictions Applicable to Nonmetallic Conduit
   1. PVC Schedule 40 and PVC Schedule 80
      a. Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, and other such areas.
      b. Do not use in hazardous (classified) areas.
      c. Do not use in fire pump rooms.
      d. Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.
      e. Do not use above grade.
      f. Convert nonmetallic conduit, to rigid steel conduit before rising through floor slab.

K. Restrictions Applicable to Flexible Conduit
   1. Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

L. Service Entrance Conduit, Underground
   1. PVC, Type-EPC 40, galvanized rigid steel.
   2. Convert nonmetallic conduit to rigid steel conduit before rising through floor slab.

M. Underground Conduit Other Than Service Entrance
   1. Tape Wrapped rigid steel; PVC, Type EPC-40. Convert nonmetallic conduit to rigid steel conduit before rising through floor slab. Ten mil tape shall be 1/2 lapped and extend a minimum of 6 inches above floor.
   2. Convert nonmetallic conduit to rigid steel conduit before rising through floor slab.

N. Conduit Installed Under Floor Slabs
   1. Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.
   2. The Electrical Subcontractor will provide and pay for excavations and backfill for under grade slab conduit runs and coordinate the same with other utilities.

3. All structural fill/bedding material must be installed in accordance with the earthwork specifications, including compaction.

O. Conduit Through Floor Slabs
1. Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.
2. Convert nonmetallic conduit to rigid steel conduit before rising through floor slab.

P. Conduit Installed in Concrete Floor Slabs
1. Rigid steel; PVC, Type EPC-40. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits.
2. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab.
3. Increase slab thickness as necessary to provide minimum one inch cover over conduit.
4. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway.
5. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab.
6. Where nonmetallic conduit is used, raceway shall be converted to rigid steel before rising above floor, unless specifically indicated.

Q. Stub-Ups
1. Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.
2. Convert nonmetallic conduit to rigid steel conduit before rising through floor slab.

R. Conduit Support
1. Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work.
2. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load.
3. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant.
4. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes.
5. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system.
6. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts.
7. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems.
8. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 foot maximum intervals.
9. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means.
10. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

S. Directional Changes in Conduit Runs
1. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

T. Locknuts and Bushings
1. Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

U. Flexible Connections
1. Provide flexible steel conduit between 3 and 6 feet in length for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

V. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

W. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

X. Raceways for Optical Fiber and Communications Cable: Install as follows:
1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

Y. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

Z. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
   d. Attics: 135 deg F (75 deg C) temperature change.
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.

3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

AA. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi recessed lighting fixtures,]equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:
1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Division 31 Section "Earth Moving."
3. 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 (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
   b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, placing them 24 inches (600 mm) O.C. Align planks along the width and along the centerline of conduit.

END OF SECTION

SECTION 260548

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. Section includes:
1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Site Class as Defined in the State Building Code.
2. Assigned Seismic Use Group or Building Category as Defined in the State Building Code.

1.04 SUBMITTALS

A. Product Data: For the following.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Welding certificates.

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Or approved equal.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.02 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti
2. Amber/Booth Company, Inc.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Or approved equal.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
   1. Basis of Design: Hilti KCM - MD cast-in anchors and KWIK HUS-EZ I post-installed screw anchor.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
   1. Basis of Design: Hilti HIT-RE 500 V3, HIT-HY 200, and HVU2 Adhesive anchors._____

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.02 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:
   1. Install restrained isolators on electrical equipment.
   2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
   5. Set anchors to manufacturer's recommended torque, using a torque wrench.
   6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.03 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.04 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
   3. Test to 90 percent of rated proof load of device.
   4. Measure isolator restraint clearance.
   5. Measure isolator deflection.
   6. Verify snubber minimum clearances.
   7. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following:
1. Identification for conductors and communication and control cable.
2. Warning labels and signs.
3. Equipment identification labels.

1.03 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, 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.

PART 2 - PRODUCTS

2.01 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.

C. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, preprinted.

D. 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.

E. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

F. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).

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

H. Warning label and sign shall include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."

2.02 ELECTRICAL SYSTEM IDENTIFICATION

A. Approved Manufacturers
1. T&B.
2. 3M
3. EMED Co.
4. Or approved equal.

B. Identification of Equipment:
1. All pieces of major electrical equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.
2. The Contractor shall make it possible for the personnel operating and maintaining the equipment and systems in this project to readily identify the various pieces of equipment, junction boxes, etc., by marking them. All items of equipment, pull boxes, junction boxes, etc., shall be clearly marked using engraved nameplates as hereinafter specified. The item of equipment shall indicate the same number as shown on the Drawings, where applicable.
3. White background and black letters equipment nameplates shall be three ply laminated plastic, a minimum of 3/32" thick, black background, white letters for normal power, red background, white letters for emergency power, and blue-white-blue for UPS power. Letters shall be similar to Roman Gothic of a size that is legible (1/2" minimum for main nameplates and 3/8" minimum for branch device nameplates) and appropriate to the application. Attachment of nameplates shall be by stainless steel screws. Rivets or adhesives are not acceptable.
   a. Electrical equipment to be identified includes: All switchgear, switchboards, unit substations, distribution panels, transformers, motor control centers, panelboards, automatic transfer switches, busway plugs, disconnect switches, motor controller/starters, lighting control panels, pull boxes, junction boxes, and similar equipment.
   b. Nameplates on switchgear, switchboards, unit substations, automatic transfer switches, transformers, distribution panels, motor control centers, disconnect switches, motor controller/starters, variable frequency drives and panelboards shall give voltage and current characteristics and the source feeding the panel. Current characteristics shall indicate the size of the overcurrent devices serving the equipment and not the equipment current rating.
      1) Provide panel and circuit designation on disconnect switches, motor controllers/starters, variable frequency drives, etc.

Example:

PANEL PP2
120/208V, 3PH, 4 W, 225 A
Fed from DPA-3
Room 1.102

c. Individual overcurrent devices and pilot lights in switchgear, switchboards, unit substations, distribution panels, motor control centers, and similar equipment shall have nameplates showing the load served and its location, where remote. Nameplates on motor starters shall indicate variable speed, time delay operation, etc., where applicable.

d. Blank nameplates shall be mounted on each spare or bussed space in motor control centers, and on each spare or space in distribution panels.

e. Branch circuit panelboards shall have neatly typed circuit directories behind clear plastic. Identify circuits by room numbers. Room numbers shall be those finally selected by the Owner; not necessarily those given on contract Drawings. Spares and spaces shall be indicated with erasable pencil; not typed. Circuit numbers shall be provided in the directory and at each circuit breaker.

C. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces, to distinguish each run as either a normal power, emergency power, fire alarm, control wiring or voice/data conduit. Except as otherwise indicated, use white banding with black lettering except that emergency power orange and white, fire alarm conduit markers shall use red banding. Provide self-adhesive or snap-on type plastic markers. Indicate voltage ratings of conductors exceeding 250 volts. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors, or enters non-accessible construction and at spacings of not more than 30' along each run of exposed conduit.

D. Cable Tray Systems: Provide engraved nameplates identifying cable tray systems as to use, on maximum 50' centers on all tray systems and whenever a tray enters a room or concealed accessible location. Nameplate text shall be submitted to the Engineer for review.

E. Underground Cable Identification: Bury a continuous, preprinted, red and silver metallic ribbon cable marker, Brady No. 91600 Series or an approved equal with each underground cable (or group of cables), regardless of whether conductors are in conduit or direct buried. Locate each directly over cables, 12" above cable below finished grade. Ribbons shall be detectable from above grade using a pipe or cable locator.

F. Cable/Conductor Identification: Coordinate a uniform and consistent scheme of color identification of power wiring throughout the building system. Identification shall be by the permanent color of the selected covering. On large conductors, secure identification by means of painted color banding or plastic tape.

1. Color scheme shall be as follows, [or as required to match the existing color coding in the building for 120/240 V systems with high leg provide Orange for phase B]

	208/120 Volt	480/277 Volt	5kV/15kV
Phase A		Brown	Black
Phase B		Purple	Red
Phase C		Yellow	Blue
Neutral	White	Gray	White
Ground	Green		Green

2. Wiring for switches shall be same color as phase wire.

3. Colored insulation in sizes up through #4. Conductors #3 and larger may have black insulation, but color coded with 1/2" wide band of colored tape, at accessible locations. Rap conductor minimum 6" width.
4. Feeder cables shall be tagged in pull boxes, wireways, wiring gutters of panels, and at other accessible locations. Tags shall be fireproof, nonconductive material, approved by Architect.
5. Maintain same conductor color from service entrance to last device.

G. Phase Rotation: Phase rotation shall be maintained throughout the project.
1. Phase rotation shall be clockwise or counterclockwise, per serving power company standards, A-B-C, and identified as such left-to-night, top-to-bottom, and front-to-back with color coding as specified above at switchboards, panelboards, substations, transformers, motor control centers, motor starters, and similar locations.
2. Motor phase reversal, if necessary, shall be made at motor controller.

H. Branch Circuit and Control Wiring Tags: All branch circuit and control wiring conductors shall be tagged using self-sticking vinyl cloth or mylar cloth wire markers. Embossed pressure sensitive plastic or metal ribbon markers will not be accepted. Tags shall be installed at all wiring splice, tap and termination points and shall correspond to the designations shown on the control wiring diagrams or panel schedules.

I. Branch Circuit Pull Boxes and Junction Boxes: Branch circuit pull boxes shall be neatly stenciled with a black permanent marker indicating the panel name and branch circuit number. Boxes on emergency power systems shall be painted orange prior to marking. Boxes on fire alarm power systems shall be painted red prior to marking.

J. Miscellaneous Switch Plates or Device Plates: Adhesive Film Label with Clear Protective Overlay for interior use: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).
1. Nomenclature shall include the panel and circuit of the outlet or switch, or the indication of the pilot, or the area of control, or equipment served.
2. Switched and non-switched device plates shall be engraved. Engraving shall be 3/16" condensed Gothic and shall be filled with black enamel.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

3.02 CLEANING AND PAINTING OF ELECTRICAL WORK

A. Prime, protective and touch-up painting is included in the Work of this Division. Finish painting in equipment spaces, concealed locations, and other locations not exposed to the view of building occupants is included in the work of this Division. Finished painting in areas exposed to the view of building occupants is specified under Division 9.

B. All equipment and materials furnished by the electrical subcontractor shall be delivered to the job with suitable factory protective finish.

C. Electrical switchgear, disconnect switches, contactors, etc., with suitable factory-applied finishes shall not be repainted; except for aesthetic reasons where located in finished areas as directed by the Architect and in a color selected by the Architect. Where factory-applied finishes are damaged in transit, storage or installation, or before final acceptance, they shall be restored to factory-fresh condition by competent refinishers using the spray process.

D. All equipment not finished at the factory shall be given a prime coat and then finish painted with two coats of enamel in a color as directed by the Architect/Engineer. No nameplates on equipment shall be painted, and suitable protection shall be afforded such plates to prevent their being rendered illegible during the painting operations.

E. The surfaces to be finish-painted shall first be prepared as follows:
   1. Galvanized and black steel surfaces shall first be painted with one coat of galvanized metal primer.
   2. Aluminum surfaces shall first be painted with one coat of zinc chromate primer.

F. All ferrous metal surfaces without a protective finish and not galvanized in exposed and concealed areas including chases, under floor and above ceilings shall be painted with two coats of zinc chromate primer as the construction progresses to protect against deterioration.

G. All junction and pull boxes and covers which are part of raceway systems distributing emergency power shall be painted orange. Where a multiple branch emergency power system is installed, the branch designation (LS, CB or EQ) shall be stenciled on the box cover in minimum one inch (1") high white letters.

H. All junction and pull boxes and covers and terminal cabinets which are part of the raceway/wiring system for emergency alarm wiring shall be painted orange and fire alarm wiring shall be painted red. A system designation (FA) shall be stenciled on the box or cabinet cover in minimum one inch (1") high white letters.

I. All conduit exposed to view shall be finish painted as directed by the Architect.

J. Before painting, all surfaces to be painted shall be suitably prepared. This shall include removing all oil, rust, scale, dirt, and other foreign material. Surfaces shall be made smooth by grinding, filing, brushing, or other approved method. In the painting operations, the primer for metal surfaces shall be of the zinc dust type unless specified otherwise, and where finish painting is specified, it shall be painted using materials and colors selected and approved by the Architect. Refer to Division 9 for additional requirements.

END OF SECTION

SECTION 260573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes requirements for computer-based fault-current, overcurrent protective device coordination and arc flash protection studies. Protective devices shall be set based on Engineer's review of submitted results of the protective device coordination study.
   1. Coordination of series–rated devices is not permitted.

1.03 PERFORMANCE REQUIREMENTS

A. Fault Current Study: Prepare computer-based, fault current study to calculate the maximum available short-circuit current in amperes RMS symmetrical at circuit-breaker positions of the electrical power distribution system based on proposed feeder routing.

B. Overcurrent Protective Device Coordination: Prepare computer-based, selective coordination study such that all overcurrent protective devices proposed for inclusion in the Work shall be selected to be selectively coordinated for total selective coordination with the overcurrent protective devices installed on their supply side such that an overcurrent event (overload, short-circuit, or ground-fault) occurring at the lowest level in the system (branch circuit) cannot cause the feeder protective device supplying the branch circuit panelboard to open.
   1. Total selective coordination shall be carried through each level of distribution for all branches of emergency power system. Emergency power systems shall include life safety, legally required standby systems, critical operations power systems, and fire pumps.
   2. The normal power system and standby power system shall be coordinate to 0.01s.

C. Arc Flash Hazard Analysis: Prepare computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.04 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.05 SUBMITTALS

A. The release of electrical equipment submittals (panelboards, engine generators, switchgear, etc.) is dependent on the receipt of a complete and accurate overcurrent protective device coordination study. The following submittals shall be in digital form:
   1. Coordination-study input data, including completed computer program input data sheets. Provide editable electronic media including all files and breaker TCC's.
   2. Study and Equipment Evaluation Reports.
   3. Coordination-Study Report; signed, dated, and sealed by a qualified professional engineer.
   4. Arc-flash study input data, including completed computer program input data sheets.
   5. Arc Flash Hazard Analysis Report; signed, dated, and sealed by a qualified professional engineer.

B. Product Data: For computer software program to be used for studies.

C. Qualification Data: For Coordination Study Specialist and Arc-Flash Hazard Analysis Specialist.

D. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399. For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

E. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

1.06 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Qualifications: Comprehensive engineering analysis by qualified Professional Engineer or personnel trained and employed by the equipment manufacturer in required calculation methodology.
   1. Analysis to be performed by Professional Engineer or personnel trained, employed, and supervised by a registered Professional Engineer.
   2. Registered professional engineer shall be a full-time employee of the electrical equipment manufacturer or a professional engineering firm.
   3. Report shall be signed and sealed by a Professional Engineer with current registration.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 1584 for performing Arc Flash Hazard Calculations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers
   1. SKM Systems Analysis, Inc.
   2. EasyPower, LLC
   3. Power Analytics Corporation
   4. Or approved equal

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399 for fault-current and overcurrent protective device coordination studies.

B. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard analysis.

C. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate coordination by computer-generated, time-current coordination plots.

2.03 POWER SYSTEM STUDIES

A. The Electrical Trade Contractor shall request information required to complete the power system studies from the Utility Company. This information shall be provided to the manufacturer upon request.

B. The manufacturer shall make all necessary modifications to the circuit breaker types for a fully coordinate electrical system to comply with the specifications.

C. Short Circuits Studies, Protective Device Evaluation Studies, and Protective Device Coordination Studies shall be provided by the Manufacturer. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

2.04 POWER SYSTEM DATA

A. The Design System Analyst performing the short-circuit, protective device coordination study, and arc flash hazard analysis shall furnish the Contractor with a list of required data immediately after award of the contract. Contractor shall expedite collection of the data to ensure completion of the study and analysis as required.

B. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

C. Source combination shall include present and future motors and generators indicated in the documents.

D. If applicable, include fault contribution of existing motors in the study and analysis.

E. Gather and tabulate the following input data to support coordination study:
   1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Impedance of utility service entrance.
   3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
      a. Circuit breakers and fuses ratings and types.
      b. Relays and associated power and current transformer ratings and ratios.
      c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, X/R ratios, taps measured in per cent, and phase shift.

d. Generator short-circuit current contribution data, including short-circuit reactance, rated kilovolt amperes, size, rated voltage, and X/R ratio.
e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity, impedance, lengths, and conductor material.
g. Motor horsepower and code letter designation according to NEMA MG 1.
h. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
i. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
   a. Special load considerations, including starting inrush currents and frequent starting and stopping.
   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
   d. Generator thermal-damage curve.
   e. Ratings, types, and settings of utility company's overcurrent protective devices.
   f. Special overcurrent protective device settings or types stipulated by utility company.
   g. Time-current-characteristic curves of devices.
   h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
   j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

2.05 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive Summary

B. Study descriptions, purpose, basis and scope of the study.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Cable size and lengths.
   3. Transformer kilovolt ampere (kVA) and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary:
   1. Calculations:
      a. Arcing fault magnitude.
      b. Protective device clearing time.
      c. Duration of arc.
      d. Arc-flash boundary.
      e. Working distance.
      f. Incident energy.
      g. Hazard risk category.
      h. Recommendations for arc-flash energy reduction.
   2. Circuit breakers rated 1200A and higher shall be provided with an Arc flash Reduction Maintenance System for accelerated instantaneous trip to reduce arc flash. The setting shall be determined by the arc flash study and set in the field by the manufacturer's representative.
      a. The pickup setting is chosen using the following steps:
         1) Calculate the arcing fault current that could flow through the circuit breaker associated with the Arc flash Reduction Maintenance System. Formulas from IEEE STD 1584TM-2002 are used to calculate the arcing current.
         2) Determine the total transient load current that can flow to loads fed by the circuit breaker equipped with the Arc flash Reduction Maintenance System. These can include motor inrush and transformer inrush.
         3) Choose a pickup setting for the Arc flash Reduction Maintenance System that is:
            a) Below 75% of calculated arcing current.
            b) Above the total transient load current.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

H. Equipment specific Arc Flash Warning Labels.

I. Recommendations for system improvements, where needed.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
   1. Proceed with coordination study and arc-flash study only after relevant equipment submittals have been assembled, but prior to their submission to the Architect.
   2. Coordination study shall accompany submission of relevant equipment submittals.

3.02 FAULT-CURRENT STUDY

A. A short-circuit current ratings indicated in the Contract Documents are based on Fault-Current study prepared by the Engineer during design and are based on available information and anticipated feeder lengths. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system based on proposed feeder routing. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
   1. Electric Utility's supply termination point.
   2. Switchgear and switchboard bus.
   3. Motor-control center.

4. Distribution panelboard.
5. Branch circuit panelboard.
6. Standby Generators and Transfer Switches.
7. Enclosed Fused Switch.
8. Enclosed Circuit Breaker.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculate short-circuit currents according to IEEE 551.

E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
1. Transformers, as appropriate for transformers included in the Work:
   a. ANSI C57.12.10.
   b. ANSI C57.12.22.
   c. ANSI C57.12.40.
   d. IEEE C57.12.00.
   e. IEEE C57.96.
2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

F. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

G. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. Notify Engineer, in writing, of any existing circuit protective devices improperly rated for the calculated available fault current.

3.03 COORDINATION STUDY

A. Coordination (Selective): Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents.
1. Emergency system (Life Safety) overcurrent devices shall be fully selectively coordinated with all supply side overcurrent protective devices (emergency and normal).

B. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

C. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

D. The studies shall include all portions of the electrical distribution system from the normal power source and emergency/standby power sources down to and including the 120/208V distribution system. Normal/emergency/standby system connections and those which result in maximum fault conditions shall be adequately covered in the study.

E. All emergency system overcurrent devices shall be selectively coordinated with the overcurrent devices installed on their supply side per Section 700.27 of the National Electrical Code. The generator circuit breakers shall be of the same manufacturer as the switchboard. Provide a letter from the manufacturer stating that the overcurrent devices have been selectively coordinated.

F. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
   1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
   2. Calculate the maximum and minimum ground-fault currents.

G. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

H. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
   1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
      a. Device tag.
      b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
      c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
      d. Fuse-current rating and type.
      e. Ground-fault relay-pickup and time-delay settings.
   2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
      a. Device tag.
      b. Voltage and current ratio for curves.
      c. Three-phase and single-phase damage points for each transformer.
      d. No damage, melting, and clearing curves for fuses.
      e. Cable damage curves.
      f. Transformer inrush points.
      g. Maximum fault-current cutoff point.
      h. Motor starting characteristics, damage points and overload relay.
      i. Thermal damage curve for motors larger than 100 HP.
      j. Generator short-circuit decrement curve and damage point, and thermal damage curve.

K. Completed data sheets for setting of overcurrent protective devices.

L. Complete Schedule of breaker settings to summarize information contained on data sheets. Sample schedule has been included at the end of this section for preferred format.

3.04 ARC FLASH HAZARD ANALYSIS

A. Comply with IEEE 1584 for arc flash hazard analysis.

B. Comply with NFPA 70E and its Annex D for hazard analysis study.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system where work could be performed on energized parts including, but not limited to, the following:
1. Disconnect switches.
2. Electrical substations.
3. Electrical switchgear and switchboards.
4. Emergency system boxes and enclosures.
5. Enclosed circuit breakers.
6. Meter Sockets and assemblies.
7. Motor starter.
8. Motor-control centers.
9. Panelboards.
10. Power transfer equipment. (ATS)
11. Transformers.
12. Uninterruptible power supply equipment.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent protection relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. Calculate the arc-flash protection boundary and the corresponding incident energy calculations for multiple system scenarios to be compared and the greatest incident energy to be uniquely reported for each equipment location. Calculations to be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions.
1. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).
2. The maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators to be decremented as follows:
1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible.

G. For each equipment location with a separately enclosed main device, calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
1. When performing incident energy calculations on the line side of a main breaker, the line side and load side contributions must be included in the fault calculation.

H. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device to compute the incident energy for the corresponding location.

I. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash even, a maximum clearing time based on the specific location shall be utilized.

J. Complete Arc Flash report to be used for the preparation of Arc Flash Warning labels for electrical equipment. Refer to Division 26 Section “Identification for Electrical Systems” for requirements of Arc Flash Study and labels.

3.05 CORRECT DEFICIENCIES, RE-CALCULATE AND REPORT

A. After Engineer’s initial review, correct unsatisfactory conditions and recalculate to demonstrate compliance; resubmit overcurrent protective devices as required to bring system into compliance.

B. Revise and Resubmit report multiple times as necessary to demonstrate compliance with requirements.

3.06 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels as specified in Division 26 Section “Identification for Electrical Systems”. Install labels under the direct supervision and control of the Arc-Flash Hazard Study Specialist.

3.07 ARC-FLASH WARNING LABELS

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Flash Hazard Boundary.
   2. Short Circuit Current Available and date the calculation was performed.
   3. Shock Hazard when Cover is Removed.
   4. Limited Approach Boundary.
   5. Restricted Approach Boundary.
   6. Prohibited Approach Boundary.
   7. PPE Requirements, including the following:
      a. Hazard Risk Category
      b. Required Minimum Arc Rating of PPE in cal/cm^2
      c. Clothing Description
   8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

END OF SECTION

SECTION 262200

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA.

1.03 REFERENCE STANDARDS

A. FEDERAL REGISTER – US Department of Energy, Office of Energy Efficiency and Renewable Energy. 10 CFR Part 430, July 29, 2004. Energy Conservation Program for Commercial and Industrial Equipment: Energy Conservation Standards for Distribution Transformers (Designated C-3).

B. ANSI/NEMA ST 20 - Dry Type Transformers for General Applications.

C. ANSI/NEMA TP-1 – Guide for Determining Energy Efficiency for Distribution Transformers.

D. ANSI/NEMA TP-2 – Standard Test Method for Measuring Energy Consumption of Distribution Transformers.

E. Metering Standards:
1. Computational algorithms per IEEE Std 1459-2000.
2. UL 916, UL 61010C-1 CAT III.
3. IEEE C57.110-1998 – IEEE Recommended Practice for establishing transformer capability when feeding non-sinusoidal load currents.
4. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
5. IEEE Standard 1100 documents how typical transformers feeding electronic equipment produce substantially higher losses under electronic equipment load compared to under linear load, requiring derating.

1.04 SUBMITTALS

A. Submit product data including the following:
1. Insulation system impregnant data sheet as published by supplier.
2. Construction Details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight.
3. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight.
   a. 25-year Product Warranty Certificate.
   b. Packaging method for shipment (meeting specification requirements) including representative picture.
   c. UL approval for non-linear loading greater than 5% and other applicable agency certifications.

1.05 DELIVERY, STORAGE AND HANDLING

A. Store and protect products

B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.

C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

1.06 COMMERCIAL PRODUCT

A. Transformer shall be a standard item in the manufacturer's catalog.

1.07 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 manufacturers

A. Approved Manufacturers
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB.
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

2.02 BASIS OF DESIGN

A. The system specified is based upon products by Eaton Electrical Inc.; and represents the performance standard upon which any equivalent solution shall be based.

2.03 RATINGS INFORMATION

A. All insulating materials are to exceed NEMA ST20 standards and be rated for 220 degree C UL component recognized insulation system.

B. Neither the primary nor the secondary temperature shall exceed 220 degree C at any point in the coils while carrying their full rating of non-sinusoidal load. Transformers are to be UL listed and labeled for K-13 as defined as the sum of fundamental and harmonic Ih(pu)2h2 per UL 1561.

C. Transformers shall be listed for 115 degree C average temperature rise. Transformers listed for 150 degree C average temperature rise shall not be accepted.

D. K-Factor rated transformers shall have an impedance range of 3% to 6%, and shall have a minimum reactance of 2% in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.

E. Transformers 15kVA and larger shall have a minimum of 6 - 2.5% full capacity primary taps for 480V primaries and a minimum of 2 - 5% full capacity taps for 208V primaries. Exact voltages and taps to be as designated on the plans or the transformer schedule.

F. The maximum temperature of the top of the enclosure shall not exceed 50 degree C rise above a 40 degree C ambient.

G. The transformer(s) shall be rated as indicated in the following schedule:
1. Identification Number(s)
2. kVA Rating
3. Voltages
4. Phase
5. Frequency
6. Temperature Rise
7. K-Factor

2.04 CONSTRUCTION

A. Transformer coils shall be of the continuous wound construction and shall be impregnated with non-hygroscopic, thermosetting varnish. Transformer coils shall be copper.

B. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating. The core laminations shall be clamped together with steel angles. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.

C. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.

D. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degeasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use. The coating color shall be ANSI 49.

E. Transformers shall be supplied with quality, full width electrostatic shields resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
1. Common Mode: 0 to 1.5kHZ - 120dB; 1.5kHZ to 10kHZ - 90dB; 10kHZ to 100kHZ - 65dB; 100kHZ to 1MHZ - 40dB.
2. Transverse Mode: 1.5kHZ to 10kHZ - 52dB; 10kHZ to 100kHZ - 30dB; 100kHZ to 1MHZ - 30dB.

2.05 SOUND LEVELS

A. Sound levels shall be warranted by the manufacturer not to exceed the following:
1. K-13 rating:15 to 50kVA - 45dB; 51 to 150kVA - 50dB; 151 to 300kVA - 55dB; 301 to 500kVA - 60dB; 501 to 700kVA - 62dB; 701 to 1000kVA - 64dB

PART 3 - EXECUTION

3.01 INSTALLATION

A. Follow all national, state, and local codes with respect to transformer installation.

B. Where sound level may be of concern, utilize the services of a recognized and established Acoustical Consultant to provide the proper installation environment to minimize noise and vibration.

C. Check for damage and loose connections.

D. Set the transformer plumb and level.

E. Mount transformer on vibration isolation pads suitable for isolating the transformer.

F. Wall Brackets: Manufacturer's standard brackets

G. Provide Seismic restraints where required.

H. Coordinate all work in this Section with that in other sections.

I. Verify all dimensions in the field.

J. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies.

K. Adjust transformer secondary voltages to provide the required voltage at the loads.

L. Non-compliant products shall be replaced at no cost to the customer.

3.02 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

3.03 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training sessions. Train the Owner's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.04 SUBMITTALS

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

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types and details for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   6. Include wiring diagrams for power, signal, and control wiring.
   7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Field quality-control reports.

E. Panelboard schedules for installation in panelboards.

F. Operation and maintenance data.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.06 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

C. Transient voltage suppression devices: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 manufacturers

A. Available Manufacturers
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

2.02 BASIS OF DESIGN

A. The system specified is based upon products by Eaton Electrical Inc.; and represents the performance standard upon which any equivalent solution shall be based.

2.03 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Kitchen/Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
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. Sub feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
1. Series rating shall not be acceptable.

2.04 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

C. Mains: Main circuit breakers in the distribution panelboards shall be Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Main circuit breakers in the lighting and appliance branch-circuit panelboards shall be Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Provide UL listed non-linear rated panels with 200% neutral bus bars and lugs for all 120/208 volt panelboards where fed from K rated transformers. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction.

E. When called for, supply Surge Protective Device (SPD) units in accordance with SPD specification section here within.

F. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

G. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

H. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.06 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
   5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
   6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
   7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
   8. 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. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      e. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
      f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
      g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

2.08 FUSIBLE BRANCH CIRCUIT PANELBOARDS (FBCP)

A. Summary
   1. Furnish and install fusible branch circuit panelboards for the life safety branch of the emergency electrical system.

B. System Description
1. The panelboards shall be UL and cULus Listed.
2. Selective Coordination: Panelboards overcurrent protective devices shall be selectively coordinated with all supply side (fed from both the normal and emergency source) Eaton's Bussmann series Low-Peak™ LPJ_SP, TCF_, LPN-RK_SP/LPS-RK_SP or KRP-C_SP fuses sized at a minimum amp ratio of 2:1.

C. Basis of Design
1. Fusible Panelboards shall be Eaton's Bussmann series Quik-Spec™ Coordination Panelboards type QSCP.

D. Panelboard Ratings
1. Panelboards shall be UL Listed with a labeled short-circuit current rating equal to or greater than that indicated on the associated schedules or drawings.
2. Panelboards shall be rated 600Vac/125Vdc but marked for actual system voltage.
3. Provide Main lug only, main fused switch or main non-fused switch as indicated in the associated schedules or drawings.
4. Provide branch circuits as indicated in the associated schedules or drawings.
5. Branch circuits must be interchangeable with fusible switches from 15A to 100A without additional required space.
6. Panelboard branch circuits shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component (1 pole, 2 pole or 3 pole) that prevents removal of the fuse while energized, provides open fuse indication, and fuse ampere rating rejection feature at 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A, and 100A. Provide open fuse indication on the branch circuit fuses where indicated in the associated schedules or drawings.
7. Provide Time-Delay Indicating Fast-Acting Class CF fuses for branch circuits.
8. Bus bars shall be tin-plated copper.
9. Neutral and equipment ground bar (isolated or non-isolated) shall be provided where indicated in the associated schedules or drawings.
10. Panelboard trim shall be door-in-door type.
11. Panelboard enclosure shall be of type indicated in the associated schedules or drawings.
12. Boxes shall be a nominal 20 inches wide and 5-¾ inches deep
13. Panelboard shall be equipped with a spare branch circuit fuse holder and spare fuses (10% of fuse for each ampacity installed in branch circuits).
14. Panelboard shall be equipped with an integral Surge Protective Device, compliant with UL 1449 4th Edition. SPD shall include remote signaling contact.

E. Construction
1. Panelboard circuits 100A and less shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component.
2. Interiors shall be factory assembled.
3. Panelboard shall be equipped with a six-space spare fuse compartment for storing replacement branch circuit fuses. Spare fuse compartment shall be located behind locking panel door.
4. Bus bars shall be tin-plated copper with sufficient cross-sectional area to meet UL 67 temperature rise requirements.
5. 200A/400A rated neutrals shall be standard, 400A or 800A rated neutral shall be provided where indicated in the associated schedules or drawings.
6. Bonded neutral shall be provided where specified in associated drawings.
7. Isolated or non-isolated equipment ground bar shall be provided as indicated in the associated schedules or drawings.
8. Where a service-entrance rated panelboard is indicated in associated schedules or drawings, a bonded neutral and non-isolated equipment ground bar shall be provided by the manufacturer.
9. Main lug conductor terminations:
   a. MLO terminations shall be rated for 60/75°C, Cu-Al
   b. Main disconnect terminations shall be rated for 75°C, Cu Only
10. NEMA 1 panelboards shall be field convertible for top or bottom incoming feed. NEMA 3R panelboards are bottom feed only.

F. Main Disconnect
1. Permanently installed lockout means shall be provided on the main disconnect for lockout tagout procedures.
2. Main disconnect shall be quick-make, quick-break type.

G. Branch Fused Disconnects
1. Device shall have visible circuit ON/OFF indication with colored and international symbol markings.
2. Device shall provide open fuse indication via permanently installed indicating light.
3. Device shall be UL and cUL Listed 600Vac/200kA or 125Vdc/100kA voltage/short-circuit current rating, load-break disconnect with amp ratings and number of poles as indicated on the panelboard schedule.
4. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
5. Fuse and disconnect shall be mechanically interlocked so as not to allow fuse removal while fuse terminals are energized.
6. No special tools shall be required for fuse removal.
7. Devices shall have bolt-on style bus connectors.
8. Device housing shall be clearly marked with device amperage.
9. Permanently installed lockout means shall be provided on the device for lockout tagout procedures. Permanently installed means for locking device in the ON position shall also be available.
10. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A & 100A.

H. Main & Branch Overcurrent Protection
1. All overcurrent protective devices shall have a minimum UL Listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.
2. Branch circuit overcurrent protection shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class CF (equivalent to Class J) performance characteristics.
3. Main overcurrent protective devices shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR Class J fuses or Class CF (equivalent to Class J) performance fuses.
4. Where panelboard main fuses are installed, fuses in panelboard branch circuits shall selectively coordinate with main fuses for all overcurrents up to 200kA.

I. Enclosure
1. NEMA 1 enclosures shall be surface or flush mount as indicated in associated schedules or drawings. NEMA 3R enclosures shall be surface mount only.
2. Boxes shall be a nominal 20 inches wide and 5-¾ inches deep (NEMA 1) or 6.3” (NEMA 3R) with wire bending space per the National Electrical Code®.
3. Panelboard trim shall be supplied with lockable door covering all disconnect handles.
4. Panelboard trim shall be dead-front construction covering all energized parts.
5. Enclosures shall be NEMA Type 1 or Type 3R as indicated in associated schedules or drawings.
6. Door-in-door type trim shall be provided for NEMA 1 enclosures where it is specified in the associated schedules or drawings.
7. Front trim shall be lockable. All lock assemblies shall be keyed alike with like NEMA rated enclosures.

J. Integral Surge Protection
1. Panelboard should include an integral UL 1449 4th Edition Recognized Type 2 Component Assembly.
2. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.
   1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

3.05 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training sessions. Train the Owner’s maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following:
1. Receptacle Outlets.
2. Switches.
3. Wall Plates.
4. Contactors.
5. NEMA 3R Enclosures
6. Handholes.
7. Conductors and Cables.

1.03 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 WIRING DEVICES

A. Manufacturers

1. Legrand; Wiring Devices & Accessories (Legrand).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Or approved equal.

2.02 Basis of Design

A. Basis of design based upon products by Legrand.

2.03 RECEPTACLE OUTLETS

A. General: All receptacle outlets shall be tamper-resistant.

B. Tamper-Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and Federal Specification W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved. Must be crimped and welded terminal right-angle application connector.
   1. Pass & Seymour: TR5351 (single), TR5362 (duplex), PTTR5362 (use with PTRA6STRNA prewired pigtail connector).

C. Weather-Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and Federal Specification W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved. Must be crimped and welded terminal right-angle application connector.
   1. Pass & Seymour: WR5362.
   2. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable while-in-use cover.
      a. Hubbell: MX3200 single gang
      b. Hubbell: MX6200 dual gang

D. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL943, Class A, and include indicator light that is lighted when device is tripped.
   1. Pass & Seymour: 2097TR.
   2. Wiring Devices Connected to Normal Power System: Color by Architect.
   3. Wiring Devices Connected to Emergency (Life Safety) Power System: Red.
   4. Controlled outlets: Color by Architect.

2.04 SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Pass & Seymour; CSB20AC1 (single pole), PT20AC1 (single pole – use with PTS6STR3 prewired pigtail connector), CSB20AC2 (two pole), CSB20AC3 (three way), PT20AC3 (three way – use with PTS6STR4 prewired pigtail connector), CSB20AC4 (four way).

C. Finishes
   1. Color by Architect.

2.05 WALL PLATES

A. Single and combination types:
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: Stainless Steel.
   3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

2.06 CONTACTORS

A. Manufacturers
1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. Or approved equal.

B. Basis of Design
1. Basis of design based upon products by Elliott Industries, Inc.

C. Description: Electrically operated and electrically held, combination type with fusible switch, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.07 NEMA 3R ENCLOSURES

A. Manufacturers
1. APC Enclosures, Inc.
2. Omega Engineering, Inc.
3. Hoffman
4. Or approved equal

B. Enclosure
1. Cabinets to be manufactured from 11 gauge minimum stainless steel with 12 gauge steel panel, mounted inside. Cabinets to have integral keyed locking mechanism, keyed alike, with provision for pad-lock. Cabinets shall be ventilated type and factory painted black powder-coat. Cabinets to have door hold-open latches.
2. The enclosures are equipped with two (2) adjustable "C" mounting channels on both side walls and back wall to provide versatile positioning of shelves or rack mounting angles.
3. Enclosures wider than 60" are equipped with four (4) adjustable "C" mounting channels.
4. The door frame opening shall be double flanged on all four (4) sides. These flanges increase the strength of the door opening and help prevent dust and liquids from dropping into the enclosure when the door is opened.
5. A removable center post shall be an integral part of the three-point latching system and shall provide increased security and environmental protection.
6. All exterior seams shall be ground smooth or sealed weathertight with silicone sealant.
7. Enclosures shall have provisions for mounting a forced air fan system that can be thermostatically controlled, and air is exhausted through a slotted vent system in the roof overhang.
8. Provide outdoor NE MA 3R stainless steel, to contain 120/240V panelboards, receptacles, etc. for power, with space for future equipment.
9. Contractor to size cabinet to coordinate with sizes of panelboard and equipment to be installed within cabinets. Dimensions shown are typical and are for reference only. Cabinet to be similar to cabinets installed at the recently renovated Parks (list provided upon request). Cabinet to include all equipment shown or implied and all equipment shall be installed inside of cabinet without physical conflicts and per NEC. Cabinet to be sized for all necessary conduits, whether active, spare or future as listed on panelboard schedules.

C. Door
1. The door shall utilize an overlapping design and equipped with a three-point latching mechanism with nylon rollers at the top and bottom.
2. The door handle shall be 0.75" stainless steel round bar and shall have provisions for a padlock.
3. The standard main door lock is Corbin #15484-1 or equal.
4. A louvered air vent with filter retaining brackets and a disposable paper filter element shall be provided.
5. The main doors shall be sealed with closed-cell neoprene gasket.
6. The continuous door hinge shall be 0.075" thick stainless steel with a 0.25" stainless steel hinge pin.

D. Finish
1. Black.
2. Painted enclosures shall be treated with an iron phosphate coating and dried by radiant heat.

2.08 HANDHOLES

A. Approved Manufacturers
1. Handholes
   a. Rotondo Precast/Old Castle.
   b. Quazite.
   c. Wasau Concrete Co.
   d. Or approved equal.
2. Frames, Covers, and Accessories:
   a. Campbell Foundry Co.
   b. East Jordan Iron Works, Inc.
   c. McKinley Iron Works, Inc.
   d. Or approved equal.

B. Quality Assurance
1. Handholes, pull boxes, and accessories shall be designed, fabricated, and installed in compliance with the Drawings.
2. Provide covers that are listed and labeled by AAHSTO for loadings specified.
3. Coordinate layout and installation of handholes and pull boxes with other installations.
4. Comply with ANSI C2.
5. Comply with NFPA 70.

C. Delivery, Storage, And Handling
1. Deliver equipment as factory-fabricated modules with protective crating and covering.
2. Lift and support components with manufacturer’s designated lifting or supporting points.

D. Coordination
1. Coordinate layout and installation of handholes and pullboxes with final arrangements of other utilities and site grading, as determined in the field.
2. Coordinate elevations of ducts and duct-bank entrances into handholes with final profiles of conduits as determined by coordination with other utilities and underground obstructions. Revise locations and elevations from those indicated as required to suit field conditions and to ensure duct runs drain to handholes.

E. Precast Concrete Handholes
1. Precast Concrete: Air-entrained, 3,000 psi (35 mPa) compressive strength at 28 days.
2. Electric Handholes are to be strong, lightweight, and non-conductive, and provided in the dimensions as shown on the Contract Drawings. Electric Handholes shall be Ultraviolet (UV) resistant, along with being unaffected by moisture, freezing temperatures, soil, and sub-soil chemicals. Electric Handholes to be Precast Concrete, as approved by Engineer. Minimum

handhole size is 24”W x 36”L x 22”D (inside Dimensions)for Communication hand holes and 10”Wx18”x15”D for Electric handholes.

3. Include cable pulling irons opposite each duct entry window.

F. Handhole Accessories

1. Handholes shall be provided with Cast Iron covers, with an “Electric” logo for power and “Communications” logo for audio, etc.. Handholes and Covers shall be design for street-rated, heavy duty applications, meeting the requirements of the either: AASHTO HS-20 or ANSI/SCTE 77-2002 Tier 15 loading, with a minimum design load of 15,000 lbs for both the handhole box and covers shall meet the requirements of the latest edition of the National Electric Code (2008 or later) with regards to structural integrity, installation methods, grounding of the cover and metallic parts, etc. Handholes shall be UL listed for the intended use.

2. Color of electric han dholes and covers to be green in grass areas, as approved by Engineer. Handholes to be installed flush with final grade.

3. Handholes for Telephone and CATV are to be per the local utility requirements, with cover logos per the utilities.

G. Preparation

1. Excavate, install base material, and compact base material.
2. Examine sitework, duct bank installation subbase placement, levelness, and compactness before placing the handholes.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

H. Installation - Precast Concrete Handholes and Pullboxes

1. Install and seal precast sections according to manufacturer's instructions.
2. Install handholes and pullboxes plumb.
3. Set top of each handhole and pullbox to finished elevation indicated.
4. Conduits in handholes shall be swept up using 45 degree sweeps, terminating a minimum of 4-inches above the gravel sub-surface. Conduits shall enter from each end, below the bottom of each handhole, within an area 1/3 of the length from the end of the handhole.
5.

I. Field Quality Control

1. Verify that installed manholes, handholes, and pullboxes are installed plumb and level and that covers will be flush with final paved surfaces.
2. Check that accessories are installed according to specifications and drawings.
3. Inspect drain lines to verify proper drainage.
4. Adjust final handhole and pullbox frame elevations to match that of final paving or grade.

J. Cleaning

1. Clean inside of handholes and pullboxes from all construction debris and verify proper operation of drains.
2. Protect handhole and pullbox interiors from entrance of construction debris after final cleaning is complete.

2.09 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at the proper heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign material from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanship manner in accordance with NECA 1 and where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
1. Take steps to ensure that devices and their boxes are protected. 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 the boxes.
2. 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.
3. 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.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. 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.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pig-tailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they 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 (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the 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.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. 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.

G. Dimmers:
1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. 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, multi-gang wall plates.

I. Install lighting control devices in accordance with manufacturer’s instructions.

J. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

K. Install lighting control devices plumb and level and held securely in place.

L. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough opening. Do not use oversized wall plates in lieu of meeting this requirement.

M. Occupancy Sensor Locations:
1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturers recommendations, in order to minimum false triggers.

N. Outdoor Photo Control Locations:
   1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install photo sensor facing east, west or down.
   2. Locate outdoor photo controls so that photo sensor do not face artificial light sources, including light sources controlled by the photo control itself.

O. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into the photo control.

P. Lamp Burn-in: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendation prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

Q. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel inaccessible ceiling near the sensor location.

R. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

S. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

T. Where indicated or required, provide cabinet or enclosure for mounting of lighting control device system components.

3.04 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."
   1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. The 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, and retest as specified above.

C. Lighting Control:
   1. Inspect each lighting control device for damage and defects.
   2. Test occupancy sensors to verify operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
   3. Test outdoor photo controls to verify proper operation, including time delays where applicable.
   4. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.06 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensors settings to minimize undesired activations while optimizing energy savings, and to achieve optimal coverage as required.

C. Where indicated or as directed by Architect/Engineer, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

D. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Architect/Engineer.

3.07 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.08 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

3.09 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training sessions. Train the Owner’s maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

3.10 EXTRA MATERIALS

A. Furnish the following component at the end of the project to the Owner:
   1. Each type of receptacle (single, duplex, normal, controlled, GFCI, USB: 10
   2. Each type of switch: 10
   3. Each type of wall plate: 10

END OF SECTION

SECTION 262813

FUSES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following:
1. Cartridge fuses rated 600 V and less for use in controllers and motor-control centers.

1.03 SUBMITTALS

A. Product Data: For each fuse type indicated.

B. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NEMA FU 1.

C. Comply with NFPA 70.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers
1. Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Or approved equal.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.01 FUSE APPLICATIONS

A. Motor Branch Circuits: Class RK1/RK5, time delay.

3.02 INSTALLATION

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

3.03 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.extra materials

B. Ten percent spare fuses. Provide a minimum of three of each type.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Non-fusible switches.
   3. Molded-case circuit breakers.
   4. Enclosures.

1.03 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and maintenance data.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FUSIBLE AND NONFUSIBLE SWITCHES

A. Approved Manufacturers
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Square D/Group Schneider.
   4. Or approved equal.

B. Fusible Switch, 1200A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Non-fusible Switch1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

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; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.02 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Approved Manufacturers
1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Square D/Group Schneider.
4. Or approved equal.

B. Molded-Case Circuit Breaker: NEMA AB 1, 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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
4. GFCI Circuit Breakers: Single- and two-pole configurations with [5] [30]-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.03 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R; Type 4X where noted.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 and concrete materials are specified in Division 03.

C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

E. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

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

G. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26.

3.02 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:
1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION

SECTION 264313

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. This Section includes the following:
   1. Surge Protective Devices (SPDs) as indicated on the project drawings and electrical diagrams.

1.03 SUBMITTALS

A. Product Data: Include all SPD data necessary to show device is in compliance with all product specifications. Include product data sheets showing the device performance, dimensions, weight, connections, and mounting requirements, along with installation instructions.

B. Operation and maintenance data.

1.04 REFERENCE STANDARDS

A. ANSI/UL 1449, Fourth Edition – Standard For Surge Protective Devices.

B. ANSI/IEEE C62.41.1 Guide on the Surge Environment in Low-Voltage AC Power Circuits.

C. ANSI/IEEE C62.41.2 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

D. ANSI/IEEE C62.45 Recommended Practice on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits.

E. IEEE C62.62 Standard Test Specification for Surge Protective Devices For Low-Voltage AC Power Circuits.

F. NFPA 70, NEC Article 285

1.05 QUALITY ASSURANCE

A. The manufacturer shall have been in the Surge Protective Device industry for a minimum of 5 years.

B. Comply with NFPA 70.

1.06 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB
3. Square D; a brand of Schneider Electric.
4. Or approved equal.

2.02 SURGE PROTECTIVE DEVICES

A. The SPD shall be Listed in accordance with UL 1449, Fourth Edition. The product and ratings shall be included in the database of the UL.com web site.

B. The surge protective device (SPD) shall be designated a location Type 1 or Type 2 device intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch panel.

C. The SPD shall be connected in parallel with the facility's electrical system.

D. The SPD shall be made up of metal oxide varistors (MOV's), or a combination of MOV's with selenium cells or silicon avalanche diodes, ensuring that all of the performance requirements are met. Gas tubes shall not be used.

E. The entire SPD shall be enclosed in a metal or ABS enclosure, NEMA rated for the location. SPDs at main service equipment shall be mounted outside the switchboard or panelboard (not integral to, or installed within the switchboard or panelboard). SPDs for branch panelboard (2nd tier) locations may be mounted outside of, or integral to, the branch panelboard. SPDs installed internal to the distribution equipment shall be of the same manufacturer as the equipment.

F. The SPD shall have a maximum continuous operating voltage (MCOV) rating not less than 115% of nominal voltage of the system it is protecting.

2.03 Protection Modes

A. The SPD shall have line to neutral (L-N), line to ground (L-G), line to line (L-L) and neutral to ground (N-G) protection modes for three-phase grounded wye configured systems. For a three-phase delta configured system, the device shall have line to line (L-L) and line to ground (L-G) protection modes.

2.04 Voltage Protection Rating (VPR)

A. The UL 1449 Voltage Protection Rating (VPR) for the device shall not exceed the following:
1. 208Y/120 volt applications: 800V L-N, L-G, N-G; 1200V L-L
2. 480Y/277 volt applications: 1200V L-N, L-G, N-G; 2000V L-L
3. 480 volt delta applications: 2000V L-G, 2000V L-L

2.05 Nominal Discharge Current (In)

A. The UL 1449 Nominal Discharge Current Rating (In) shall not be less than the following:
1. 20kA for service entrance, switchboard, and main distribution panel locations
2. 10kA for branch panelboard (2nd tier) locations

2.06 Short Circuit Current Rating (SCCR)

A. The SPD shall have a UL 1449 Short Circuit Current Rating (SCCR) of not less than 200kA.

2.07 Surge Current Rating

A. The single-pulse (8 X 20 microsecond waveform as specified in ANSI/IEEE Standard C62.41) surge current capacity shall not be less than the following:
   1. 100kA per mode (200kA per phase) for service entrance, switchboard, and main distribution panel locations
   2. 50kA per mode (100kA per phase) for branch panelboard (2nd tier) locations

B. Each SPD shall include externally-mounted LED visual status indicators that indicate the on-line status of the unit, for each phase.

C. At service entrance, switchboard, and main distribution panel locations each SPD shall include the following features:
   1. Audible diagnostic monitoring by way of an audible alarm function
   2. One set of NO/NC dry contracts for alarm conditions

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install SPD units in accordance with manufacturer's written instructions, applicable requirements of NEC and NEMA standards, and recognized industry practices.

B. The SPD units shall be installed at the locations shown on the drawings, or as indicated in the one-line diagram. They shall be parallel-connected to, and located adjacent to the switchboard or panelboard being protected. Locate as close as practical to the bus, keeping lead length as short as possible (less than 3 feet preferred to ensure optimum performance).

C. SPDs shall be connected through a multi-pole circuit breaker or fused disconnect switch, not into main lugs. Circuit breaker or fused disconnect switch shall be 60A for main service device, 30A for branch panelboard device or as recommended by the manufacturer.

D. Use schedule 40 PVC conduit or metallic conduit between the SPD and the switchboard or panelboard as recommended by the manufacturer. Avoid sharp bends, excess length, and splices in the wires. Where possible, use a close-nippled connection with wires going directly to a circuit breaker within the switchboard or panelboard.

E. Setup and test per the manufacturer's recommendations.

3.02 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

3.03 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct two 4-hour training sessions. Train the Owner’s maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION

SECTION 265668

EXTERIOR ATHLETIC FIELD LIGHTING

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.

B. The purpose of these specifications is to define the lighting system performance and design standards for the Indian Hill Park lighting project using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.

C. The sports lighting will be for the following venues:
1. Softball (2)
2. Multipurpose
3. Security

D. The primary goals of this sports lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore, light levels are guaranteed to not drop below specified target values for a period of 25 years.
2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
3. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.

E. All manufacturers, regardless of approval, must demonstrate that they meet all performance and quality specifications as outlined herein. Systems that do not meet all the performance and quality specifications specified herein shall not be accepted.

1.03 SUBMITTALS

A. Complete bill of material and current brochures/cut sheets for all products being provided. Listing 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. Drawing(s) showing field layouts with pole locations.

C. Lighting design drawing(s) showing:

1. Field Name, date, file number, prepared by

2. 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
3. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics
4. Height of light test meter above field surface.
5. Summary table 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 (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
6. Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals and 3-feet above grade along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
7. Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience. Ball Tracking luminaries are excluded from this qualification.

D. Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.

E. Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar, and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Massachusetts, if required by owner.

1. Test borings were conducted for general assessment and are published in volume 4 appendices, Appendix A, Geotechnical report. Test boring locations are shown on the published existing conditions drawings, grading is shown on the civil drawings. This Trade contractor/vendor to review the published information for the design criteria and the pole design (the front poles are in fill) rock should be anticipated based on the borings/test pits and excavations and be included in the design. Should ledge as defined under sections 31 20 00 be encountered, contractual adjustments for excavations only. Should the contractor deem test borings are required based on the above information, the cost to be included in the bid price.

F. Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system.

G. Provide written warranty information including all terms and conditions.

H. Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Massachusetts. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.

I. Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.

J. Manufacturer shall list all items that do not comply with the specifications.

1.04 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. 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). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Softball 1	50FC (infield) 30FC (outfield)	2:1 (infield) 2.5:1 (outfield)	25 (infield) 71 (outfield)	20’ x 20’
Softball 2	50FC (infield) 30FC (outfield)	2:1 (infield) 2.5:1 (outfield)	25 (infield) 20 (outfield)	20’ x 20’
Multipurpose	30FC	2.5:1	44	20’ x 20’

NOTE: Each pole shall have (1) OSQ luminaire mounted at 30’ on a separate security zone.

B. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
2	A3 and A4	60’
6	A1, A2, B1, B2, B3, and B4	70’

1.05 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.

PART 2 - PRODUCT

2.01 MANUFACTURERS

A. The basis of design product shall be by Musco’s Light-Structure System™ with TLC for LED™.

2.02 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

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 of 18-8 grade or better, 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 cross-arms, pole, or electrical components enclosure.

C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assembly.
2. Non-approved pole technology:
    a. Square static cast concrete poles will not be accepted.
    b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.
3. Lighting systems shall use concrete foundations. See Section 2.4 for details.
    a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.
    b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-inforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.
4. Manufacturer will supply all drivers and supporting electrical equipment
    a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed.
    b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.
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 cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.
7. Control cabinets to provide remote on-off control, monitoring of the lighting system and power outlets as noted on the plans. See Section 2.3 for further details.
8. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.
    a. Integrated grounding via concrete encased electrode grounding system.
    b. 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 minimum size of 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.

D. Safety: All system components shall be UL listed for the appropriate application.

2.03 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:
   1. Electric power: 480/277 Volt, 3 Phase
   2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 32kW, or less.

C. Electric Power Requirements for power outlets in the dugout and batting cage, MuscoVision camera and flag pole lights:
   1. Electric power: 208/120 Volt, 3 Phase

2.04 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires and power outlets as noted on the plans.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming with be set via scheduling options (Website, app, phone, fax, email).

D. 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.

   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.

   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. 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).

F. 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 luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

   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. Report hours saved by using early off and push buttons by users.

G. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.

H. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

2.05 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 130mph and exposure category C.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If no geotechnical report is available, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2015 IBC Table 1806.2.

D. Foundation Drawings: Project specific foundation drawings stamped by a registered 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. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 - EXECUTION

3.01 SOIL QUALITY CONTROL

A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:

1. Providing engineered foundation embedment design by a registered engineer in the State of Massachusetts for soils other than specified soil conditions;
2. Additional materials required to achieve alternate foundation;
3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.02 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 10-12 weeks from receipt of approved submittals and receipt of complete order information.

3.03 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, 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.

B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.
2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.
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.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles and uniformity ratios are not in conformance with the

requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.04 WARRANTY AND GUARANTEE

A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

3.05 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct four 4-hour training sessions. Train the Owner's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

C. Required submittal information for all manufacturers:

All items listed below are mandatory, shall comply with the specification. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

Yes / No	Tab	Item	Description
	A	Letter/ Checklist	Listing 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. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by 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, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table 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 (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or

			an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Massachusetts, if required by owner. (May be supplied upon award).
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of Massachusetts.
	J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Massachusetts.
	K	Project References	Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Massachusetts. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	L	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.
	M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.

END OF SECTION

SECTION 271000

COMMUNICATIONS CABLING SYSTEMS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. All Work included in this Section has been configured so as to be issued as a separate "telecommunications" trade. If any duplicates or conflicts with other specification Sections should occur, the item of higher standard shall dictate.

B. General compliance requirements: Telecommunications Contractor shall provide a complete and operable system in compliance with the specifications, referenced standards, all applicable building codes, and all requirements of the AHJ. The scope of this project includes all planning, design, materials, equipment, labor, configuration, programming, testing, startup/commissioning services, and documentation costs for a complete and operable system, meeting all requirements contained in the specifications.
   1. Where conflicts exist between applicable documents or standards, the most stringent requirements shall apply.
   2. Work includes all items required for a complete system whether or not it is identified in the specification or on the drawings.
   3. No exclusion from or limitation in, the symbolism used on the drawings for telecommunications Work or the language used in the specifications for telecommunications Work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.
   4. Any telecommunications drawings, elevations, details and riser diagrams shall be considered diagrammatic and therefore the Telecommunication Contractor is responsible for all quantities and sizes in order to provide a fully operational system.

C. Telecommunications Contractor must comply with all contract documents, specifications, drawings, and manufacturer's instructions.

D. Complete and Usable Work: Telecommunications Contractor shall provide complete and usable work in accordance with the contract documents including all materials and equipment, along with all accessories and additional work required for field conditions, as well as additional work and accessories required for complete, usable, and fully functional construction and systems, even if not explicitly specified or indicated. Contractor shall provide a complete and operable system in full compliance with all specification requirements, and shall include but not be limited to all required accessories, devices, equipment, wiring, programming, configuration, and work required to provide a complete and operable system complying with all drawing, specification, and performance requirements. If necessary, in order to comply with all contract requirements, provide controllers and control panels with greater capabilities and capacities than those indicated.

E. Telecommunications Contractor shall coordinate installation work with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70, "National Electrical Code" and the manufacturer's instructions shall be provided. Comply with additional requirements indicated for access and clearances. The Contractor shall verify all field conditions and dimensions that affect the selection and provision of materials and equipment, and shall locate equipment, devices, and wiring as required to comply with all contract requirements.

F. Items and installation methods as described in any drawings and specifications provided for telecommunications Work are to be used only under normal work conditions as hereinafter described unless there are specific notations to the contrary.

G. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any telecommunications item in the drawings and specifications for telecommunications Work carries with it the instruction to furnish, install and connect the item as part of the telecommunications Work regardless of whether or not this instruction is explicitly stated.

H. It shall be understood that any specifications and drawings are complementary and are to be taken together for a complete interpretation of the telecommunications Work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.

I. To the extent that they govern the basic Work, the specifications also govern change order Work if any.

J. Any drawings for telecommunications Work utilize symbols and schematic diagrams that have no dimensional significance. The telecommunications Work shall, therefore, be installed to fulfill the diagrammatic intent expressed on telecommunications drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades.

K. Information as to general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.

L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

M. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

N. The Work called for under this Contract shall be carried on simultaneously with the Work of other trades and Owner's functions in such a manner as to not delay the overall progress of the construction project.

O. When directed by the Owner's representative, the Telecommunication Contractor shall, without extra charge, make reasonable, minor modifications in the layout of hardware as needed to prevent conflict with Work of the trades, Owner's functions or for proper execution of the Work.

P. The Telecommunication Contractor shall be responsible for providing adequate protection of equipment before and after installation.

Q. The Telecommunication Contractor is responsible for cleanup of debris on a daily basis and cost of cleanup is the responsibility of the Telecommunication Contractor unless otherwise specified.

1.03 SUBMITTALS

A. Telecommunications Contractor may be asked to provide complete technical and project approach submittals for the following submissions:
   1. RFP Submittals: If requested, proposal submittals included with an RFP should contain:
      a. Executive Summary
      b. Compliance Certification
      c. System operation description covering this specific project
      d. Equipment data cut sheets
      e. Recommendations for system modifications to improve performance or functionality
      f. System schematics and wiring diagrams

2. Approval Submittals: Telecommunications Contractor's submission of contract submittals for review and approval for use on the project. Include all submittals specified herein and in the respective specification sections for the work specified in this contract.
3. Operations & Maintenance Manuals.

B. Submittals shall be presented in a clear and thorough manner and shall include all information required by the applicable specification sections. Submit quantities as directed otherwise by the Owner.

C. The Contractor shall not be eligible for extensions of contract schedule or additional charges resulting from additional reviews of submittals resulting from incompleteness, incorrect information, or non-compliance with the contract provisions.

D. Approval Submittals: Prior to ordering of materials, beginning work, and prior to the pre-installation meeting specified herein, contractor shall submit the specified documentation in the complete set quantities required by the Owner's representative, or as specified in the project specification general requirements. Submittals of related systems shall be fully coordinated and submitted for review concurrently. Submit compliance certifications and submissions to the Authority Having Jurisdiction (AHJ) where specified.

E. Operation and Maintenance Manuals: Telecommunications Contractor shall prepare manuals and additional requirements specified in this section or other sections. Include data for each type product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be provided. Upon project completion, submit operation and maintenance manuals, consisting of the following information as a minimum. Additional requirements are specified in the individual specification sections.
1. Index sheet, listing contents in alphabetical order.
2. Description of function, normal operating characteristics and limitations, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
3. Manufacturer's equipment parts list of all functional components of the system.
4. Auto-CAD disk of system schematics, including wiring diagrams, in format approved by the Owner's representative.
5. Interconnection wiring diagrams, as installed and tested.
6. Manufacturer's user manuals for operations, administration, installation, and maintenance.

F. Test Reports: Submit results of all required factory and field testing. Submit results of all required startup and commissioning activities.

G. Record Drawings: Prepare manuals in accordance with specifications and maintain a separate hard copy set of drawings, elementary diagrams, and wiring diagrams of the structured cabling systems provided in this contract, to be used for record drawings. This set shall be kept up to date by neatly drawn hand annotations in red ink, reflecting all changes and additions made to the SCS. Copies of the final record drawings shall be provided to the Owner in .DWG format using the version of AutoCAD directed by the Owner's representative. Record drawings shall include:
1. Raceway and pathway systems, size and location, for both exterior and interior; locations of all equipment and devices.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Record the locations and invert elevations of underground installations.
5. Installed cable routes, equipment and outlet locations, and administration labeling information prior to project completion.

1.04 QUALITY ASSURANCE

A. Installer/Provider Qualifications: Comply with any additional requirements specified in this section or other sections. Prior to bidding, obtain and maintain all licenses required for the system installation work required by the local AHJ.

B. Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authority having jurisdiction (AHJ).

C. Product Listing: Systems and equipment shall be listed and labeled by a nationally recognized testing laboratory (NRTL) for compliance with the referenced standards. All items of the SCS shall be listed as a product of the specified structured cabling system manufacturer under the appropriate category by the NRTL and shall bear the appropriate label.

D. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and manufacture of said components or systems and shall be manufacturer's latest standard design that complies with the specification requirements.

1.05 WARRANTY

A. General Requirements: Telecommunications Contractor shall comply with any additional or extended warranties required in other specification Sections. Provide all services, materials and equipment necessary for the successful operation of the entire SCS system for a period of one year after beneficial use. Scope of warranty includes all equipment, devices, wiring, accessories, software, hardware, installation, programming, and configuration required to maintain a complete and operable system. The contractor shall furnish the Owner a minimum one (1) year's warranty on materials and workmanship furnished and performed under this contract, plus additional warranties specified in other specification sections of this project, including but not limited to specification sections related to the telecommunications cabling system. This shall apply to all items except those specifically excluded, or items wherein a longer period of service and warranty is specified or indicated. All warranties shall be effective for one year, minimum, from the date the telecommunications cabling system accepted by the Owner. Use of systems provided under this section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by the Owner and shall not automatically initiate the warranty period. The warranty shall cover repair or replacement of defective materials, equipment, workmanship, and installation that may be incurred during this period. Warranty work is to be done promptly and to the Owner’s satisfaction. In addition, the warranty shall cover correction of damage caused in making necessary repairs and replacements under warranty. Additional warranty responsibilities are:
   1. Obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner’s designated name.
   2. Replace material and equipment that require excessive service during the guarantee period as determined by the Owner.
   3. Provide 24-hour service beginning on the date of Substantial Completion and lasting until the termination of the warranty period. Service shall be at no cost to the Owner. Service can be provided by installing contractor or by a separate service organization. Choice of service organization shall be subject to Owner's approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.
   4. Submit copies of equipment and material warranties to Owner before final acceptance.
   5. At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to the Owner.
   6. If warranty work problems cannot be corrected immediately to Owner's satisfaction, advise Owner in writing, describing efforts to correct the situation, and provide analysis of cause for the problem. If necessary, to resolve the problem, provide at no cost the services of the manufacturer's engineering and technical staff at the site in a timely manner to analyze the warranty issues, and develop recommendations for correction, for review and approval by the Owner.

B. This paragraph shall not be interpreted to limit the Owner's rights under applicable codes and under this Contract.

C. Other Specification Sections may specify warranty requirements that exceed those of this Paragraph.

1.06 COMPLETENESS OF WORK

A. Complete and Usable Work: The Telecommunications Contractor is responsible for providing complete and usable work in accordance with the contract documents. All materials and equipment shall be provided with all accessories and additional work required for field conditions, as well as additional work and accessories required for complete, usable, and fully functional construction and systems, even if not explicitly specified or indicated. The horizontal cabling systems described in this specification shall be provided as complete and operable systems in full compliance with all requirements on the drawings and all specification requirements. If drawings are utilized, they are to be considered as diagrammatic and the specifications as performance-based; the Contractor shall provide all work required to comply with the drawings and specifications, even if not explicitly indicated or specified. The Contractor shall be responsible for coordinating installation of the electrical systems with all field conditions and the work of other trades. Minimum clearances and work required for compliance with NFPA 70, "National Electrical Code" and the manufacturer's instructions shall be provided. Comply with additional requirements indicated for access and clearances. The Telecommunications Contractor shall verify all field conditions and dimensions that affect the selection and provision of materials and equipment, and shall provide any disassembly, reassembly, relocation, demolition, cutting and patching required to provide the work specified or indicated, including relocation and reinstallation of existing wiring and equipment. The Telecommunications Contractor shall protect from damage resulting from the Contractor's operations the existing facility, equipment, and wiring. Extra charges for completion and contract time extension will not be allowed on account of field conditions or additional work required for complete and usable construction and systems.

B. Installation and Coordination: Use judgment and care to install any telecommunications work to function properly and fit within building construction and finishes. Provide electrical conductors, conduit, and components not shown or specified that are required for any device or system to function as a complete and fully operational system. Verify device/equipment-mounting heights as required by project conditions prior to rough-in. Route conduits and wiring associated with new equipment and systems above ceilings, in existing chases, and concealed within building structure, except where indicated of specified to be exposed. Provide proper number of cables to provide a complete and fully operational system for all work indicated in the contract documents.

C. Drawings and Specifications form complementary requirements; provide work specified and not shown, and work shown and not specified as though explicitly required by both. Except where explicitly modified by a specific notation to the contrary, it shall be understood that the indication or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, provided complete.

D. As used in this specification, "provide," means "furnish and install." "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

E. Give notices, file plans, obtain permits and licenses, pay fees, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.

F. Provide supplementary or miscellaneous items, appurtenances, devices and materials necessary for a sound, secure and complete installation. Examine Drawings and other Sections of the Specifications for requirements that affect work of this section. Completely coordinate work of this Section with work of other Sections and provide a complete and fully functional installation. Refer to all other Drawings and other Specifications Sections that indicate types of construction in which work shall be installed and work of other Sections with which work of this Section must be coordinated.

G. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete the work.

1.07 PROJECT CONDITIONS

A. Field Verification: The Telecommunications Contractor shall carefully verify the location, use and status of all material, equipment, and utilities that are specified, indicated, or deemed necessary for removal. Verify that all materials, equipment, and utilities to be removed are completely inactive and will not be required or in use after completion of the project. Replace with equivalent any material, equipment and utilities that were removed by the Contractor that are required to be left in place.

B. Existing Cabling System: Do not interrupt any existing SCS-serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide a temporary SCS according to requirements indicated:
   1. Notify Owner in writing at least 14 days in advance of proposed interruptions.
   2. Do not proceed with interruptions without Owner's written permission.
   3. Installation:
      a. Determine suitable path for new SCS and consider project conditions.
      b. Verify clearance requirements and locate equipment to meet installation tolerances.
      c. Revise locations and elevations from those indicated to those required to suit Project.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products in accordance with manufacturer's instructions.

1.09 PERMITS

A. The contractor shall secure and pay for all licenses, permits, and inspection fees required by local agencies and/or other agencies having jurisdiction. The contractor, by submitting his bid, agrees to furnish any additional labor or material required in order to comply with all local and other agencies having jurisdiction at no additional cost. The contractor shall obtain any required certificates of inspection and approval from all authorities having jurisdiction, and forward copies of same to the Owner's representative prior to request for project acceptance inspections, final completion inspections, substantial completion inspections, and acceptance testing/demonstrations.

1.10 SUMMARY

A. Section Includes:
   1. Pathways.
   2. UTP cabling.
   3. Cable connecting hardware, patch panels, and cross-connects.
   4. Telecommunications outlet/connectors.
   5. Cabling system identification products.
   6. Field Quality Control

B. This document shall be used (in conjunction with telecommunications drawings) to obtain a competitive bid for the SCS associated with the project.

C. This document shall be distributed for the planning of the supporting infrastructure.

1.11 DEFINITIONS

A. As used in the drawings and specifications for telecommunications Work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the general conditions or other documents governing the telecommunications Work.
   1. “Furnish" -- Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the telecommunications Work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances. Payment of sales taxes is, however, specifically excluded.
   2. "Install" -- Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the telecommunications Work.

3. "Provide" – means to "furnish" and "install."
4. "New" -- Manufactured within the past two years, equal to the current version or revision number, and never before used.

B. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the telecommunications, Work shall be understood to have the specific meanings ascribed to them in the following list:-

1. "Accessible Corridor" - A common horizontal pathway which can be approached or entered easily in which telecommunications cables are run until they branch out to individual workstation terminations.
2. "Assembly" A defined set of elements of telecommunications Work.
3. “Category 3” -- Cables/connectivity with transmission characteristics rated for 16 MHz as defined in TIA-568.C.2 and all related addendums or bulletins.
4. “Category 5” -- Cables/connectivity with transmission characteristics rated for 100 MHz as defined in TIA-568.C.2 and all related addendums or bulletins.
5. “Category 5e” -- Cables/connectivity with transmission characteristics rated for 100 MHz that has been optimized for applications that use 4 pairs as defined in TIA-568.C.2 and all related addendums or bulletins.
6. “Category 6” -- Cables/connectivity with transmission characteristics rated for 250 MHz as defined in TIA-568.C.2 and all related addendums or bulletins.
7. “Augmented Category 6 or Category 6A” -- Cables/connectivity with transmission characteristics rated for 500 MHz as defined in TIA -568.C.2 and all related addendums or bulletins.
8. "Circuit" -- An electrical or optical path used for communications between two devices.
9. “Communications Plenum cable (CMP)” -- Cable listed as being suitable for use in ducts, plenums, and other air-handling spaces.
10. “Communications Riser cable (CMR)” -- Cable listed as being suitable for use in a vertical shaft or from floor to floor.
11. "Telecommunications Room” (TR) -- An enclosed area or space specifically designated for the routing, termination and/or cross-connecting of telecommunications cable (i.e., riser cable) to other telecommunications cable and/or equipment (i.e., workstation cables or concentrators). This may also be referred to as the telephone or communications closet.
12. "Telecommunications Infrastructure" -- Any telecommunications Work which consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.
13. "Telecommunications Work" -- All telecommunications Work as defined by the telecommunications drawings and specifications.
14. "Electromagnetic Interference (EMI)” – An undesirable effect on electronic equipment or signals, created by radiated or conducted electromagnetic energy.
15. "Entrance Point" -- Point at which telecommunications cabling enters the building. Where cable enters in conduit that is buried in a concrete floor, the point at which the conduit emerges from the floor is considered the entrance point.
16. “Horizontal Cross-connect (HC) -- A floor or area-serving group of connectors that allows backbone and horizontal cabling, equipment, systems and subsystems to be cross-connected or interconnected using patch cords or jumpers.
17. “Horizontal Cabling”-- Distribution media that connects the telecommunications outlet or connector in the work area to a consolidation point or horizontal connection point or to the first piece of connecting equipment in the horizontal cross-connect.
18. “Intermediate Cross-connect (IC) -- A group of connectors between the first and second level backbone that allows equipment, systems and subsystems to be cross- connected.
19. “Insulation displacement connector (IDC) – Wire termination where the insulation around a conductor is displaced at the point of connection.
20. "Intermediate Distribution Frame (IC)” – See Horizontal Cross-connect and Intermediate Cross-connect.
21. "Local area network (LAN)” – A computer network that encompasses a relatively small area, floor, group of floors, building or campus.

22. "Low Voltage" – 1. Circuits less than 50 volts (NEC Article 720) 2. Voltage 0-150 AC/DC (Article 725)
23. "Main Distribution Frame (MDF)" -- See Main Cross-Connect.
24. Main Cross-connect (MC) -- A group of connectors, normally located in the (main) equipment room, that allows the cross-connection and interconnection of entrance cabling, first-level backbone, horizontal cabling, equipment, systems and subsystems.
25. "Patch Panel" -- A system of terminal blocks, patch cords, and backboards that facilitates administration of cross-connect fields for moves and rearrangements.
26. "Plenum" -- A building space that forms part of the air distribution system for heating, ventilation or air conditioning.
27. Polyvinyl chloride (PVC) -- A general purpose, water-resistant thermoplastic use as a jacketing and insulation material for wire and cable.
28. "Raceway" -- Any pipe, duct, extended enclosure, or conduit (as specified for a particular system) which is used to contain wires or cables.
29. "Riser" -- 1. The space used for cable to pass from floor-to-floor. 2. Vertical sections of cable.
30. "Station Cable" -- See Horizontal Cabling.
31. "Shielded Twisted-Pair (STP) -- Multiple twisted copper pair cable with an additional metallic shield covering each individual pair.
32. Structured Cabling System (SCS) – A complete collection of telecommunications cabling and associated hardware in a given location.
33. "Telecommunications Outlet/Connector (TO)" -- A connecting device in the work area upon which horizontal cabling terminates and into which the work area cable (cord) is connected.
34. ."Unshielded Twisted-Pair (UTP) -- One or more pairs of twisted copper conductors with no metallic shielding.
35. "Voice over Internet Protocol (VoIP)" -- Hardware or software that enables the Internet to be used as the transmission medium for telephone calls by sending voice data in packets using IP rather than by traditional circuit transmissions of the public switched telephone network.
36. "Work Area" or "Workstation" -- The location where end users interact with telecommunications or network equipment.

C. Reference to "U.L. (Materials Construction) Standards" shall mean the "Standards for Safety," published by Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, Illinois 60062.

D. Reference to "NEMA Standards" shall mean the "Approved Standards" published by the National Electrical Manufacturers Association, 2101 "L" Street, N.W., Washington, D.C. 20037.

E. Reference to "ANSI Standards" shall mean the standards published by the American National Standards Institute, 1819 L Street, NW, Suite 600, Washington, DC 20036.

F. Reference to "TIA Standards" shall mean the standards published by the Telecommunications Industry Association, 1320 North Courthouse Road, Suite 200 Arlington, VA 22201

G. Reference to "IEEE Standards" shall mean the standards published by the Institute of Electrical and Electronics Engineers, 3 Park Avenue, 17th Floor, New York, N.Y. 10016.

H. Reference to "BICSI Standards" shall mean the guidelines and methods described in the Telecommunications Distribution Methods Manual (TDMM), 13th Edition, (2014) published by the Building Industries Consulting Service International (BICSI), 8610 Hidden River Pkwy., Tampa, FL 33637.

I. Reference to "RUS Standards" shall mean the standards published by the Rural Utilities Services, 1400 Independence Ave., SW, Rm. 5151, Washington, DC 20250.

J. Reference to "Bell Standards" shall mean the standards published by Telcordia Technologies, formerly Bell Communications Research, Incorporated (Bellcore), One Telcordia Drive, RRC 1B-180, Piscataway, NJ 08854.

K. Reference to “NRTL” shall mean any of the laboratories listed in OSHA’s Nationally Recognized Testing Laboratory program, N3653, Frances Perkins Building, 200 Constitution Ave. NW, Washington, DC 20210.

L. Reference to “BICSI ITSIM” shall mean the Information Transport Systems Installation Manual (ITSIM), 6th Edition, (2011) published by the Building Industries Consulting Service International (BICSI), 8610 Hidden River Pkwy., Tampa, FL 33637.

1.12 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross- connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.
   1. TIA-568-C.1 defines the minimum requirement for telecommunication outlets for each work area.
   2. Horizontal cabling shall contain no more than one transition point, consolidation point or horizontal connection point between the horizontal cross-connect and the telecommunications outlet/connector. Bridged taps and splices shall not be installed in the horizontal cabling, except as permitted in TIA-862, Building Automation Systems Cabling Standard for Commercial Buildings.
   3. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m) and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable length of the horizontal link is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross- connect.

1.13 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, Intermediate and Main Cross-connects mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.14 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal and Backbone cabling system(s) shall comply with transmission standards in TIA-568-C, when tested according to test procedures of this standard.

B. Manufacturer Seismic Qualification Certification (if applicable): Submit certification that distribution racks and their components will withstand seismic forces: Include the following:
   1. Basis for Certification: Base certification on the maximum number of components capable of being mounted in each rack type. Identify components on which certification is based. Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity of each rack-mounted component and of each assembled rack type and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.15 QUALITY ASSURANCE

A. Installer Qualifications:
1. System installer must have on staff a Registered Communication Distribution Designer (RCDD) certified by Building Industry Consulting Service International (BICSI).
2. The basis of design product shall be SYSTIMAX Solutions or approved equal.
3. The Telecommunication Contractor selected must be an Authorized SYSTIMAX Solutions PartnerPRO and provide a resume of SYSTIMAX SCS qualifications for the Telecommunication Contractor's Project Manager and on-site supervisors and technicians that will be assigned to the project.
4. The Telecommunication Contractor selected must provide a list of SYSTIMAX SCS training and certification for the Telecommunication Contractor's personnel that will install any SYSTIMAX materials for the project. The list will be subject to review and approval by the Owner's representative.
5. The Telecommunication Contractor shall have at least five (5) years' experience installing and servicing telecommunication systems.
6. The Telecommunication Contractor shall be a SYSTIMAX Solutions Prestige or Authorized PartnerPRO and be able to provide a twenty (20) year manufacturer warranty.
7. The Telecommunication Contractor shall be approved by the Owner and an active participant of ITC09 contract.

B. Verification Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain all SCS products including twisted-pair and fiber-optic cables through one source from a single manufacturer, e.g. CommScope, Inc.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.

G. New equipment and materials shall:
1. Be Underwriters Laboratories, Inc. (U.L.) labeled and/or listed where specifically called for or where normally subject to such U.L. labeling and/or listing services.
2. Be clearly labeled identifying the transmission parameters specified (specifically with reference to Category 6A or higher ratings).
3. Be without blemish or defect.
4. Be in accordance with the latest applicable standards.
5. Be products that meet with the acceptance of the agency inspecting the telecommunications Work.

H. Manufacturer's Recommendations: Where installation procedures of any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

I. Telecommunications Pathways and Spaces: Comply with TIA-569-B.1.

J. Grounding: Comply with ANSI-J-STD-607-A.

1.16 CODES, PERMITS AND INSPECTIONS

A. All telecommunications Work shall meet or exceed the latest requirements of all national, state, county, municipal, and other authorities exercising jurisdiction over the telecommunications Work and the project.

B. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the telecommunications Work. In the event that no official authority exists which will issue a certificate attesting to the safety of the electrical installations, such a certificate shall be acquired from an independent agency selected by the Owner. Inspection and certification fees levied by this agency shall be paid for as part of the telecommunications Work.

C. Any portion of the telecommunications Work which is not subject to the requirements of an electric code published by a specific authority having jurisdiction (AHJ) shall be governed by the National Electrical Code and other applicable Sections of the National Fire Code, as published by the National Fire Protection Association.

D. In the event the authority having jurisdiction does not require a permit for this scope of Work, Telecommunication Contractor must obtain that information, in writing, from the AHJ and provide to Owner, prior to the start of the Work.

E. Installation procedures, methods and conditions shall comply with the latest requirements of the Federal Occupational Safety and Health Administration (OSHA).

1.17 GUARANTEES AND CERTIFICATIONS

A. All telecommunications Work shall be guaranteed to be free from defects. Any defective materials or workmanship, as well as damage to the telecommunications Work of all trades resulting from same, shall be replaced or repaired as directed for the duration of stipulated guarantee periods.

B. The duration of guarantee periods following the date of acceptance of the telecommunications Work shall be:
   1. For Work not otherwise specified -- one year.

C. The date of acceptance shall be the date of the final payment for the telecommunications Work or the date of a formal notice of acceptance, whichever is earlier.

D. Non-durable items shall be replaced up to the date of acceptance, such that they shall have had no use prior to this date.

E. Certification shall be submitted attesting to the fact that specified performance and other criteria are met by all items of telecommunications Work for which such certification is required.

F. The Telecommunication Contractor must possess the required certifications to install and offer manufacturer’s warranties for the specified cabling system and other components or systems. Proof of such certifications must be included with the bid response.

1.18 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with the Owner.

B. Adjust arrangements and locations of cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

C. The Telecommunication Contractor is responsible for reviewing coordination drawings produced by other trades to make sure proper clearances are maintained and cable routing and space layouts are coordinated. Any problems shall be brought to the attention of the engineer.

D. The Telecommunication Contractor is responsible for coordinating the exact location of the telecommunications outlets along with their associated power receptacle(s) with the Owner's representative.

E. The Telecommunication Contractor is responsible for the coordination of all trades that impact any of the telecommunication rooms. Any alteration within or around the telecommunication rooms that effects the protection of the telecommunication cables and equipment shall be brought to the attention of the Owner's representative.

1.19 SEPARATION OF WORK BETWEEN TRADES

A. The specifications for the overall construction delineate various items of Work under separate trade headings. The list below sets forth this delineation to the extent that it affects the telecommunications Work.

B. In the absence of more detailed information, the list shall be taken as a specific instruction to the Telecommunications Trade to include the telecommunications Work assigned to it.

C. Indications that any trade is to perform an item of Work means that it is to perform the telecommunications Work for its own accommodation only, except as specifically noted otherwise.

D. Include in the telecommunications Work all necessary supervision and the issuing of all coordination information to any other trades who are supplying Work to accommodate the telecommunications installations.

E. For items of equipment which are to be installed but not purchased as part of the telecommunications Work, the telecommunications Work shall include:-
   1. The coordination of their delivery.
   2. Their unloading from delivery trucks driven into any point on the property line at grade level.
   3. Their safe handling and field storage up to the time of permanent placement in the project.
   4. The correction of any damage, defacement or corrosion to which they may have been subjected.
   5. Their field make-up as may be necessary for their proper operation.
   6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
   7. Included shall be the purchase and installation of any substitute lugs or other wiring terminations as may be necessary to adapt their terminals to the wiring as called for and to the connection methods set forth in these specifications.

F. Items of equipment which are to be installed but not purchased as part of the telecommunications Work shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the telecommunications Work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The telecommunications Work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

G. Where materials are specified to be provided by the Owner or their representative, the following shall be performed:
   1. Prior to ordering of the cabling, the Telecommunication Contractor shall identify the types, quantities, colors, etc. required and provide them to the Owner to be ordered.
   2. The Telecommunication Contractor shall ensure that the information is complete and accurate. Any errors or omissions in the ordering information will be the Telecommunication Contractor's responsibility.
   3. At the beginning of the Work, the Telecommunication Contractor shall coordinate lead times of all material with the Owner's representative. The Telecommunication Contractor shall bear all responsibility for this coordination or lack thereof.
   4. The Owner's ordering deadline shall be based on the lead times agreed upon. The Telecommunication Contractor shall be informed of any changes in material lead time as the Work progresses.
   5. The Telecommunication Contractor shall bear the responsibility of any delays in the Work if requests for materials are not placed with the Owner in writing at least one business day in advance of the Owner's ordering deadline, taking the agreed upon lead times into account.

1.20 RECORD DRAWINGS

A. As part of the required telecommunications Work, a complete set of "as-built" or record telecommunications drawings shall be made up and delivered to the Owner's representative.

B. The drawings shall show:
   1. All telecommunications Work installed exactly in accordance with the original design and/or specification.
   2. All telecommunications Work installed as a modification or addition to the original design and/or specification.
   3. The dimensional information necessary to delineate the exact location of all circuitry and wiring runs which are concealed as to be untraceable by inspection through the regular means of access established for inspection and maintenance.
   4. The numbering information necessary to correlate all telecommunications items (or outlets for same) to the patch panel, end user or head end device to which they are connected.

C. The as-built drawings shall be produced using AutoCAD 2000 (or later version) design package.
   1. Another CAD program (Visio preferred) may be utilized as the as-built drawing package of choice subject to review and approval by the Owner's representative as to the specific software and version, etc., to be used.
   2. Prior to developing any "as-built" drawings, the Telecommunication Contractor shall coordinate with the Owner's representative the layering structure, colors, etc., of CAD drawings.

D. The quantity of design drawings which are made available represents the minimum number of drawings to be included in the record drawing set and shall in no way be interpreted as setting a maximum limit to the number of drawings necessary to show the required "as-built" information.

E. Any and all costs for document conversion (if necessary), printing, etc., are the responsibility of the Telecommunication Contractor.

F. Design drawings will be made available in Visio, for the exclusive purpose of producing "as-built" drawings. These documents remain the property of the Owner and shall be used for no other purpose without expressed, written consent. The Telecommunication Contractor shall assume all liabilities resulting from unauthorized modifications to the drawings.

G. "As-built" information submitted to the Engineer and/or Owner's representative for approval shall contain the following:
   1. CAD (or Visio with prior approval) drawing file on CD-ROM or other approved electronic media.
   2. Two (2) sets of printed ANSI E sized drawings.

H. The Telecommunication Contractor shall establish cable records during the installation. Cable records will be maintained on Microsoft Excel. These records shall correlate the workstation ID number, distribution cable number, punch down block or rack assignments, conduit or duct path and station location. These records shall be updated as the project progresses to reflect any required changes made either in the field or as a result of design changes. As-built Records/Drawings will be furnished as specified after the completion of installation and acceptance of the space by the Owner's representative. The database format (i.e., field and record descriptions) shall be submitted to the Owner's representative for approval prior to beginning Work.

PART 2 - PRODUCTS

2.01 PATHWAYS

A. General Requirements: Comply with TIA-569-B.1.

B. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Conduit and Boxes: (Flexible metal conduit shall not be used.)
1. Outlet boxes shall be a double gang box with a single gang reducer bracket, unless otherwise noted.
2. Each telecommunication outlet shall have a 1" conduit stubbed up with pull string to the nearest accessible ceiling and/or cable tray.

2.02 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. For optimum performance, the entire cable infrastructure system shall have the same performance (transmission speeds) for all components. The Telecommunication Contractor shall provide all of the necessary components to install a completely operational cabling system (regardless if they are shown on the drawings or listed in this specification).

B. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in riser cables, positions in riser and horizontal cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase.

2.03 UTP CABLE (HORIZONTAL)

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer:
1. Berk-Tek
2. General Cable
3. SYSTIMAX Solutions; a CommScope, Inc. brand
4. Or approved equal

B. Description: 100-ohm, 4-pair UTP.
1. Comply with ANSI/ICEA S-90-661-2002 for mechanical properties.
2. Comply with TIA-568-C.1 for performance specifications.
3. Comply with TIA-568-C.2, Category 6A.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
   a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
      1) The horizontal cable's fire rating shall meet that of the ceiling space to where the cables are intended to be routed.

5. Design recommendations:
    a. Voice/Data: Category 6A Plenum Rated Cable
        1) Blue (Data): Berk-Tek 10130484 LANmark-10G2

2.04 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Leviton
2. SYSTIMAX Solutions; a CommScope, Inc. brand
3. Panduit
4. Or approved equal

B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Basis of design recommendations (Leviton).
1. Wall Plates:
    a. 43080-1S1 - 1 port stainless steel faceplate
    b. 43080-1S2 - 2 port stainless steel faceplate
    c. 43080-1S3 - 3 port stainless steel faceplate
    d. 43080-1S4 - 4 port stainless steel faceplate
    e. 4108W-1SP - wall phone faceplate
2. 41AB2-1F4 100-Pair 110-punchdown block kit.
3. 41AB2-3F4 300-Pair 110-punchdown block kit.
4. Category 6A Component Rated jack modules
    a. 6AUJK-S*6 UTP Connectors with shutters
        1) * = L – Blue
    b. Provide icons to match jack modules.
    c. Jack modules with field installed shutters shall not be acceptable.
5. 41084-FWF F - connector modules
6. 6AS10-xx* (coordinate with owner on lengths-xx) Category 6A Component Rated patch cord. Provide color coded patch cables to match the connectors.
7. 6A587-U48 CAT 6A 48-port modular angled jack panel
    a. Arrange patch panels to allow for mounting of the chassis switch in between the patch panels rather than mounting the switch on the bottom of the rack or in a separate.

2.05 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA-568-C.1.
1. Work station outlets shall match the category rating of the associated cable (i.e. Category 6A).
2. Each voice and data cable shall terminate on individual RJ-45 jacks following the T568B wiring scheme.
3. All voice cables shall be terminated on 110-type termination blocks in the MC/IC, unless designated for VoIP in which they would be terminated on patch panels. All data cables shall be terminated on modular Category 6A jacks (or a data patch panel) in the MC/IC.
4. All jacks shall be terminated on a faceplate. Blank modules and jack icons shall be installed, and the faceplate shall be labeled as described elsewhere.
5. Each cable in a standard workstation shall be identified with the same cable ID and a separate description identifying the particular cable (i.e., voice, data, etc.).
6. Cabling to wall mounted workstation outlets shall terminate in a double-gang plaster ring with a single gang reducer plate provided by the Telecommunication Contractor. The Telecommunication Contractor shall provide the necessary connectors (as described elsewhere) under a single-gang faceplate. The type of faceplate to be used shall be coordinated with the Architect for color, finish, etc.

7. All twisted pair voice & data cables shall be terminated in 8-position/8- conductor RJ45 type jack conforming to the TIA T568B wiring standard. This wiring scheme shall be maintained throughout the installation (i.e., workstation outlets, patch panels, etc.).
8. All twisted pair cables shall terminate in vapor tight, insulating displacement type connectors (IDC). The Telecommunication Contractor shall confirm that sufficient space exists within the outlet box/raceway to maintain recommended bend radius and that strain relief is provided for all cable terminations.
9. The copper cabling system components shall comply with the TIA-568-C.2 Standard. All twisted pair cables shall terminate in vapor tight, insulating displacement type connectors (IDC). The Telecommunication Contractor shall confirm that sufficient space exists within the outlet box/raceway and that strain relief is provided for all cable terminations.

B. Workstation Outlets:
1. Plastic Faceplate: High-impact plastic. Coordinate color with architect and/or Owner's representative.
2. Metal Faceplate: Stainless steel / brass,
3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
   a. Flush mounting jacks, positioning the cord at a 90-degree angle.
4. Legend: Factory labeled by silk-screening or engraving for stainless steel/brass faceplates.
5. Legend: Machine printed, in the field, using adhesive-tape label.
6. Legend: Snap-in, clear-label covers and machine-printed paper inserts.
7. Refer to outlet configuration details on the drawings for additional information.

2.06 OPTICAL FIBER CABLE

A. Approved Manufacturers
1. Berk-Tek
2. Mohawk
3. General Cable
4. Or approved equal

B. Basis of Design
1. The system specified is based upon products by Berk-Tek and represents the performance standard upon which any equivalent solution shall be based.

C. Description: Multimode, 50/125-micrometer, laser optimized, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568 for performance specifications.
3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG.
   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
4. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
5. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

D. Description: Single mode, 8.3/125- micrometer, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568 for performance specifications.
3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
   a. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
d. General Purpose, Conductive: Type OFC or OFCG.
e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

E. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer cable; Orange for 62.5/125-micrometer cable and Yellow for single mode fiber.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

F. Design recommendations:
1. Multi-Mode fiber - for data backbone system infrastructure, multi-mode 50/125-micron, OM4 laser optimized, indoor/outdoor rated, manufactured by Leviton,
a. 6-Strand: P/N PDPK006FB3010/F5-I/O-C4C5(AQU) OM4 armored.
b. 12-Stand: P/N PDPK012FB3010/F5-I/O-C4C5(AQU) OM4 armored.
c. 24-Strand: P/N PDPK024FB3010/F5-I/O-C4C5(AQU) OM4 armored.
d. 50/125 multimode fiber shall be terminated with SC style connectors.
2. Single-Mode Fiber, indoor/outdoor rated, manufactured by Leviton,
a. 6-Strand: P/N PDPK006AB0707-I/O-C4C5(YEL) armored.
b. 12-Strand: P/N PDPK012AB0707-I/O-C4C5(YEL) armored.
c. 24-Strand: P/N PDPK024AB0707-I/O-C4C5(YEL) armored.
d. 8.3/125 single-mode fiber shall be terminated with SC style connectors.

2.07 OPTICAL FIBER CABLE HARDWARE

A. Approved Manufacturers
1. Leviton
2. Panduit
3. Hubbell
4. Or approved equal

B. Basis of Design
1. The system specified is based upon products by Leviton and represents the performance standard upon which any equivalent solution shall be based.

C. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604. Comply with TIA-568.
1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

D. Basis of design recommendations:
1. Leviton 5R2UM-F06, rack mount distribution enclosure, 2RU.
2. Leviton 5F100-62C, single mode 12-strandS with SC connectors.
3. Leviton 5F100-6AC, multimode 50 Micron 12-strands with SC connectors.

E. Patch Cords: Provide patch cords for all fiber ports in each telecommunications closet.
1. Leviton UPDCL-SXX, SC-LC single mode patch cord.
2. Leviton 54DCL-MXX, laser optimized OM4 duplex, SC-LC 50 Micron multimode patch cord.
3. Provide patch cord for each port, minimum length shall one 1 meter. Coordinate exact lengths with the Owner.

2.08 IDENTIFICATION PRODUCTS

A. Comply with TIA-606 and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.09 SOURCE QUALITY CONTROL

A. Factory test UTP and optical fiber cables on reels according to TIA-568-C.1.

B. Factory test UTP cables according to TIA-568-C.2.

C. Factory test multimode optical fiber cables according to TIA-526-7 and TIA-568-C.3.

D. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

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

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. General: Sequence, coordinate, and integrate the various elements of the SCS, materials, and equipment. Comply with the following requirements as a minimum:
1. Coordinate systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for wiring, cabling, and equipment installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom and access for service and maintenance as possible.
7. Coordinate connection of materials, equipment, and systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, request direction in writing from the Owner's representative.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install cabling, wiring, and equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
11. Provide access panel or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Comply with all requirements and work indicated on the drawings (if applicable).
14. Avoid interference with structure and with work or other trades, preserving adequate headroom and clearing doors and passageways to satisfaction of the Owner and in accordance with code requirements.
15. Install equipment and cabling/wiring so as to properly distribute equipment loads on building structural members provided for equipment support under other Sections. Roof-mounted equipment shall be installed and supported on structural steel or roof curbs as appropriate.

16. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs as necessary for floor, wall and ceiling mounting of equipment as required.
17. Provide steel supports and hardware for proper installation of hangers, anchors, guides, and other support hardware.
18. Obtain and analyze catalog data, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.
19. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Practice of American Institute of Steel Construction.
20. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would void the warranty.

3.02 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with the following requirements apply:
1. Perform cutting, fitting, and patching of telecommunications equipment and materials required to uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.

B. Demolition and Removal: Cut, remove, and legally dispose of selected equipment, components, and materials as indicated, including but not limited to removal of material, equipment, devices, and other items indicated to be removed and items made obsolete by the new Work.

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

D. Protection of Work: Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed. During cutting and patching operations, protect adjacent installations. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers.

3.03 PENETRATIONS AND SLEEVES

A. General: Coordinate work with other Sections. Set sleeves in forms before concrete is poured. Provide core drilling as necessary if walls are poured or otherwise constructed, without sleeves and a wall penetration is required. Do not penetrate structural members. Provide sleeves and packing materials at all penetrations of foundations, walls, slabs (except on-grade), partitions, and floors. Sleeves shall meet requirements of the pertinent specifications. Lay out penetration and sleeve openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.

B. Sleeve Fill: Sleeves that penetrate outside walls, basement slabs, footings, and beams shall be waterproof. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of conduit or cable. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes. Sleeves through floors shall be watertight and shall extend 2 inches above floor surface. Where raceways passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.

C. Conduit Sleeves:
1. Annular space between conduit and sleeve shall be at least 1/4 inch.
2. Sleeves shall not be provided for slabs-on-grade unless specified or indicated otherwise.
3. For sleeves through rated fire walls and smoke partitions, comply with requirements for firestopping specified in section "Firestopping".

D. Supports: Do not support piping risers or conduit on sleeves.

E. Future Use: Identify unused sleeves and slots for future installation.

3.04 CORE DRILLING

A. Core drilling shall be avoided where possible. Where core drilling is unavoidable locate all required openings prior to coring. Coordinate openings with other trades and utilities, and prevent damage to structural reinforcement. Thoroughly investigate existing conditions in vicinity of required opening prior to coring. Set sleeves prior to installation of structure for passage of pipes, conduit, ducts, etc. Protect all areas from damage.

3.05 CLEANING

A. Cleaning shall be performed prior to commissioning. After completion of project, clean the exterior surface of all equipment, including concrete residue, dirt, paint residue, etc.

3.06 ACCESS AND ACCESS PANELS

A. Where Required: Provide access to materials and equipment that require inspection, replacement, repair or service. Provide access panels and/or doors as required to allow service of all equipment components. Provide access panels where items installed require access and are concealed in floor, wall, furred space or above ceiling. Ceilings consisting of lay-in or removable splined tiles do not require access panels. Locations of equipment requiring access shall be noted on record drawings. Access panels shall have same fire rating classification as surface penetrated.

B. Coordination: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to the Owner.

C. Construction: Panels shall be at least 12 inches by 12 inches and located to provide optimum access to equipment for maintenance and servicing. Verify access panel locations and construction with Owner’s representative.

3.07 STARTUP AND OPERATIONAL TESTING OF EQUIPMENT AND SYSTEMS

A. General: The Owner maintains the right to have access to the entire project site to develop operational procedures. Completion of startup and field testing shall be accomplished as a prerequisite for substantial completion. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum, complete systems startup and testing.

B. Requirements:
1. Provide installation testing of equipment where required by manufacturer's installation instructions.
2. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner. Acceptance requires, at a minimum, complete systems startup and testing.

3.08 SPECIAL RESPONSIBILITIES AND INFORMATION

A. Coordination of Information: Cooperate and coordinate with work of other Sections in executing work of this Section. Perform work such that progress of entire project including work of other Sections shall not be interfered with or delayed. Provide information as requested on items furnished under this Section which shall be installed under other Sections. Obtain detailed installation information from manufacturers of equipment provided under this Section.

B. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by the Owner. Keep fully informed as to shape, size and position of

openings required for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at no expense to the Owner.

C. Housekeeping Pads: Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for floor mounted equipment.

D. Use of premises: Use of premises shall be restricted as directed by the Owner's representative and as required below:
   1. Cleaning and Rubbish Removal: Remove and dispose of dirt and debris and keep premises clean. During progress of work, remove equipment and unused material. Put building and premises in neat and clean condition and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of the Owner's representative.
   2. Storage: Store materials in a manner that will maintain an orderly, clean appearance. If stored on site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks and covered with tarpaulins.

E. Protection of Fireproofing:
   1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fire proofing work.
   2. Conduits and other items, which would interfere with proper application of fireproofing, shall be installed after completion of spray fire proofing work.
   3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by the Section responsible for damage and shall not constitute grounds for an extra to the Owner.

F. Movement of Materials: Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.

3.09 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA-569-B-1.

B. Comply with TIA-569-B-1for pull-box sizing and length of conduit and number of bends between pull points.
   1. Pull boxes are required every 100' or 180 degrees of conduit bends.
   2. All conduits shall be bushed and reamed and free of any sharp edges that can cause damage to the cables.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.10 SUPPORTS

A. Support Work in accordance with best industry practice and the following.

B. Include supporting cabinets to floor in telecommunications closets and main equipment room.

C. Supporting cables with Kindorf, cable hangers and threaded rod are the responsibility of the Telecommunication Contractor.

D. Nothing (including outlet, pull and junction boxes and fittings) shall depend on conduits, raceways or cables for support.

E. Nothing shall rest on, or depend for support on, suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Vertical members which suspend the

ceiling (together with their horizontal bracing which occurs above the ceiling), however, may be used for support.

F. As a minimum procedure, in suspended ceilings support small runs of circuitry from ceiling suspension members as defined above. Support larger runs of circuitry directly from structural slabs, decks or framing members.

G. Where support members must of necessity penetrate air ducts, include, in accordance with instructions issued in the field, airtight sealing provisions which allow for a relative movement between the support members and the duct walls.

H. Include in the telecommunications Work channel sills or skids for leveling and support of all floor mounted telecommunications equipment.

I. Where permitted loading is exceeded by direct application of telecommunications equipment to a slab or deck, include in the telecommunications Work proper dunnage as required to distribute the weight in a safe manner.

J. Fire-resistant Velcro cable ties shall be used for securing riser cables. The cable ties shall be laced through the strands of the messenger and secured to the cable to be supported.

K. All cable ties used to support telecommunications cabling shall be of the fire-resistant Velcro type. The support rating of the cable ties used shall be a minimum of twice that of the weight per unit of the cable(s) to be supported. Nylon cable ties shall not be used during any part of the installation of the cabling system, even during the pulling of cabling.

3.11 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
1. Comply with TIA-568-C.1.
2. Comply with BICSI ITSIM, Ch. 6, “Cable Termination Practices."
3. Comply with SYSTIMAX Solutions GigaSPEED XL Design & Installation Guideline Documentation.
4. Install 110-style IDC termination hardware unless otherwise indicated.
5. A Multi-User Telecommunications Outlet Assembly (MUTOA) shall not be used as a cross-connect point.
6. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
   a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
   b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.
   c. Note: This requirement does not apply to Horizontal Connection Points deployed as part of a building automation system (BAS) as defined in TIA-862.
7. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
8. Cables may not be spliced.
9. Secure and support cables at intervals not exceeding 60 inches (1.5 m) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
10. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
11. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" chapter. Install lacing bars and distribution spools.

12. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
13. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
14. In the communications equipment room, install a 10-foot- (3-m-) long service loop at the telecom room and 12" service loop at the workstation end, located at the nearest accessible ceiling.
15. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions. Telecommunication Contractor to follow manufacturer's recommendation for pulling tension.
16. All telecommunication cables shall be carry a fire rating (i.e. plenum-CMP) to match the environment of that space.

C. UTP Cable Installation:
1. Comply with TIA-568-C.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:
1. Comply with TIA-568-C.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 4-5' apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm) in diameter below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-B-1 for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.12 MOUNTING HEIGHTS

A. Heights of all wall mounted outlets shall be in accordance with the following list. (Dimensions are above finished floor unless noted.)
   1. Telecommunications outlet in field constructed wall, partition or column unless otherwise specified below -- 18" to centerline.
   2. Telecommunications outlet in factory fabricated wall or partition, unless otherwise specified below -- Dimension determined by wall or partition construction.
   3. Telecommunications outlet in telecommunications closets, mechanical spaces, electric switchboard rooms, electric closets -- 5'-0" to centerline.

B. Heights of all wall mounted outlets shall be in accordance with the architectural drawings and details. Equipment mounting heights shall be in accordance with telecommunications details. Any discrepancies shall be brought to the engineer's attention.

C. Architectural drawings and field instructions issued by the Architect take precedence over the above list and shall be adhered to.

3.13 FIRESTOPPING

A. Comply with TIA-569-B-1, Annex A, "Firestopping."

B. Comply with BICSI TDMM, Chapter 11, "Firestopping Systems".

C. Firestopping shall be provided for all penetrations of conduit, wireways, bus ducts, cable trays, etc., through fire-rated walls and floors and other fire-rated separations as follows:
   1. Excess space in framed openings through structural floors between conduits and concrete shall be grouted in with concrete to a depth of at least the thickness of the slab plus 2" minimum above the slab.
   2. Conduit penetration through poured concrete or masonry walls shall be grouted in with concrete and provided with tight fitting escutcheon plates on both sides.
   3. Conduit penetrations through fire-rated dry walls shall be with sleeves through the wall fitted with escutcheon plates on both sides with excess openings filled with fire stop material specifically manufactured for the purpose.
   4. Excess space within conduit sleeves or stubs through floor slabs or walls where low voltage/telecommunications cables pass through shall be filled with firestopping material specifically manufactured for the purpose.
   5. Utilize fire-rated fittings, as specified elsewhere for penetrations through floor slabs for supplying floor outlets.

D. All conduits/sleeves used for vertical cable passage shall be sealed utilizing suitable material after the installation of cables as follows:
   1. The material shall be non-corrosive to the cable jacket or insulation that it applies to.
   2. The material shall provide for a minimum of three (3) hour fire rating.
   3. The material shall be non-shrinking, waterproof and smoke tight.
   4. The material shall remain flexible and non-hardening.
   5. The material shall be of the type that when installed will not slip through the openings, will stick to the surfaces of the openings and the cable and will not require any pressure to be applied to the cable in order to keep it in place.
   6. The material shall be installed in a neat and workmanlike manner and the final installation shall be smooth finished to the top of the sleeve or conduit.
   7. The material shall be easily removable without damaging the cables after being set or cured for at least one week.

E. All horizontal cable penetrations through rated walls shall be sealed in a manner that will provide a fire rating equal to the wall construction.

F. All materials used for firestopping shall be approved for the purpose and the rating of the wall or floor and all methods employed shall meet with the approval of the local authorities.

G. Refer to architectural drawings and specifications for all locations of fire rated walls and floors.
   1. crimp-style, 2 bolt, UL-listed grounding lugs.

3.14 IDENTIFICATION

A. Identify individually:
   1. Each and every telecommunications cable.
   2. Each outlet (and each port).
   3. Each termination block and patch panel (and each termination).
   4. Each equipment termination frame and cabinet.
   5. Each junction box used for telecommunications wiring.
   6. Each system (i.e., voice, LAN, etc.).

B. The nomenclature used to identify cables, blocks, equipment, etc. shall be as specified on the drawings or elsewhere in this specification. Missing or unclear nomenclature criteria for the items specified above shall not be construed as a reason not to identify the items and shall be brought to the Engineers attention.

C. All materials required for labeling shall be provided by the Telecommunication Contractor. All labels shall be permanently adhered, easily visible and shall be smudge-proof. All text shall be electronically printed (not handwritten). All cables shall be labeled at both ends minimum.

D. Identification for the wires and cables shall be by means of wrap around type labels at both ends (Brady or similar).

E. Labels for risers, cables, wires, faceplates, cover plates, etc., shall be provided with textual descriptions.

F. Identify each outlet box, junction box, and cabinet used in conjunction with empty raceway for wires of a future system by means of indelible markings on the inside denoting the system.

G. Prior to installing identifying tags and nameplates, submit their nomenclature for approval. Conform to any revisions issued by the Owner’s representative.

H. Junction boxes used for telecommunications wiring and located in unfinished spaces (i.e., hung ceilings, equipment rooms, etc.) shall be clearly identified on the outside as "COMM."

I. All identification products and methods shall comply with TIA-606.

J. Refer to drawing details for additional information.

3.15 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
   2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
   3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross- connection.
   a. Test instruments shall meet or exceed applicable requirements in TIA- 568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
5. Optical Fiber Cable Tests:
   a. Test instruments shall meet or exceed applicable requirements in TIA- 568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Link End-to-End Attenuation Tests:
      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.
      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA-568-C.1.
6. UTP Performance Tests:
   a. Test for each outlet. Perform the following tests according to TIA-568- C.1 and TIA-568-C.2:
      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss (attenuation).
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).
      8) Return loss.
      9) Propagation delay.
      10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA-568-C.1 and TIA-568-C.3.
8. Coaxial Cable Tests:
   a. continuity
   b. isolated conductors
   c. no shorts to ground

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

3.16 RECORD OF TEST RESULTS

A. A record of all required tests shall be provided to the Owner’s representative. The information shall be maintained as permanent record for the purposes of maintenance and restoration.

B. A brief description outlining the test equipment used and a single line diagram indicating the test setup shall be provided to the Engineer and/or the Owner’s representative for their review. The level of description should be sufficient enough to allow an individual who is not familiar with the specific test equipment to recreate any portion of the test.

C. Test results to be provided shall contain the following minimum information:
1. For all similar cable runs include:
   a. Project name
   b. Description of test (i.e., voice riser, workstation cable, etc.)
   c. Cable origin
   d. Cable destination
   e. Cable ID
   f. Cable pair/strand

g. Test date
h. Tester (individual responsible for conduct of the test)
i. Page___of ___

2. For copper cables:
   a. No shorts, no crosses, no breaks
   b. For the indicated pairs of the cables include:
      1) Wire Map
      2) Length
      3) Insertion Loss
      4) NEXT Loss, Pair-to-pair
      5) PSNEXT Loss
      6) ELFEXT Loss, Pair-to-pair
      7) PSELFEXT Loss
      8) Return Loss
      9) ACR
      10) PSACR
      11) Propagation Delay
      12) Delay Skew
      13) Test equipment settings.

D. Submitted test results shall be direct output from the tester. The Telecommunication Contractor shall provide a copy of the required viewing software for the Owner to review the results.

E. The Telecommunication Contractor shall provide a summary sheet indicating the cables tested and summary results.

F. All test results shall be provided in the following formats:
   1. Printed (1 bound copy)
   2. Disk (CD Rom or other approved electronic media).

G. A copy of the test results in both electronic and printed formats shall be provided to the Engineer and/or Owner's representative for review and for their records.

H. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

3.17 EQUIPMENT INSTALLATION AND TESTING

A. The Telecommunication Contractor shall be available during equipment installation and testing to help isolate faults which may exist in the cabling or LAN system installation.

B. The Telecommunication Contractor shall coordinate with other vendors where necessary to resolve any discrepancies between the cabling system and the vendors cabling or equipment

3.18 CORRECTIVE ACTION

A. Any defects or deficiencies discovered in any of the telecommunications Work shall be indicated on the test report and be corrected.

B. Upon completion of testing and problem resolution, all connections tested are to be 100% error free.

C. Any connections determined to be not correctable shall be indicated at each end of the termination as "bad" (in red).

3.19 CLEANING

A. The Telecommunication Contractor shall clean all equipment prior to acceptance and turn over the installation clean and dust-free.

END OF SECTION

SECTION 274100

AUDIO VIDEO COMMUNICATIONS

PART 1 – GENERAL

1.01 GENERAL PROVISIONS

A. The Contractor, Subcontractors, and/or suppliers providing goods and services referenced in or related to this Section shall also be bound by the documents identified in Division 00 Procurement and Contracting Requirements and Division 01 General Requirements.

1.02 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.

B. The purpose of these specifications is to define the automated sports broadcasting system performance and design standards for Indian Hill Park. The manufacturer / contractor shall supply equipment to meet or exceed the standards set forth in these specifications.

C. The automated sports broadcasting system will be for the following venues:

1. Softball 1

D. The primary goals of this project are:

1. Video/Audio Capture: Provide the design and supply of a complete video system including pole structure, foundation system, poletop camera assembly, electrical component enclosure for networking equipment, wire harnessing, and all required mounting brackets and associated hardware.
2. Connect: Design and supply the onsite data network for the video system including automated alerts for network and/ or camera outages.
3. Automated production: Provide an automated video production solution that can analyze game play and produce a broadcast including automated camera switching and/or automated pan.
4. Distribution of video content: Provide a video distribution portal to allow viewers to find and watch broadcasts on a computer, mobile device, or smart TV. System must include subscription options, payment processing system, and revenue sharing agreement.
5. Ease of Operation: Provide a web-based broadcast management tool that allows facility owner to enter broadcast schedules.

PART 2 – PRODUCT

2.01 MANUFACTURERS

A. The basis of design product shall be by Musco's Light-Structure System™ with TLC for LED™.

2.02 AUTOMATED SPORTS BROADCASTING SYSTEM CONSTRUCTION

B. Manufacturing Requirements: All components shall be designed and manufactured as a system. All cameras, wire harnesses, networking equipment, and enclosures shall be factory assembled, wired, and tested.

C. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent 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 camera, pole, or electrical components enclosure.

D. System Description: Automated sports broadcasting system shall consist of the following:

1. Pole Structures

   a. Fiberglass Reinforced Composite Poles (diamond fields): Camera systems mounted on 12 foot fiberglass pole.

      i. For a foundation with a fiberglass reinforced composite base system, the base shall be embedded with a two-part polyurethane expanding foam.

2. Camera Equipment: Manufacturer will supply all cameras, including supporting software and electrical equipment.

   a. Optics: System should provide various optical configurations, with wide (180 degrees), medium, or narrow viewing angles. The narrow viewing angle for baseball outfield applications shall have either optical or zoom capabilities to capture a narrow shot from 20 feet on either side of the batter's box. See site layout for location specific optical requirements

   b. Image Processing

      i. Image Stitching: If multi-sensor cameras are utilized, the system shall be capable of stitching the images together to provide seamless image in regard to resolution, color, and angle to provide broadcast quality image.

      ii. Image De-warping: In order to provide a broadcast quality image, the system shall correct for lens barrel distortion. This applies to both single sensor and multi-sensor cameras.

   c. Audio

      iii. Ambient Microphone: System must include one microphone for capturing ambient sound.

3. Electrical Components Enclosure: System shall include electrical components enclosure for any electric or electronic equipment including networking equipment, power supplies, surge suppression, or other required equipment.

4. Wire harness complete with plug-in connections for fast, trouble-free installation.

5. Equipment required for remote management and diagnostics. (See Section 2.3)

6. For steel poles, manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.

   a. Integrated grounding via concrete encased electrode grounding system.

   b. 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 minimum size of 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.

D. Safety: All system components shall be UL listed for the appropriate application.

2.03 AUTOMATION

A. Broadcast Production: To provide the best view of game play and create an exciting broadcast, the system must include all hardware and software required for one or both of the following:

1. Automated camera switching: The system shall be capable of analyzing game play and automatically switching cameras based on game action.
2. Automated camera control: The system shall be capable of following play and digitally panning the camera based on game play.

2.04 VIDEO DISTRIBUTION

A. Manufacturer shall provide a full featured viewing platform including:
   1. Resolution: Streaming content must be 720p resolution minimum
   2. Content Viewing: Content shall be available in three different formats:
      a. Live Viewing
      b. On-Demand Viewing: Broadcasts must be recorded, stored, and available for on-demand viewing for a period of at least three (3) months after live broadcast
      c. Broadcast Download: Recorded broadcasts must be available for download to viewer's local device storage
   3. Video Player Controls
      a. Play, Pause, Rewind, Fast Forward
   4. Payment system: System shall have a payment system allowing viewers to purchase subscriptions to access content. The system shall be capable of processing credit card transactions.
   5. Viewing Platforms: All functions should be available on the following platforms
      a. Website
      b. Mobile Application for IOS and Android
      c. Content Applications
         i. Apple TV
         ii. Android TV
         iii. Roku
         iv. Amazon Fire

2.05 CONTROL

A. Remote Control System: System shall allow owner and users with a security code to schedule broadcasts via a web site, telephone, fax, mobile device, or email up to ten years in advance. Equipment manufacturer will provide a mobile application suitable for IOS and Android devices. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

   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.

B. Remote Monitoring System: System shall monitor broadcast and notify manufacturer if a camera or network outage is detected so that appropriate maintenance can be scheduled.

C. Management Tools: Manufacturer shall provide a web-based database of actual usage and provide reports.

D. Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field video system that is readily accessible to the owner.
   1. Communication Costs: The facility owner is responsible for internet communication cost.

E. Streaming hours: The manufacturer shall supply 750 streaming hours for each field or court with

installed equipment. The control system shall be capable of:

1. Reporting current balance and usage of streaming hours
2. Notification when remaining streaming hours fall below set point

2.06 ELECTRICAL

A. Electric Power Requirements for control cabinet and camera equipment:
   1. Line Voltage
      a. Electric power: 120 Volt, Single Phase
      b. Maximum total voltage drop: Voltage drop between distribution panel and broadcasting equipment shall not exceed three (3) percent of the rated voltage.
   2. Power over Ethernet: Cameras remote from power may utilize power over ethernet with wire run distance of 300’ or less.

2.07 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 130mph and exposure category C.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If no geotechnical report is available, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2015 IBC Table 1806.2.

C. Foundation Drawings: Project specific foundation drawings stamped by a registered 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. These drawings must be submitted at time of bid to allow for accurate pricing.

PART 3 – EXECUTION

3.01 SOIL QUALITY CONTROL

A. It shall be the Contractor’s responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner’s approval / payment for additional costs associated with:
   1. Providing engineered foundation embedment design by a registered engineer in the State of Massachusetts for soils other than specified soil conditions;
   2. Additional materials required to achieve alternate foundation;
   3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.02 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 10-12 weeks from receipt of approved submittals and receipt of complete order information.

3.03 FIELD QUALITY CONTROL

A. If in the opinion of the owner, or owner's representative, the video system provided does not meet this specification, manufacturer is responsible for any necessary repairs or alterations, up to and including replacement of the entire video system.

3.04 WARRANTY AND GUARANTEE

A. 5-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 5 years from the date of shipment for all parts and labor. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Required submittal information for all manufacturers:

All items listed below are mandatory, shall comply with the specification. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

Yes/ No	Tab	Item	Description
	A	Letter/ Checklist	Listing 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. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with camera locations.
	C	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner.
	D	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Massachusetts, if required by owner. (May be supplied upon award).
	E	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system.
	F	Warranty	Provide written warranty information including all terms and conditions.
	G	Project References	Manufacturer to provide a list of > 5 projects where the technology proposed for this project has been installed. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	H	Product Information	Complete bill of material and current brochures/cut sheets for all product provided.
	I	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	J	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.

END OF SECTION

SECTION 310000
EARTHWORK

Part 1 - GENERAL

1.01 GENERAL

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. Prospective bidders are advised that significant quantities of topsoil are present at the property and presumably available for reuse if compatible with the requirements of this specification. The Contractor shall be responsible for amending topsoil, as required to comply with this specification.

1.02 SUMMARY

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include but is not limited to the following:

1. Excavation of all existing material for site improvements to the depth required in the plans and specifications to meet the required lines and grades.

2. Providing, placing and compacting Structural Fill, Gravel Fill, Crushed Stone, Blast Rock Fill (Rip Rap), Ordinary Fill, and Sand for site improvements specified herein and/or indicated within the drawings.

3. Providing, placing and compacting infield mix at locations specified herein and/or indicated within the drawings.

4. Providing, placing and compacting all other specified fill materials at locations specified herein and/or indicated within the drawings.

5. Excavating, screening stockpiling and rehandling all existing topsoil excavated within the construction site for reuse on-site.

6. Compaction of all disturbed and undisturbed surfaces which are to receive new foundations, footings, slabs, and other load-bearing elements, to ensure against any weak areas in the substrate.

7. Perform all operations and provide such equipment as necessary to maintain excavated areas free from water from any source whatsoever and to avoid the disturbance of the subgrade

8. Installation of sheeting, shoring and bracing and protection of adjacent properties, streets utilities and structures as may be required due to the earthwork performed.

9. Rough grading.

10. Dust control.

11. The Contractor shall legally dispose off-site all the excess excavated material originating from the construction of this site.

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Division 2 Section 024100 “Site Preparation and Demolition” for site stripping, grubbing, topsoil removal, and tree protection.

B. Division 2 Section 031216 “Bituminous Concrete” for roadway pavements.

C. Division 2 Section 334200 “Storm Drainage System” for coordination, trenching and backfilling.

D. Division 2 Section 32 30 00 “Site Improvements” for required excavation and backfilling of site improvements.

1.04 DEFINITIONS

A. Excavation consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials excavated.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Owners Representative. Unauthorized excavation, as well as remedial work directed by the Owners Representative, shall be at Contractor’s expense.

1. Backfill and compact unauthorized excavations with structural fill as specified for authorized excavations, unless otherwise directed by the Owners Representative.

C. Additional Excavation: Consists of the removal of material as directed by the Owners Representative beyond the required subgrade that is determined as unsuitable. The Contractor shall continue excavation until suitable bearing materials are encountered. The Contract Sum shall be adjusted by an appropriate Contract Modification. The following constitute unsuitable materials:

1. Topsoil and loam.

2. All peat, organic soil, or soil containing sod, roots, or any other material subject to decomposition or decay.

3. All soft, spongy or compressible soil, including, but not limited to, silt and loose fine sand.

4. All buried building material, which may include but is not limited to the following:

a. Concrete rubble
b. Re-bars
c. Asphalt

d Electrical materials and debris
e. Wood
f. Brick, block, tile (ceramic/quarry)
g. Pipe
h. Ashes
i. Metal pieces/parts
j. Insulation
k. Any other material remaining from previously demolished building

D. Sub-grade: The undisturbed earth or the compacted soil layer immediately below granular sub- base.

E. Structure: Foundations, footings, slabs, or other man-made stationary features occurring above or below ground surface.

F. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

G. Free Water: Water with or without suspended material, which when sampled is pourable.

1.05 SUBMITTALS

A. Test Reports: Submit the following test reports directly to the Owners Representative from the testing services.

1. Test reports on borrow material.

2. Test reports on subbase material.

The Contractor shall furnish a Certified Laboratory Report showing the soils classification and nutrient analysis of representative samples of the Loam that is proposed to be used, including the extent of lime and fertilizer required. Samples submitted for approval must be representative of the total volume to be reused, taken in the presence of the Owners Representative, and delivered -to a certified laboratory by the Contractor; all costs for such shall be borne by the Contractor.

If the material does not conform to the above requirements it shall be rejected and additional sources shall be found. Sampling and testing shall be accomplished as specified herein until an approved material is found, all at the Contractor's expense.

To assure that materials fulfill specified requirements regarding textural analysis, organic matter content, pH, and fertility testing may be undertaken:

a. Prior to site delivery; at source.

b. At time of delivery; on-site; and or

c. Immediately following spreading on site, Soil sampling shall also indicate if specified soil was supplied uniformly to the minimum specified depth.

B. Product Literature: Prior to ordering the below listed materials, submit product literature to the Owners Representative for approval.

1. Each type of plastic warning tape

C. Submit the following samples prior to ordering the below listed materials to the Owners Representative for approval.

1. Twelve (12) inch length of each detectable warning tape specified.

1.06 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with all local and state regulations, laws and ordinances and with requirements of authorities having jurisdiction.

B. Testing and Inspection Service: The Contractor shall coordinate and submit all tests as specified herein.

1. Owner's Responsibility: The Owner, at his option, shall employ a qualified geotechnical testing agency to verify that soils comply with specified requirements and to perform required field and laboratory testing for the following:

a. Field in-place density tests

b. Optimum moisture-maximum density curve for each type of soil encountered

c. Bearing tests

2. Contractor's Responsibility: The Contractor shall employ a qualified geotechnical testing agency, and as approved by the Owner, to verify that soils comply with specified requirements and to perform required field and laboratory testing for the following:

a. Test reports on Borrow Material

b. Test reports on Sub-Base Material

c. Re-testing of all tests which are performed by the Owner's geotechnical testing agency that are found in non-compliance to the specifications.

C. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Special Conditions Section “Project Meetings”.

1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Consultants, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least three (3) working days prior to convening conference. Contractor shall record discussions and agreements and furnish a copy to each participant.

1.07 PROJECT CONDITIONS

A. The Contractor shall fully inform himself of existing conditions both surface and sub-surface before submitting his bid and shall be fully responsible for carrying out all site work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. No claim for additional compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed. The Owner shall not be responsible for interpretations or conclusions drawn from data or interpretations by the Contractor.

1. Test borings and other exploratory operations may be performed by Contractor, at the Contractors option; however, no change in the Contract Sum will be authorized for such additional exploration.

2. The Contractor may assume that excavated material from on-site shall conform to the requirements specified as Ordinary Borrow and be approved for on-site construction where indicated on the drawings or specified herein.

B. Existing Utilities:

1. All locations of existing utilities shown on the plan have been developed from existing utility records and/or above ground inspection of the site. Completeness or accuracy of locations or depth of underground utility or structures cannot be guaranteed. Contractor must verify the location and depth of all underground utilities or structures prior to the start of work.

2. Locate all existing underground utilities in areas of excavation work. Disconnect, seal and/or protect, as required, all existing utilities, including but not limited, to water, gas, sewerage, storm, electrical and telephone in accordance with the regulations concerned. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

a. Contractor shall be responsible for all on-site coordination with utility companies and public agencies and for obtaining all required permits and paying all required fees. In accordance with M.G.L., Chapter 82, Section 40, including amendments; Contractor shall notify all utility companies and government agencies in writing prior to such excavation, (exclusive of Saturday, Sundays and Holidays) Contractor shall also call “Dig Safe” at 1(888) 344-7233 no less than 72 hours prior to such excavation. Documentation of requests and numbers provided to Contractor.

b. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

c. Do not interrupt existing utilities servicing facilities occupied by Owner or others, during occupied hours, except when permitted in writing by the Owners Representative and then only after acceptable temporary utility services have been provided.

d. Provide minimum of forty-eight (48) hours notice to the Owners Representative, and receive written notice to proceed before interrupting any utility.

e. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

D. Use of Explosives: Use of explosives is not permitted.

E. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dryout to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

F. Adjoining Property: No construction work, temporary or permanent, shall take place on the adjoining private property. The Owner does not have nor will obtain any legal easement for this purpose. The Contractor shall be fully responsible for monitoring and maintaining that no construction activities trespass onto the adjoining property for the duration of the contract.

G. In advance of installing the new infield mix surfacing, the Contractor shall be responsible for removal of existing infiled materials and installing 6” of crushed stone and 2” of peastone as indicated on the details. Excavated materials may be reused as stipulated in the construction drawings and specifications.

1.08 BENCHMARKS, LINES AND GRADES

A. The Contractor shall engage a professional land surveyor, registered in the Commonwealth of Massachusetts and submit the name, address and registration number of such persons to the Owners Representative for approval to perform the following work:

1. Furnish all stakes, pins, grade markings and lay out all lines and grade work, required to implement the work, in accordance with Drawings.

2. Establish permanent benchmarks, maintain all established bounds and benchmarks, and replace as directed any which are destroyed or disturbed.

3. Establish all lines and vertical and horizontal alignment grades for the work and verify all locations, property lines, work lines, and other dimensioned points indicated on the Contract Drawings for the existing site.

4. Submit to the Owners Representative, a written confirmation of locations of all lines, and any discrepancies between conditions and locations as they actually exist and those indicated on the Contract Drawings. Such confirmation shall bear the Owners Representative’s or Surveyor’s registration stamp.

B. The Contractor shall inform the Owners Representative when the general layout is completed and shall not begin excavation until the various alignments are approved. Any discrepancies encountered in field conditions shall be reported to the Owners Representative immediately.

1.09 WORK IN THE PUBLIC WAYS

A. Notify the appropriate municipal officials at least seven (7) calendar days in advance of commencing any work in the public ways pay for and obtain all required permission and permits to perform this work. Perform all work in the public ways in a manner required by the municipal authorities.

B. Should there be any conflict between requirements specified in the Contract Documents and those of the municipal authorities, the municipal requirements shall govern.

C. Do not close or obstruct any streets or sidewalks unless and until they have been discontinued by the appropriate municipal authority or unless and until the Contractor shall have first secured all necessary or other permits therefor. No materials whatsoever shall be placed or stored in the streets. Conduct all operations to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks, or other facilities near enough to the work to be affected thereby.

D. The Contractors attention is directed to the fact that the work on this project is to be performed in areas which are utilized by pedestrians as well as by vehicles. The Contractor shall be responsible for the installation of adequate precautions and other safety measures and controls deemed necessary by the authorities having jurisdiction, for the general public and for his own personnel.

1. The Contractor shall without additional compensation be required to provide safe and convenient access during the execution of the work. Necessary areas for fire apparatus and other emergency vehicles shall be maintained at all times.

1.10 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with applicable provisions and recommendations of the following:

1. Standard Specifications and Details: City of Worcester, Department of Public Works and Parks, Parks Recreation and Cemetery Division.

2. Standard Specification: Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, supplemental specifications latest edition.

3. AASHTO: American Association of State Highway and Transportation Officials, latest edition.

4. ASTM: American Society of Testing and Materials, latest edition.

5. ADA: Americans with Disabilities Act, latest edition.

6. ABB: Architectural Barriers Board, Commonwealth of Massachusetts Regulation Chapter 521 CMR, latest edition.

1.11 NOTIFICATION

A. The Contractor shall notify the Owner in writing at least ten (10) days in advance of the time he intends furnishing Root Zone Mix stating the location and amount of such deposit, the name and address of the supplier and also shall furnish such facilities, transportation and assistance as the Owner may require for collecting and forwarding samples.

1.12 SUBSURFACE SOIL DATA

A. Review logs of borings, jar soil samples, records of explorations and other pertinent data for the site. After obtaining Owner's permission, take whatever additional subsurface explorations deemed necessary at no expense to the Owner.

B. Boring logs are appended to these specifications. Jar soil samples may be examined upon written request to the Owner's Representative

C. The above data are for general information and are accurate only at the particular locations and times the subsurface explorations were made. It is the Contractor's responsibility to make interpretations and to draw conclusions based on the character of materials to be encountered and the impact of his work based on his expert knowledge of the area and of earthwork techniques.

D. The Drawings showing existing ground elevations are only for whatever use the Site Work Contractor may make of them with no responsibility on the part of the Surveyors, the Owner, or their Representatives for the accuracy and/or the reliability of the information given.

PART 2 - PRODUCTS

2.01 FILL MATERIALS

A. Structural Fill shall consist of inert material that is hard, durable stone, gravel and coarse sand, free from loam and clay, surface coatings, and deleterious materials.

U.S. Standard Sieve	Percent Passing by Weight	
	Min.	Max.
4''	100	
2''	65	100
#4	30	80
#20	10	65
#40	5	40
#100	0	20
#200	0	8

B. Compacted Gravel Fill (See Project Special Conditions)

C. Crushed Stone shall consist of inert angular material derived from a stone quarry that is hard, durable, washed stone, free of deleterious materials. Gradation shall conform to Massachusetts Highway Department, M2.01.4, and the following:

U.S. Standard Sieve	Percent Passing by Weight	
	Min.	Max.
1"	100	
3/4"	90	100
1/2"	10	50
3/8"	0	20
#4	0	5

Crushed stone for infiltration areas shall be 1" stone.

D. Sand Borrow shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock, free from clay or loam, surfacing coatings, and deleterious materials, with the following gradation limitations, as determined by AASHTO T11 and T27 and shall conform to Massachusetts Highway Department Specification Designation, M1.04.1 and the following:

U.S. Standard Sieve	Percent Passing by Weight	
	Min.	Max.
1/2"	100	
3/8"	85	100
#4	60	100
#16	35	80
#50	10	55
#100	2	10

E. Ordinary Borrow shall be well graded, natural inorganic soil, approved by the Owners Representative and meeting the following requirements:

1. It shall be free of organic or other weak or compressible materials, of frozen materials, and of stones larger than six (6) inches maximum dimension.

2. It shall be of such nature and character that it can be compacted to the specified densities.

3. It shall be free from highly plastic clays, from all materials subject to decay, decomposition, or dissolution and from cinders or other material which will corrode piping or other metal.

4. It shall have maximum dry density of not less than one hundred (100) pounds per cubic foot.

5. Material from excavation on the site may be used as ordinary fill if it meets the above requirements and is approved by the Owners Representative.

H. Excavated Materials: Material from on-site excavation may be utilized for ordinary borrow in locations indicated within the drawings or specified herein if that material meets the specifications indicated within paragraph 2.1.E of this section. If sufficient suitable fill and backfill material is not available from excavations under the Contract, additional material, suitable for use, shall be brought to the site from other sources at no additional cost to the owner.

I. Blast Rock Fill: shall be well-graded blasted rock with a maximum size hereinafter specified. Well- graded means that at least twenty-five percent (25%) is less than six inches (6") in size, and at least ten percent (10%) is less than three-quarters inch (3/4") in size. The Contractor shall select materials sources in order to meet these gradation requirements.

2.02 DETECTABLE WARNING TAPE

A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, six (6) inches wide and four (4) mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2'-
6" deep.

1. Tape Colors: Provide tape colors for utilities as follows:

   a. Red: Electric.
   b. Yellow: Gas, oil, steam, and dangerous materials.
   c. Orange: Telephone and other communications.
   d. Blue: Water systems.
   e. Green: Sewer systems.

2.03 GEOTEXTILE

A. Fabric shall be a non-woven polypropylene product with UV protection.

PART 3 - EXECUTION

3.01 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 sub-grades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion control measures to prevent erosion or displacement of soils and discharge of soil- bearing water runoff or airborne dust to adjacent properties and walkways.

D. Provide tree protection as specified in Division 2 Section “Site Preparation”.

3.02 DUST CONTROL

A. Refer to Article 36 DEMOLITION, SITE EXCAVATION AND PREPARATION for dust control requirements.

3.03 DEWATERING

A. Upon entering the premises, assume responsibility for site and subsurface drainage and maintain such drainage during the life of this Contract in a manner acceptable to the Owners Representative, at all times protecting and maintaining the existing conditions in adjacent areas. Presence of ground water in the soil shall not constitute a condition for which any increase may be made in the Contract Price.

B. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding project site and surrounding area.

C. Protect subgrades and foundation soils from softening and damage by rain or free water accumulation.

D. Legally remove by pumping, draining or bailing all water which may accumulate or be found on the site within the Contract limits, where excavation and grading are to be done. Excavate and form all pump wells, sumps, dams, flumes or other necessary works to keep excavations entirely clear of water. Protect newly-placed concrete and newly-constructed masonry from damage resulting from dewatering work, by the use of canvas, tarpaulins, or by such other sufficient method as the Owners Representative may approve. Maintain at all times upon the work sufficient and satisfactory pumping machinery, including standby equipment. Provide pump wells or well points and under drains as may be required, where needed to properly handle the water. The final approved trimming excavation shall not be done until the Owners Representative has approved the manner of dewatering. Maintain excavations free from water until all backfilling operations and new construction has been completed. Provide portable generator if temporary power is not available.

E. Dispose of water from excavations in such a manner as will not (a) cause injury to persons, (b) endanger public health, (c) cause damage to public or private property, (d) cause damage to the work completed or in progress, and (e) cause any interference with the use of any area beyond the Limit Lines of this Contract.

3.04 EROSION CONTROL

A. Install and maintain erosion control measures as specified within the Division 2 Section "Site Preparation" and the following:

1. Schedule the delivery and placement of fill materials, obtained from off-site sources, in a manner which will minimize the length of time such fill materials would be stored on site and subject to erosion.

2. Limit new embankment slopes to three (3) horizontal to one (1) vertical, maximum unless indicated as steeper on plans.

3.05 FROST PROTECTION

A. Do not excavate to full indicated depth when freezing temperatures may be expected, unless footings or slabs can be poured immediately after the excavation has been completed. Protect the excavation from frost if placing of the concrete is delayed. Should protection fail, remove frozen materials and replace with concrete or gravel fill, as directed, at no cost to the Owner. Once footings or slabs are placed, protect same from frost.

B. Keep the operations under this Contract clear and free of accumulations of snow as required to carry out the work.

3.06 SHEETING, SHORING AND BRACING AND PROTECTION

A. The Contractor shall furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation below that necessary for proper construction, or otherwise injure or delay the work or endanger adjacent structure or personnel. If the Owners Representative is of the opinion that at any point sufficient or proper support has not been provided, he may order additional supports put in at the expense of the Contractor.

1. Prior to installation of sheeting, the Contractor and the Owners Representative shall notify and consult with residents who may be affected by vibrations caused by equipment installing the sheeting.

B. Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material

from behind the sheeting. If necessary, to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled with sand and compacted.

C. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing which the Owners Representative may direct him to leave in place at any time during the progress of the work, for the purpose for preventing injury to structure, personnel, utilities, or property at no additional cost. Timber or steel sheeting and bracing to be left in place shall be cut-off at least two feet below finish grade. This shall not constitute a waiver of the Contractor's responsibility to use his own judgment in where sheeting shall be left in place.

D. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheeting shall be immediately backfilled with approved material and compacted by ramming with tools especially adapted to that purpose, by watering, or otherwise as may be directed.

E. Comply with local safety regulations or in the absence thereof, with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc.

1. Submit sheeting and shoring design for review to the Owners Representative. The sheeting and shoring design shall be prepared by a professional Owners Representative registered in the Commonwealth of Massachusetts and in the employ of the Contractor

3.07 EXCAVATION: GENERAL

A. Classified Excavation: Excavation is classified and includes excavation to required sub-grade elevations indicated, regardless of character of materials and obstructions encountered. Excavation will be classified as earth excavation or rock excavation as follows:

1. Earth Excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

a. Intermittent drilling or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

b. All excavation shall be done with a backhoe whose bucket is equipped with a wedge plate across the teeth to provide a smooth bottom profile or equivalent equipment approved by the Owners Representative.

2. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered that cannot be dislodged and excavated with modern, track- mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock excavation equipment is defined as Caterpillar Model No., 973 or equivalent track-mounted loader, rated at not less than 210 HP flywheel power and developing minimum of 45,000- pound breakout force (measured in accordance with SAE J732).

3. Rock excavation for trenches includes removal and disposal of materials and obstructions encountered that cannot be excavated with a track-mounted power excavator, equivalent to Caterpillar Model No. 215C LC, and rated at not less than115 HP flywheel power and 32,000-pound drawbar pull and equipped with a short stick and a 42-inch wide, short tip radius rock bucket rated at 0.81 cubic yard (heaped) capacity. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

B. Material, encountered in the excavation, to qualify as rock, must be two (2) cubic yards or more in undisturbed size in open excavation and in trenches. To be considered for classification as rock, material shall be any one of the following:

1. Rock, stone or shale (in original ledge) and all other material, including buried building foundations, which cannot be broken and removed by power excavation equipment and requires the use of drills.

2. Boulders.

C. When, during the progress of excavation, rock is encountered, uncover and expose the material, and notify the Owners representative before proceeding further. Do not proceed with the excavation of material claimed as rock until the material has been classified by the Landscape Architect. Failure on the part of the Contractor to uncover such material or notify the Owners Representative, and take cross-sections, will forfeit the Contractors right-of-claim to any additional compensation or extension of time.

1. Employ qualified personnel, acceptable to the Owners Representative, to take cross-sections of rock three (3) feet on center before removal of same; and to provide computations of cross-sections.

3.08 STABILITY OF EXCAVATIONS

A. Excavation of slopes shall be constructed to comply with all OSHA regulations and with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations. Notify the Massachusetts Department of Labor and Industries of the start of excavation work.

3.09 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions as indicated within the drawings within a tolerance of plus or minus 0.10 foot. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing service and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Mechanical or Electrical Appurtenances: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 0.10 foot. Do not disturb bottom of excavations intended for bearing surface.

3.10 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades as indicated within the drawings.

3.11 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated slopes, lines, depths, and below invert elevations as indicated within the drawings.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to twelve (12) inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: Twelve (12) inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to receive bedding for pipes and conduit. Shape bedding to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.

1. Where rock is encountered excavate six (6") inches below required elevations and backfill with compacted gravel fill to required elevations.

3.12 APPROVAL OF SUBGRADE

A. Maintain foundation excavations at least twelve (12) inches above design bearing level until final excavation immediately before footing construction, or placing fill. If footings will not be constructed within the same day as final excavation to subgrade level, a three (3) inch, thick lean concrete mud slab should be cast over the exposed bearing surface immediately after approval of the subgrade bearing surface by the geotechnical Owners Representative.

B. Notify the Owners Representative when excavations have reached required subgrade for inspection of conditions and approval to proceed with construction.

C. If the Owners Representative determines that unforeseen unsuitable material is present, he may direct the Contractor to continue excavation until suitable bearing materials are encountered.

D. Re-construct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owners Representative, at no cost to the owner.

E. Do not place fill material until the subgrade is approved by the Owners Representative.

3.13 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation with structural fill material as directed by the Owners Representative. Flowable fill may be used to bring elevations to proper position when acceptable to the Owners Representative.

B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by Owners Representative at no additional cost to the owner.

3.14 STORAGE OF SOIL MATERIALS

A. Stockpile excavated materials approved as backfill materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent erosion and install siltation controls.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

2. Intermixed stockpiles as determined and directed by the Owners Representative shall be re-tested for compliance to specified requirements or removed from site immediately, at no additional cost to the owner.

3.15 PROOF COMPACTION

A. Proof compact the bottom of excavations or existing subgrade, as applicable. Proof compaction shall consist of making ten (10) passes with a tenton vibratory roller or by a minimum of three (3) coverages from the rear wheel assembly of a fully loaded ten-wheel dump truck or by a minimum of three (3) coverages from the treads of a tractor dozer weighing at least 30,000 pounds and observing the subgrade for any soft or weaving areas.

1. If, in the judgement of the Owners Representative, compaction of receiving surfaces is no required or will disturb the natural soil, the subgrade compaction requirements will be waived.

B. Prior to placing fill in trench areas, thoroughly compact the trench bottoms and fill all depressions to a smooth uniform surface.

3.16 PLACEMENT AND COMPACTION OF FILLS

A. General: Backfill excavations as promptly as work permits, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

2. Coordinate installation of drainage systems.

3. Surveying locations of underground utilities for record documents.

4. Testing, inspecting, and approval of underground utilities.

5. Concrete formwork removal.

6. Removal of trash and debris from excavation.

7. Removal of temporary shoring and bracing, and sheeting.

8. Remove vegetation, topsoil, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.

9. When sub-grade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and recompact to required density.

B. Notify the Owners Representative when areas to receive fill are ready for inspection. All

subgrades to receive fill shall be compacted to a minimum ninetyfive (95) percent of maximum dry density beneath proposed foundations, slabs-on-grade and paved parking areas and walkways. Unless otherwise noted within the drawings or specified herein.

C. Place approved fill materials in layers not exceeding six (6) inches compacted thickness and compact as specified below for various fill conditions.

D. Before filling against walls, the permanent structures must be completed and sufficiently aged to attain strength required to resist fill pressures without damage. Temporary bracing of permanent structural wall will not be permitted. Correct all damages to the structure caused by the filling operations at no additional cost to the Owner.

1. Place no stones over four (4) inches in diameter closer than eighteen (18) inches to foundation or retaining walls.

E. Placing Structural Fill

1. Place structural fill and compact to specified dry density as indicated within the drawings and beneath building structural elements, including footings foundations and slabs and as specified herein.

F. Placing Compacted Gravel Fill

1. Place gravel fill and compact to specified densities as indicated within the drawings and all exterior site construction requiring filling and backfilling operations as a result of excavation operations and/or filling to required subgrades from existing grades.

G. Placing Crushed Stone

1. Place crushed stone and compact to specified densities as indicated within the drawings and/or specified herein.

H. Placing Sand Borrow

1. Place sand borrow and compact to specified densities as indicated within the drawings and specified herein.

I. Placing Ordinary Borrow

1. Ordinary borrow may be utilized, if approved by the Owners Representative, as fill and backfill material beneath pavements, structures and lawn and planting areas not indicated within the drawings or specified herein as structural fill, gravel fill, crushed stone or sand borrow.

2. Place ordinary borrow and compact to specified densities as indicated within the drawings and specified herein.

J. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557 and in place density in accordance with ASTM D 1556.

1. Under structures and pavements, compact the sub-grade and each layer of backfill or fill material at 95 percent maximum dry density.

2. Under walkways, compact the subgrade and each layer of backfill or fill material at 95 percent maximum dry density.

3. Under planting areas or unpaved areas, compact the sub-grade and each layer of backfill or fill material at 90 percent maximum dry density.

K. Placing Blast Rock Fill (Rip Rap) on the slope located on the high side of the Existing Retaining Wall on Providence Street shall be completed after the wall repair is 100% complete and the 6' chain link fence is installed. The blast rock shall be placed evenly along the slope in 6" lifts by individual bucket loads. Placement of rock on the slope by dumping from a truck is prohibited.

3.17 UTILITY TRENCH BACKFILL

A. Place bedding course on bearing surfaces and to fill unauthorized excavations. Shape

bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits to spring line.

B. Concrete backfill trenches that carry below or pass under footings and that are excavated within eighteen (18) inches of footings. Place concrete to level of bottom of footings.

C. Provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" belo surface of roadways. After installation and testing, completely encase piping or conduit in minimum of four (4) inches of concrete before backfilling or placing roadway sub-base.

D. Place and compact backfill material to a minimum height of twelve (12) inches over the utility pipe or conduit and as indicated within the drawings.

1. Carefully compact material and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. Coordinate backfilling with utilities testing.

F. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.

G. Place and compact final backfill of material to final sub-grade.

H. Install warning tape directly above utilities, twelve (12) inches below finished grade, except six (6) inches below subgrade under pavements and slabs.

3.18 ROUGH GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between existing adjacent grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish sub-grades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus, or minus 0.10 foot.

2. Walks: Plus, or minus 0.10 foot.

3. Pavements: Plus, or minus 0.10 foot.

3.19 FIELD QUALITY CONTROL

A. Testing Agency Services: Allow testing agency to inspect and test each sub-grade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.

1. Perform field in-place density tests according to ASTM D 1556 (sand cone method).

a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gauges according to ASTM D 3017.

b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Owners Representative.

2. Footing Sub-grade: At footing sub-grades, perform at least one (1) test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing sub- grades may be based on a visual comparison of each sub-grade with related tested strata when acceptable to the Owners Representative.

3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one (1) field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.

4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one (1) field in- place density test for each 100 feet or less of wall length, but no fewer than two (2) tests along a wall face.

5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one (1) field in-place density test for each 100 feet or less of trench, but no fewer than two (2) tests.

B. When testing agency reports that sub-grades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, recompact and retest until

required density is obtained, at no additional cost to the Owner.

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 re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth directed by the Owners Representative; reshape and recompact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

D. All additional, repairing, removing and restoring work shall be completed at no additional cost to the owner.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove and legally dispose of surplus or excavated materials not required to complete construction, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION

Section 31 22 00
GRADING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS: This Section is only a portion of the Contract Documents. All of the Contract Documents, including Division 1 General Requirements, apply to this Section.

1.2 SECTION INCLUDES:

A. Provide facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this Section, and as shown on the Drawings.

B. The Contractor shall contact the Owner to obtain a copy of the geotechnical report. If conflicts exist between the geotechnical report and the technical specifications, the Contractor shall inform the Engineer prior to earthwork operations.

C. The work of this Section includes but is not necessarily limited to:

1. Excavation, fill, and backfill, including compaction as indicated or required, to the lines and grades indicated on the Drawings.
2. Excavation and disposal of unsuitable or excess materials off-site, unless other on-site locations are designated. Excavation shall include removal and satisfactory disposal of all unclassified material encountered throughout the site.
3. Rough grading, including placement, moisture conditioning and compaction of fills and backfills.
4. Placement of base and subbase course materials under structures, slabs and footings, including compaction.
5. The removal, hauling and stockpiling of suitable excavated materials for subsequent use in the work. Stockpiling shall include protection to maintain materials in a workable condition.
6. Rehandling, hauling and placing of stockpiled materials for use in refilling, filling, backfilling, grading and such other operations.

D. Contractor shall be responsible for notifying all owners of affected utilities and for contacting Dig Safe at least 72 hours prior to excavation.

1.3 EXCAVATION CLASSIFICATIONS:

A. Excavation: Excavation shall be unclassified and no consideration will be given to the nature of the materials. Excavation shall comprise and include the satisfactory removal and disposal

of all materials encountered regardless of the nature of the materials and shall be understood to include but not limited to earth, fill, foundations, pavements, curbs, piping, railroad track and ties, cobblestones, footings, bricks, concrete, previously abandoned drainage structures and utility structures abandoned and not removed by the utility and debris.

B. Rock Excavation: Rock is defined for payment purposes as stone or hard shale in original ledge, boulders over two cubic yards (2yd3) in volume in open areas and one cubic yard (1yd3) in volume in trenches, and masonry or concrete that cannot be broken or removed by normal job equipment (power shovels, scoops, or D-8 bulldozers with ripper attachment) without the use of explosives or drills. The classification does not include materials that can be removed by means other than drilling and blasting or drilling and wedging but which, for reasons of economy in excavating, the Contractor prefers to remove by drilling and blasting. The word "trenches" shall mean excavation having vertical sides the depths of which exceed the width, made for drain, sewer, water, and gas pipes; electric and steam conduits; and the like.

C. Hazardous Waste:

1. The Contractor shall be familiar with the State Department of Environmental Protection (DEP) Hazardous Waste Regulations 310 CMR 30.00 and the Massachusetts Contingency Plan (MCP) 310 CMP 40.00 when conducting earthwork operations.
2. In general, a hazardous waste (contaminated with oil or hazardous materials) is a waste or combination of wastes which, because of its quantity, concentration or physical, chemical or infectious characteristics, may cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible or incapacitating reversible illness or pose a substantial present or potential hazard to human health, safety, or welfare, or to the environment when improperly stored, treated, transported, or disposed of, or otherwise managed. (Additional criteria and characteristics to determine if a waste is hazardous are contained in 310 CMR 30.111, 30.112 and 30.120 through 30.125).

1.4 LAWS AND REGULATIONS:

A. Work shall be accomplished in accordance with regulations of local, county and state agencies and national or utility company standards as they apply.

1.5 QUALITY ASSURANCE:

A. The Owner may retain and pay for the services of a Geotechnical Consultant to perform on-site observation and testing during the different phases of the construction operations. The scope of services will be determined by the Owner and the Geotechnical Consultant. The Owner reserves the right to modify or waive Geotechnical Consultant services.

B. The Geotechnical Consultant's presence does not include supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Geotechnical Consultant, nor any observations and testing performed by him, nor any notice of failure to

give notice shall excuse the Contractor from defects discovered in his work.

C. Costs related to retesting due to failures shall be paid for by the Contractor at no additional expense to the Owner, and the costs thereof will be deducted by the Owner from the Contract Sum.

1.6 COORDINATION:

A. Prior to start of earthwork the Contractor shall arrange an on-site meeting with the Engineer and Geotechnical Consultant for the purpose of establishing the Contractor's schedule of operations and scheduling observation and testing procedures and requirements.

B. As construction proceeds, the Contractor shall be responsible for notifying the Engineer prior to the start of earthwork operations requiring observation and/or testing.

1.7 SUBSURFACE SOIL DATA:

A. Review logs of borings, jar soil samples, records of explorations and other pertinent data for the site. After obtaining Owner's permission, take whatever additional subsurface explorations deemed necessary at no expense to the Owner.

B. Boring logs are appended to these specifications. Jar soil samples may be examined upon written request to the Engineer.

C. A geotechnical engineering report has been prepared by GEI Consultants, Inc. This report is specifically not part of the bid documents, but is available to bidders for informational purposes for use in preparing their bids.

D. The above data is for general information and are accurate only at the particular locations and times the subsurface explorations were made. It is the Contractor's responsibility to make interpretations and to draw conclusions based on the character of materials to be encountered and the impact of his work based on his expert knowledge of the area and of earthwork techniques.

E. The Drawings showing existing ground elevations are only for whatever use the Site Work Contractor may make of them with no responsibility on the part of the Surveyors, the Owner, or their Representatives for the accuracy and/or the reliability of the information given.

1.8 TOLERANCES:

A. Construct finished non-paved surfaces to plus or minus 1 inch of the elevations indicated. Complete embankment slopes to plus or minus six inches of the slope line (toe or tip) shown. Maintain the moisture content of fill materials as it is being placed within plus or minus two percent of the optimum moisture content of the material as determined by the laboratory tests herein specified

1.9 APPROVALS:

A. No earthwork materials will be accepted on the jobsite without written approval from the Engineer.

PART 2 – PRODUCTS

Not Used

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS:

A. The Contractor shall control the grading so that ground is pitched to prevent water from running to excavated areas, eroding slopes, damaging other structures, or adjacent properties.

B. Perform dewatering operations to maintain excavated subgrades in a dry condition.

C. Control dust during the course of the contract.

D. Construction Traffic: Disperse travel paths of traffic and construction equipment over entire width of compacted surfaces to aid in obtaining uniform compaction. Protect exposed soil layers with high moisture content from excessive wheel loads.

E. Use of Materials Found on Site:

1. Suitable excavated materials shall be used for embankment, backfill, or any other purpose as directed and the material shall be placed and compacted in a manner conforming to the specifications for the particular type of work required at no additional cost to the Owner.
2. Suitable material that cannot be readily placed shall be stockpiled in an area designated by the Engineer and used in the manner and purpose described above. All work necessary to stockpile and re-handle suitable material will be at no additional cost to the Owner and will be included in the Contract unit price for the particular excavation it was obtained from. If the Contractor desires to store suitable material off the jobsite, or

remove suitable material from the jobsite, written permission shall be obtained from the Engineer.

3. All unsuitable material and suitable material not required for the proper completion of the Contract will become the property of the Contractor and shall be removed and disposed of away from the job site at no additional cost to the Owner.
4. Do not excavate or remove any material from within the site which is not within the excavation, as indicated, without written authorization from the Engineer.

F. Salvaging Topsoil: Salvage topsoil within the neat lines as indicated, or as otherwise designated by the Engineer, and stockpile at the jobsite at locations approved by the Engineer. Prevent topsoil from contamination by other materials, and provide adequate drainage and erosion protection. Clear, grub, and rough-grade storage areas so that the maximum amount of stockpiled material will be available for reuse.

G. Stockpiling of Excavated Material: Establish excavated material stockpiles on site only in locations where they will not interfere with the progress of the work and only as approved by the Engineer. Offsite stockpiling and rehandling, if required, shall be the responsibility of the Contractor, at no additional expense to the Owner. Such offsite stockpiling shall require written permission from the Engineer.

H. Disposal of Surplus and Unsuitable Material: Haul from site and dispose of excavated materials which are excess or are determined to be unsuitable for embankment and backfill, at no additional expense to the Owner. When approved by the Engineer, such material may be disposed of at designated locations within the site.

I. Unfavorable Weather: Do not place, spread, roll or compact fill material that is frozen or thawing, or during unfavorable weather conditions. If interrupted by heavy rain or other unfavorable conditions, do not resume until ascertaining that the moisture content and density of the previously placed soil are as specified.

J. Maintenance of Excavation, Slopes and Embankments:

1. Excavate and remove material outside the limits of excavation which in the opinion of the Engineer, is unsuitable and constitutes potential slides, and material which comes into excavations for any reason including the driving of piles therein.
2. Maintain slopes and embankments until final completion and acceptance of the work. Promptly repair slides, slipouts, washouts, settlements, and subsidence which occur for any reason, and refinish the slope or embankment to the original lines and grades or as required by the Engineer.
3. Provide earth retention systems as required by federal, state and local regulations. Shoring and bracing of trenches and other excavations shall be in accordance with the latest OSHA Standards and Interpretation, Subpart P – Trenches and Shoring, and to all other applicable codes, rules and regulations of the federal, state and local authorities.

K. Hazardous Material:

1. The Contractor shall immediately halt soil movement activities and notify the Owner if visual, olfactory or other evidence suggests that soils are contaminated with oil or hazardous materials. Proper assessment activities shall follow.
2. The Contractor shall contact an environmental professional (such as a Licensed Site Professional) to test any earth materials suspected of containing hazardous waste. The results shall be evaluated by the environmental professional and compared with reporting thresholds found in the Massachusetts Contingency Plan (MCP) 310 CMR 40.0000. The Contractor shall inform the Owner/Operator of the laboratory test results as soon as possible and discuss the possible soil management / disposal / recycling options available. If present, contaminated soils shall be managed and handled in compliance with the referenced state / federal regulations, guidelines and policies. Time and expenses associated with contaminated soils, if any, shall be negotiated with the Owner prior to the start of the soil management / disposal / recycling work.
3. There is a possibility of encountering oil or hazardous materials on this site. Appropriate testing, as recommended by an environmental professional, shall be accomplished to assess the potential presence of oil or hazardous material. Earth material shall not be removed from the site unless on-site reuse is not possible.
4. Proper documentation of legal disposal shall be provided by the Contractor. Additional guidance for possible disposal activities can be found in the Department of Environmental Protection's Policy #COMM-97-001, Reuse and Disposal of Contaminated Soil at Massachusetts Landfills.

3.2 OBSTRUCTIONS NOT INDICATED AND NOT VISIBLE:

A. All available information was used to establish the location of pipes, drains, structures, and utilities, as shown on the Drawings. However, accuracy and completeness of such drawings cannot be guaranteed. Therefore, if the Contractor encounters such items within the indicated limits of excavation which will be damaged if work is to continue or which will cause delays, notify the Engineer immediately so the obstruction can be addressed and documented for payment, as authorized by the Owner.

3.3 TEST PITS:

A. Test pits may be ordered by the Engineer during the course of contracted work, to locate existing pipes, drains, structures, or utilities. The Contractor shall perform the test pit operations.

3.4 ROCK EXCAVATION:

A. Cross Sectioning: When rock is encountered during excavation, it shall be uncovered and exposed, and the Engineer shall be notified in writing by the Contractor before blasting work proceeds. The areas in question shall then be measured, and payment shall be determined. Excavation of material in question before agreement by the Engineer as to the character of the material, or failure to notify the Engineer or to take measurements will forfeit the Contractor's

right to payment for rock excavation. The quantity of rock to be removed shall be based on the limits established below. Measurements shall be made by a Registered Surveyor, paid for by the Contractor, and approved by the Engineer.

B. Measurement: Excavation of rock if ordered in writing by the Engineer with the prior written approval of the Owner, measured in place within the Contract limits as defined on the Plans or in any duly authorized modifications thereto. Measurement for rock excavation will be made for:

1. Foundations within the limits of the concrete lines as defined by the working plans or by duly authorized modifications thereto, plus twelve inches (12") outside the vertical concrete lines and twelve inches (12") below base.
2. Pipe trenches to a depth of six inches (6") below the bottom of the bell and for a width equal to the inside diameter of the pipe, plus fifteen inches (15") beyond the inside diameter on each side, provided that overlapping computed volumes of any ledge or boulder excavation shall be paid for only once.
3. Paved areas to the underside of the respective subbase for such areas.
4. Lawns and planting areas to a depth of twenty-four (24") below finished grade.
5. Any foreseen rock or boulder encountered, which must be removed for construction of the work defined on the plans or in modification thereto, shall be measured in its original position to the limits of clearly defined vertical construction lines and to the depth required for the defined construction; payment will be at the unit prices stated above.

C. Blasting:

1. The Driller and Geotechnical Engineer shall log the bottom elevation of all drill holes made for blasting within the building area.
2. No blasting shall be done without the Engineer's approval. Written permission and approval of methods must be obtained from the local government authority.
3. Contractor shall, before doing any blasting work, present to the Engineer written certificate of insurance showing evidence that his insurance includes coverage for blasting operations.
4. Experienced powerment or persons who are licensed or otherwise authorized to use explosives shall do blasting. Accurate records shall be maintained, noting location of each blast, time of detonation, total explosive weight in each blast, maximum explosive weight per delay in each blast hole, and designation of delay cap used in each hole.
5. Explosives shall be stored, handled, and employed in accordance with state and local regulations, or, in the absence of such, in accordance with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. and in accordance with applicable OSHA regulations.
6. The amount of vibration and airblast overpressure generated by blasting shall not exceed regulatory statutes or directives established by state, local or other governing authorities, such as but not limited to, 527 CMR 13.091. In no case shall the maximum Peak Particle Velocity (PPV) exceed the limits indicated on figure B-1, Appendix B, of the United States Bureau of Mines Report of Investigations, RI8507, 1980 (copy attached). These limits shall apply at all existing and under construction structures, utilities as well as at property and construction limits. (The Engineer may designate lower levels at sensitive structures.)

7. Contractor shall take great care to do no damage to existing buildings, foundations, glazing and trees to remain. All damage caused by Contractor's blasting operations shall be repaired to the full satisfaction of the Engineer at no additional cost to the Owner.

3.5 UNACCEPTABLE SUBGRADE:

A. If unacceptable material is encountered below or at the subgrade which excavation was indicated to be taken to, remove such materials and dispose of it as specified herein. After removal of unsuitable materials, backfill with crushed stone or gravel borrow, and compact to specified density requirements. Limits of removal shall be as directed by the Engineer. For such work not caused by the Contractor's operations or lack of surface drainage control, the Contractor shall be paid as Extra Work, as approved by the Owner.

B. Where subgrade has been softened or eroded by flooding, equipment traffic or placement during unfavorable weather, it shall be considered "unacceptable material" and handled in accordance with paragraph A above, at no additional cost to the Owner.

3.6 SUBGRADE PREPARATION AND PROTECTION:

A. General Requirements: All subgrade areas shall be made ready for fill by removal of all organic material, topsoil, loose fill, unsuitable soils and deleterious materials, as directed by the Engineer.

B. Proof Rolling Subgrades: Prior to placement of fill, proof roll natural ground above groundwater levels by making a minimum of two passes with approved compaction equipment.

C. Deep Compaction (In areas of loose fill where applicable)

D. Rock Subgrades:
   1. Subgrades outside building area may have a maximum 2-foot zone of overblast rock provided that:
      a. Loose rock is covered with suitable layer of crushed stone or choke stone; and
      b. Prior to placing crushed stone or choke stone, the area is rolled with at least four passes of a heavy vibratory roller.
   2. Bottom of rock excavations for support of foundations shall be cleaned of all loose materials.
   3. Rock surface for footings shall have a maximum slope of 4 horizontal to 1 vertical.
   4. Rock excavations for footings carried below design grades shall be backfilled by placement of concrete with same strength as footing at the Contractor's cost. At the discretion of the structural engineer, footings could be dropped below design elevation

onto competent rock.

3.7 PLACEMENT AND COMPACTION OF MATERIALS:

A. General Requirements:

1. The soils testing laboratory will determine the optimum moisture content to achieve the maximum dry density for all soils specified or indicated to be compacted to a percentage of its maximum dry density.
2. Unless other material is indicated or specified, place excavated acceptable material for backfilling trenches and around structures and filling for embankments. The composition of these materials and tests performed to determine moisture-density relationships will govern both their acceptability for backfill and method best suited for their placement and compaction. If sufficient excavated acceptable material is not available from the excavations, provide backfill material of ordinary borrow, or as otherwise directed by the Engineer.
3. Provide adequate pumping and drainage facilities to keep the excavation area dry from groundwater and/or surface runoff so that it does not adversely affect construction procedures or cause excessive disturbance of underlying natural ground.
4. Compaction by puddling or jetting is prohibited.
5. Protect fill area by grading to drain and providing a smooth surface, which will readily shed water. Grade the surface of the areas in such a manner as to prevent ponding of surface runoff water in areas to receive compacted fill.
6. Do not place frozen fill. Do not place fill on frozen ground.
7. Placement of fill shall not begin prior to observation and approval of subgrade conditions by Engineer.
8. To the extent that is practicable, each layer of fill shall be compacted to the specified density the same day it is placed. Fill shall be placed in horizontal layers. Where the horizontal layer meets a natural rising slope, the layer shall be keyed into the slope by cutting a bench during spreading of preceding lift.
9. Prior to backfilling between foundation wall and excavation limits, remove unsuitable material, including rubbish, organic materials or other debris.
10. Do not commence filling operations until Engineer and/or Architect have observed conditions.
11. Protect foundations, footings, foundation waterproofing, and site utilities during backfilling. Repair damage at no cost to Owner.
12. Backfill shall not be placed against masonry, concrete or walls until they are braced or have cured sufficiently to develop strength necessary to withstand, without damage, pressure from backfilling and compacting operations.
13. Provide shoring, sheeting, and/or bracing of excavations as required to assure complete safety against collapse of the earth at the side of excavations. Alternatively, lay back excavations to a stable slope.
14. Upon completion of the work, the final ground surface shall be left in a firm, unyielding, true, uniform condition, free from ruts. Repair disturbed areas caused by equipment traffic at no cost to Owner.

B. Equipment:

1. Compaction equipment used in open areas where space permits shall consist of vibratory rollers weighing at least 10,000 pounds.
2. Compaction equipment for fill against foundation walls and in other confined areas shall be accomplished by means of drum-type, power-driven, or by hand-guided vibratory plate compactors.

C. Compaction:

1. Compaction Requirements:

The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Method C. The compaction requirements are as follows:

Area of Compaction	Minimum Degree
Below footings	95%
Below slabs	95%
Pavement base and subbase courses	95%
Detention basin berms	95%
General fill below pavement subbase	90%
Trench backfill (inside bldg.)	95%
Trench backfill (outside bldg.):	
- Below pipe to spring line	95%
- Spring line to 1 ft. above pipe	90%
- 1 ft. above pipe to pavement subbase or finish grade	93%

Landscape areas	90%

Compactions percentages are based on the laboratory derived Maximum Density values.

2. Moisture Control:
   a. Discontinue backfilling and compaction from November to April (wet season) unless the Contractor demonstrates successful moisture and compaction control techniques to achieve the indicated or specified density requirements.
   b. Fill material that is too wet for proper compaction shall be harrowed, or otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill at his expense.
   b. Fill material that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be applied until the optimum moisture content is reached, as determined by the soil testing laboratory.
   c. In no case shall fill be placed over material that is frozen. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.
   d. The Contractor shall continue to compact until the indicated or specified density requirements are achieved.
3. Placement and Lift Thickness of Material:
   a. Distribute material such that stones and lumps do not become nested, causing voids between stones. Distribute such that voids are completely filled with fine materials regardless of compaction method.
   b. Deposit and spread material in uniform parallel layers not to exceed 12 inches (12") in thickness when utilizing heavy compaction equipment, and 6 inches (6") when utilizing light hand-operated compaction equipment.

3.8 DISPOSAL OF SURPLUS, UNACCEPTABLE OR HAZARDOUS MATERIAL:

A. No excavated material shall be removed from the site or disposed of by the Contractor unless approved by the Engineer.

B. Surplus excavated acceptable materials shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill or as otherwise directed by the

Engineer. Upon written approval of the Engineer, surplus excavated materials shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes as indicated by the Owner, within its jurisdictional limits; all at no additional cost to the Owner.

C. Surplus excavated material not needed as specified above shall be hauled away and disposed of by the Contractor at no additional cost to the Owner, at appropriate locations, and in accordance with arrangements made by him.

D. Disposal of all unacceptable, surplus, and hazardous materials shall be in accordance with all applicable local, state and federal regulations.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 – GENERAL

1.01 GENERAL

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. This Section specifies requirements for temporary erosion and sedimentation control provisions.

B. The work includes:

1. Providing all temporary erosion control measures shown on the Drawings and required by the Owners Representative during the life of the Contract to control soil erosion and water pollution.

2. The installation and maintenance of coir logs, erosion control barriers, berms, ditches, sedimentation basins, construction exits, fiber mats, erosion control blankets, catchbasin filters, siltation control fencing, straw, netting, gravel, trenches, mulches, grasses, slope drains and other approved erosion control devices or methods.

1.03 RELATED SECTIONS

A. Sections which directly relate to the work of this Section include:

1. Article 36 - Site Preparation and Demolition

2. Section 310000 - Earthwork

3. Section 329219 - Loaming and Seeding, for installation of erosion control mat (jute netting).

4. Section 329000 - Planting

1.04 SUBMITTALS

A. Prior to the start of the construction, the Contractor shall submit to the Owners representative for acceptance, schedules for the construction of required stormwater detention basins, temporary and permanent erosion and sediment controls, clearing and grubbing, grading, structures at watercourses, construction, and paving. No work shall be started until control schedules and methods of operations have been accepted by the Owners Representative.

B. Submit product data for siltation fencing and erosion control blanket.

1.05 REFERENCES

A. Massachusetts Highway Department (MHD), Standard Specification for Highways and Bridges, latest edition, hereinafter referred to as MHDSSHB.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Coir logs,

B. Quick growing grasses, such as wheat, rye or oats, shall be in accordance with MHDSSHB Section M6.03.1 Erosion Seed.

C. Filter fabric at construction entrance shall be a woven polypropylene geotextile used for soil separation and road grade stabilization and meeting the following criteria:

Grab Tensile Strength	ASTM D 4632	1.40
Grab Tensile Elongation	ASTM D 4632	15/10
Trapezoid Tear Strength	ASTM D 4533	0.53
Mullen Burst Strength	ASTM D 3786	4134
Puncture Strength	ASTM D 4833	0.53
UV Resistant after 500 hours	ASTM D 4355	70
Apparent Opening Size	ASTM D 4751	0.425
Permittivity	ASTM D 4491	0.05

D. Catch Basin Filters – see Section 024100.

E. Erosion Control Netting - Jute Mat - Use jute mat made of unbleached, undyed, and loosely-twisted yarn. The unit yarn weight shall be from 0.90 to 1.50 lb/yd² (488 to 814 g/m²). A 48 in (1.2 m) width shall show between 76 and 80 warpings, and a 36 in (900 mm) length shall show between 39 and 43 weftings. Furnish woven mesh strips of at least 45 in (1.1 m). Anchoring Staples shall be cold-drawn wire 14 gauge or wider in diameter, formed into a U shape from a wire 12 in or longer.

PART 3 - EXECUTION

3.01 EROSION CONTROL - GENERAL

A. Erosion and sediment controls shall be in placed prior to any soil disturbing activities including, but not limited to, clearing and grubbing, earthwork, dewatering, and excavation work.

B. All disturbed soils shall be stabilized, either permanently or temporarily, within two (2) weeks of disturbance.

C. At a minimum, the following shall apply:

1. Brush and stumps shall not be removed until one (1) week prior to the start of pipe laying in that area or as directed by the Owners Representative.

   The existing ground surface shall be disturbed as little as possible until no more than one (1) week prior to the start of pipe laying.

2. Drainage leaving the site shall flow to water courses in such a manner as to prevent erosion.

3. Loaming and seeding or mulching shall take place as soon after backfilling of laid pipe as practicable. This shall be considered part of the pipe work, and full payment for the pipe work need not be made until it has been completed.

D. Measures for control of erosion must be adequate to assure that turbidity in the receiving water will not be increased more than ten (10) standard turbidity units (s.t.u.), or as otherwise required by the State or other controlling body, in waters used for public water supply or fish unless limits have been established for the particular water. In surface water used for other purposes, the turbidity must not exceed twenty-five (25) s.t.u. unless otherwise permitted.

E. When excavating in wetlands or river floodplain, where no temporary diversion structure is required, the excavated material shall be placed within the limits of the construction easement shown on the construction drawings.

F. Failure by the Contractor to control erosion, pollution, and siltation shall be cause for the Owner to employ outside assistance to provide the necessary corrective measures. The cost of such assistance, including review Engineer costs, will be charged to the Contractor and appropriate deductions made to the Contractor's monthly progress payment request.

G. When it becomes necessary, the review Engineer engaged by the Owner will inform the Contractor of construction procedures and operations that jeopardize erosion control provisions. If these construction procedures and operations are not corrected promptly, the Engineer may suspend the performance of any or all construction until corrections have been made, and such suspension shall not be the basis of any claim by the Contractor for additional compensation from the Owner nor for an extension of time to complete the Work.

H. The r e v i e w Engineer has the authority to order immediate, additional, temporary control measures to prevent contamination of adjacent streams or other watercourses, or other areas of water impoundment and damage by erosion.

I. The Contractor shall remove sediment from erosion control facilities as required, and as directed by the Engineer. The Contractor shall modify and improve erosion control facilities and replace deteriorated hay bales and other devices as required, and as directed by the Engineer.

J. The Contractor shall construct all permanent erosion and sediment control features at the earliest practical time as outlined in the accepted schedule. Temporary erosion and sediment control measures shall be used to correct conditions that develop during construction which were unforeseen, but are needed prior to installation of permanent control features, or that are needed temporarily to control erosion or sedimentation which develops during construction operations.

K. Where erosion is likely to be a problem, clearing and grubbing operations shall be scheduled and performed so that grading operations and permanent erosion and sediment control features can follow immediately thereafter, if conditions permit; otherwise, temporary control measures will be required between successive construction stages.

L. Temporary and permanent erosion and sedimentation control measures are shown on the Drawings. The Contractor shall strictly adhere to the provisions. Additionally, temporary measures shall be constructed to accommodate field conditions that develop during construction.

3.02 MAINTENANCE AND CLEAN UP

A. The Contractor shall inspect erosion control devices immediately after each storm event and at least daily during prolonged rainfall and maintain them in good operating condition for the life of the contract. Hay bales shall be replaced when deteriorated, and as directed by the Owners Representative.

B. The Contractor shall inspect the condition of diversion dikes and ditches, filter berms, interceptor dikes, sediment basins and other erosion and sedimentation control devices after each rainstorm and during major storm events. Repairs shall be made as necessary and as directed by the Owners Representative.

C. Accumulated sediment trapped by erosion and sedimentation control devices shall be removed as required, and as directed by the Owners Representative.

D. During construction, temporary outlets of the drainage systems shall direct the flow to temporary or permanent sedimentation basins.

E. Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when directed by the Owners Representative. Upon removal of the temporary controls, the site shall be restored to original condition in accordance with Section 329219 - Loaming and Seeding.

END OF SECTION

SECTION 321313
CONCRETE PAVING

PART 1 - GENERAL

1.01 GENERAL

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include but is not limited to the following:

1. Concrete Sidewalk

2. Haunched Concrete Sidewalk

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 310000 “Earthwork” for preparation of the sub base.

B. Article 38“Cast-in-place Concrete” for related specifications.

1.04 SUBMITTALS

A. Provide samples, manufacturer’s product data, test reports, and material certifications as specified Article 38 “Cast-in-place Concrete”.

B. Provide “Material Certificates” signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

1.05 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with applicable provisions and recommendations of the following:

1. Standard Specifications and Details: City of Worcester, Department of Public Works and Parks Engineering Division.

2. Standard Specification: Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications latest edition.

3. AASHTO: American Association of State Highway and Transportation Officials, latest edition.

4. ASTM: American Society for Testing and Materials, latest edition.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Comply with the requirements of the applicable Section 033000 "Cast-in-Place Concrete" for concrete materials, admixtures, bonding materials, curing materials, and other specified items.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Bars: Deformed epoxy coated steel bars, ASTM A 615, Grade 60. B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185.

1. 6'' x 6'' x 10/10 W.W.M. in flat sheets only, no rolls will be allowed.

C. Bar supports, metal accessories and other devices necessary for proper assembly of concrete reinforcing shall be of standardized factory-made wire bar supports. Wire for tieing shall be 18-gauge black annealed wire conforming to ASTM Specification A-82.

2.03 EXPANSION JOINT MATERIALS

A. Compressible filler: Provide asphalt impregnated preformed expansion joint filler which shall be non-extruding, resilient and shall conform to AASHTO M213 requirements for premolded rigid cane fiber board impregnated throughout with asphaltic compound.

1. The Contractor shall provide certificate that the asphalt cement content is at least 35% by weight of the filler.

2. All expansion joints shall be a minimum of 1/2" thick and full depth of slab thickness.

B. Joint sealer: For use at expansion joints shall meet Federal Specification TT-S-00230C, Type II, Class A, and shall be a sealing compound, synthetic, rubber case, single component, chemically curing material.

2.04 FORM MATERIALS

A. The contractor shall utilize 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.

1. Use straight forms, free of distortion and defects.

2. Use flexible spring steel forms or laminated boards to form radius bends as required.

B. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

2.05 ADMIXTURES

A. Liquid-Membrane forming and Sealing Curing Compound: Comply with ASTM C 309, Type I, Class A unless other type acceptable to the Engineer.

2.06 CONCRETE MIX, DESIGN, AND TESTING

A. Comply with requirements of applicable Division 3 Section 03300 “Cast-in-Place Concrete” for concrete mix design, sampling and testing, and quality control and as herein specified.

1. Obtain strength of 4,000 psi at twenty-eight (28) days.

2.07 DETECTABLE WARNING PANELS

A. Warning panels shall comply to City of Worcester standards.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. Remove loose material from compacted sub-base surface immediately before placing concrete.

B. Proof-roll prepared sub-base surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3.02 FORM CONSTRUCTION

A. Set forms to required grades and lines braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least twenty- four (24) hours after concrete placement.

B. Check completed formwork for grade and alignment to following tolerances:

1. Top of forms not more than 1/8 inch in ten (10) feet.

2. Vertical face on longitudinal axis, not more than 1/4 inch in ten (10) feet.

C. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

3.03 REINFORMCEMENT

A. Locate, place and support reinforcement as specified in the applicable Division 3 Section “Cast-in- Place” Concrete and as indicated within the drawings.

B. Provide number four (4) rebar perpendicular to support bars two (2) inches from expansion joint

or slab edge at each end.

C. Keep welded wire fabric clean and free from rust. Place individual sheet or strips flat and free from distortion. Remove bends or kinks in individual wires before the sheet is laid in the pavement.

D. Place welded wire fabric in sheets or strips at depth shown. Lap sheet six (6) inches and tie firmly together by wire or clips spaced not more than four (4) feet apart.E. Provide sand plates at twenty-four (24) inches on-center to support welded wire mesh. Locate one (1) bar two (2) inches from expansion joint or slab edge at each end.

3.04 EXPANSION JOINTS

A. General: Construct expansion joints true to line with face perpendicular to surface of concrete. If joints are not installed and constructed as indicated within the drawings and specified herein the Engineer shall instruct the Contractor to remove and dispose those areas identified as non-compliant. The Contractor shall repair, replace or install new concrete in those areas identified at no additional cost to the owner.

B. Verify location of expansion joints as indicated within the drawings and their relationship to other work.

C. Where expansion joints are not shown, the Contractor shall provide expansion joints a minimum twenty (20) feet on center in any direction and where concrete abuts all vertical surfaces and/or fixed construction including but not limited to; buildings, structures, walls, stairs, light poles and curbs.

D. Provide premolded joint filler for expansion joints abutting curbs, catch basins, manholes, inlets, structures, walks, and all other fixed objects, unless otherwise indicated.

1. Deliver materials in manufacturer's original containers, clearly labeled with manufacturer's name and address and product identification.

2. Store materials in original containers protected from direct contact with the ground and from the elements.

3. Store materials above ground on framework or blocking and cover with protective waterproofing covering. Provide for adequate air circulation throughout material stacks.

4. Extend joint fillers full width and depth of joint, top of joint filler flush with finished concrete surface.

5. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one (1) length is required, lace or clip joint filler sections together.

6. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

3.05 CONTRACTION AND CONSTRUCTION JOINTS

A. General: Construct contraction and construction joints true to line with face perpendicular to surface of concrete. If joints are not installed and constructed as indicated within the drawings

and specified herein the Engineer shall instruct the Contractor to remove and dispose those areas identified as non-compliant. The Contractor shall repair, replace or install new concrete in those areas identified at no additional cost to the owner.

B. Contraction Joints: Provide contraction joints, sectioning concrete into areas as shown on drawings to a depth equal to at least 1/3 concrete thickness and as follows:

1. Form joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a joiner.

C. Construction Joints: Place construction joints at end of placements and at expansion joints.

3.06 CONCRETE PLACEMENT

A. General: Comply with the applicable requirements of Division 3 Section “Cast-in-Place Concrete” for mixing and placing concrete, and as herein specified.

B. Do not place concrete until sub-base and forms have been checked for line and grade. Moisten sub-base if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with 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 dislocation of reinforcing, dowels, and joint devices.

D. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than hour, place a construction joint.

E. Do not place concrete on a soft, muddy or frozen base course. Do not permit workmen to walk in the concrete with boots or shoes covered with earth or other foreign substances.

F. Place lower layer of concrete followed promptly by the welded wire fabric and then place the upper layer of concrete. Remove any portions of the bottom layer of concrete which have been placed more than fifteen (15) minutes without being covered with top layer and replace with freshly mixed concrete.

G. Consolidate concrete thoroughly by tamping, spading and vibrating to eliminate honeycombing and voids. Space carefully to avoid dislocation of reinforcing materials, dowels and joints installing devices.

3.07 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to produce uniform texture.

B. After floating, test surface for trueness with a ten (10) foot straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs and formed joints with an edging tool, and round to one half-inch radius or as indicated within the drawings.

1. Eliminate tool marks on concrete surface.

D. After completion of floating and when excess moisture or surface sheen has disappeared, complete trowelling, complete contraction joints/scoring pattern indicated in drawings, and finish surface as follows:

1. Broom finish by drawing a broom across concrete surface perpendicular to line of traffic.

a. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.

E. Do not remove forms for twenty-four (24) hours after concrete has been placed. After form removal, clean ends of joints and joint-up any minor honeycombed areas.

1. Remove and replace areas of sections with major defects, as directed by the Engineer.

3.08 CURING

A. Protect and cure finished concrete paving in compliance with applicable requirements of Division 3 Section 033000 “Cast-in-place Concrete”. Use membrane-forming curing and sealing compound or approved moist-curing methods.

3.09 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, as directed by the Engineer.

B. Drill test cores where directed by the Engineer 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 until acceptance of work. Exclude traffic from pavement for at least fourteen (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. Sweep concrete pavement and wash free of stains, discoloration, dirt, and other foreign material one (1) week prior to substantial completion.

END OF SECTION

SECTION 321600
CURBING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 WORK INCLUDED

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work on this section as indicated in the drawings and specified herein, which shall include, but is not limited to, fabricating, furnishing, and installing the following:

1. Vertical Granite Curbing
2. Sloped Granite Curb with Cobbles; to be a mountable curbing
4. Cast-in-place Concrete Curbing at the Playground

1.03 RELATED SECTIONS

A. Section 024100 – SITE PREPARATION AND DEMOLITION
B. Section 310000 – EARTHWORK
C. Section 321313 – CONCRETE PAVING
D. Section 323119 – ORNAMENTAL FENCE & GATES
E. Article 38 – CAST-IN-PLACE CONCRETE

1.04 REFERENCES

A. Except as modified by governing codes and by the Contract Documents and Drawings, comply with applicable provisions and recommendations of the Standard Specifications and Details of City of Worcester, Department of Public Works and Parks.

B. The Drawings depict the locations, general arrangement, sizes and materials for curbing, and are not intended to show every dimension, radius, or fit with adjoining materials, or every structural difficulty that may be encountered; none- the-less, curbing shall be installed to suit and best achieve the layout shown in the drawings. All measurements shall be verified at the project site.

C. Unless indicated otherwise, comply with applicable requirements of the following standards and those referenced in the Specifications, including:

1. Commonwealth of Massachusetts Highway Department (MHD): Standard Specifications for Highway and Bridges, and the Standard Specifications Section 500, “Curb and Edging”.

1.05 SUBMITTALS

A. Shop Drawings, as further refinement of the drawings, Contractor shall:

1. Submit complete shop drawings of each pre-fabricated curb type, with scaled depiction of lengths, shapes, dimensions, and finishes for approval by Owners Representative, prior to ordering the fabrication of curbing from manufacturer.
   a. Details shall include base gravel and concrete pad necessary for Granite Curb with Cobbles to be a mountable curb, able to support emergency vehicles.
2. Submit complete shop drawings for each segment and type of on-site fabrication of curbing, with scaled depiction of lengths, shapes, dimensions, and finishes for approval by Owners Representative, prior to commencing the erection of formwork.
   a. Submit layout plan for ornamental fence post foundation locations at Playground based on surveyed field measurements, showing segments of concrete curbing to be installed between fence post foundations. Include details for juncture between concrete fence post foundations and concrete curbing.
   b. Submit detail or show method for anchoring Playground ornamental fence posts into cast-in-place concrete footing.
   c. Contractor shall coordinate layout of fence post foundations and curbing with location and alignment of fencing as dimensioned in the approved fence shop drawings. For ornamental fence specifications, see Section 323119.

B. Samples and sample panel; Contractor shall provide:

1. Three (3) representative samples of the granite cobbles to be utilized in construction of the Granite Curb with Cobbles, for approval by Owners Representative prior to ordering cobbles or constructing the sample panel.
2. One sample panel of the sloped granite curb with cobbles, at least 5 feet long, for approval by Owners Representative prior to ordering balance of cobbles.

1.06 PROTECTION OF SUBSURFACE UTILITIES

A. The Contractor shall recognize that within the central portion of the project site, over-which the Playground is to be built, running roughly north-to-south there exist a large subsurface drainage line and a sewer main, and running east-to-west there exist a number of water lines. Contractor shall take the necessary precautions and care in installing foundations for Park structures, fencing, and improvements adjacent to these subsurface utilities.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Curb units shall be delivered to the job adequately protected from damage during transit.

B. Curb shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained segments will be rejected and shall not be employed in the work or accepted by the Owner.

PART 2 - PRODUCTS

2.01 GRANITE CURB

A. Granite for vertical curb, radius curb, corners, curb inlet and transition curb shall be engineering grade structural granite conforming to ASTM C615 requirements. Sizing of curb and comers shall be as shown on the Drawings. Granite curb shall be Type V A4 as per the "Standard Specification."

B. Granite shall be of smooth splitting character and free from seams which impair its structural integrity. Natural variations characteristic of the deposit will be permitted. Granite shall come from an approved quarry.

C. Cement mortar shall meet requirements of Section M4, Paragraph M4.02.15 of the Standard Specifications. Color shall be “natural” to match color of curb.

D. Concrete shall be 4,000 psi concrete as specified under Section 033000 CONCRETE, herein.

E. Processed gravel borrow as specified under Article 39 of the City’s Project Special Conditions and under Section 310000 Earthwork.

2.03 CAST IN PLACE CONCRETE CURBING AT PLAYGROUND

A. Concrete shall be provided and installed in conformance with Article 38, Cast-In-Place Concrete and the drawings.

B. Sleeves, if utilized for anchoring fence posts, are to be as specified in Section 323119, set into the concrete with top flush with top of concrete. Alternatively, fence posts may be installed into foundations by coring. Grey cement or non- shrinking grout shall be used to anchor posts, similar in color to the concrete.

2.04 PRECAST CONCRETE CURB AT PARKING AREA:

A. Precast concrete curbing shall conform to the current edition of the Massachusetts Highway Department Standard Specifications for state Highways and Bridges (MHDSSHB). Precast concrete curbing shall be as specified in Section M4.02.14.

B. All precast curb with radius of 100 foot or less shall be formed to the radius shown on the Drawings.

C. Precast concrete curb units shall be rub finished:
After the concrete has properly hardened, the exposed surfaces shall be rubbed with a #16 carborundum stone or an approved abrasive to fully remove laitence and sand grain finish. No cement shall be used in the rubbing process.

1. The finish of the units shall be uniform and shall conform to those of adjacent work in their final position.

D. Precast concrete curb sections shall be furnished with sockets in each end to receive dowels to maintain the horizontal and vertical alignment of the curb. The dowel socket shall be 11/16 inch by 2-1/2 inches. 5/8 inch by 4 inch dowels shall be provided.

PART 3 - EXECUTION

3.01 LAYOUT AND PROGRESS INSPECTION

A. All layout and staking of alignments and control grades for curbing shall be executed by a registered Professional Engineer or registered Land Surveyor engaged by the Contractor, and shall be in place prior to installation of curbing, available for review and approval by Owners Representative, prior to installation of curbing or formwork.

3.02 GRANITE CURBS

A. Furnish and install new granite curb and reset existing granite curb removed and stockpiled for reuse, herein. Vertical Curb shall be set straight, plumb and as shown on the Drawings. Any new granite curb shall match existing and be approved by Owner's Representative prior to installation.

B. Vertical Curb shall be set in a concrete cradle in a trench excavated to a width of twenty- four inches (24"). The subgrade of the trench shall be at a depth below proposed finish grade of the curb, equal to six inches (6") plus the depth of the curb stone. Base course shall then be filled with processed gravel fill to proper level to support curb at final grade and thoroughly tamped.

C. Sloped Curb with Cobbles shall be set in a concrete cradle and pad in a trench of adequate width to support the curbing, over compacted processed gravel, as depicted in the drawings.

D. Place curb units in accurate line, each piece butting the next with joint spacing no larger than three-eights inch (3/8). Final points shall be joined by closure pieces made to order. No curb shall be cut in the field. After alignment, the curb shall be carefully backfilled as shown on the Drawings. Care shall be taken to not disturb alignment following installation and during subsequent construction. Patch street and sidewalk pavement as required.

3.03 CAST IN PLACE CONCRETE CURBING

A. Contractor shall provide and install Concrete Curbing at Playground and for synthetic turf around tree pits as depicted in the Drawings and as refined by the approved Shop Drawings.

B. Curbing for synthetic turf shall be round and located to slope with the slope of the finish grade.

C. All bumps, lines of excess concrete from form junctures, or sharp edges are to be rubbed smooth by the Contractor.

3.04 QUALITY CONTROL AND ACCEPTANCE

A. Contractor shall replace or repair any defective portion of curbing as required by the

Owners Representative, at no additional cost to Owner.

END OF SECTION

SECTION 321723
PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Provide all labor, equipment, materials, arrangements for traffic details, and perform All operations necessary for removal of existing pavement markings, preparation of the surface for new markings, and construction of new pavement markings.

1.03 RELATED SECTIONS

A. Sections which directly relate to the work of this Section include:

1. Section 321216 – Bituminous Concrete Pavement, for pavement markings and basketball court color system.
2. Section 321600 - Curbing

1.04 SITE CONDITIONS

A. The Contractor shall cordon off areas where markings are being applied but maintain Access for vehicular and pedestrian traffic as required for other construction activities. Flagmen, barricades, drums, warning signs, warning lights and similar devices shall be provided by the Contractor and used as required.

1.05 SUBMITTALS

A. Submit material certificate to the Owners Representative, signed by the material producer and Contractor, certifying that materials comply with these specifications and have been approved for use by the Commonwealth of Massachusetts, Department of Highways and the City of Worcester Department of Public Works and Parks, Traffic Engineering.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Pavement markings shall conform to Section 860 of the current Commonwealth of Massachusetts Department of Highways Standard Specifications for Highways and Bridges and Manual of Uniform Traffic Control Devices, current edition.

B. Traffic and parking area markings shall be white, non-reflectorized traffic paint.

PART 3 - EXECUTION

3.01 PREPARATION

A. The Contractor shall clean the pavement of dust, dirt, old pavement markings, concrete curing compounds and other foreign material which may be detrimental to the adhesion of the marking material.

3.02 PAVEMENT MARKING REMOVAL

A. Existing pavement markings that conflict with the proposed markings, and those shown on the Drawings, shall be removed. Pavement markings shall be removed before any change is made in the traffic pattern. Any excessive damage to the pavement caused by pavement marking removal shall be repaired by the Contractor by methods acceptable to the Owners Representative at no additional cost to the Owner.

B. Approved removal methods include:

1. Sand blasting using air or water.
2. High pressure water.
3. Steam or superheated water.
4. Mechanical devices such as grinders, sanders, scrapers, scarifiers and wire brushers.

C. Painting over a pavement marking line with asphaltic liquids or paints is not permitted, unless approved by the Owners Representative.

D. Material deposited on the pavement from removal operations shall be removed as the work progresses. Accumulations of sand or other material which might interfere with drainage or could constitute a hazard to traffic will not be permitted and shall be removed immediately.

3.03 PAVEMENT MARKING APPLICATION

A. The material shall be applied to the pavement by equipment designed and manufactured specifically for the application of pavement markings.

B. The Contractor shall employ the services of a Registered Land Surveyor to provide control for layout of pavement markings or as approved by the Owners Representative.

C. Paint markings shall be applied at a minimum thickness of 15$\pm$ 1 mil.

D. Pavement markings shall be applied in accordance with the layout shown on the drawings.

E. No paint or markings shall be applied to new bituminous pavement until the top course has cured at least one week, and allow two weeks curing for newly installed bituminous concrete curbing. Bituminous Concrete pavement shall be thoroughly cleaned and vacuumed prior to the application of pavement markings.

F. All parking stalls shall be single stripe and shall be spaced equally. The line indicated on the Drawings is on the center line of the stall marking.

G. Where entire areas are to be cross-hatched, the striping shall conform to the cross hatching shown on the Drawings.

H. All parking stall markings shall be straight with sharp corners and clean edges. Directional arrows, cross hatching, lane divider stripes, stop lines, graphic symbols, and lettering shall be painted white to the size, length, and spacing shown on the Drawings.

I. All markings shall be applied in one coat with brush, spray, or marking machine over dry clean pavement surfaces, when the atmospheric temperature is at or above 40°F and when the weather is otherwise favorable in the opinion of the Owners Representative.

J. Use only skilled workmen who are experienced and normally employed in the work of installing pavement markings. Supply all the necessary equipment and materials required for the work.

K. The Contractor shall protect the buildings, walks, pavement, curbing, trees, shrubs, mulch, and other site fixtures and surfaces from over-spray of paint and damage from marking operations. Contractor shall clean up over-spray as directed by the Owners Representative.

L. Traffic shall not be permitted on the pavement until the paint is thoroughly dry.

END OF SECTION

Section
32 18 23.60
INFIELD MIX

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall furnish and construct infield mix surfaces to the lines and grades shown on the plans as specified in this Section, including the provision of all materials, labor, tools, equipment and transportation necessary to complete the work.

B. In advance of installing the new infield mix surfacing, the Contractor shall be responsible for removal of existing materials and installing a 2-inch sand base as indicated on the details. Excavated materials may be reused as stipulated on the construction drawings and specifications.

1.2 RELATED SECTIONS

A. Section 31 00 00 - Earthwork

1.3 SUBMITTALS

A. Submit the following under provisions of General Conditions

1. Two (2) weeks prior to ordering the material, the Contractor shall submit to the Landscape Architect, at the Contractor's expense, a representative sample of the material to be used, and a copy of a soils analysis from an accredited laboratory classifying the mixture and tabulating the sieve analysis.
2. If the mixture is disapproved by the Landscape Architect, the Contractor shall continue to obtain other sources of material and have them tested, at his own cost, until the Landscape Architect approves the mixture to be utilized for the clay infield mix surface.

1.4 DELIVERY, STORAGE AND HANDLING

A. Do not deliver infield mix to the site, until all specified submittals have been submitted to, and approved by, the Owner and Landscape Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with the requirements specified herein, manufacturers offering similar products include the following, or equal:

1. ACCUSOILS of Hooksett, NH,
2. Read Custom Soils of Canton, MA.
3. Holliston Sand Company of Slatersville, RI.

B. Single Source: All work of this Section shall be produced by a single manufacturer, unless otherwise approved by the Architect.

2.2 MATERIAL

A. The clay infield mixture shall be the "Native Infield Mix-Light Brown Blend". In general, Native Infield Mix-Light Brown Blend is a combination of New England clays and sands.

B. The sieve analysis (% by weight passing) of the material shall be as follows:

Sieve Size	Result
#4	100
#10	98.9
#18	4.5
#35	5.5
#60	8.8
#140	12.3
#270	16.8

C. Hydrometer results shall be as

follows: Silt = 48.7%

Clay = 6.3%

Sand = 45.0%

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Beginning of installation means acceptance of existing project conditions.

3.2 INSTALLATION

A. Install Upon removal of existing surfaces and installation of the required 2-inch bed, the Contractor shall install, roll and compact the infield mix specified to a compacted finished depth of three (3) inches. Complete installation of clay infield surfaces in conformance with the manufacturer's recommendations or as otherwise directed.

B. The edges of the infield mix shall meet the grades of adjacent turf areas and hardscape areas. No ridges or depressions will be permitted at edges.

End of Section

SECTION 323000
MISCELLANEOUS SITE IMPROVEMENTS

PART 1 - GENERAL

1.01 GENERAL

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification, and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include, but is not limited to, the following:

1. Softball field – Backstop, Chain-link fence and gates
2. Softball field – netting system
3. Softball field – Temporary outfield fence
4. Softball field – Foul Pole
5. Softball field – Home plate, Bases with Anchor and Stanchion system (4 sets)
6. Bleachers
7. Player's Bench
8. Dugout shelter
9. Score Board
10. Flagpole
11. Picnic Tables
12. Benches
13. Handrail at stairs
14. Steel Gates
15. Waste Receptacles
16. Handicap Parking space signs
17. Construction Sign (See Special Conditions)
18. Speakers
19. Fence Guard

B. Work shall include the laying out, forming, placing, and all other operations necessary to provide concrete footings, foundations, and pads associated with installing the site improvements required under this section. Perform concrete work in accordance with Section 033000 – Cast-in-Place Concrete.

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 310000 – "Earthwork", for excavation and backfill operations.

B. Article 40 – "Cast-in-place Concrete".

1.04 SUBMITTALS

A. Prepare and submit Shop Drawings and Catalog Cuts of all items listed in Section 1.02 A for approval by the Owners Representative prior to ordering the listed materials.

1. Coordinate shop drawings and product selections, which shall show, required sizes, dimensions, sections, profiles of units, the arrangement of and provision for jointing, anchoring, fastening, and support, and other necessary details for delivery and lifting devices and reception or installation of other work.

2. Show in large-scale details any unique fabrication and setting requirements, and indicate finish surface and color options, or any other material or product attribute seen as necessary or as directed by the Owners Representative.

3. Shop drawings and catalog cut submittals shall indicate specification section and paragraph requiring items submitted.

4. For Site Improvements listed below, also provide two (2) sets of structural calculations signed and sealed by a Professional Engineer:

   a. Score board
   b. Flagpole
   c. Dugout shelter
   d. Backstop and netting system

B. Prepare and submit construction plan and details for Chain Link work including: Chain link backstops, fence and gate layout and details including posts, rails, tension wires, details of extended posts, extension arms, netting system components and other hardware and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

C. Provide complete product literature and color samples for approval by the Owners Representative prior to ordering the below listed materials:

1. Chain link fence and netting system, backstop
2. Outfield fence
2. Dugout shelter, Picnic Tables, Benches and Waste Receptacles
3. Bleachers, Players Benches, Flagpole and scoreboards

D. Submit Samples of the following site improvements for approval by the Owners Representative prior to ordering the below listed materials:

1. Chain Link Mesh
2. Steel Gate framing, 6-inch length samples of Posts, rails, and cross members; and Reflective markings for steel gate
3. Handicap signpost, 6-inch sample of post

E. For Site Improvements that involve galvanized metal components, Contractor shall submit to the Owners Representative a certificate of compliance from the galvanizer with all galvanizing requirements including ASTM number and weight of coatings in ounces per square foot. Certificate of compliance shall also contain the following:

1. Sole Source Responsibility: Include statement that galvanizer accepts sole responsibility for coatings under this Section. Galvanizer who does not accept this responsibility is not

acceptable and will be rejected.

2. Quality Assurance: Include evidence that Galvanizer meets requirements of ANSI Q90.

3. Certification of Compliance with Current Environmental Regulations: Galvanizer shall certify that coatings proposed for use comply with applicable environmental regulations. Contractor and Galvanizer shall be responsible for penalties assessed by governmental or environmental authorities for coatings that do not comply with current environmental regulations. All coatings shall be lead-free.

F. Product warranties – Contractor shall submit product warranties for Scoreboard, flagpole, Dugout Shelter, Picnic Tables, Benches, Bleachers and Players Benches, from the manufacturers of these site improvements.

1.05 QUALITY ASSURANCE

A. Site improvement work shall be assigned to experienced and qualified subcontractors employing experienced workmen who will work under the full-time supervision of a qualified foreman with a minimum of five (5) years of experience on projects comparable to this project. The contractor shall use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the work in this Section. The Contractor shall demonstrate that he has successfully completed work of similar size and scope.

B. Dugout Shelter:

1. These prefabricated structures shall be designed and fabricated at a facility operated and directly supervised by the manufacturer.

2. The Manufacturer shall have at least 5 years of experience in the design and fabrication of pre-engineered steel shelters, have current memberships in the American Institute of Steel Construction and the American Welding Society, and have an on-staff licensed Professional Engineer and full time on-staff quality control manager.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for timing the delivery of site improvement materials so as to minimize on-site storage time prior to installation. Contractor shall take all necessary precautions to protect all items from chipping, cracking, staining, bending, or other damage during the transportation of these materials to the project, and during unloading and storage on the site. Deliver materials in original sealed containers marked with name of manufacturer and identification of contents. All stored materials shall be protected from weather, careless handling, and vandalism.

B. General Contractor, Sub-Contractors, and suppliers are all individually to furnish their own equipment necessary to get workers, material, and equipment from the point of delivery at the project site to the point of use or installation within the project site. All crane and rigging services required are the responsibility of each individual contractor or trade.

C. Damaged or deficient items and materials will not be allowed to be installed and should any damaged items be found in constructed work, such items shall be removed immediately and

replaced by the Contractor, with no additional cost to the Owner.

1.07 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. Installers of site improvements shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of the work. Beginning work means installer accepts substrates, subgrades, previous work, and conditions. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or rehandling items prior to final installation.

1.08 STANDARDS

A. Except as modified by governing code and by the Contract Documents and drawings, comply with applicable provisions and recommendations of the following:

1. AASHTO: American Association of State Highway and Transportation Officials, latest edition.

2. ASTM: American Society for Testing and Materials, latest edition.

3. ADA: Americans with Disabilities Act, latest edition.

4. AAB: Architectural Access Board Commonwealth of Massachusetts regulation Chapter 521 CMR, latest edition.

1.09 REFERENCES FOR THE DUGOUTS

A. ASTM A 36/A 36lvl - Standard Specification for Carbon Structural Steel.
B. ASTM A 325 - Standard Specification for Structural Steel Bolts, Heat Treated, 120,000-PSI Minimum Tensile Strength.
C. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength; 2003a.
D. ASTM A 563 - Standard Specification for Carbon and Alloy Steel nuts
E. ASTM A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2003a.
F. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Mot-Dip Process; G. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy Coated by the Hot-Dip Process; 2003.
H. American Institute of Steel Construction (AISC).
I. American Iron and Steel Institute (AISI) Specifications for Cold Formed Members. J. American Society of Testing Material (ASTM).
K. American Welding Society (AWS).
L. OSHA Steel Erection Standard 29 CFR 1926.750 Part R.
M. SSPC-SP 2 -Wand Tool Cleaning; Society for Protective Coatings.
N. SSPC-SP 10 -Near-White Blast Cleaning; Society for Protective Coatings.

0. ICC Evaluation Service, ESR-1006, Structural Insulated Panels.

1.10 BUILDING REQUIREMENTS FOR THE DUGOUTS

A. Standard Design Loads: International Building Code (IBC latest Edition), 50 P.S.F. (Ground Snow), 100 M.P.H., Exposure C, Seismic Design Category B.

B. Column to footing connection to be in compliance with OSHA Steel Erection Standard CFR 1926.750 Part R, which requires a minimum of four (4) anchor bolts per column.

C. Design Method shall be per applicable local building code requirements. Manufacturer's design shall utilize a three-dimensional structural analysis to determine all member loads and forces.

D. The pre-engineered package shall be shipped as a pre-cut (except for standing seam roof panels) and prefabricated package that shall include the structural framing members, roof panels, fasteners, and trim as well as the installation instructions. The structure shall be shipped un-assembled.

E. Field labor shall be only for the assembly of the prefabricated parts. No onsite welding shall be required or permitted. Tube frame connection bolts and fasteners shall be concealed, within the tubing or hidden, except as approved by Owners Representative. All rafter tails shall be factory welded into place as well as all compression ring/tube covers. On multi-tiered buildings the rafter risers shall be welded to the lower rafters for ease of installation. No through bolting shall be allowed for any connections due to the possibility of the deformation of the tube steel parts.

PART 2 - PRODUCTS

2.01 SOFTBALL FIELD – BACKSTOP, CHAIN-LINK FENCE AND GATES

A. The chain-link fence at the ball fields shall be located as shown in the Drawings. The rails and gauge of mesh shall be as shown in the drawings. Otherwise, chain link fencing shall conform with City's standards contained in Project Special Conditions-Article 41.

2.02 SOFTBALL FIELD – SPORTS NETTING SYSTEM

Sports netting system to consist of 50' long class 2 southern pine, penta treated wood poles, 30' long class 4 southern pine penta treated wood poles, galvanized pole line hardware consisting of 5/8" through bolts & washers, 3-bolt clamps, thimbles, steel deadend shoes, 5/8 D-rings, 5/16" preform wraps, helix ground anchors, yellow guy guards, clips and black #21 twine. The netting is to be westerbeke black #252 2 1/8" stretch mesh squared with a 3/8" nylon rope border. Contact Fernandez Line Construction www. Fernandeslineconstruction.com or approved equal for details.

2.03 SOFTBALL FIELD – TEMPORARY OUTFIELD FENCE

A. Temporary outfield fence shall be MarkSmart fence package, by Markers Inc. wwwmarkerinc.com; or approved equal. Fencing shall be 48" high, green or blue color, with yellow banding at the top. The fence package shall include posts and ground sockets, and socket plugs.

2.04 SOFTBALL FIELD – FOUL POLE

A. Foul poles shall be a yellow flagged mesh foul pole such as Model #BBCFP-20 as manufactured

by Jaypro Sports, Inc. www.jayprosports.com; model # 1273 as manufactured by PW Athletic Mfg. Co www.pwathletic.com or approved equal.

B. The foul poles shall measure 20' height above finished grade and shall have a telescoping type post with 3-1/2" outside diameter at the base.

C. Finishing, including priming and powder coating, shall be consistent with the manufacturer's specifications for the particular model.

D. Quantity of foul poles: 4

2.05 SOFTBALL FIELD – PITCHER'S AND HOME PLATE

A. Pitcher's plate, home plate will be supplied by the Owner and will consist of rubber plates attached 5" thick concrete anchors. Quantity to be four (4) pitcher's plates and four (4) home plates.

2.06 BLEACHERS

A. New Bleacher shall be 15 feet long anodized aluminum bleachers as shown in the drawings and as specified here-in, mounted on a concrete pad. Provide products complying with requirements from the following manufacturer:

1. Provide 4-Row Preferred Low Rise bleachers with double footboards, model # NB-0415ALRPRF made by National Recreation Systems (888) 568-9064 sales@bleachers.net.

2.07 PLAYER'S BENCH

A. New player's benches at the dugouts as well as at practice field behind backstop (location as per drawings) , shall be 12 feet long anodized aluminum backless bench as shown in the drawings and as specified here-in, mounted on a concrete pad. Provide products complying with requirements from the following manufacturer:

1. Provide inground mounted Backless Player's bench, Model # BE-DD01200 manufactured by National Recreation Systems. (888) 568-9064 sales@bleachers.net.

2.08 DUGOUT SHELTERS

A. New dugout shelter shall be a pre-engineered, prefabricated all-steel framed shelter, including column, rafter, and purlin structure, with metal raised seam roof panels or T&G roof deck or Sandwich Panel roof deck, all flashing, trim, accessories, and fasteners required for a complete installation.

1. Layout as shown in the drawings and as specified here-in: 10' x 24' rectangular structure with multi-rib metal roof and 8' clearance height.
2. Colors of Shelter frame and roof to be selected by Owners Representative.
3. Contractor to provide foundation/footing design based on manufacturer's Structural Engineer design recommendations.
4. Contractor to provide shop drawings for chain link fence enclosure around shelter for the architect's approval.
5. Electrical Access: Access holes shall be placed in the connection plates to allow electrical wiring from the column base up to the peak.

B. The Manufacturer of the Shelter shall be fully qualified to provide a durable, high- quality product meeting or exceeding these specifications, and shall be following, or an approved equal:

1. Model LINK UP' Dugout integrated with chain link fencing (chain link fencing by others) by Poligon & Porter Corp Manufacturing, 4240 N. 136th Avenue, Holland -MI 49424; 800-354-772 1, fax 61 6.399.9123 www.poligon.com .or approved equal.

C. Substitutions must be approved a minimum of ten (10) days prior to the bid date. Any approval of alternate manufacturers shall be through an addendum prior to the bid date and shall not be allowed without written notification. Alternate suppliers shall meet the requirements shown in Section 1.09. Alternate suppliers must provide proof of equivalency of the shot blast, e-coat and powder coat process and finish. Structural design shall include all loads to the foundation and shall not exceed the loads specified in the chart on the installation drawings. Designs using wood, light gauge metal framing or sheet metal other than roof/wall panels and related trim and flashing shall not be approved.

D. Warranty

1. Provide manufacture's standard five-year warranty.

2.9 SCORE BOARD

A. The scoreboard shall be model # BA-2518 by Daktronics, www.daktrononics.com or approved equal. It shall also include two ad panels: 1' high x 9' long panel above the scoreboard, and a 2' high x 9' long panel below the scoreboard. The Contractor shall supply the support system, and League (via the Owner) will supply the scoreboard, ad panels and 2 controllers.

2.10 FLAGPOLE

A. The 30 and 35-foot internal halyard aluminum flagpoles shall be American Beacon Flagpole Lighting Internal Halyard Beacon-Dual Light #ABW2-Flagpole by:

1. American Flagpole & Flag Co. 3546 Lake Elmo Ave., Suite 3, Lake Elmo MN 55042
2. The Flagpole Co. P.O. Box 765 Brooklyn MI 49230.
3. American Flagpoles and Flags, 124 St. James Ave., Unit G, Goose Creek, SC 29455 or approved equal.

B. Listing as an acceptable manufacturer does not remove responsibility for meeting specifications.

2.11 PICNIC TABLES

A. Picnic tables shall be provided as shown in the drawings and specified herein, including:

Picnic Table – Accessible – 8'-0" long with end-overhang. Provide wheelchair accessible heavy duty aluminum picnic table with galvanized steel legs by National Recreation Systems (888) 568-9064 sales@bleachers.net ,or approved equal, with galvanized hardware for surface-mounting into concrete pad.

C. Tables shall be anchored into Concrete Pad at ground surface below tables, or as indicated in drawings.

2.12 BENCHES

A. The benches shall be with backrests as indicated in the drawings, each made of steel and cast-iron end supports, and include:

1. With backrests – Models 58-60 and 58-80 manufactured by Dumor Site Furnishings, Inc., or approved equal, with surface mounting. Bench to be powder coated, color shall be selected by owner / match existing.

2.13 HANDRAIL AT STAIRS

A. The handrail shall be custom fabricated as specified here-in and similar to the design shown in the drawings. Posts and railing shall be shop-welded into a single piece, made from carbon steel structural 2" diameter pipe, hot-dip galvanized, and powder coated finish. 'E-Z install, or other modular assemblies will not be acceptable. Handrail posts are to be anchored into the treads of the concrete steps or into a concrete footing as shown in the drawings. Two (2) identical Handrails shall be required unless the City of Worcester Accessibility Officer agrees that only one (1) rail in the middle of the
stair will be adequate.

1. Handrail extent, heights, pipe diameters, and configuration shall be in compliance with the Code of Federal Regulations 28 CFR Part 36 – ADA Standards for Accessible Design, 2010 or most current edition, or as accepted by the City of Worcester Accessibility Officer.

2. Contractor shall coordinate the construction of the concrete stair to include sleeves or other anchoring provisions to enable installation of the handrails.

3. Galvanizing:

a. Hot dip galvanize all items under this section in compliance with ASTM A 123, ASTM A 153, or ASTM A 386. Provide minimum of 1.5 oz. of zinc coating per sq. ft. of steel surface. Galvanize after fabrication.

b. Following galvanizing, each item shall receive surface grinding to remove lumps, sags or spikes resulting from the welding or galvanizing process. The finished surface following grinding shall be hand smooth and without bumps or irregularities.

4. Powder Coat finish:

a. Primer and Finish color coating shall be Color Galvanized Black powder coating as provided by Duncan Galvanizing, Inc., or approved equal.

b. Color to be black.

2.14 STEEL GATES

A. Steel gates are required; each shall be as shown in the drawings and constructed in conformance with these specifications and with City Standards for pipe gates. Gates include:

1. Single Swing Gate – located at the secondary entry and leading to H.C. parking near the concession stand to include lockable single swing gate and stanchion posts to hold gate

in closed and open position; see drawings.

2.15 WASTE RECEPTACLES

A. The trash receptacles shall be Model 84-32 with surface mounting manufactured by DuMor Site Furnishings Inc. or approved equal. Receptacle to be powder coated, color Black, with 32-gallon polyethylene liner and DM – Dome Top.

2.16 HANDICAP PARKING SPACE SIGNS

A. HC Sign in front of the HC parking space shall Be provided in compliance with ADA Requirements and City Standards.

2.17 CONSTRUCTION SIGN (SEE SPECIAL CONDITIONS)

A. The construction sign shall conform exactly to the City of Worcester's Park, Recreation and Cemetery's Department prototype park sign including but not limited to backer material, font, font size, capitalization, color, font relief, style, rainproofing, fasteners and fastener location.

2.19 SPEAKER SYSTEM

A. Speaker System: The Contractor shall provide outdoor, weather-resistant audio speakers (one per pole), on 2 new sports lighting poles (A1 and A2 on the Drawings), 1 per pole. Speakers shall be 120W, 2-way horn loaded co-axial, weather-resistant loudspeakers, and shall be multi-tap for 70V and 100V inputs. Speaker size shall be 16" x 16" x 16" and manufactured by Community Prof. Loudspeaker (model R.5-94TX), Audio Vox, Bose, or approved equal. Audio cabling shall be 14-gauge minimum, waterproof cable.

2.20 BASEBALL FENCE GUARD

A. New fence guard shall be UB resistant yellow polyethylene, 4 ½" diameter. Zip-ties used to secure guard to fencing shall be yellow, white, or clear color, and shall be UV resistant.

PART 3 – EXECUTION

3.01 GENERAL

A. Contractor shall layout the locations for each of the site improvements, based on the drawings and as further refined by manufacturers submittals or shop drawings approved by the Owners Representative, and coordinate related work necessary for each site improvement, including but not limited to, sub-grade preparation, electrical conduit, concrete foundations and pads, and backfilling. Site improvements shall be installed following manufacturers guidelines, in accordance with approved submittals, and in compliance with City of Worcester safety regulations.

B. Anchor bolts for anchoring the improvement to a concrete pad or foundation shall be hot-dip galvanized or stainless steel, as specified here-in.

C. The above-ground portion of all site improvements shall not be installed until all rough grading, back-filling, and adjacent finish surfacing has been completed, unless other arrangements are made with the Owners Representative.

D. Contractor shall protect each improvement and paint finishes from damage during installation and shall replace any damaged components and re-paint any surfaces marred or scratched during installation. Contractor shall take measures to protect each

improvement following installation from construction-related damage and be responsible for the improvements until accepted by the Owners Representative.

E. Manufacturer's warranty information shall be submitted to the Owner, prior to acceptance.

F. Additional execution guidelines specific to individual improvement are included below.

3.03 CHAIN LINK FENCE (See Project Special Conditions)

3.04 DUGOUT SHELTER

A. When unloading, pad the forks and use other precautions to protect the powder-coated finish. Do not use chains to move materials. Handle all materials carefully in the field to avoid scratching the finish. Before installing the roof, clean the steel and touch up any scratches and chips in the powder-coat finish using touch up paint from the manufacturer,

B. The shelter shall be anchored into prepared footings installed below the level of the concrete slab or sidewalk. Footing details and steel re-enforcement shall be designed by an Engineer, based on load information and as indicated in the shop drawings provided by the manufacturer. Foundations shall be constructed to all local building code requirements and per good construction practices for the specific site conditions.

C. In accordance with OSHA Steel Erection Standard 29 CFR 1926.750 Part R, anchor bolts shall be installed for proper column stability and shall have a minimum of four (4) anchor bolts per column.

D. Install all parts and pieces per the manufacturer's supplied installation instructions and these specifications. The underside of the tongue and groove decking or sandwich panel roof deck shall be sealed before installation as specified and approved by the landscape architect or Owner.

3.05 PICNIC TABLES

A. Install picnic parallel with the ground plane and positioned at locations indicated on Drawings.

3.06 BENCHES

A. Locate and install benches complete as indicated in the drawings and as directed by the Owners Representative in accordance with approved shop drawings and manufacturer's written instructions.

B. Install benches parallel with the ground plane and positioned at locations indicated on Drawings.

1. Where benches are located within the Playground, the concrete pad below the bench shall be poured with top of concrete pad ½" below finish grade of the play surfacing. Once cured, the concrete pad is to be surfaced with the top wearing course of safety surfacing. The four legs of the bench are to be set onto 3/8" thick stainless-steel spacer plates of the same dimension and hole-pattern as the bottom of the bench legs, cut into the playground wearing surface, and anchored with galvanized anchor bolts into the concrete pad.

3.07 BLEACHERS

A. The excavation for the concrete base shall be brought to line and grade as shown in the contract drawings and as specified in Section 310000 of these Specifications. The excavation shall be brought to the proper depth to provide for the detailed amount of processed gravel

base.

B. The processed gravel base shall be installed and compacted, as specified in Section 310000 and special conditions of these Specifications and as shown in the Drawings.

C. The base pad shall be cement concrete-cast in place, formed, finished, and cured as specified in Section 03 30 00 of these Specifications and to the line and grade shown on the contract drawings. There shall be four anchor bolts (two on each side) cast in the proper location in the pour. Provide positive pitch away from pad for drainage.

D. The bleachers shall be set over the anchor bolts and securely bolted down. The ends of the bolts shall be cut off one-eighth (l/8) inch above the bolts and then carefully peened over the nut.

3.11 WASTE RECEPTACLES

A. Locate and install trash receptacles complete including tamper-proof pre-assembled bolt anchors as indicated within the drawings and as directed by the Owners Representative in accordance with manufacturer's written instructions and in accordance with approved shop drawings.

3.12 PARK CONSTRUCTION SIGN

A. Installation of the park construction sign shall conform with the City of Worcester's Park, Recreation and Cemetery's Department prototype park sign installation requirements.

3.13 SPEAKER SYSTEM

A. Installation of Speaker System: Speakers shall be mounted a minimum of 30 feet above finished grade, with stainless steel hardware. Each speaker shall have a home run back to the PA cabinet behind the backstop.

B. Refer to Electrical Plans and Specifications.

3.14 FLAGPOLE

A. Flagpoles

1. Excavation for flagpole footings shall be in firm, undisturbed or compacted soil, as herein specified in Section 31 23 16 Excavation. Excavate the hole to the lines and grades as shown on contract plans.
2. Place cement concrete around posts in a continuous pour. Tamp for consolidation. Check and adjust each post for vertical and top alignment, as necessary, and hold in position during placement and finishing operation.
3. Top of flagpole footing shall be flush with finish grade as shown in drawings, pitched to drain.

3.15 BATTING CAGE NETTING AND CABLES

A. The Contractor shall install cables and netting in accordance with the Drawings.

B. The Contractor shall submit a shop drawing of the cable and netting installation to the Owner's Representative for approval, prior to installation.

3.16 FOUL POLES

A. The foul poles shall be integrated into the chain link fence as shown on the Drawings.

B. The foul poles shall be mounted in cement concrete footings. See the Drawing detail and Section 03 30 53 (Cast-in-Place Cement Concrete) for footing requirements.

C. The Contractor shall place cement concrete around post in a continuous pour and tamp for consolidation. He/she shall also check and adjust post for vertical and top alignment, as necessary, and hold in position during placement and finishing operation.

D. The top of the foul pole shall be 20' above finished grade. The wing of foul pole shall be oriented toward the inside of the ball field.

E. The foul pole locations shall be marked i n the field for review and approval by the Owner's Representative prior to installation.

3.17 BASEBALL INFIELD APPURTENANCES

A. Home Plate and Pitcher's Plate (Rubber): The Contractor shall excavate to the thickness of the concrete anchor, compact the excavation, and install plates/anchors so the bottom edges of the rubber plates are at finished grade.

B. Bases: The base system shall be installed in accordance with manufacturer's instructions. Concrete to pour in the manufacturer's anchor forms shall meet the requirements of Article 38 -Cast-in-Place Cement Concrete. The Contractor shall install anchors/sleeves for both 60' and 70' bases, install the youth base plates and tops on the 60' base sleeves, and install plugs in the 70' base sleeves. The 3 base tops and plates shall be delivered to the Owner's Representative.

C. The bases shall be installed so that the outside corner of each base will be located at the point where the base lines intersect. Home plate shall be installed so the pointed end is situated at the point where the base lines meet. Base lines are shown on the Drawings as broken lines. Pitcher's plates shall be installed where indicated on the Drawings.

3.18 BASEBALL FENCE GUARD

A. The Contractor shall install new and relocated fence guard in accordance with manufacturer's instructions and shall secure fence guard to fencing with plastic zip-ties through predrilled holes.

B. Fence guard shall be installed along all 4' high athletic field permanent fencing.

3.19 TEMPORARY OUTFIELD FENCE

A. The ground sockets and fencing shall be installed in accordance with the manufacturer's written instructions and the Drawing detail.

B. The Contractor shall deliver the socket plugs to the Owner's Representative.

C. The Contractor shall install the ground sockets for terminal posts as close to the terminal chain link fence posts as possible.

D. The Contractor shall mark the layout of the temporary fence for approval by the Owner's Representative prior to installation of the ground sockets.

3.20 BASEBALL SCOREBOARD

A. The Contractor shall submit shop drawings for the scoreboard and support structure, which shall include posts, footings, and electrical connections. Shop drawings shall be stamped and signed by an engineer licensed in Massachusetts.

B. The Contractor shall install the support structure, scoreboards, ad panels, and electrical connection. The scoreboard shall be mounted on a support system consisting of two (2) posts, with bottom of scoreboard at l O' above finished grade. The Contractor shall verify that the scoreboard, ad panels, and structure are plumb and level.

C. The posts shall be mounted in cement concrete footings. The design engineer for the shop drawings shall determine depth and diameter of footings. See Section 03 30 53 (Cast-in-Place Cement Concrete) for footing concrete requirements.

D. The Contractor shall test the two control units by connecting units to all jacks and checking for proper operation of control units and scoreboard. He/she shall deliver the control units in carrying cases and other loose accessories to the Owner's Representative.

END OF SECTION

SECTION 323100
WOOD GUARDRAIL

Part 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this section as indicated in the drawings and specified herein which shall include but is not limited to the following:

1. Install new wood guardrail.

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Division 2 Section 310000 “Earthwork” for extent of excavation and backfilling work.

1.04 SUBMITTALS

A. Product Literature: Prior to ordering the materials listed under ‘PRODUCTS’ below, submit product literature to Owners Representative for review. Do not order materials until approval from Owners Representative has been obtained.

1. Submittals shall be made for all work to be furnished under this Section, or as requested by the City Engineer.

B. Samples:
1. In accordance with the provisions of the Project Special Conditions, submit samples of the carriage bolt and other hardware to be used to assemble the wood guardrail.

1.05 REFERENCE STANDARDS AND SPECIFICATIONS

A. Reference to the standards, specifications and test of technical societies, organizations, and governmental bodies as made in the contract documents.

1. "Standard Grading Rules for West Coast Lumber".
2. AASHTO M 133: Preservatives and Pressure Treatment Processes for Timber
3. AASHTO M 168: Wood Products
4. AASHTO Standard Specifications for Highways and Bridges
5. American Wood-Preservers' Association (AWA) Book of Standards
6. Western Wood Products Association (WWPA) Standard Grading Rule

PART 2 - PRODUCTS

2.01 WOOD GUARDRAIL

A. All timber shall be Southern Yellow Pine, of a “Select Structural” grade, and shall be of the finest appearance. No planer chips are allowed in dressing. Reference is made to the provisions of paragraph 131-a., Standard Grading Rules for West Coast Lumber. To minimize slivering, timbers must be free of wave, and edges must be eased with 1/2" bevel at 45 degrees (square corner edges are not allowed). Except as otherwise noted, Timbers shall be of the sizes indicated in the drawings.

B. After all fabrication processes are complete; each wood member will be treated with an ACQ pressure preservative treatment in compliance with industry standards for structural wood specified for exterior use. Only preservatives deemed suitable by USEPA for skin contact may be used in the wood members.

C. All hardware shall be hot-dipped galvanized in accordance with ASTM-A153 and conform to ASTM A307 requirements.

D. An "ASSOCIATION INSPECTION CERTIFICATE" shall be furnished by the Contractor, at his own expense, certifying that the grade and quality is fully in accordance with the requirements of the specifications. This certificate shall be issued by the association whose grading rules govern this particular class of wood. Wood that is "GRADE MARKED" by an accredited association will be accepted in lieu of the "ASSOCIATION INSPECTION CERTIFICATE".

PART 3 - EXECUTION

3.01 WOOD GUARDRAIL

A. The installation of the wood guardrails shall be in accordance with the dimensions and details indicated in the Contract Drawings and these Specifications. All cuts made in the field shall be painted with two (2) brush coats of the wood preservative.

B. All wood guardrail post locations shall be marked out in the field for review and approval by the City Representative prior to installations.

C. Posts shall be set plumb, in hand or mechanically dug holes. Post holes shall be backfilled with approved materials placed in successive layers no greater than 12 inches and compacted to 95% density.

D. Rails and hardware shall be installed as shown in the drawings.

E. All hardware shall be installed cleanly, with carriage bolt heads and nuts fully countersunk and not projecting outside the face of the rail.

3.02 GUARANTEE AND ACCEPTANCE

A. Any defective elements shall be replaced in part or whole by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 323119
ORNAMENTAL FENCE AND GATES

PART I - GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SCOPE OF WORK

A. The work under this Section consists of furnishing and installing steel picket fence and steel picket gates with posts, sleeves and appurtenances as shown in the drawings and as specified herein including all labor, materials, equipment, and operations necessary to finish the work complete in place.

B. Fence must meet all playground code requirements for picket spacing and public safety.

1.03 RELATED SECTIONS

A. Section 321600 – Curbing, for concrete curbing along fence lines
B. Article 38 – Cast-in-Place Concrete

1.04 REFERENCE STANDARDS

A. References herein to any technical society, organization, group or body are made in accordance to abbreviations and standards of the following:

1. ASTM American Society for Testing Materials
2. AWS American Welding Society
3. CPSC Consumer Product Safety Commission

1.05 SUBMITTALS

A. SHOP DRAWINGS

1. Based on the drawings, the Contractor shall submit complete manufacturer's shop drawings which shall include the horizontal layout and vertical alignment for the proposed installation to the Architect and Owners Representative for approval.

2. Field verify all post sleeve spacing prior to fabrication. No material may be ordered prior to receiving written approval from the Owner’s Representative.

B. SAMPLES

1. The Contractor shall submit finished samples of all parts of the fences for the Owner's Representative review and approval. The workmanship and finish of the completed fences shall equal the approved samples.

2. The Contractor shall provide samples of fencing hard-ware as the Engineer directs; and, shall supply representative samples, in factory-sealed containers, of the cold galvanizing compound, the primer, and finish paint, suitable for touch-up.

PART II – MATERIALS

2.01 FENCE STANDARDS AND MANUFACTURE

A. **Ornamental picket fence to match existing.** The fence must meet the requirements of the commercial ornamental steel fence system of the Ameristar® Aegis Plus® (Majestic™) design as manufactured by:

1. Master Halco of 63Manley St. W. Bridgewater, MA 02379 (800) 969-1669.

2.02 STEEL MEMBERS

A. Posts shall be carbon steel structural tubing conforming to ASTM Designation A500.

1. Sleeves for fence posts shall be 3" x 3" x 1/2" thickness galvanized steel square tube weighing 20.88 lbs./ft. or sized to post dimensions.
2. Sleeves for fence gate posts, if utilized, shall be sized to the gate posts.

B. Material for fence pickets shall be 3/4" square x 17 Ga. tubing.

C. Galvanizing:

1. Hot-dip galvanize all items under this section in compliance with ASTM A 123, ASTM A 153, or ASTM A 386. Provide minimum of 1.5 oz. of zinc coating per sq. ft. of steel surface. Galvanize after fabrication.

2. Following galvanizing, each item shall receive surface grinding to remove lumps, sags or spikes resulting from the galvanizing process. The finished surface following grinding shall be hand smooth and without irregularities. Take care not to damage the galvanized surface coating.

D. Pickets, top and bottom rails and crossbars and hinge assemblies, called for on the drawings, shall conform to ASTM Designation A36.

E. Bolts, nuts, washers and any other fasteners shall conform to ASTM Designation A307.

F. Post caps shall be cast iron or steel in the sizes required, finished in conformance with all other fence elements. Caps shall be as manufactured by Julius Blum & Co., Inc., Carlstadt, NJ; Boundary Fence and Railing Systems, Inc. Richmond Hill, NY; Monumental Iron Works, Inc., Baltimore, MD; or approved equal. All caps are to be coated with a minimum 3.0 mil thickness of liquid galvanizing compound by dipping.

G. All gates shall be equipped with a positive type latching device capable of retaining the gate in a closed position and have provision for padlock. Latches shall permit operation from either side of gate and must be approved by the Owners Representative prior to the installation.

H. Double gates: Provide locking cane-bolt style drop rod to hold inactive leaf. Pro-vide gate stop pipe to engage center drop rod. Provide locking device and pad- lock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

2.03 FINISH

A. Cold galvanizing compound shall be a single component zinc rich compound yielding a dry film of at least 85% pure zinc. Galvanizing compound shall meet or exceed the requirements of Federal Specification MIL-P-21035, TT-P-641d primer for zinc rich compounds.

B. Finish color coating shall be Color Galvanized Black as provided by Duncan Gal-vanizing, Inc., or approved equal.

2.04 CEMENT CONCRETE

A. Cement concrete for footings and curbing shall conform to Section 033000 of these Specifications.

PART III – EXECUTION

3.01 FENCE FABRICATION, GALVANIZING FINISHING AND ERECTION

A. The fence sections shall be shop fabricated in strict conformance to the sizes and dimensions called for on the approved shop drawings and in accordance with these specifications, all as field verified by the Contractor.

B. All welding shall be by arc welding process conforming to the latest AWS Specifications. All welds shall be as designated on the drawings, shall be ground smooth to a neat finish and shall be watertight with care to minimize locked-up stresses and distortion due to wear. All welds shall be made on bare, clean metal equal to "white" metal.

C. After fabrication, all steel surfaces shall be thoroughly cleaned of all mill scale, rust, dirt, weld flux, weld splatter and other foreign matter by power wire brushing or sand blasting.

D. Prime and finish all materials in accordance with industry requirements. Galvanizing shall provide a visually acceptable substrate for applied coatings, and be free of lumps, globules, or heavy deposits which will interfere with intended use or esthetic appearance of materials.

E. Field erection of the fabricated fence sections shall be as called for on the Drawings and as refined in the Shop Drawings prepared by the Contractor/Manufacturer and approved by the Owners Representative.

F. Excavation and backfilling for post footings shall conform to Section 310000 “Earthwork” of these Specifications.

G Fence posts shall be set plumb in cement concrete footings which shall be mixed and placed in accordance with Section 033000 Cast-in-Place Concrete and Section 321600 “Curbing” of these Specifications. The fence rails shall be parallel with the fence curbing and the fence posts and pickets shall be set plumb, when the fence is erected into its final position.

H. Surfaces that are abraded or damaged during field erection or from which galvanizing compound has been damaged shall be thoroughly wire brushed and cleaned, removing all loose and cracked coating, after which the surface shall be painted with two (2) coats of the approved cold galvanizing compound and reviewed with the Owners Representative.

3.02 TOUCHUP PAINTING AND INSPECTION

A. After erection, all rust spots, scratches or abrasions in the galvanized surface shall be repaired with finish surfacing treatments that are compatible with factory applied color galvanizing applications and be made satisfactory in all regards to the Owners Representative.

B. The gates shall operate and close smoothly, without sag, and be easily lock- able. Padlock shall be keyed as directed by Owners Representative. Gate operation shall be inspected by the Contractor and Owners Representative; any deficiencies shall be corrected as necessary at no additional cost to the Owner.

END OF SECTION

SECTION 323219
LARGE BLOCK RETAINING WALL WITH DRAIN DITCH

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. All wall locations shall be marked out in the field for review and approval by the City Representative prior to installation.

1.02 SUMMARY

A. Provide all labor, equipment, materials and perform all operations necessary to complete the work of this section as indicated within the drawings and specified herein, which shall include but is not limited to installation of the following:

1. Large Block Retaining Wall with Drain Ditch.

B. Quality Assurance and qualifications of subcontractors – The Contractor shall engage only Subcontractors and persons skilled and fully qualified to do the work required under this Section. The work shall be performed by adequate numbers of skilled workers who are trained and experienced in the necessary crafts; and the Contractor shall inform these parties of pertinent information in these specifications required for proper performance of the work.

1.03 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 024100 “Site Preparation and Demolition” for salvaging existing fieldstone, rock, and boulders for later re-use in fieldstone retaining wall.

B. Section 310000 “Earthwork” for excavation and backfilling operations.
C. Section 033000 “Cast-in-place Concrete”.
D. Section 034000 “Precast Concrete”.

1.04 SUBMITTALS

A. Product Literature: Prior to preparing shop drawings or ordering the below listed materials, submit product literature to Owners Representative for review and approval. Do not order materials until Owners Representative approval has been obtained. Submit Product Literature with texture choices and color chart for:

1. Precast Concrete Large Block Retaining Wall with Drain Ditch.

B. Shop Drawings: Prepare and submit Shop Drawings for approval by the Owners Representative prior to ordering the Large Block Retaining Wall with Drain Ditch.

1. Coordinate shop drawings, which shall show required block sizes, dimensions, sections, profiles of entire wall of large blocks, the arrangement of and provisions for alignment, jointing, and other necessary details for delivery and placement, and the integration with other associated work, such as the gravel base, drain and emergency spillway from the detention basin, site grading, erosion controls, and riprap.

2. Note guidelines and show details for any unique fabrication or installation requirements as necessary to meet manufacturers requirements, or as directed by the Owners Representative.

3. Large Block Retaining Wall with Drain Ditch requires two (2) sets of structural calculations signed and stamped by a Professional Engineer certifying the capacity of the Large Block Retaining Wall shown in Shop Drawings to support the earth material above the wall.

a. Submit samples and/or descriptive literature of all items specified by the Engineer. C. Samples:

1. Submit a sample of the masonry block or veneer block for approval by the Owners Representative prior to ordering the Cement Block for the Block-faced Wall.

2. Should additional fieldstone need to be imported to complete the fieldstone retaining wall, submit a sample of 3 to 4 fieldstones for approval by the Owners Representative prior to importing.

1.05 REFERENCE STANDARDS AND SPECIFICATIONS

A. Refer to the standards, specifications and tests of technical societies, organizations, and governmental bodies identified in Section 033000 “Cast-in-Place Concrete” and Section 034000 “Precast Concrete”. Additional Reference standards include:
1. ASTM C94 Ready-Mixed Concrete
2. ASTM C1372 Segmental Retaining Wall Units.

1.06 MATERIALS OWNERSHIP

A. Owner shall keep the fieldstone and boulders salvaged during site preparation not utilized for wall construction until such time that the Owners Representative deems the material to be surplus and directs the Contractor to remove it from the site or haul it to another City property. The Contractor shall do so at no additional cost to the owner.

PART 2 - PRODUCTS

2.01 LARGE BLOCK RETAINING WALL WITH DRAIN DITCH

A. Wall units shall be precast concrete blocks of a shape and dimension similar to that shown in the drawings, and capable of being installed with curved alignment. Blocks are to be produced by a licensed manufactured, specifically by the following, or an approved equal:

1. Big Block Inc., P.O. Box 861140, Shawnee, KS 66286

https://bigblockinc.com/

2. Old Castle Infrastructure, distributed by REHOBOTH, MA, 41 Almeida Road, Rehoboth, MA, 02769. Phone: (508) 336-7600. https://oldcastleinfrastructure.com/

3. Shea Concrete Products, 773 Salem Street Wilmington, MA 01887. Phone: 978-658-2645. Fax: 978-658-0541. sales@sheaconcrete.com https://sheaconcrete.com/

4. Redi-Rock International, manufactured by Carroll Concrete and Redi-Rock Walls of New England, P.O. Box 1000, Newport, NH 03773 Atten: Casey Scavone, (617)620-1667 or (603)863-1000 www.carrollconcrete.com

B. Wall units shall be made with Ready-Mixed concrete in accordance with ASTM C94, latest revision, and meet the following minimum standards:
   1. air content between 1.5 % to 4.5 %
   2. have a 28 day compressive strength of 4,000 psi.
   3. slump of 5" +/-1.5".

C. Large block dimensions shall be uniform and consistent, with max. deviation of 1% excluding intentionally rugged exposed architectural surfaces.

D. Exposed face to be selected by Owners Representative, following review of product literature submitted by the Contractor.

E. Leveling pad below the large block retaining wall is to be crushed stone, compacted to 95%.

F. Free Draining Backfill material behind the wall shall be washed stone, placed to a minimum of 1'-0" width behind the back of the wall extending from the leveling pad to an elevation 4" below the top of the wall. Backfill material shall be as specified by the Engineer.

PART 3 - EXECUTION

3.01 LARGE BLOCK RETAINING WALL WITH DRAIN DITCH

A. The installation of the large block retaining wall shall be in accordance with the dimensions and details included in the Contract Drawings and with these Specifications, and as further refined by Shop Drawings submitted by the Contractor and approved as Construction Drawings by Owners Representative.

B. Prior to excavation, the contractor shall survey-layout the alignment for the large block retaining wall and provide reference heights of the wall at the top and bottom ends of the wall, and at the point along the wall closest to the proposed parking area Once the Owners Representative has approved the location, alignment, and heights, the contractor shall commence excavation, prepare the subgrade, place the base leveling pad, and install the wall.

C. The wall shall be installed over acceptable native subsoils as approved by the Geotechnical Engineer. In-situ foundation soil shall be examined to ensure that the actual foundation soil strength meets or exceeds assumed design strength. Native soils not meeting the required strength shall be removed and replaced with acceptable, compacted material. Foundation subsoil shall be compacted to 95% of standard

proctor prior to placement of the leveling pad.

D. The leveling pad shall be placed as shown on the Construction Drawings on undisturbed native soils or suitable replacement fills. Leveling pad shall have at least 6 inches depth and extend beyond the blocks in all directions to a distance at least equal to the depth of the pad or as designed by the Engineer. The leveling pad shall be compacted to 95% of standard proctor to ensure a level, hard surface on which to place the first course blocks. Pad shall be constructed to proper elevation to ensure the final elevation shown in the drawings.

E. All first course blocks shall be placed on the prepared leveling pad with the aesthetic surface facing out and the front edges tight together. All units shall be checked for level and alignment as they are placed. Each unit shall be in full contact with leveling pad. Proper care shall be taken to maintain straight lines and smooth curves as per wall layout.

F. The backfill in front and back of entire base row shall be placed and compacted to firmly lock base-row blocks in place. Sweep excess material from the top of block units prior to setting the next course of blocks.

G. Install wall base course, subsequent courses, and free draining backfill in accordance with manufacturer's instructions, contract documents, and City building codes, standards, and requirements.

H. Integrate Large Drain Ditch Block (top course) with spillway from Stormwater Basin, drain line outflow rip rap and rip rap at bottom of Drain Ditch Retaining Wall to insure that drainage functions properly and soil erosion along or below the wall is prevented.

3.04 GUARANTEE AND ACCEPTANCE

A. Any defective elements shall be replaced in part or whole by the Contractor at no cost to the Owner.

END OF SECTION

SECTION 328400
IRRIGATION AND WATER SUPPLY

PART 1 GENERAL

1.1 SUMMARY

A. Provide all materials, labor, installation equipment, and technical service to complete automatic athletic field irrigation system, plumbing equipment, enclosures, as well as the testing and warranty of the system as defined in this Specification and Construction Drawings.

B. Items of work specifically included are:

1. Procurement of all applicable licenses, permits, and fees.
2. Coordination of all utilities.
3. Verification of site conditions.
4. Maintenance during guarantee period.

1.2 QUALIFICATIONS.

A. Qualified irrigation system installers must have a minimum experience of five (5) years with work and products specified herein, including:

1. Internet-Based Smart Controllers
2. Athletic Field Irrigation Systems
3. Domestic Water Plumbing Systems

B. Submit three (3) references for similar work performed in the last five (5) calendar years, including:

1. Contact name
2. Company Name
3. Contact Phone Number
4. Project Name and Location
5. Brief Project Description

1.3 WORK DESCRIPTION

A. Athletic Field Irrigation System shall be a new irrigation system with its own controller and water supply. Sprinkler head placement and throw radius shall be better than head-to-head coverage.

B. Provide new pressure reducing valve within backflow enclosure to reduce incoming street pressure of 180 psi to 75 psi

C. Provide drain and blow-out port in backflow preventer enclosure.

D. Provide and train Owner on remote irrigation management through Internet based platform through cellular internet service as part of irrigation system controls.

1.4 UTILITIES

A. Water Service Point of Connection

1. Existing static water pressure within Ararat Street is purported to be 180 psi (to be confirmed).
2. Provide and plumb new pressure reducing valve within existing backflow preventer enclosure and set pressure to 75 psi.
3. Provide branched mainline to provide separate mainline for quick coupling valves in Phase 1 and Phase 2 infield skins behind each pitching mound.

a. Flow and pressure requirements at Athletic Field:
   1) Flow: Maximum 30 gallons per minute
   2) Pressure: 70 pounds per square inch (downstream of plumbing enclosure)

B. Electrical Power Source to New Outdoor Controller

1. With licensed electrician provide power from existing Phase 1 electrical handhole in conduit into pedestal controller through concrete pad..

   a. Power Requirements for Irrigation Controller within Pedestal

      1) 120-Volt, 1-Phase, 60-Hz, 20-Amp Breaker
      2) Irrigation Controller has internal transformer for 24VAC valve wire

   b. Conduits

      1) Provide minimum Schedule 80 PVC conduits through Irrigation Controller pedestal concrete pad with long elbow sweeps and under all hardscape through sleeves.

C. Internet for Outdoor Controller

1. Provide cellular card for internet-based access through any web-enabled device.

D. Pipe Sleeves

1. Pipe sleeves to be provided by Earthwork Contractor beneath all hardscape, as indicated on Construction Drawings.

   a. Pipe sleeve requirements

      1) Two (2) parallel 4-inch Schedule 40 PVC
      2) Extend 18 inches beyond edge of hardscape
      3) Minimum cover: 24 inches

1.5 RELATED REQUIREMENTS

A. Coordinate with other project trades and refer to overall project Construction Document Specifications and Drawings, including, but not limited to:

1. Division 01 – General Requirements
2. Division 02 – Existing Conditions
3. Division 03 – Concrete
4. Division 22 – Plumbing
5. Division 26 – Electrical
6. Division 31 – Earthwork
7. Division 32 – Exterior Improvements
8. Division 33 – Utilities
9. Construction Drawings:

   a. IR1.0 – Irrigation Plan
   b. IR2.0 – Irrigation Details
   c. IR2.1 – Irrigation Details
   d. Review all other Project Construction Documents for coordination.

1.6 APPLICABLE STANDARDS AND CODES

A. At a minimum, comply with the following standards and codes:

1. American Society for Testing and Materials (ASTM)
2. National Standard Plumbing Code (NSPC)
3. National Electric Code (NEC)
4. National Sanitary Foundation (NSF)
5. Underwriters Laboratories, Inc. (UL)
6. Occupational Safety and Health Administration (OSHA)

B. Comply with applicable laws, standards, and regulations of the local governing authority. All local laws more stringent than those referenced above shall take precedent.

1.7 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 – Submittal Procedures:

1. Literature: Manufacturer's product data sheets, specifications and installation instructions for materials listed in this Specification (Part 2 – Products).

a. Product submittals shall be concise (no extraneous pages or sections) and clearly marked to show submitted product model, type, size, etc.
b. Substitute Product Submittal:

1) Provide specified product submittals for “an approved equal” to Owner’s Representative for approval.
2) Alternate products are acceptable when products of equal or better quality and performance are submitted and approved by the Owner’s Representative.
3) Substitute Product Submittals constitute representation that:

a) Substitute products have been thoroughly investigated and have been determined to be equal or superior in all respects to that specified.
b) Substitute products shall provide the same warranties as specified products.
c) Substitute products are compatible with interfacing items.
d) Assume responsibility of and guarantee system performance as a result of product substitution, including making all subsequent changes to meet design specifications.

c. Work shall not commence until all products specified are submitted and approved in a written notification by Owner’s Representative.
d. All product installed shall be new, without defects, and of quality and performance as specified.

2. Schedule: Submit Schedule of all products to be furnished hereunder, indicating manufacturer, size, and model.

a. Ensure that all of the types/styles of products and installation equipment specified herein can be furnished by the manufacturer submitted.
b. Provide all spare irrigation parts as noted (see Spare Irrigation Parts)
c. Prior to submitting schedule, confirm current site conditions are as provided in the Construction Drawings.

1.8 DELIVERY, STORAGE AND HANDLING

A. Do not deliver materials to the site, until all specified submittals have been submitted to, and approved by, the Owner’s Representative.

B. Coordinate with Owner’s Representative for temporary storage and staging areas.

C. Protect materials from damage from construction traffic, weather, corrosion, and other causes while stored on-site. Minimize on-site storage as possible.

D. Store and handle all products and materials in compliance with manufacturer instructions and recommendations.

1.9 GUARANTEE AND REPLACEMENT

A. Guarantee entire irrigation system, parts and labor, for one (1) year from official written date of acceptance by Owner’s Representative. Provide written warranty showing date of completion and period of warranty prior to request for final payment.

B. System malfunctions occurring during the guarantee period due to defective materials, poor workmanship, or improper adjustment shall be corrected to satisfaction of Owner's Representative at no additional cost to the Owner.

1. Repair all defects within 10 days of notification from Owner or Owner's Representative.
2. Repair defects with approved products.

C. First-year spring system start-up and winterization shall be included in system guarantee.

D. Manufacturer warranties shall be provided for all products and materials where such warranties are offered in published product data. Copies of manufacturer warranties are to be included in the Operations and Maintenance Manual (See Operation and Maintenance).

PART 2 PRODUCTS

2.1 AUTOMATIC IRRIGATION CONTROLLER

A. Controller

1. Size: 16-Station Maximum
2. Construction: Electronic with 120-Volt Input and 24-28 Volt Output; Outdoor Stainless-Steel Pedestal Enclosure.
3. Standards: UL-Listed
4. Features: Manual and Automatic Control, Water Budgeting, Cycle-Soak, Sensor Input Terminals, Internal Transformer, Flow Monitoring Capability, Lightning Protection, Remote Control via Internet, Conventional Wire.
5. Manufacturer/Model: Rain Bird ESP-LXME (per Owner)

B. External Devices (Matching Manufacturer and Compatible with Controller)

1. Stainless Steel Pedestal Enclosure (VIT Strongbox, Model SB-16SS)
2. Wired Rain Sensor (free of Overhead Obstruction, attached to pedestal in perforated canister)
3. 1.5-Inch Brass Flow Sensor
   a. Provide Isolation Valves and Unions on Each Side for Winterization
   b. Flow Range = 2 – 105 gpm
4. Surge Suppression and Grounding (at Controller)

C. Outdoor Controller Grounding

1. Size
   a. Wire: 6AWG
   b. Rod: 5/8-Inch Diameter x 12-Foot Long
   c. Plate: 4-Inch x 96-Inch x 1/16-Inch Thick
2. Construction
   a. Wire: Bare Copper
   b. Rod: Copper
   c. Plate: Copper with Loresco PowerSet Ground Enhancement Material Above and Below
3. Ratings: UL-Listed
   d. Features: Cadweld Connectors from Wire to Rod, Plate Manufacturer provided Plate Connections, PVC or ADS Drain Pipe and Grate Cover over Rod Plate with

Metal Detection

2.2 WIRE

A. Conventional Wire

1. Size: 14AWG Minimum
2. Construction: Single Strand Solid Copper Conductor with PVC Insulation
3. Ratings: UL-Listed, NEC (Class II Circuit), Direct Burial UF/TWU, up to 600-Volt Potential
4. Standards: ASTM B-3, ASTM B-8
5. Markings: Manufacturer, Rating, Size, and Type
6. Manufacturer/Model: Paige Electric Model P7001D; Service Wire Company UF14, UF12; Regency Wire & Cable 14AWG, 12AWG; or Approved Equal.

B. Wire Splices

1. Type: Direct Burial Wire Splice Kit (All Components Intact)
2. Construction: Lockable Plastic Tube, Pre-Filled with Insulation Gel
3. Ratings: UL-Listed, NEC, Direct Burial and Submersion, up to 600-Volt Potential
4. Manufacturer/Model: 3M DBY-6; Rain Bird DB Series; or Approved Equal.

C. Wire Conduit

1. Size: 1-Inch Minimum
2. Construction: PVC, Solvent Weld
3. Ratings: Schedule 80
4. Fittings: Long Sweep Elbows
5. Manufacturer: Cresline; Certainteed, JM Eagle; or Approved Equal.

2.3 PIPE AND FITTINGS

A. Irrigation Mainline and Lateral

1. Size: 2-Inch Maximum
2. Construction: Polyvinyl Chloride (PVC), Solvent Weld
3. Ratings: Class 200 SDR 21
4. Markings: Manufacturer, Nominal Size, Class or Schedule, Pressure, Extrusion Date, Pipe Insertion Mark.
5. Manufacturer: Cresline; Certainteed; JM Eagle; or Approved Equal.
6. Fittings
    a. For Valves Toe Nipples: Schedule 80 PVC
    b. Other Fittings: Schedule 40 PVC
7. Markings: NSF Designation, Size, Class or Schedule
8. Manufacturer: Lasco; Spears; Dura; or Approved Equal
9. Solvent
    a. Type: NSF Type I or Type II PVC
    b. Standards: ASTM D-2564
    c. Manufacturer: IPS Weld-On 711; Oatey HD Cement; Rectorseal Gold; or Approved Equal
10. Primer
    a. Type: NSF for PVC
    b. Standards: ASTM F-656
    c. Manufacturer: IPS Weld-On P-68; Oatey Clear Primer; Rectorseal Jim PR-2; or Approved Equal

2.4 ELECTRIC ZONE VALVES

A. Sprinkler Zone Valve

1. Size: 1-Inch and 1.5-Inch
2. Construction: Plastic Globe Valve with Reinforced Nylon or Fiberglass Body
3. Ratings: 200 psi
4. Features: Manual Bleed Screw, Flow Control, Pressure Regulation, and Filter/Scrubber
5. Manufacturer/Model: Hunter ICV-FS; Rain Bird PESB; or Approved Equal

B. Master Valve

1. Size: 1.5-Inch
2. Construction: Brass Globe Valve
3. Ratings: 220 psi
4. Features: Manual Bleed Screw, Flow Control, Pressure Regulation, and Filter
5. Manufacturer/Model: Hunter IBV-FS; or Approved Equal

2.5 ISOLATION VALVES

A. Small Mainline Isolation Valve

1. Size: 1.5-Inch and Smaller
2. Construction: Bronze, Gate Valve
3. Ratings: 200 psi
4. Features: Steel Cross Handle, Non-Rising Stem
5. Manufacturer/Model: Nibco T-113K; Apollo 102T-K; or Approved Equal

2.6 QUICK COUPLING VALVES

A. Small Mainline Quick Coupling Valve

1. Size: 1-Inch, Normally Closed
2. Construction: Brass, Spring-Loaded Valve Seat, Key Engaged
3. Ratings: 125 psi
4. Features: 1-Inch NPT Inlet, ACME Key, Locking Vinyl Cover, Anti-Rotation Stabilization Wings
    a. Swing Joint Assembly
        1) Size: 1-Inch
        2) Construction: PVC, with O-Ring Seals and Brass Threaded Outlet
        3) Manufacturer: Hunter HSJ-1 with SnapLok; or Approved Equal
5. Manufacturer/Model: Hunter HQ-44RC-AW; or Approved Equal.

2.7 VALVE BOXES

A. General

1. Size:
    a. 12-Inch Standard Valve Box
        1) Single 2-Inch Electric Zone Valve
        2) Double 1-Inch or 1½-Inch Electric Zone Valves
    b. 6-Inch Round
        1) Wire Splice
    c. 10-Inch Round
        1) Single 1-Inch or 1½-Inch Electric Zone Valve
        2) Isolation Valve
        3) Quick Coupling Valve
2. Construction: Resin
3. Ratings: Tensile Strength 3,000-5,000 psi

4. Color: Green or Black (per Owner's Representative)
5. Features: Lockable, Bolt-Down Covers, Brick Supported
6. Manufacturer/Model: Carson, Model Specification Grade NDS Pro; Rain Bird VB; or Approved Equal

2.8 SPRAY SPRINKLERS

A. Body

1. Size: 6-Inch Pop-Up for Lawn
2. Construction: Plastic, Ratcheting Riser, Removable Nozzle, Internal Check Valve
3. Ratings: Pressure Regulated to 30 psi
4. Manufacturer/Model: Hunter PROS-4-PRS30-CV, Hunter PROS-6-PRS30-CV and Hunter PROS-12-PRS30-CV; or Approved Equal

B. Nozzles

1. Size: 2' – 15' Radius (see Contract Drawings)
2. Features: Full and Part-Circle Fixed-Arc and Strip Patterns, Special Micro-Stream
3. Manufacturer/Model: Hunter Pro Spray; Rain Bird MPR; Toro Precision; or Approved Equal

2.9 ROTARY SPRINKLERS

A. Body

1. Size: 6-Inch Pop-Up
2. Construction: Plastic, Ratcheting Riser, Removable Nozzle, Internal Check Valve
3. Ratings: Pressure Regulated to 40 psi
4. Manufacturer/Model: Hunter PROS-06-PRS40-CV; Rain Bird 1806-SAM-PRS-P45, or Approved Equal

B. Nozzles

1. 12' – 30' Radius (see Contract Drawings)
2. Features: Full and Part-Circle Fixed-Arc and Strip Patterns
3. Manufacturer/Model: Hunter MP Rotator, Toro Precision Rotating, or Approved Equal

2.10 GEAR-DRIVEN ROTOR SPRINKLERS

A. General

1. Size: 6-Inch Stainless Steel Pop-Up Riser with ¾-Inch or 1-Inch NPT Bottom Inlet
2. Construction: Gear-Driven, Removable Nozzle, Internal Check Valve, Stainless Steel Retraction Spring, Rubber Cover, Stainless Steel Riser
3. Features: Adjustable, Part, and Full Circle
4. Manufacturer/Model:
   a. Turfgrass: Hunter I-20-06-SS; Rain Bird 5006-SAM-PRS-SS
5. Spacing: As shown on Drawings, generally 80% - 100% of manufacturer rating

B. Swing Joint Assembly

1. Size: ¾-Inch or 1-Inch with 12-Inch Lay Arm
2. Construction: PVC, with O-Ring Seals and Threaded Outlet
3. Manufacturer: Hunter HSJ-1-12; Rain Bird TSJ-12; Lasco G132-100 or Approved Equal
4. Provide Combination PVC Insert Tee Fitting with FPT Outlet at Lateral for Swing Joint

2.11 PRESSURE REDUCING VALVE

A. General

1. Size: 2-Inch
2. Construction: Bronze, Stainless Steel Springs,

3. Features: Adjustable Screw for Pressure Reducing from 25 – 75 psi, Manufactured in USA, Integral Stainless Steel Strainer, Double Union NPT with Pressure Gauge Option
4. Manufacturer/Model: Apollo, Model 36, or Approved Equal.
5. Spacing: As shown on Drawings, generally 80% - 100% of manufacturer rating

2.12 EARTH MATERIALS

A. Stone (in Valve Boxes)

1. Type: ¾-Inch (minimum) Crushed Stone

B. Clean Sand

1. Gradation: (passing by weight)

a. No. 4 Sieve= 80% Minimum
b. No. 200 Sieve = 5% Maximum

C. Concrete Pads

1. Ratings: 3,000 psi 28-day Compressive Strength
2. Standards: ASTM C-33, ASTM C-94, ASTM-C150

2.13 COPPER PIPE (INSIDE ENCLOSURE)

A. Size: 1.5-inch

B. Construction: Type K Copper

C. Standards: ASTM B-88

D. Fittings: Wrought Copper, Silver Solder Joint (per ASTM B-828), Non-Corrosive Flux

2.14 SPARE PARTS

A. Wrenches, Keys, and Tools for Servicing and Adjusting Sprinkler Heads (2)

B. Quick Coupler Valve Keys (1)

C. Gate Valve (1 of each size on Drawings)

D. Electric Zone Valve (1 of each size on Drawings)

E. Sprinkler Heads and Nozzles (3 of Each)

F. Assorted Valves and Fittings

PART 3 EXECUTION

3.1 GENERAL

A. Competent superintendents and assistants shall be on-site at all times during product delivery, installation, testing, and system adjustments.

1. Field communication by Owner or Owner's Representative to superintendent shall be binding.

B. System features shall be laid out as indicated on Drawings, making minor adjustments for variations in planting arrangements or field conditions. Major changes shall be reviewed with Owner's Representative before acceptance.

1. Irrigation lines shown on Construction Drawings are diagrammatic only. Location of irrigation equipment is contingent upon and subject to integration with all other underground utilities, tree roots, and hardscape design elements.

3.2 EXAMINATION

A. Review and verify project conditions are as indicated on Construction Drawings prior to starting work, including but not limited to:

1. Utilities provided by Others
2. Site grades and dimensions
3. Athletic Field, landscaping and features
4. Structures
5. Pipe sleeves

B. Report any irregularities of site conditions to the Owner's Representative prior to beginning work.

C. Beginning of installation connotes acceptance of existing project conditions.

3.3 PROJECT COORDINATION

A. Coordinate with Owner's Representative to expeditiously install system.

B. Provide written notifications (electronic is acceptable) to Owner's Representative prior to work commencement, weekly for progress report, for any proposed changes to system design, and upon installation completion.

C. All questions of design intent, proposed design changes, field notifications, and product substitution after installation commences shall be in writing to Owner's Representative as a Request for Information (RFI).

D. Utility Coordination:

1. Maintain 6-inch minimum clearance between irrigation lines and any utility line. Do not install sprinkler lines directly above another utility of any kind.
2. Exercise care when excavating, trenching and working near existing utilities.

3.4 SITE PROTECTION

A. Protect landscaping, paving, structures, walls, footings, etc. from damage caused during work. Damage to work of another trade shall be reported at once.

B. Replace or repair any damage with same product or material, to the satisfaction of Owner's Representative at no additional cost to the Owner per Guarantee.

C. Route pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, provide proper root pruning and sealing methods to all roots 1-inch and larger.

3.5 EXCAVATION, TRENCHING, AND BACKFILLING

A. Notify and request approval from Owner's Representative if pipe pulling is the intended installation method. Pipe pulling is an accepted installation practice only under the following conditions:

1. Maximum pipe size 2 inches, and
2. Suitable soils (i.e. naturally rounded loamy soils without sharp rocks), and
3. Specified pipe burial depth can be maintained.

B. Pipe Trench:

1. Excavate trenches straight and true, minimizing site disturbance as possible.
2. Final trench bottom shall be undisturbed soil and shall be free of rocks and debris larger than 1 inch or with sharp edges. If trench base is unsuitable for laying pipe, over excavate 2 inches below pipe invert, and place Clean Sand or Stone.

C. Clean Backfill:

1. Material: Clean Sand (See Earth Materials)

a. Clean backfill must be free of foreign material, debris, frozen material and rocks larger than 1-inch.

2. Carefully place clean backfill a minimum depth of 10-inches over pipe and wire, tamp in place.
3. Carefully place material around pipe and wire, tamp in place.

D. Trench Backfill:

1. Material: Re-use excavated material

   a. Clean backfill must be free of foreign material, debris, frozen material, and rocks larger than 1-inch.

2. Place and compact in maximum 6-inch lifts to dry density equal to undisturbed soil. Compaction by truck or equipment tires is prohibited.
3. Avoid backfilling in hot weather.
4. Match adjacent subsurface grades without hills or depressions. Repair settling (as required by Guarantee).
5. If final planting soils, mulch, or sod were removed or disturbed during trenching, replace to match Project Specifications and regrade as necessary.

   a. Use sod cutter where applicable, or reseed disturbed areas to acceptance of Owner.

3.6 PIPE INSTALLATION

A. Copper Pipe Installation

1. All copper work within backflow enclosure shall be installed by licensed plumber.

B. PVC Pipe Installation

1. Cut plastic pipe with handsaw or pipe cutter, removing all burrs at cut ends. All pipe cuts shall be square and true. Bevel cut end as required to conform to manufacturer instructions.
2. Make all solvent-weld joints as per manufacturer's instructions and avoid applying excess primer or solvent. Do not wipe off excess solvent from each connection.

   a. Allow welded joints minimum 5 minutes set-up/curing time before moving or handling.

      1) Above 80ºF: Allow connections to set 24 hours
      2) Below 80ºF: Follow manufacturer instructions
      3) Below 40ºF: Prohibited

3. Maximum deflection per joint shall not exceed manufacturer limits.
4. Maintain 1-inch minimum between lines which cross at angels of 45 to 90 degrees

C. Pipe and wire shall run in same trench as mainline, at the elevation of the pipe invert (See Wire Installation).

D. Pipe Cover (unpaved surfaces):

   a. PVC Mainline = 22 inches
   b. PVC Lateral = 16 inches

E. Pipe Protection:

1. Prevent foreign material from entering pipe during installation.
2. Open ends of pipe shall be closed by watertight plug or seal when not in use.
3. Securely store pipe when not scheduled for installation.
4. Pipe shall not be installed when water is in trench, during rainstorms, or when temperature is below 40 ºF.

   a. No additional pipe may be installed or backfilled if water enters trench during pipe installation. Remove all water from trench before resuming installation.
   b. Pipe installed at temperatures below 40 ºF shall be removed and replaced at no cost to owner.

5. Trenched PVC pipe shall be snaked to accommodate for expansion and contraction due to changes in temperature.

3.7 PIPE SLEEVE INSTALLATION

A. Coordinate with Owner's Representative for provided pipe sleeves and locations installed by Earthwork Contractor.

B. New Pipe Sleeves:

1. Pipe Sleeve Cover: Minimum 24 inches
2. Install pipe sleeves where irrigation pipe runs under hardscape (see Construction Drawings).
3. Extend pipe sleeves minimum 18 inches beyond edges of hardscapes.
4. Prior to installation of pipe, pipe sleeve ends shall be field marked with vertical wood stakes extending above grade to allow field location during irrigation system installation.

C. Cutting through or jacking under new pavement shall be strictly prohibited. Failure to provide sleeves shall require notification to Owner's Representative for resolution.

3.8 ELECTRICAL CONDUIT INSTALLATION

1. Outdoor Electrical conduit shall be installed:

a. Under and through all hardscape areas
b. For all above ground wiring

2. Electrical conduit shall extend 18 inches beyond edges of hardscape.

3.9 ELECTRIC ZONE VALVE INSTALLATION

A. Install electric zone valves on level crushed stone base generally where shown on Construction Drawings. Do not pour stone around valves that are already installed.

B. Install all Schedule 80 PVC threaded nipples with Teflon tape, isolation valves, and/or union couplings in and out of electric zone valves as shown on details on Construction Drawings.

C. Set valves plumb with adjusting handle and all bolts, screws, and wiring accessible through valve box opening.

D. Install at sufficient depth to provide between 4-6 inches of cover from top of valve to finish grade.

E. Install specified valve box over all electric zone valves. Ensure lid is flush with final proposed grade (coordinate with Site Contractor).

F. Adjust zone valve operation after installation using flow control device on valve.

3.10 ISOLATION VALVE INSTALLATION

A. Install isolation valves per detail where indicated on Construction Drawings.

B. Install all isolation valves on level crushed stone base for operation ease with appropriate valve wrench. Do not pour stone around valves that are already installed.

C. Install specified valve box over all isolation valves. Ensure lid is flush with final proposed grade (coordinate with Site Contractor).

D. Check and tighten valve bonnet packing before valve box and backfill installation.

3.11 QUICK COUPLING VALVE INSTALLATION

A. Install quick coupling valves where indicated on Construction Drawings; generally, at ends of mainline branches and immediately downstream of well.

B. Mount mainline quick coupling valves on 1-inch diameter, 12-inch long brass swing joint

assemblies and stabilizers.

C. Where mainline pressure exceeds 60 psi, install pressure regulating valves to 40 psi off quick coupling valve service tee.

3.12 WIRE INSTALLATION

A. Install wiring per local codes for less than 30-Volt service.

B. Install valve wire in trench alongside mainline at invert elevation. Backfill carefully to avoid any damage to wire insulation on conductors.

1. In areas of unsuitable material, use clean sand in bottom of trench before placing wire (see Excavation, Trenching, and Backfilling)
2. Minimum cover: 12-inches

C. Maintain sufficient slack for expansion, contraction and servicing. Do not install wiring tightly.

1. Provide 30 inches slack between for valve wire in valve boxes.
2. Provide sufficient length of wire in valve boxes to allow valve solenoid, splice, wire, and all connections to be brought above grade for servicing.
3. Coil slack for neatness in valve box.

D. Provide waterproof splices at all in-ground wire connections using approved splice kits. All splices shall be made in valve boxes and recorded on Record Drawings.

E. Provide complete wiring diagram showing wire routing for connections between controller and valves as specified in Record Documents.

F. Securely store wire when not scheduled for installation.

3.13 GROUND INSTALLATION

A. Controller Grounding

1. Wire 6AWG Bare Copper Wire to Grounding Rod and Plate as shown on drawings.
2. Grounding Rod

a. Coordinate with Site Contractor to ensure no obstructions below grade at grounding rod site (Call 811 / DIG-SAFE if necessary)
b. Prepare valve box for grounding rod installation 8 feet from all valve boxes and electrical equipment. Drive 8-foot grounding rod into earth with 6 inches minimum below valve box lid.
c. Make Cadweld connection between bare copper wire from lightning arrestor splice to grounding rod lug.

3.14 SPRINKLER INSTALLATION

A. Sprinklers shall not exceed maximum spacing as indicated on Construction Drawings.

B. Install sprinklers flush with grade on PVC swing joints as specified.

C. Flush system before installing internals, flush caps, and nozzles (see Testing and Adjustments)

D. Adjust all sprinklers after installation using flow control device on valve. Do not exceed radius reduction recommendations from manufacturer.

3.15 VALVE BOX INSTALLATION

A. Furnish and install valve boxes as per valve schedule above for each valve, splice, or sensor.

B. Install valve boxes on minimum 4-inches crushed stone base. Pouring stone into valve box after installation is not acceptable.

C. Finish elevation of all boxes shall be at grade, unless otherwise noted in Drawings.

D. Provide level brick supports beneath valve boxes.

1. For square/rectangular boxes, provide four (4) supports - one at each corner.
2. For round boxes, provide three (3) supports equally spaced.

3.16 AUTOMATIC IRRIGATION CONTROLLER INSTALLATION

A. Controller

1. Controller located inside Stainless Steel Enclosure.
2. Wire valves and external sensors into controller through conduits and set proper programming.
    a. Program “Cycle-Soak” feature for all zones with sloped or poorly draining soils.
    b. Install and calibrate soil moisture sensors as per manufacturer instructions.
    c. Soil moisture sensors are not required for each irrigation zone. Assign representative soil moisture sensors for similar zones, such as:
        1) Sun vs. Shade
        2) Lawn vs. Plantings
        3) Heavy vs. Light Soils
3. Use Irrigation Plans provided for Recommended Quantity and Assignment
4. Using licensed electrical, wire controller to 120-Volt, 20-Amp electrical supply provided by Electrical Contractor.
5. Provide keys to Owner after final walkthrough.

B. Rain Sensors

1. Install sensors within Sensor Guard welded to irrigation controller enclosure. Wire sensor through Sensor Guard, through enclosure, and into Controller.
2. Exposed sensor wire shall be installed within ½-inch galvanized conduit, where applicable.
3. Rain Sensor shall have direct overhead exposure to atmospheric conditions and not in contact with overhead irrigation.

C. Grounding

1. Provide outdoor grounding for irrigation controller with grounding rod and grounding plate. Refer to Ground Installation and Construction Drawings details for installation steps.

3.17 TESTING AND ADJUSTMENTS

A. Include all testing and adjustments in submitted bid price.

B. System Flushing:

1. Open electric zone valves and flush out irrigation system under full head of water before installing sprinkler internals, flush caps, and nozzles.
2. Flush entire irrigation system after complete installation.
3. Clogged nozzles shall be remedied after completion of irrigation system.

C. Testing:

1. Test all pipe and valves for leaks at operating pressure. Repair all leaks and retest until leaks are remedied.
2. Perform coverage test with Owner’s Representative present. Operate electric zone valves for five (5) minutes minimum during coverage test. Readjust sprinkler nozzles and head locations (as necessary) to attain proper coverage. Replace any equipment that does not meet specified standards.
3. After testing, clean all equipment of debris during installation.

D. Adjust sprinkler heads and valve boxes as necessary for mowing and landscaping.

E. Throughout guarantee period, adjust sprinklers and ensure coverage due to settlement and landscaping operations.

3.18 RECORD DOCUMENTS

A. Record (As-Built) Drawings

1. Maintain and update Record Drawings with red-line markings as project progresses, including locations of:
    a. Sprinklers and descriptions (nozzle, pop-up height, and type)
    b. Valve Boxes and descriptions (valve type, zone numbers, splice, etc.)
    c. All equipment installed with distinct symbols
    d. Pipe routing and tees
    e. Wire routing and splices
2. Locations of installed equipment (valve, controller, sensors) shall be referenced by two permanent locations (swing ties) or GPS.
3. Make all notes legible as work progresses, any new equipment added shall use distinct symbols denoting location.
4. Document any changes from original Construction Drawings.
5. Prints of original Construction Drawings may be obtained from the Owner's Representative at cost (0% markup).
6. Record Drawings shall be used as basis of payment for work completed. Provide copies of red-lined set to Owner's Representative along with payment request.

B. Record Documents

1. Record Documents shall be on-site at all times. Maintain record of the following as the project progresses:
    a. Materials Approved and approval date
    b. Pressure Test results, testing personnel and testing date.
    c. Materials delivered, Accepted, and Installed by whom and date.
    d. Field Communications and Requests for Information (RFI)

C. Prior to final punchlist, provide complete electronic and hard copy files of Record Drawings and Documents to Owner's Representative as part of project completion. All information must be complete and shall be added to submitted documents prior to acceptance.

3.19 OPERATION AND MAINTENANCE

A. General

1. Bid price shall include up to four (4) hours of irrigation system overview and instruction with Owner and/or Owner's Representative.

B. Operation and Maintenance Manual

1. Provide three (3) hard cover binders titled "Operation and Maintenance for Indian Hill Park Irrigation System" prior to application for acceptance and final payment.
2. Operation and Maintenance Manual shall include, but not be limited to:
    a. Title Page and Table of Contents
    b. One-Paragraph Written Description of Irrigation System
    c. Manufacturers' Data and Cut Sheets of Equipment, including:
        1) Copies of all approved submittals
        2) Wire resistance readings to each electric valve at completion (for future troubleshooting)
        3) Recommended operating settings
        4) Recommended maintenance schedule
        5) Name, address, and telephone number of installer (for repairs, spring startup, and winterization during 1-year guarantee period)

6) Irrigation program for periods without rain and recommended settings including, zone run time, days per week, cycle-soak, and rain sensor suspension.
7) Hydrawise (Weather Network) settings, login, and troubleshooting

d. Winterization and Spring Startup Instructions (after 1-year guarantee period)
e. Guarantee Data
f. Pockets with Folded Plans of:

1) Original Design Drawing
2) Final Record Drawing
3) Controller Valve and Wiring System Diagram Drawing
4) Stop-and-Waste Valve Locations

3.20 SITE CLEANUP

A. Remove all unused materials and equipment from project site safely and efficiently. Dispose of all unused materials legally - including construction debris and trash.

B. Adjust ground, compact, and re-plant around irrigation sprinkler heads and trenches as necessary for proper angle and elevation.

C. Fill all depressions, erosion rills, tire tracks, etc. with proper planting soil mix to ensure site drainage.

3.21 FINAL OWNER ACCEPTANCE

A. Final Owner Acceptance of Irrigation System is predicated on:

1. Complete system installation, adjustment, testing, and instructional overview.
2. Submission of Operation and Maintenance Manuals to Owner's Representative.
3. Proper Programming and Internet Connection of Automatic Irrigation Controller
4. Completed and approved all punchlist items.

B. Owner and/or Owner's Representative shall provide written notice (hard copy and/or electronic) for Final Acceptance. Date of Final Acceptance notice shall serve as start of 1-year Guarantee period as described above.

END OF SECTION

SECTION 329000
PLANTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Provide all facilities, labor, materials, tools, equipment, appliances, transportation, supervision, and related work necessary to complete the work specified in this section, and as shown on the Drawings.

B. The work of this section includes the planting work as indicated on the drawings and/or as specified herein. Information on plant species, sizes, locations, and planting details are located in the drawings. The work shall include but not be limited to the provision and installation of trees shrubs, and groundcover plants, and associated staking, fertilizing, backfill soil mix, one-year maintenance contract, clean-up, and guarantee.

1.03 RELATED SECTIONS

A. Sections which directly relate to the work of this Section include:

1. Section 310000 – Earthwork
2. Section 312500 - Erosion and Sediment Control
3. Section 329219 – Loaming and Seeding

1.04 REFERENCE STANDARDS

A. References herein to any technical society, organization, group or body are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this section shall conform to the latest edition as applicable:

NAA -	National Arborist Association, 3537 Stratford Road, Wantagh, New York, 1793, USA, as published in Standards for Pruning Shade Trees, 1979, or latest edition (for pruning standards).
ASNS -	American Standard for Nursery Stock prepared by the American Association of Nurserymen, latest edition.
MHDSSHB-	Massachusetts Highway Department Standard Specifications for Highways and Bridges as most recently amended
AOAC -	Association of Official Agricultural Chemists
SPN -	Standardized Plant Names as Designated by the American Joint Committee on Horticultural Nomenclature
ANSI -	American National Standard Institute

1.05 LAWS AND REGULATIONS

A. Do not close or obstruct any street, sidewalk, alley or passageway without prior notification and permission. Conduct operations as to interfere as little as possible with the use ordinarily made of roads, driveways, alleys, sidewalks, or other facilities near enough to the Work to be affected thereby.

B. Contractor shall verify all utility locations and elevations prior to excavation. The Contractor shall be responsible for any damages done by himself or his workmen to existing utilities, which shall be repaired or paid for by the Contractor. Before construction starts, all utility companies, public and private, must be contacted including those in control of utilities not shown on the plans. Contractor must contact Dig Safe at 1-888-344-7233, seventy-two (72) hours prior to any excavation. Report any discrepancies in writing to the Owners Representative and receive written instructions prior to proceeding.

1.06 SUBMITTALS

A. Plant Material Availability Confirmation: At least 60 days prior to anticipated planting, the Contractor shall submit a confirmation of availability for all plants on the list, accompanied by nursery sources. No substitutions shall be made without the written consent of the Owners Representative.

B. Tagging Schedule: At least 30 days prior to planting, the Contractor shall submit a schedule for tagging material to the Owners Representative. Once tagged, the Contractor shall provide written documentation to the Owners Representative that trees have been paid for or a retainer has been placed on the plant material to ensure that the nursery will hold the plants until planting operations can begin. If, due to schedule delays, the planting will be delayed and the plant material needs to be released, the Contractor shall submit the request to release material in writing, for approval of the Owners Representative. No plant material shall be released without approval in writing from the Owners Representative.

C. Manufacturers Product Data

1. Specification confirmation:
   Instructions: Submit material specifications, manufacturer's literature and installation instructions where applicable attesting that the following materials meet the requirements specified:
   a. Fertilizer
   b. Anti-desiccant
   c. Weed block fabric
   d. Mulch
   e. Stakes
   f. Soil Amendments

D. Samples

1. Submit the following samples:

   a. Bark Mulch - 1/2 cubic foot sample in sealed container

   b. Loam borrow - 1/2 cubic foot sample in sealed container

E. Soil Test Reports

1. See Section 329219 – Loaming and Seeding, for requirements.

2. Written approval of loam borrow shall be obtained prior to delivery of any materials to the site.

F. Certificates

1. A Certificate of Compliance to the specifications shall be submitted by the nursery grower with each shipment of each type of plant, certifying that plants meet the genus, species and cultivator type specified on the plant list and have been grown in Zone 5 or hardier conditions.

2. Massachusetts Certified Arborist - submit certification number and qualifications. G.

Maintenance Manual

1. The landscape contractor shall submit a written manual, prepared for the Owner that outlines a schedule for proper maintenance of the plantings. This schedule should include timing and methods for watering, fertilization, mulching, pruning and other maintenance operations to be conducted after the one-year maintenance contract period.

H. Submittal Schedule

1. Before installation:

a. Schedule b. Samples
c. Manufacturer's Product Data
d. Soil Test Reports
e. Plant Availability Confirmation
f. Tagging Schedule
g. Plant Certification
h. Arborist information

2. After installation and before acceptance:

a. Maintenance Manual.

1.07 QUALITY ASSURANCE

A. Loam/Topsoil: Landscape Contractor shall be responsible for screening, amending and spreading of loam and/or existing topsoil (if available).

B. 2. Plant Approval: All plants will be subject to the approval of the Owners Representative. Plants shall be inspected at the grower's nursery and upon delivery at the site for conformity to specification requirements. Approval of plants at the source does not alter the right of inspection and rejection at the site, or during the progress of the work. Rejected plants shall be removed immediately from the site. A Landscape Contractor's representative shall be present at all inspections. The Owners

Representative shall provide plastic tags for marking the plants that are selected. All plants on the Plant List shall be pre-selected by the Landscape Contractor to ensure that plants of specified size and species are available at the nursery before the plant selection trip is scheduled. Unless otherwise specified, inspection outside the Commonwealth of Massachusetts shall be made at the expense of the Landscape Contractor, including transportation, accommodations and meals. If, at the discretion of the Owner, nursery tagging and review of the plant materials during delivery at the site are waived, the Contractor is still obligated to supply materials that meet or exceed the quality as established by these specifications.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver plant materials to site in healthy and undamaged condition. Tree trunks shall be protected during shipping by a heavy walled cardboard sleeve or other suitable material. Plants shall either be shipped in enclosed trucks, or all surfaces, leaves and branches shall be wrapped to prevent damage and desiccation.

B. Rootballs shall be moist upon arrival and shall be kept moist until installation. All balled and burlapped plants that cannot be planted at once must be heeled in by setting them in the ground, covering the rootballs with soil, and watering them adequately.

C. All plants on-site shall meet the requirements specified on the planting plan. Any plant material on site which does not meet the criteria specified shall be replaced with approved plants at the Contractor's expense. Prior approval of plants at the source shall not alter the right of inspection or rejection at the site or during the progress of the work.

D. Only move plant material with solid balls wrapped in burlap or synthetic wrapping or in wire baskets.

E. Deliver plant materials immediately prior to placement. Keep plant materials moist. As required by temperature or wind conditions, apply anti-desiccant emulsion to prevent drying out of plant materials. If installation is delayed more than six (6) hours after delivery, store plants in shade and cover rootballs with mulch. Plants shall not be stored on pavement. Plants shall be watered daily.

F. Reject plants when ball of earth surrounding roots has been cracked or broken prior to, or during, process of planting.

G. Reject plants when burlap, staves and ropes required in connection with transplanting have been displaced.

1.09 GUARANTEE

A. The contractor shall warranty trees, shrubs and groundcover for a period of one (1) year after date of issuance of the “Substantial Completion”, against defects including dead and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer’s control.

B. Replace plant materials found dead or not in a healthy growing condition. Plants shall exhibit healthy branching and foliage, and be free of insect or disease damage. Replace plants during normal planting season.

C. Replacements: Plant materials of same size and species, with a new warranty commencing on date of replacement. The Owners Representative shall be given a five (5) day notice of installation of replacement plants to allow inspection of plant material.

1.10 INSPECTION FOR ACCEPTANCE

A. After the initial ninety (90) days of the maintenance period, the Contractor shall request the Owners Representative, in writing, for an inspection to determine whether the plant material is acceptable. If the plant material and workmanship are acceptable, written notice will be given by the Owners Representative to the Contractor stating that the guarantee period begins from the date of the certificate of Substantial Completion.

B. If a substantial number of plants are sickly and dead at the time of inspection, acceptance will not be granted, and the Contractor's responsibility for maintenance of all the plants shall be extended until replacements are made. All dead and unsatisfactory plants shall be promptly removed from the project. Replacements shall conform in all respects to the specification for new plants and shall be planted in the same manner.

PART 2 - PRODUCTS

2.01 PLANT MATERIAL

A. The Contractor shall furnish and plant all plants shown on the drawings. Plants shall conform to measurements and species designated on plant list and standards as established in American Standard for Nursery Stock ANSI Z60.1-1996 or as most recently amended. All plants shall be typical of their species or variety in growth habit. Plant sizes, habit rootballs, and containers shall be in accordance with the American Standard for Nursery Stock (ASNS, latest edition), Standards of the American Association of Nurserymen (AAN) as a minimum requirement for acceptance. No substitutions will be accepted, without prior approval of the Owners Representative. Such requests shall be made at least one (1) month prior to nursery inspections. Requests shall list at least five (5) major nursery sources contacted for confirmation of unavailability.

B. All plant material shall be nursery grown and shall be shapely, well-grown, healthy, sound and free of disease, insect pests, eggs or larvae, and shall have a well developed root system. All plants shall be typical of their species or variety and shall have a normal habit of growth. They shall conform to the trade classification of "heavy specimen".

C. All trees and shrubs shall be freshly dug; no heeled-in plants and no plants from cold storage will be accepted. Plants shall have been transplanted or root pruned at least once in the last 3 years. All plants shall be hardy under climatic conditions similar to those in the locality of the project. All plant materials shall be properly identified by name on legible, weatherproof labels securely attached thereto.

D. Deciduous Trees: Provide trees of height and aliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.

The height of trees (measured from the crown of the roots to the tip of the top branch) shall not be less than the minimum size designated. Take caliper measurement 6 inches above ground level. The trunk of each tree shall be a single trunk growing from a single un-mutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire and other causes. No pruning wounds shall be present having a diameter exceeding two inches and such wounds must show vigorous bark on all edges. Plants shall not be pruned prior to delivery.

E. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required. Shrubs shall meet the requirements for spread or height specified in the "Plant Schedule".

The measurements for height shall be taken from the ground level to the average height of the shrub and not to the longest branch. The thickness of each shrub shall correspond to the trade classification "No. 1." Single stemmed or thin plants will not be accepted. The side branches must be generous, well twigged, and the plant as a whole well branched to the ground. The plants must be in a moist vigorous condition, free from dead wood, bruises, or other root or branch injuries. Plants shall not be pruned prior to delivery.

F. Coniferous and Broad-leafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.

G. Ground cover plants, vines, and perennials: shall be of size, age and/or condition listed in the "Plant Schedule". Plants shall be healthy, free of insects and diseases. Ground cover plants shall be potted. Perennials shall be container-grown. Vines shall be balled and burlapped or container-grown.Provide plants established and well rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size shown or listed.

H. Container-grown stock shall have been in a container long enough for the root system to have developed sufficiently to hold its soil together firm and whole, and hold planting mix intact after removal from containers without being root-bound.

I. Plants that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected

J. Trees which have a damaged or crooked leader, or multiple leaders, will be rejected. Trees with abrasion of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 1 ¼ inches that have not completely calloused, will be rejected.

K. Certificates of inspection shall accompany the invoice for each shipment of plants as may be required by laws for transportation. File certificates with the construction manager prior to unloading of the material. Inspection at place of growth does not preclude rejection of the plants at the site.

L. Plant material which, under special conditions, is approved in advance by Owners Representative to be planted after the specified seasons for planting shall be dug during the normal season for digging of the particular plant material and be stored and maintained

in good health until planting. The Contractor shall assume all costs for maintaining plant material while it is being stored.

M. Plant List - If there is any discrepancy between quantities shown on the Plant List and work shown on the drawings, the Landscape Contractor shall supply the plants necessary to complete the work as intended on the drawings. Where the size of a plant on the Plant List is a variation between a min. and max. dimension, the sizes of the plants furnished will be equal to the average of the two dimensions. Where a single dimension is given, this dimension represents the minimum size of the plants to be furnished.

2.02 TOPSOIL

A. The landscape contractor shall be responsible for screening, amending and spreading existing topsoil.

B. Utilize previously stripped and stockpiled topsoil prior to obtaining additional loam borrow from off-site sources. If quantity of stockpiled topsoil is insufficient, provide additional loam borrow as required to complete the landscape work at no additional cost to the Owner.

1. Topsoil, which has been stockpiled on the site, may be used provided it can be made to comply with these Specifications herein for loam borrow/planting soil and as outlined in Section 329219 – Loaming and Seeding.

2.03 LOAM BOROW

A. The Contractor shall provide loam borrow, as outlined in Section 329219 – Loaming and Seedi
ng.

2.04 SOIL AMENDMENTS FOR PLANTING SOIL

A. See Section 329219 – Loaming and Seeding, Part 2 - for soil amendments.

B. Planting Soil for backfilling around plant roots shall be prepared by the Contractor as specified herein.

2.05 PLANT BACKFILL MIXTURE

A. Topsoil/loam, organic material and bonemeal for plant backfill (planting soil) for both planting beds and individual plants shall be thoroughly premixed in the proportions of one (1) part of organic material with seven (7) parts of loam together with ten (10) pounds of bonemeal per cubic yard of mixture or as directed by the Owners Representative.

B. The plant backfill mixture shall have an acidity range of between 5.5 pH and 7.0 pH.

2.06 MULCH

A. Native shredded hemlock bark, 100 percent organic, aged at least one (1) year, having a moisture content not exceeding 40 percent, free of any disease, insects, and shall pass a
1-inch square mesh and be retained on a 1/8-inch square mesh. Mulch shall not

contain pieces more than 1/4-inch thick or an excess of fine particles. Mulch shall be dark brown in color, not and not be orange brown in color.

2.07 WATER

A. Water shall be furnished by the Contractor and shall be potable and suitable for irrigation and free from ingredients harmful to plant life.Hose and other watering equipment required for the work shall be furnished by the Contractor.

B. Automatic tree watering shall be provided by the use of 20 Gallon sized drip tree bag such as “Tree Gator”, “Ooze Tube”, “Tree Camel Bag”, or approved equal. Provide one bag for each installed tree. Cost of drip tree bag shall be incidental to the planting price.

2.08 WEED BLOCK FABRIC

A. A weed block fabric that is easily permeable by water but inhibits the growth of weeds shall be provided by the Contractor as indicated in the drawings.

2.09 STAKING MATERIALS

A. Staking shall be at the discretion of the Owners Representative.

B. Wire and hose shall NOT be used for staking and guying. Arbortape, or equal, shall be used to fasten trees to stakes.

C. Stakes shall be 2’ x 2” minimum hardwood stakes, pointed at one end. Length shall be 8’ minimum.

2.10 ANTI-DESICCANT

A. Anti-desiccant emulsion which provides a protective film over plant surfaces, permeable enough to permit transpiration, delivered in containers with manufacturer's directions. Anti-Desiccant shall be "Wiltpruf", manufactured by Nursery Specialty Products, Inc., Stubbins Road, Groton Falls, New York, or approved equal. Apply according to manufacturer's recommendations.

PART 3 – EXECUTION

3.01 INSPECTION OF PLANTING AREAS

A. All planting areas shall be inspected by Contractor before starting work.

B. Any defects, such as incorrect grading, etc., shall be reported to the Owners Representative prior to beginning work.

C. Commencement of work by Contractor indicates acceptance of and full responsibility for planting areas.

3.02 PLANTING DATES

A. Plant within the following dates:

1. Evergreen trees and shrubs:
    a. Spring: April 15 - June 1
    b. Fall: September 1 - November 1

2. Deciduous trees and shrubs:
    a. Spring: April 1 - June 15
    b. Fall: October 1 - November 15

3. Planting shall be prohibited in frozen or muddy ground.

B. Special conditions may warrant a variance in the above dates. Contractor shall notify the Owners Representative of the conditions and the proposed variance. Permission will be given if the variance is warranted.

C. Approximate planting dates schedule shall be furnished by Contractor to the Owners Representative for approval. Material planted out-of-season shall be given extra care and attention by the Contractor.

D. Contractor shall schedule tree selection and digging operations so as to comply with nursery industry recognition of “Spring Dig Only”/“Fall Hazard” plant materials. No substitutions of plant materials will be allowed for fall planting based on unavailability due to the “Spring Dig Only”/“Fall Hazard” restrictions. Contractor shall have selected and had the material dug during the previous spring or shall obtain material from a nursery skilled at fall digging.

3.03 PREPARATION OF PLANTING BACKFILL MIXTURE

A. Mix specified soil amendments and fertilizers with topsoil and/or loam borrow, prior to spreading, at rates specified by testing agency and Owners Representative. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days. Thoroughly and evenly incorporate amendments throughout the soil by approved methods.

B. Topsoil/loam, organic material and bonemeal for plant backfill for both planting beds and individual plants shall be thoroughly premixed in the proportions of one (1) part of organic material with seven (7) parts of loam together with ten (10) pounds of bonemeal per cubic yard of mixture or directed by the Owners Representative.

C. For pit and trench type backfill, mix amendments into planting soil prior to backfilling, to assure an evenly blended mixture.

D. For planting beds, mix amendments for planting soil prior to planting.

1. Mix lime with dry soil prior to mixing of fertilizer.
2. Prevent lime from contacting roots of acid-loving plants.
3. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

E. Maintain at all times during the planting operations one or more stockpiles of approved planting soil.

3.04 EXCAVATION OF TREE PITS AND PLANTING BEDS

A. Stake out on the ground locations for trees and outlines of all planting beds. Obtain approval of Owners Representative before excavation.

B. If rock, utilities, underground construction work, tree roots or obstructions are encountered in the excavation of shrub beds and tree pits, alternate locations may be selected by consulting with the Owners Representative.

C. Prior to excavation of tree pits, Contractor shall remove soil and wrapping covering trunk flare, and measure between trunk flare and bottom of root ball to determine minimum depth of tree pit excavation for each tree.

D. Excavate tree pits and planting beds to depths required by drawings. Remove subsoil and dispose of properly. Do not mix with planting soil or use as backfill. Tree pits shall be circular in outline. Tree pits shall be three times wider than the root ball diameter. Planting beds for shrubs shall be continuous and continue for at least 18 inches from the edge of ball. Scarify bottom and edges of pit.

E. Test drainage of planting beds and pits by filling with water twice in succession. Owner's representative shall be present at time of testing. Conditions permitting the retention of water for more than 24 hours shall be brought to attention of the Owners Representative.

F. Notify the Owners Representative in writing of all soil or drainage conditions which the Contractor considers detrimental to growth of plant material.

3.05 PLANTING

A. Remove all wrappings so that the plant canopy and stems and trunks may be reviewed for damage or disease.

B. Place trees in the center of the holes. Set the trunk flare of the plant 2-3" above finish grade.

C. Cut and remove all ropes, wires, burlap, synthetic wrap, and wire baskets completely from root balls and dispose of offsite. Owner's Representative shall be shown root balls freed from containment materials prior to backfilling.

D. Set plant plumb, turned to face best side of plant for optimal viewing, and brace firmly in position. Loosen surface soil of root ball and comb out any exposed roots. Prune all broken or girdling roots.

E. Use planting mix to backfill plant pits. Planting mix shall be a minimum of 12" deep within planting/shrub bed areas. See Drawings for specific depths. Place planting mix in layers not to exceed 8 inches. When plant pits have been backfilled approximately two-thirds full, water thoroughly before installing remainder of the planting soil to eliminate air pockets. Add remainder of backfill. Using the end of a shovel handle, push handle into soil at a 45degree angle down into backfill to provide water access to eliminate air pockets. Holes should be provided around circumference of root ball. Add water until soil is thoroughly saturated.

F. Score or butterfly-cut rootball of all container grown plants prior to planting.

G. Form 3" deep soil saucers around tree pits and shrub beds.

H. Water all plants immediately after planting. All plants shall be flooded with water twice within first 24 hours of planting.

I. Install weed block fabric as called for in the drawings and mulch all pits and beds to depth indicated in details immediately after first watering. Depth shall be measured after settlement. No mulch shall be applied prior to first watering of plants.

J. Plants shall not be wrapped after installation. A shade barrier of plastic mesh shall be placed at the base of all trees whose flares were covered with soil to prevent sunscald on the newly exposed bark. Mesh shall be at 12" in height and shall not come into contact with the truck.

3.06 TREE SUPPORT

A. Firmly stake or guy all trees immediately after planting. Plants shall stand plumb after staking or guying. Stakes shall be plumb and neat, and installed in accordance with the details.

B. Support plants upright in position by guy arbor tape and stakes.

C. Upright stakes shall penetrate at least 18 inches below bottom of backfilled excavation and extend at least 72 inches above grade.

3.07 PRUNING

A. Each tree and shrub shall be pruned by a Massachusetts Certified Arborist in accordance with American Nurserymen Association standards to preserve the natural character of the plant and in a manner to meet its particular requirements in the landscape.

B. Pruning and trimming shall include the following:

1. Remove all dead wood, suckers and broken or badly bruised branches. Never cut a leader.

2. Prune to preserve natural character of plant.

3. Use only clean, sharp tools.

4. Disinfect tools between each plant

a. Wound shall not be painted.

b. Apply anti-desiccant to foliage if conditions warrant as deemed appropriate by Landscape Contractor or Owners Representative.

C. Time of Pruning:

1. At installation: pruning shall consist of removing dead branches, and broken or badly bruised branches.

2. Near end of Guarantee Period: prune as noted in A, above and to remove rubbing branches etc.

3.08 CLEAN-UP

A. Soil or other material brought onto paved areas shall be promptly removed. Keep paved areas clean at all times.

B. Upon completion of work under this section, all excess stones, debris and soil resulting from planting work shall be cleaned up and removed from the project site.

C. Broom and hose clean all pavements.

D. Repair any damage to site or structures to restore them to original condition at no additional cost to the Owner.

3.09 MAINTENANCE AND PROTECTION OF PLANTINGS

A. Maintenance shall begin immediately after each plant is planted and shall continue until final acceptance, but in no case less than one year after substantial completion of planting.

B. Maintenance shall include but not be limited to the following:

1. Maintenance of new planting shall consist of pruning, watering, cultivating, weeding, mulching, tightening and repairing of stakes or guys, resetting plants to proper grades or upright position, restoration of the planting saucer and furnishing and applying such sprays as are necessary to keep the planting free of insects and disease.

2. Planting areas and plants shall be protected at all times against trespassing and damage of all kinds for the duration of the maintenance period. If any plants become damaged or injured, they shall be treated or replaced as directed at no additional cost.

3. All plantings shall be watered at least twice per week (April through November) during maintenance period. At each watering the soil around each tree or shrub shall be thoroughly saturated. If sufficient moisture is retained in the soil, as determined by the Owners Representative, the required watering may be reduced.

C. The Contractor shall provide a maintenance manual for all plant material under his direction. This manual shall contain all necessary maintenance and scheduling information which will enable the Owner to maintain new plantings in a vigorous condition. Before planting work is completed, one copy of the manual is to be submitted to the Owners Representative for approval. Before the acceptance of the planting work, two copies of the manual shall be furnished to the Owner for his future reference. The Owners Representative may require re-submittals of the Owner maintenance manual if it is determined that the information provided is not sufficient to allow for proper maintenance.

3.10 REJECTION AND REPLACEMENT

A. Promptly remove rejected plant material from site.

B. Replace as soon as planting conditions permit all such rejected material with plants

of same species and of the quality stated in Contract documents.

3.11 ONE YEAR GUARANTEE AND INSPECTIONS

A. One year after the date of substantial completion, the Contractor, at the request of the Owner, shall arrange for a meeting with the Owners Representative to review the condition of the plantings. Prior to the meeting, the Contractor shall remove tree support systems and tags on plants. The Contractor's certified arborist shall provide final pruning of trees for shape and form and to remove items such as crossing branches, dead or broken branches. Any disease or insect pests, eggs or larvae shall be treated/ removed. A letter from the arborist certifying the above has been completed shall be provided with the meeting request. The Owners Representative will provide a written report on the results of the inspection. At the Owner's discretion, the Contractor shall replace any dead or unhealthy plants at this time or provide a credit to the Owner.

END OF SECTION

SECTION 329219
LOAMING AND SEEDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Project Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Provide all labor, materials, equipment, transportation and perform all services and operations necessary to complete the work of this section as indicated within the drawings and specified herein which shall include, but is not limited to, the following:

1. Providing screened loam
2. Processing and re-use of topsoil stripped from site and stockpiled
3. Fine grading
4. Providing and incorporating all fertilizers and additives as necessary
5. Hydroseeding and Seeding
6. Erosion Control Matting
7. Repairing lawn areas disturbed by Contractor's operations
8. Maintenance including watering, mowing, and over-seeding until accepted by Owner.

B. After approval of rough grading, loam shall be placed on all areas affected by the Contractor's operations, (unless shown in the drawings to be finished with other surface treatments such as pavement, stone dust, synthetic turf, etc.)

1.03 RELATED SECTIONS

A. Section 310000 – Earthwork, for rough grading required to establish elevations indicated on drawings.
B. Section 312500 – Erosion and Sedimentation Control
C. Section 328000 – Landscape Irrigation

1.04 REFERENCE STANDARDS

A. USDA Standards for determining soil characteristics

B. Current Standards of the Association of Official Analytical Chemists, (AOAC International)

1.05 QUALITY ASSURANCE

A. The Contractor must be a member in good standing of the Associated Landscape Contractors of America.

B. The Contractor must show previous evidence of having successfully installed and maintained landscape projects of similar scope to the subject project with regard to quantities of loaming and seeding involved, complexity and a minimum of five (5) years' experience on projects similar to this one. The Owner's Representative shall have the right to review the qualifications and references of the Contractor for approval to work on this project.

C. Source Quality Control:

1. Analysis and standards: For packaged products, provide with manufacturers certified product analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Analytical Chemists, wherever applicable.

1.06 S U B M I T T A L S

A. SAMPLES/ TESTING: The Contractor shall furnish a Certified Laboratory Report documenting the soils USDA textural classification and nutrient analysis of representative samples of the Loam proposed to be used, including the extent of nutrient and pH adjustments required. Samples submitted for approval must be representative of the total volume to be furnished, taken in the presence of the Owners Representative, and delivered to a certified laboratory by the Contractor; all costs for such shall be borne by the Contractor.

1. The Laboratory shall conduct tests for: standard fertility with extractable nutrient levels (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, B lead and aluminum), pH, organic matter concentration, soluble salts, and for traces of other heavy metals or hazardous materials.

2. If the material does not conform to the requirements here-in it shall be rejected and additional sources shall be found. Sampling and testing shall be accomplished as specified until an approved material is found, all at the Contractor's expense.

3. The Contractor shall seek confirmation with the Owners Representative that the screened loam proposed to be used is acceptable, at least three weeks prior to the planned date for spreading loam. The Contractor shall submit to the Owner a one (1) cubic foot representative sample, address of the sources, and certified test results for loam materials.

B. Based upon the Soil amendment and fertilizer recommendations from the Testing Laboratory, the Contractor shall provide two marked up prints to the Owners Representative indicating square footages for all lawn areas with quantities of all soil additives for each area, prior to beginning work.

C. Seed Mixes: The Contractor shall submit manufacturers' seed mix composition as specified, to the Owners Representative for approval.

D. Sod: statement of composition percentages of purity and germination of each grass species variety.

E. Catalogue cuts of proposed Slope protection materials, erosion control blanket or matting, shall be submitted by Contractor for approval by the Owners Representative.

F. Provide watering, fertilizing, mowing, and over-seeding schedule to Owners Representative for approval, following installation of seed.

G. No material shall be ordered or delivered until the required submittals have been submitted and approved by the Owner Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner reserves the right to reject, on or after delivery, any material that does not meet these specifications.

1.07 EXISTING TOPSOIL STRIPPED FROM THE SITE

A. Existing Topsoil stockpiled on-site may be used provided it is screened and can be made to comply with the specifications herein for screened loam. Two (2) test samples shall be taken and analyzed from each potential existing topsoil stockpile on site. Site of samples shall comply with testing lab requirements. Contractor shall deliver samples to testing laboratory, have testing report sent directly to the Owner's Representative and pay all costs. Report shall be submitted at least one (1) month before any loaming is to be done.

1. Textural and chemical analysis shall be by a public extension service agency or a certified private testing laboratory in accordance with the current "Standards" of the Association of Official Analytical Chemists and acceptable to the Owners Representative.

2. Soil test report shall include a mechanical sieve analysis with soil classification. Organic content shall be reported. Chemical analysis shall include pH (1:1 soil-water ratio), buffer pH, Soluble Salts (1:2 soil-water ratio), Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Aluminum, Magnesium, Manganese, Ferric Iron and Sulfate.

3. Test report shall clearly recommend appropriate limestone and fertilizer requirements.

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver all items to the site in their original containers with all labels intact and legible at time of Owner's inspection.

B. Immediately remove from the site all seeding materials, which are not true to name, and all materials, which do not comply with the provisions of this Section of these Specifications.

C. Use all means necessary to protect seeding materials before, during, and after installation and to protect the installed work and materials of all other trades.

D. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

PART 2 – PRODUCTS

2.01 SCREENED LOAM

A. Screened Loam shall be "coarse sandy loam" determined by mechanical analysis (ASTM D-422) and based on the "USDA" Classification System". Screened Loam has the following mechanical analysis:

Textural Class	Percentage of Total Weight Percentage	Average
Sand (0.05 – 2.0mm dia. range)	45 – 75	60
Silt (0.002 – 0.05mm dia range)	15 – 35	25
Clay (Less than 0.002mm dia. range)	5 – 20	15

Coarse Sandy loam shall have: less than 30% fine /very fine sand, and 50% or more medium/coarse/very coarse sand.

B. Screened Loam shall be a natural, fertile, friable product consisting primarily of natural topsoil, free from subsoil, and obtained from naturally well-drained areas which has never been stripped. It shall not be delivered when in a wet or frozen condition. Screened Loam shall have the following characteristics:

1. Screened Loam shall not contain less than 5 percent nor more than 15 percent organic matter as determined by the loss on ignition of oven-dried samples, at 100°C ± 5°C. To adjust organic matter content, the soil may be amended, prior to delivery or use, by the addition of composted organic matter or peat moss, well-blended into the soil mix.

2 . It shall be capable of sustaining vigorous plant growth.

3. Screened Loam shall be without admixture of subsoil, and refuse, resulting in a homogeneous material free of stones greater than ½" in the longest dimension, be free of lumps, plants, glass, roots, sticks, excessive stone content, debris, and extraneous matter as determined by the Owners Representative.

4. It shall fall within the pH range of 6.0 to 6.5 except as where noted on plans and planting details. If limestone is required to amend the screened loam to bring it within a pH range of 6.0 to 6.5, no more than 200 pounds of limestone per 1,000 cubic feet of loam, incorporated into the soil, or 50 pounds of limestone per 1,000 square feet of loam surface shall be applied within a single season.

5 . It shall be uncontaminated by salt water, foreign matter and substances harmful lto plant growth. The maximum soluble salt index shall be 100. Screened Loam shall not have levels of aluminum great than 200 parts per million and be free of heavy metals in concentrations hazardous to human health.

C. The Owner will reject any material delivered to the site that, after post-delivery testing, does not meet these specifications. If the delivered screened loam does not meet the specifications stated in this specification, the delivered screened loam will be removed by the contractor at

the contractors expense and at the time of rejection.

D. The Contractor shall take representative samples of topsoil from the site and from screened loam to be hauled in and shall submit samples to a Soil Testing Laboratory for chemical analysis, and physical analysis. The Contractor shall indicate to the testing agencies that turf is to be planted and who the Owner is. The Contractor shall forward to the Owner two copies of analysis and recommendations of the testing agencies.

E. Topsoil, which has been stockpiled on the site, may be used provided it can be made to comply with these Specifications herein for screened loam.

F. All loam provided from off-site sources shall be brought to the site meeting all specification requirements. No loam shall be spread prior to screening.

G. To assure screened loam borrow purchased and topsoil stockpiled fulfills specified requirements regarding textural analysis, organic matter content, and pH, the soil testing results shall be obtained by the Contractor and submitted to the Owner's Representative for approval one (1) month before any loam is delivered to the site.

2.02 SOIL ADDITIVES

A. Fertilizer, compost, humus, peat or other soil additives shall be used to address soil deficiencies as recommended by the soil analysis and as directed by the Owner's Representative.

B. Fertilizer: shall be commercial fertilizer, 10-8-4 U.F., and be a mixture containing at least fifty percent (50%) of organic nitrogen.

1. Percentages of nitrogen, phosphorous and potash shall be based on laboratory test recommendations as approved by the Owners Representative. For purpose of bidding, assume ten percent (10%) nitrogen, twenty percent (20%) phosphorus and six percent (6%) potash by weight. At least fifty percent (50%) of the total nitrogen shall contain no less than three percent (3%) water- insoluble nitrogen.

2. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to th Owners Representative. Store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be compromised.

3. Fertilizer shall be applied in two (2) applications. The first application shall be prior to the time of seeding or sodding at the rate of thirty-five (35) pounds per thousand (1,000) square feet harrowed into the top two (2) inches of sod bed. The second application shall be done as a maintenance application.

C. Humus: shall be natural humus, reed peat or sedge peat.It shall be free from excessive amounts of zinc, low in wood content, free from hard lumps and in a shredded or granular form. According to the methods of testing of A.O.A.C., latest edition, the acidity range shall be approximately 5.5 pH to 7.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water absorbing ability shall be 200% by weight on an oven-dry basis.

D. Manure: shall be well-rotted, unbleached stable manure not less than eight months and not more than two years old. It shall be free from sawdust, shavings or refuse of any kind and shall not contain over twenty-five (25) percent straw. The Contractor shall furnish information as to the kind of disinfectant or chemicals, if any, that may have been used in storage of the manure, upon request by the Owners Representative.

E. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100- mesh sieve.

F. Aluminum Sulfate: Commercial grade.

G. Bonemeal: Commercial, raw, finely ground; 4% Nitrogen and 20% phosphoric acid. H.

Superphosphate: shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 18% available phosphoric acid. Superphosphate shall be applied with the fertilizer at the rate of twenty (20) pounds per thousand (1,000) square feet. At least 4 days shall lapse after the application of lime and fertilizer before sodding may begin.

I. Water: The Contractor shall be responsible for furnishing his own supply of water to the site at no extra cost. If possible, the Owner will furnish the Contractor upon request with an adequate source and supply of water at no charge. However, if the Owners water supply is not available or not functioning, the Contractor will be held responsible to furnish water.

1. Water shall be free of impurities injurious to vegetation.

2.03 SEED

A. Seed mixtures shall be fresh, clean, new crop seed. Seed shall be of the previous years crop and in no case shall weed seed content exceed 1% by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean, sealed and properly labeled containers. All seed shall comply with State and Federal seed laws. Submit manufacturers Certificate of Compliance. Seed that has become wet, moldy or otherwise damaged will not be acceptable.

B. Lawn Seed Mix-for general areas outside the active play areas shall be composed of the following grass varieties, as a mix roughly in the proportions indicated, and shall test to minimum percentages, purity and germination, as specified below:

Sun & Shade Mix, or approved equal, with: 30% Bluegrass, 40% Fescues, and 30% Perennial Ryegrass varieties similar to the mix below.

Percent by Germination		Percent of Weight seed	Percent Purity
15%	Shamrock Kentucky Bluegrass	98%	88%
15%	Wildwood Kentucky Bluegrass	98%	88%
20%	Hard Fescue	98%	90%
20%	Creeping Red Fescue	98%	90%

30%	Greenville Perennial Ryegrass	98%	90%

(ALL VARIETIES SUBJECT TO CHANGE)

1. Seed mixture to be applied at the following rate:
   a. At least Five (5) pounds per 1,000 square feet.
2. Seed shall be mixed by manufacturer/ dealer.

C. Athletic Field Seed Mix-for active play areas shall be composed of the following grass varieties, as a mix roughly in the proportions indicated, and shall test to minimum percentages, purity and germination, as specified below:

Sun & Shade Mix, or approved equal, with: 30% Tall Fescue, 30% Perennial Ryegrass, and 30% Kentucky Bluegrass, and 10% Annual Ryegrass varieties similar to the mix below.

Percent by Germination		Percent of Weight seed	Percent Purity
30%	Tall Fescue “Fawn	98%	88%
30%	Perennial Ryegrass “Confetti III”	98%	88%
15%	Kentucky Bluegrass “Merit”	98%	90%
15%	Kentucky Bluegrass “Kelly”	98%	90%
10%	Annual Ryegrass	98%	90%

(ALL VARIETIES SUBJECT TO CHANGE)

1. Seed mixture to be applied at the following rate:
   a. At least Five (5) pounds per 1,000 square feet.
2. Seed shall be mixed by manufacturer/ dealer.

D. Conservation/ Wildlife Seed Mix: shall be composed generally of the plant species listed below, installed in the area of the stormwater basin as indicated in the drawings, and sown in accordance with the manufacturer’s guidelines.

New England Conservation/ Wildlife Mix, of Amherst, MA (413) 548-8000 www.newp.com , or approved equal mix, containing:

Virginia Wild Rye, Little Bluestem, Big Bluestem, Creeping Red Fescue, Switch Grass, Partridge Pea, Deer Tongue, Indian Grass, Common Milkweed, Ox Eye Sunflower, Purple Joe Pye Weed, Grass Leaved Goldenrod, Blue Vervain, Golden Alexanders, Flat Topped/ Unbrella Aster, and Early Goldenrod

1. Seed shall be mixed by manufacturer/ dealer.
2. Seed mixture to be applied at the following rate:
   Six-tenths (0.6) pounds per 1,000 square feet, (or 25 lbs per acre min.)
3. Fertilizer will not be required.

PART 3 – EXECUTION

3.01 PROJECT CONDITIONS

A. All areas to be loamed and seeded shall be inspected by the Contractor and the Owners Representative before starting work and any defects, such as incorrect grading, etc., shall corrected prior to beginning this work. The commencement of work by the Contractor shall indicate his acceptance of the areas to be loamed, finish graded and seeded, and he shall assume full responsibility for the work of this Section.

B. Contractor shall coordinate loaming and seeding operations with shade and ornamental tree planting, so large plantings are installed prior to loaming and seeding.

1. Loam, organic material and bonemeal for plant backfill for both planting beds and individual plants shall be thoroughly premixed in the proportions of one (1) part of organic material with seven (7) parts of loam together with ten (10) pounds of bonemeal per cubic yard of mixture.

2. Maintain at all times during the planting operations one or more stockpiles of approved loam borrow or topsoil from stockpile.
3. Depth of planting soil in plant beds to be at least eight (8) inches deep.

4. Depth of tree and shrub pits and planting soil around trees and shrubs to be as indicated in the drawings.

5. Plant large plantings prior to or concurrently with finish grading.

3.03 FINE GRADING AND LOAMING

A. After the areas to be loamed have been brought to rough grade, and immediately prior to and spreading the loam borrow or topsoil, the subgrade shall be loosened by disking or rototilling to a depth of at least three inches to permit bonding of the loam to the subsoil. Remove all stones greater than one (1) inch in diameter and all debris or rubbish. Such material shall be removed from the site, at no additional cost to the Owner.

B. Provide a minimum depth of six (6) inches of screened loam for in all areas indicated for seeding and all areas disturbed by excavation and construction operations.

C. Screened loam borrow or screened topsoil from stockpile shall be placed and spread over approved areas to a depth sufficiently greater than six inches so that after natural settlement and light rolling, the completed work will conform to the lines, grades, and elevations indicated. Supply additional loam, after testing and approval as may be needed, to give the specified depths and finished grades under the Contract without additional cost to the Owner.

D. Disturbed areas along the edges of full-depth loaming shall be finish graded with loam tapered to meet existing lawn areas to be retained.

E. No subsoil or loam shall be handled in any way if it is in a wet or frozen condition.

F. Sufficient grade stakes be set for checking the finished grades. Stakes must be set in the bottom

of swales and at top of slopes. Grades shall be established which are accurate to one tenth of a foot either way. Connect contours and spot elevations with an even slope.

G. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, glass, roots, stumps, litter and other foreign matter, and stones over one inch in diameter shall be removed from the loam. Loam shall also be free of smaller stones in excessive quantities as determined by the Owner's Representative.

H. The whole surface shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlements or rolling shall be filled with additional loam and the surface shall be re-graded and rolled until it presents a smooth and even finish to the required grade.

I. Contractor shall obtain Owner's Representatives written approval of fine grading and bed preparation before doing any seeding.

3.04 EROSION CONTROL MATTING, MESH, OR BLANKET

A. After grassing, place erosion control matting or blanket in areas indicated in the drawings or as directed by the Owners Representative.

B. Roll the matting out in the direction of flow. Overlap adjacent strips by at least 6 inches. Overlap adjoining ends by at least 6 in. For all overlaps, place the upstream section on top. Use a Type 2 check slot at the downstream end of the mesh that does not connect to a structure.

C. Apply mesh without stretching. Lay it evenly but loosely on the soil surface.

D. To keep the area smooth, do not allow workers to walk directly on the seedbed before or after applying mesh.

E. Bury the up-channel end of each installation in a narrow, 6 in deep trench and cover with at least 4 inches of loam.

F. After burying the mesh, backfill, tamp, and staple the trench.

G. Where one roll of mesh ends and a second begins, use a junction slot to make the connection.

H. Stapling: Hold matting strips firmly in place with one row of staples as follows:

1. Staple along each edge. Staple each row along the middle. Space staples no more than 3 ft apart in each row. Space the staples in the middle row alternately with those at the edges. For strips wider than 60 in., space staples no more than 3 ft apart. At the ends of the covered area and at overlapping joints, space staples no more than 18 in apart. Ensure that staples remain flush with the ground.

I. Rolling: After placing and stapling the mesh, firmly embed it in the soil by tamping or rolling. Secure mesh that bridges over soil surface irregularities with extra staples to provide firm overall contact with the soil.

3.05 SEEDING

A. All areas indicated in the drawings shall be loamed and seeded only after written approval of the Owner's Representative of bed preparation. All disturbed areas outside the limit of seeding shall also be seeded.

B. Immediately before seeding, the ground shall be restored, as necessary, to the proper surface and to a loose friable condition by dicing, raking, or other approved method to a depth of not less than 1". The surface shall be cleared of all debris, weeds, and of all stones 1" or more in diameter.

C. Seeding shall be done only during the period from April 1 to May 30 or August 15 to October 15. The actual planting of seed shall be done, however, only during periods within this season which are normal for such work as determined by weather conditions and by accepted practice in this locality. At his option, and on his responsibility, the Contractor may plant seed under unseasonable conditions at no increased cost to the Owner.

D. If there is insufficient time in the planting season to complete the fertilizing and seeding, the permanent seeding may be left until the following planting season at the option of the Contractor or on the order of the Owner. In that event, a temporary cover crop shall be sown by the Contractor, which shall be cut and watered as necessary until the beginning of the following planting season, at which time it shall be plowed or harrowed into the soil, the surface re-finish graded and fertilized, and the permanent seed crop shall be sown as specified.

E. Seeding of lawns and other seeding mixes shall be done only by experienced workmen under the supervision of a qualified foreman.

F. Soil additives shall be spread and thoroughly incorporated into the layer of loam by harrowing or other methods approved by the Owner's Representative. The following soil additives shall be incorporated, unless indicated otherwise by instructions from approved seed mix manufacturers:

1. Spread ground limestone as required by soil analysis to achieve a pH of 6 to 6.5, but the maximum amount applied shall be one pound per square yard.

2. Spread fertilizer at the rate of forty (40) pounds per one thousand (1,000) square feet or more as required by soil analysis.

3. Spread Superphosphate at the rate of twenty (20) pounds per one thousand (1,000) square feet.

4. Incorporate humus in the soil as required by soil analysis prior to delivery to site. Contractor shall have loam retested with organic matter incorporated and shall obtain approval prior to brining any loam on the site.

G. Seed only when the bed is in a friable condition, not muddy or hard.

H. Apply the various seed mixes in a manner consistent with instructions from the manufacturer for each mix; and complete soil amendments, watering, and maintenance in a manner appropriate to each mix.

I. Seed all areas to be seeded with specified ground cover seed, sowing evenly with an approved mechanical seeder at the rate specified for each seed mix . Sow x pounds per 1,000 square feet in one direction and x pounds per 1,000 square feet atright angles to the first seeding. Spread seed when soil is moist. Cultipacker, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible to cultipacker, the seeded ground shall be lightly raked and rolled in two directions with a water ballast roller. Extreme care shall be taken during seeding and raking to insure that no change shall occur in the finished grades and that the seed is not raked from one spot to another. Hydroseeding is an acceptable manner of seeding, providing the Contractor certifies in writing that the hydro-seed fertilizer mix is as herein specified and applied at the equivalent specified seeding rates per 1,000 square feet.

J. If covering and rolling is not properly accomplished by the seeding machine, the seed shall be lightly raked into the ground, after which the ground shall be rolled with roller not weighing over 100 pounds per linear foot of tread; then thoroughly and evenly watered with a fine spray to penetrate the soil to a depth of at least two (2) inches.

K. Promptly after seeding, wet the seedbed thoroughly, keeping all areas moist throughout the germination period.

L. Mulch shall be placed immediately after seeding. Straw or salt marsh hay that has been thoroughly fluffed shall be spread evenly and uniformly at the rate of two to three tons per acre. Lumps and thick mulch materials shall be thinned. All mulch anchor stakes, strings and matting shall be removed before final acceptance of lawns. In addition, following mulching, all slopes of 2.5 : 1 or greater shall be covered with jute, biodegradable coconut netting, or approved equal, Securely stapled in place. Overlap all joints in netting a minimum of 6".

M. Hydroseed mix: All work shall be installed using an approved spraying machine specifically used for this purpose. Amounts of fertilizer used shall be as the testing agency recommendations prescribe and as directed by the Owner's Representative. The Contractor shall submit to the Owner's Representative for approval prior to the start of any seeding work, a certified statement as to the number of pounds and types of fertilizer, amounts and types of seed mix and processed fiber per one hundred (100) gallons of water.

1. Hydro-mulch shall be Terra-Sorb GB or approved equal.
   a. Add Terra-Sorb to the hydroseed tank at the rate of sixty (60) pounds per acre.

3.06 MAINTENANCE FOR SEEDED AREAS

A. Maintenance shall begin immediately after any area is seeded and shall continue until final acceptance, but in no case, less than the following period.

1. Sixty (60) days after substantial completion of seeding.

   a. Maintenance may continue until the next growing season if in the opinion of the Owner's Representative the season enters a winter dormancy and no maintenance should continue.

   b. Over-seeding the in next growing season shall be provided for each of the seeded areas, with application rates to be half of those initially applied.

   c. General Acceptance by the Owners Representative will be granted for seeded

lawn areas and ball fields when all areas have a close stand of grass which has received a minimum of three mowings, has no bare spots greater than two inches in diameter, and at least 90% of the grass established shall be permanent grass species. The Contractor shall maintain all seeded areas until final acceptance.

B. Maintenance shall include reseeding, mowing, watering, weeding and fertilizing.

C. Watering of Seeded Areas:

1. First Week: The Contractor shall provide all labor and arrange for all watering necessary to establish an acceptable lawn or ground cover. In the absence of an adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least two inches.

2. Second and Subsequent Weeks: The Contractor shall water the lawn and ground covers as required to maintain adequate moisture, in the upper two inches of soil, necessary for the promotion of deep root growth.

3. Watering shall be done in a manner, which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one complete coverage to the seeded areas in an eight (8) hour period.

D. Protection:

1. Seeded areas shall be protected by stakes and caution tape or snow fence as directed by the Owners Representative. Wire shall not be used.

2. Barriers must be installed immediately after seeding and shall be maintained until acceptance.

E. Reseeding: After the grass or ground covers in seeded areas has appeared, all areas and parts of areas which, in the opinion of the Owner's Representative, fail to show a uniform stand of grass, for any reason whatsoever, shall be reseeded and such areas and parts of areas shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass. Reseeding together with necessary grading, fertilizing, and trimming shall be done at the expense of the Contractor.

F. Mowing:

1. At the time of the first cutting, there shall be a uniform stand between 3 and 3-1/2" high, and mower blades shall be set between 2-1/2" and 3" high.
2. Mowing shall include removal of clippings.

G. Fertilizing: A second application of fertilizer, as specified herein, shall be applied after one (1) season of growth of a minimum of two (2) months duration, but only during the months of April, May, August or September. Fertilizer shall be applied at the rate of thirty (30) pounds per one thousand (1,000) square feet in lawn areas.

H. Liming: If more than one initial application of limestone is required by the soils analysis to bring the pH of the stockpiled topsoil/loam borrow to a specified range, the Contractor shall be responsible for a second required lime application.

3.07 CLEANUP AND PROTECTION

A. During seeding work, keep pavements clean and work area in an orderly condition.

B. Protect seeding work and materials from damage due to landscape operations, operations by other contractors or trades, and trespassers.

1. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.08 ACCEPTANCE

A. The Owner shall inspect all work for Acceptance upon written request of the Contractor. The request shall be received at least 10 calendar days before the anticipated date of inspection. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Owner, he shall certify in writing to the Contractor as to the Acceptance of the work.

3.09 ACCEPTANCE IN PART

A. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so and when approval is given to the Contractor in writing to complete the work in parts. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

3.10 CLEANUP

A. After completion of all planting operations, dispose of all debris and excess material to the satisfaction of the Owner. All pavements shall be swept and hosed clean.

3.11 FINAL INSPECTION AND ACCEPTANCE

A. At the end of the guarantee period, the Owner will inspect all guaranteed work for the Final Acceptance upon written request of the Contractor. The request shall be received at least 10 calendar days before the anticipated date for final inspection.

B. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Owner at that time, he shall certify in writing to the Contractor as to the Final Acceptance of the project.

END OF SECTION